Interactive Installation for an Educational Ethics Lab

Bachelor Thesis

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Ethics Education, Ethics in Design, Design Engineering, Ethics Research, Design Process

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Abstract

This graduation project identifies common issues found in ethics education in design programs and presents a practical solution. It carries out exploratory research into the application of a practical pedagogical approach in the environment of a dedicated educational space focused on ethics in design. The practical pedagogical approach in question is an interactive installation designed around the classical ethical dilemma of the panopticon, developed by Jeremy Bentham. The project used the methodology of the Creative Technology Design Process to develop a prototypical installation. This installation facilitates meaningful interaction through designed experience which embraces modernised themes, such as surveillance, presented in the panopticon and exposes individuals to the ethical issues surrounding privacy through confrontation. By doing this, the experience created by the installation aims to stimulate ethical consideration and ethically based dialogue or discussion among peers. Through varying research methods and evaluation of the installation, new insights were reached which support the continuation of research into both practical pedagogical approaches, dedicated educational spaces for ethics in design, and the benefits to be found in the combination thereof.

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1 Introduction

This project encapsulates a design assignment posed by the Professorship of Ethics and Technology at the Saxion University of Applied Sciences in Deventer. The Professorship is chaired by Steven Dorrestijn, a philosopher of technology. Within their team, they acknowledge the objective of exploring ethical consequences of technology from a practical standpoint.

In support of the research group's vision and their overarching goal of educating students through a practical approach to ethics, it is their desire to facilitate a physical space that offers students a dedicated environment to reflect upon the ethical impact of technology. The ethos of this space is not too dissimilar to that of the DesignLab found at the Technical University of Twente. Similarly, both spaces aim to stimulate deliberation, consideration and experimentation throughout different stages of the students' design processes. Distinctively, the research group directs focus on exhibiting the historical background of ethics through the creation of a museum presenting 'the canon of ethics and technology'.

The design assignment captures this focus by presenting the challenge of developing an interactive installation which presents users with a classical ethical dilemma, allowing them to physically experience it. This installation will be placed into the aforementioned context of a museum, and it will facilitate the goal of teaching students utilising a practical educational approach which explores the relation between ethics and technology.

Within this, the overarching goal of the installation evaluated in this project is to empower young designers to make dialogue discussing ethics and technology in an inclusive way. It should prepare students to address ethical issues in their own projects through ethical experience, and it should further develop their ethical analysis proficiency. Practically, the installation should introduce students to complex ethical dilemmas and allow them to grapple with issues that arise from understanding ethical issues, and subsequently aid them in considering how their projects might affect the world (Finelli et al., 2012). Optimistically, it could present "the individual as an agent of positive social change, capable of affecting both local and global communities" through ethics education and confrontation (Hollander et al., 1995, p. 86).

1.1 Context

The connection between ethics and design engineering is clearly solidified. Thorough evidence exists for the case that ethics is intrinsically linked with society and technology (Donia & Shaw, 2021), and more specifically design engineering. Winner (1980) and Moor (1985) provide early argumentation for this connection to ethics, supporting that design is fundamentally and inherently viewed in today's professional societies as a creative activity subjecting itself to ethical repercussions (Buwert, 2017; Corple et al., 2020). However, recent literature proves that design as a principle is changing, experiencing a growing focus on design as a process that encumbers increasingly non-technical facets (Cassim, 2013). Following the trajectory of changes found in technical fields, this change in the role of the designer has not come completely unexpected. However, even though literature argues abundantly for the responsibility of designers to society needing to be supported by ethical awareness (Eggink et al., 2022; Finelli et al., 2012; Hollander et al., 1995), and for the importance of ethics education in universities effectively moulding ethical citizens and defending human rights in the process (Briones & Lara, 2016), research into ethical representation in design engineering programs in- and outside the curriculum finds this to be lacking (Lim et al., 2021; Lönngren, 2021; Martin et al., 2021). Moreover, in many professional and academic communities, the ethical component, which should be present throughout the design process, is diminished and delegated to ethics checklists and processes assigned by ethics committees (Sochacka et al., 2018; Vilaza & Bækgaard, 2022). This treatment of ethics constitutes to the common view of ethics being an afterthought, separate from the design process.

1.2 Purpose

Generally, this project and subsequent research should, first and foremost, contribute to the positive representation of ethics education in engineering programs. Secondly, it should explore the application of practically driven methods as an extension of the ethics education pedagogy. More specifically, it should open the conversation of co-curricular exposure to ethical issues facilitated through physical installations as a way of furthering students' development of ethical consideration and analysis from a practical approach. Thirdly, it should bid towards the application of more creative teaching methods and approaches facilitated through the development of dedicated ethical spaces. In essence, through this advocacy, the research should further legitimise the education of ethics and its general importance throughout the design process. Finally, through evaluation and analysis of the usefulness of the installation resulting from this project, the research questions outlined in the following section, Section 1.3, should be answered.

1.3 Research Questions

Since the goal of the project is clearly outlined over the previous sections, it remains to the research questions noted below to guide the research toward eventual correct purpose. These questions generally inquire about the state and perception of ethics in technology, potential and progress in the field of ethics education, and finally the usefulness and application of the ethics installation to be evaluated through this research.

Main question:

> *"How can an ethics installation stimulate young designers to make dialogue exploring ethics in design?"*

Sub-questions:

- *"What are current practices of educating students in design programs on ethics in design?"*
- *"Which problems are reflected in research on the educational quality of ethics in design?"*
- *"What are the possible avenues of teaching young designers to incorporate ethical consideration into their design process?"*
- *"How can this project take steps to improve the ethical proficiency of design students?"*
- *"How does an ethics installation used to increase the consideration of ethics with young designers affect varying educational levels?"*

2 Background Research

In order to correctly align the focuses of the installation to be developed through this project, various approaches to background research were consulted. These approaches will be detailed concurrently in the following chapter, with the aim of creating a foundation upon which conclusions can be drawn and preliminary requirements for the project can be outlined. The approaches used toward this extent include analysis of the problem space, research toward a classical ethical dilemma, comprehensive literature research, stipulations upon this research toward possible research directions, and finally analysis of related works.

2.1 Research Foundations

The following section will detail the problem statement, exploring the origin and underlying theoretical foundations of the problem, as well as presenting the subject of the literature research found in Section 2.2. Furthermore, this section will introduce and describe a classical ethical dilemma in the panopticon.

2.1.1 Consolidation of the Problem

The problem, as understood from the client, concerns the absence of dedicated space and time allocated to ethical consideration provided by engineering programs. This is reflected in research through a lack in both spaces dedicated to ethical practice and a lack in space made available in curricula toward the purpose of ethics education.

Conventionally, ethics are taught in engineering programs either through lectures concerning traditional approaches to ethics from faculty who are usually underqualified, case studies concerning the recognition and analysis of ethical issues, theoretical assignments supported by self-study into ethical concepts, or dedicated courses featuring workshops in rare cases. The last approach, should in all cases serve as the minimum toward preparing ethically competent designers and engineers. Furthermore, these courses should entertain more practical and inclusive methods in order to improve the degree to which ethics education is being understood. Notable examples of such methods are co-teaching, discussions, ethical design assignments, creative exercises, workshops and similar co-curricular activities.

2.1.2 Establishing the Panopticon

The panopticon refers to Jeremy Bentham’s design of a circular prison, originating from the 18th century. The design presents prison cells with glass walls arranged in a circular manner to be visible from a central guard tower. A visualisation of the panopticon is found in Figure 2.1.2. This design allows prison staff to individually observe each cell from a central point of vision at a time, without the prisoners in those cells being able to tell if and when they are being watched. This fact of not knowing automatically leaves all of the prisoners with the notion that they could be observed at any and all times. In turn, their situation would implore them to regulate their behaviour.

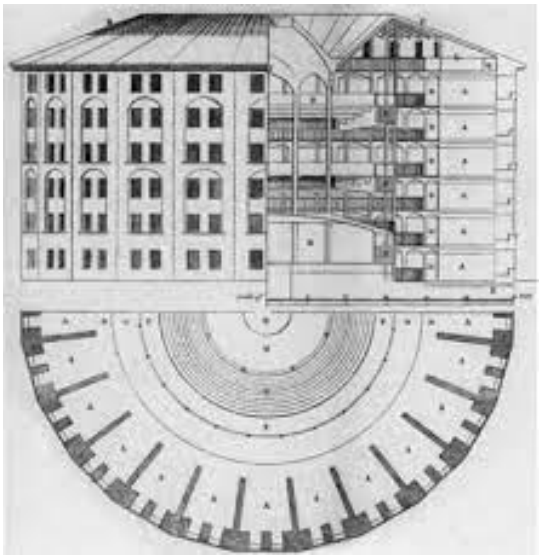


Figure 2.1.2: Drawing by Willey Reveley of Jeremy Bentham's panopticon prison, 1791
Courtesy of:
https://www.google.com/url?sa=i&url=https%3A%2F%2Fblogs.illinois.edu%2Fview%2F25%2F801310&psig=AOvVaw3kcNKMgYl5XpfQw9aR4Jsv&ust=1668084181320000&source=images&cd=vfe&ved=2ahUKEwj4w_f5j6H7AhWdmP0HHTPyA1kQr4kDegUIARDUAQ

2.1.2a Bentham

Jeremy Bentham, born February 1748 to England, is seen as the founding father of modern utilitarianism. In his professional life he was a philosopher, jurist, and social reformer. He was an avid advocate for personal and societal freedoms, human and animal rights, separation of church and state, and an abolitionist for slavery, capital and physical punishment.

His panopticon prison came forth from the idea of constant observation of the working class and aimed to exploit the concept of invisible omnipresence of the guards to its fullest extent. This concept of continuous surveillance would through Bentham's theory lead to imprisoned individuals practising self-discipline, as they might be observed at any time. Bentham considered the punishment of imprisonment as sufficiently cruel, taking stances against physical and capital punishment. Conversely, he argued for those imprisoned to work fixed hours during their sentences on labour that could otherwise be carried to a market competing with the state. These individuals would in turn need to be overseen in order to fully and efficiently extract labour from those in the panopticon prison.

2.1.2b Foucault

Paul-Michel Foucault, born October 1926 to France, mainly addressed the relationship present between power and knowledge. In his professional life he was a philosopher, historian of ideas, writer, political activist, and literary critic. Socially, he actively involved himself with campaigns against racism, human rights abuses, and for penal reform.

His analysis of the panopticon does not relate to the physicalization of a prison so much as it does to the metaphor it creates of a system of surveillance. He conveys the power built into such a system and how the panopticon as an architectural apparatus functions as a machine continuously upholding the power relation between watcher and watched independent of the exercising force's actions and activity. More importantly than seeing the theoretical

widespread application of such a system, Foucault experiences the panopticon in its effect as an architectural image of a mode of constant expression of power. He argues that the panopticon should be understood as a generalisable model of functioning, applicable as a figure of political technology. He then identifies that this way of exercising power has become the dominant form in modern society. A statement that rings true even in our modern society, as power expressed through surveillance systems also leads to self-discipline in society. Subsequently, he denoted the emergence of the modern disciplinary society focused on docility and utility, where discipline serves as a technique into ordering human complexities. This ultimately roots from a term coined by Foucault, panopticism, in which the observer ceases to be external. Rather than individuals being affected by the presence of a powerful external actor, the gaze of the watcher is ingrained in society up to a point where individuals start to self-discipline, effectively becoming their own guard.

2.1.2c Criticisms

The panopticon itself poses a multitude of ethical issues and difficulties, with different historians, among which Shirley Robin Letwin, arguing that it represented a monstrous tool for efficiency, which disregards humanity and exploited themes such as oppression and social control at the cost of human complexities. But in more recent times, members of the entertainment industry, prompted by comparison to panoptical ideas, flipped the script on the panopticon. They removed the connotations of threat or punishment, referring to the amusement, liberation, and pleasure elicited from ethically problematic shows such as Big Brother. Peter Weibel even argued for the pleasures experienced by the populus in getting a televised taste in power, sadism, voyeurism, exhibitionism, scopophilia, and narcissism.

2.2 Literature Review: A Consideration of Ethics in Design Engineering

The development of students' ethical competence has become a growing requirement in many educational and academic institutions, with the standards and emphasis on ethics education in engineering curricula increasing (Finelli et al., 2012; Hughes et al., 2020; Skirpan et al., 2018). Countless economic and industrial catastrophes have proven ethical review of systematic decisions to be a solidified aspect of design engineering. To find proof for the link between ethics and design, one only has to look as far as blunderous oil spills, mass industrialised pollution, globalised privacy concerns, and the most recent international wave of socio-economic peril caused by the COVID-19 pandemic. Accordingly, ethical consideration in design engineering should not be an afterthought (Finelli et al., 2012; Borrett et al., 2016). Unfortunately, the development of ethics curricula and ethical competency of students and faculty alike have not caught up to the newfound demand for ethically inclined engineers (Keefer et al., 2013; Martin et al., 2021). From a broad scope this can be attributed to a set of narratives.

Firstly, the slow adaptation of the academic engineering ethics community to increasing standards (Martin et al., 2021; Mitcham, 2009; Reed et al., 2004). Secondly, the reshaping process of the role the designer fills as they are challenged with increasingly complex issues (Cassim, 2013; Holsapple et al., 2012; McBride, 2014) and the reassessment of the priorities and responsibilities designers have to society (Finelli et al., 2012). Lastly, the general disregarding view of ethical accountability, methods, and processes found among researchers, students and faculty (Borrett et al., 2016; McBride, 2014; Lim et al., 2021; Sochacka et al., 2018).

With this in mind, it is the goal of the following literature review to research the root causes for the lack of ethics education in design engineering. Subsequently, it aims to provide commentary on proposed developmental curricular directions and solutions. To this aim, this paper will embody three parts.

Firstly, the common professional consensus on ethics in research and academia is discussed. Secondly, the problems that accrue in the teaching of ethics in design at different levels of the educational system are presented. Lastly, possible avenues to further construe ethical discussion into design programs will be explored.

2.2.1 Commentary on ethics in professional communities

Ethical review or ethical consideration in the design process is commonly perceived as an obligation by professionals and students alike. The root of this sentiment stems from the delayed realisation from the engineering community of the ethical implications of their work, as Roeser (2012) highlights that disciplines such as engineering were interpreted as having a morally neutral footing. Accordingly, as described by Ehrlich (2000), exact sciences "did not require ethical instruction" (Martin et al., 2021, p. 60). Consequently, the adaptation of ethics into professional practice, business and research standards, and the development of ethics in the educational curricula has been slow (Martin et al., 2021; Mitcham, 2009; Reed et al., 2004).

The substantiated disregard of ethics in design and engineering resulted in the adaptation of explicit rules in order to conform to increasing ethical standards. Hanna et al. (2014) outlines how codes of conduct are designed with the health and well-being of the public at the forefront, while at the same time ensuring the ethical behaviour among practitioners.

Whereas, Vilaza and Bækgaard (2022) argue that such “ethics checklists” are used by companies as means of alleviating the ethical complexities faced by designers. However, Eggink et al. (2022) suggests that despite the efforts and merit of professional codes of conducts and ethical evaluation through rules, “the crux remains that the ethical evaluation stays at the side” (Eggink et al., 2022, p. 2). This is a fact that is relevant across the literature. There exists a community-wide or cultural disregard toward ethical review procedures and methods, denoting ethical considerations as addendums to be addressed after the fact, resulting an attitude with ethics being an oversight (Borrett et al., 2016; McBride, 2014; Lim et al., 2021; Sochacka et al., 2018). In their analysis, Borrett et al. (2016) identify a culture of neglect concerning ethical consideration and report on the culture’s view towards ethics through committees. They argue that current ethical procedures are obtrusive to the design process, as they fail to find substantiated emphatic value through ethical evaluation. In short, they establish that the frameworks associated with ethics in design are top-down, reactive, non-embedded, and non-inclusive (Borrett et al., 2016). Similar to Hanna et al. (2014), Sochacka et al. (2018) note that formal ethics evaluation procedures are instrumental in protecting the rights and privacy of research participants (Guillemin & Gillam, 2004; Tracy, 2010). However, they go on to show that “they do not sufficiently prepare interpretive researchers to respond to and manage in-process ethical considerations” (Sochacka et al., 2018, p. 2). The underlying argument being that these ethical review procedures stem from utilitarian ethics in which social sciences are considered value-neutral. This is in line with the previous observation by Roeser (2012) and Ehrlich (2000). McBride (2014) supports this argument by describing how such utilitarian philosophies balance equations concerning ethical costs and benefits, and how similar deontological approaches have pushed for the creation of a set of ethical rules. Sochacka et al. (2018) go on to suggest that review procedures externalise and inflexibly formalise ethical consideration, creating an adverse effect by systematically limiting professionals in their process. Likewise, Eggink et al. (2022) suggest that the current practices for ethical evaluation come across as monitoring of the design process, creating similar limitations in their development.

As a response, researchers and designers tackle the challenges in dealing with formal ethical review procedures by “expanding traditional notions of subjectivity established across a range of qualitative research fields” (Sochacka et al., 2018, p. 3). Accordingly, by embracing the moral position of the professional practitioner as an ethical individual (Sochacka et al., 2018), they are subscribing to a community where microethics are placed on the moral composure of the individual and macroethics are subjected to the community. This corresponds to the argument made by McBride (2014), supporting agent-based approaches to ethical evaluation.

On the whole, the comments against formal ethical review procedures can be abstracted through an outline by Buwert (2017) based on previous work from Agamden and Hardt (1993) and Aristotle. They describe the ethical not as any obligation to institution or society, but rather as the experience of one’s own ‘potentiality’. It is through this insight, the effective constraining of ethics as being an individualistic experience to be moulded by outside influences, that approaches such as virtue-ethics and value sensitive design could succeed in forming a community where moral behaviour can be learnt through practice, as identified by MacIntyre (2007). Therefore, it is important to view and analyse the academia and curricula behind the education of ethics.

2.2.2 Commentary on ethics in education

Engineering ethics education should be an integral part of any curriculum which aims to prepare its students with ethical competency. As such, faculty must strive toward the goal of instilling ethical skills concerning moral sensibility and knowledge, analysis and situatedness, judgement and character (Martin et al., 2021), and at the core professional responsibility (Herkert, 2002). However, there exist significant discrepancies among engineering colleges between the perceptions and views of faculty and students regarding curricular ethics education (Holsapple et al., 2012). Holsapple et al. (2012) report that, despite faculty believing their curricula encompasses nuanced ethical education focussing on varying ethical competencies, students had a lesser view of ethics in their education. The students reported only experiencing education on laws and rules, sticking to codes of conduct and largely following what can be described as business ethics principles (Bowden, 2010).

It is found that, in spite of overall agreement about the importance of ethics education in design engineering, the current standards and method of teaching may not be adequate to prepare students with necessary ethical competencies (Holsapple et al., 2012). As a matter of fact, Sheppard et al. (2009) even claim that education on ethics is the “least realised, most outsourced, and least connected” (p. 136) component of the engineering curriculum. This claim has some merit, as the subjection of ethical components to binary assessment as pass/fail or complete failure to assess the students’ understanding of ethics is common (Keefer et al., 2014; Martin et al., 2021). Nonetheless, the importance of ethics instruction in engineering is clear and its learning goals are well defined. Actually, the blame for the seeming lack of quality ethics education is more easily attributed elsewhere. Students oftentimes find the shift in perspective when identifying ethical issues quite challenging (Burr & King, 2012; Lim et al., 2021; Vilaza & Bækgaard, 2022). Burr and King (2012) suggest that, because of the complex nature of ethical issues, quantitative thinking is often favoured over qualitative thinking. They are able to support this argument by pointing out how textbooks dealing with research ethics prioritise teaching the former. This leads to a lower level of ethical competence and moral understanding when confronted with complex ethical scenarios in practice. Lim et al. (2021) repeat the previous sentiment by showing that students struggle to identify the social and ethical aspects in their engineering and design education. They suggest that highly-structured undergraduate engineering curricula push out the ethical dimension in favour of exposure to the technical. Additionally, Corple et al. (2020) offer a different perspective which finds a similar conclusion. They note how there is little knowledge or theory about students’ ethical decision-making when designing in uncertain, real-life contexts. In order to alleviate this issue and successfully prepare ethically competent designers, they urge for the expansion of research into students’ ethical decision-making throughout the design process.

On top of the unsystematic implementation (Colby & Sullivan, 2008) and low weight (Barry & Ohland, 2012) that is attributed to ethics in design engineering education, there exists a fundamental lack of understanding and research of the pedagogy for ethics education and the methods involved (Finelli et al., 2012; Hess & Fore, 2018; Martin et al., 2021). One of the major challenges reported by faculty encompasses the expected roadmap to achieving the formulated learning goals (Colby & Sullivan, 2008; Herkert, 2002; Sheppard et al., 2009). Martin et al. (2021) observe that the educators’ lesser familiarity with ethics are at the core of this challenge. The faculty members tasked with engineering ethics education find it difficult to comfortably engage with the subject matter. Keefer et al. (2014) support this observation, narrowing the challenge found with educators to the complexity to align the theoretical

frameworks, teaching activities, and assessment methods involved, which could also lead to missed educational opportunities (Li & Fu, 2012). As a consequence of this resistive attitude toward ethics education, Holsapple et al. (2012) determine that students fail to see faculty as the positive ethical role models which faculty believe themselves to be. Briones and Lara (2016) extend one step above this observation by claiming that the educators inhibit the absence of moral character within the curriculum. They argue that this occurs because “the focus is more centred on providing the teachers with content and technical skills than with a critical social conscience” (Briones & Lara, 2016, p. 100). Martin et al. (2021) highlights this fact as the prominent cause for the substantiated disregard of ethics in design engineering communities and education. Specifically, they argue that “the valorisation of the technical and the marginalisation of the societal dimension of engineering” (Martin et al., 2021, p. 60) characterises the culture around engineering education. In simpler terms, the curriculum and cultural milieu surrounding engineering ethics education supports the technical over the ethical. With this perspective, Lönngren (2021) echo’s the problems encountered in the previous section. To repeat in short, ethics in engineering (education) is separated from the dominant technical dimension as less important, or even as an obstructive obligation. This leads to an educational culture of “disengagement” (Lim et al., 2021) where, despite best efforts from the faculty, students condemn design engineering ethics as a non-essential or even an irrelevant component (Lönngren, 2021).

2.2.3 Proposed developments & solutions

It is adamant that cultural and systematic changes need to occur in order to further integrate the ethical dimension into design engineering communities and curricula. However, as the challenges encountered are likely varied per community or academic institution, it is most beneficial for immediate changes to occur at the individual or curricular levels. To this extent, Sochacka et al. (2018) find that when professionals critically self-analyse their motivations and intentions when encountering ethical issues, they elicit broader consideration of microethics using their skills for ethical analysis. Likewise, when applying the same method, analysing their broader cultural agendas and challenging their cultural assumptions improves their consideration of macroethics. In principle, they support the argument that placing ethical improvement as a task at the hands of a motivated individual encourages the desired culture shift through the approach of virtue-ethics (Sochacka et al., 2018). In similar fashion, McBride (2014) argues that, through the approach of MacIntryean virtue-ethics, professionals reflect and differentiate between moral positives and negatives. Through this approach, educators can be placed as ethical motivators, instead of instructors, supporting a more healthy, ethically-backed culture (McBride, 2014). This approach supports the individual ethical competence by developing students’ understanding of what constitutes a positive moral vision (Donia & Shaw, 2021). Following a different narrative, Borrett et al. (2016) argue that in order to set in motion a culture of ethical research, rather than ethical oversight, ethical consideration must be the consensus among individuals. Mainly, they argue for a proactive bottom-up approach to ethical evaluation, and further implementation of ethical analysis methods throughout the design process. This is a sentiment also made by Hollander et al. (1995) as they suggest that engineering ethics education should be started as soon as students start developing their critical thinking skills. Contrastingly, Cassim (2013) argues towards the nurturing of design thinking skills before introducing ethical consideration.

Notably, a defining culture shift can not be accomplished solely by presenting individual students and faculty with immediate changes. Systematic changes are necessary to enhance the institutions responsible for educating future professionals (Martin et al., 2021; Finelli et al., 2012; Lim et al., 2021; Borrett et al., 2016). For instance, co-teaching between engineering and philosophy or social sciences programs could alleviate the demand for engineering educators concerning themselves with complex or abstract ethical issues (Martin et al., 2021). This could address the challenges faced by educators being presented with unfamiliar and uncomfortable ethical problems. Additionally, co-teaching could in turn prove the importance of the subject to students (Martin et al., 2021). Consequently, co-teaching could facilitate a more conscious opportunity toward meaningful interdisciplinary ethical discussion in class between engineers and ethicists (Lim et al., 2021). According to Lim et al. (2021), this would better prepare students with a more holistic concept of design engineering ethics and contribute to a well-rounded view on professional ethics. Accordingly, understanding the interconnectedness of their fields and responsibility to society as a whole would improve their grasp of macroethics. In similar fashion, exposing students to varying ethical factors and perspectives could improve their ethical sensitivity (Corple et al., 2020). Consequently, this exposure combined with ethically based cooperation and teamwork could develop the students' understanding of microethics (Corple et al., 2020).

Another approach to systematically integrate ethical consideration into different stages of the design process could be to expand the formal curriculum outside of the classroom. Academic institutions, or external groups, could take advantage of students' desires to engage in positive ethical behaviour by leveraging co-curricular experiences that support the use of varied educational approaches (Finelli et al., 2012). Co-curricular activities offer a path to effectively add to the curriculum without having to introduce or alter formal curricular courses. These co-curricular experiences also have the opportunity to experiment with innovative and less-proven pedagogical methods. As such, Briones and Lara (2016) advocate toward the inclusion of a structured and guided form of debate about a moral dilemma, including students from different cultures. This is something which is not often present in design engineering courses and can not readily be achieved outside of curricular workshops. Additionally, Briones and Lara (2016) have pointed out that pedagogical methods of this nature have favourable effects on students' ability to identify values and ethical issues, while also improving the quality of the arguments they produce. Moreover, Hitt and Lennerfors (2022) put forward a more innovative and creative pedagogical method, which, similar to the previous, is difficult to include without co-curricular activities. Film studies can be used as an intuitive way to start ethical discussion among students and educators, as well as connect complex and abstract ethical issues concerning engineering and professional ethics to more life-like scenarios (Hitt & Lennerfors, 2022). Additionally, film can be applied as a medium to inspire moral imagination and develop ethical identification skills (Vilaza & Bækgaard, 2022). Subsequently, these examples of innovative, creative pedagogical methods beg the question if they deserve more research, potentially proving they belong in design spaces.

2.3 Conclusions & Further Research

To summarise, this literature research provides an overview of the common consensus in professional and academic engineering communities on the importance, integration, and developments of engineering ethics education. Many professional communities inhibit a culture of disregard to ethics in their professions. This stems from the background of utilitarian ethics and deontological approaches experienced by the engineering principle, leading to the adaptation of ethics checklists (or codes of conduct) in order to formalise ethical evaluation procedures. This general disregard has been reciprocated into academic curricula. However, through recent developments, ethical consideration has become more important to academic institutions as research shows the interconnectedness of the technical and the ethical dimensions. This demand has been challenging to engineering faculty and students alike, as students are faced with complex ethical issues and educators are confronted with a lack of expertise. These challenges are substantiated by the unsystematic implementation and low weight attributed to ethics in design engineering education, as well as the culture of disengagement perpetuated by the appraisal of the technological dimension of engineering programs and the marginalisation of the ethical dimension as a counterbalance. Now, the task stands to culturally and systematically change the academic perspective on ethics in design engineering education. In this aim, the initial direction for development utilises the approach of virtue-ethics, effectively enabling motivated individuals to improve their consideration of microethics and macroethics through critical self-analysis. Conversely, more systematic changes to curricula would positively impact the culture around ethics in academia. Notably, the implementation of co-teaching and the addition of co-curricular experiences could address many of the challenges identified by students and educators.

Performing further research in the field of ethics education in engineering as a whole is important the progression of the principle and the safe harbouring of any future technologies which might negate ethical boundaries. Toward this purpose, it would be beneficial to engage in systematic evaluations of ethics courses in engineering programs in order to dictate the most effective path towards ethically prepared students. Consequently, academic faculty must figure out how to successfully alter curricula to cater more towards ethics education. Specifically in this direction, they must configure the most preparatory course material and research the effectiveness of contemporary teaching methods when applied to ethics education. Additionally, research could be done into the effective application of co-teaching combinations. Similarly, research should be performed in order to determine the ultimate role and relation academic institutions harbour in co-curricular activities, as these could prove essential in the short term of improving ethics education in many slow adapting programs and curricula. Finally, additional research into innovative pedagogical methods and the adaptation thereof could help to foster qualitative discussion and harbour ethical consideration.

This is where this project is able to lend itself. Through a qualitative, exploratory research study on the teaching of ethics to design engineers through the use of an interactive installation focused around classical ethical theory and dilemmas, the teaching of ethics by use of practical experiences and innovative analysis can be evaluated.

2.4 Related Work: Analysis of State of the art

The following paragraphs will analyse a range of existing works with unique relations to the project. Their purpose is to inform about and shape the design environment of an ethical installation. Additionally, the findings of this section serve as inspiration toward the ideas detailed in Section 4.4.

Specifically, the following paragraphs will highlight the contexts of individual works and how their differences relate to the design assignment. It accomplishes this by analysing aspects such as the purpose of the artefact, the target audience, and the presented moral message.

The first half of the state of the art will entertain the general concept of an interactive installation driven by the ethical dimension. These works are presented in Section 2.4.1 and Section 2.4.2. The second half of the state of the art experiences a more directed focus on works which encompass the specific concept of the panopticon. This focus extends to Paragraph 2.4.3, Section 2.4.4, and Section 2.4.5.

2.4.1 Sarah W. Newman

Sarah W. Newman is the Director of Art & Education at metaLAB at Harvard. She is also the Co-Founder of The Data Nutrition Project. Her work aims to explore the interrelations and connections present between complex technical systems and possible social implications. She explores this facet through teaching, research, and interactive art.

2.4.1a Moral Labrinth

This interactive art installation tries to broaden the conversation about the relations between ethics and technology. It accomplished this by creating an inclusive physical and online space for the perspectives of all individuals to be shared and valued. In providing this platform, it aims to create awareness for the need for a consensus that the development of future technology and programming needs to be thoughtful, with values embedded by the select few who build them. With this, the project aims to empower individual technologists to find confidence in ethical deliberation, teach them to learn from and incorporate outside perspectives, and to sustain and further ethical dialogue around inclusivity and positivity.

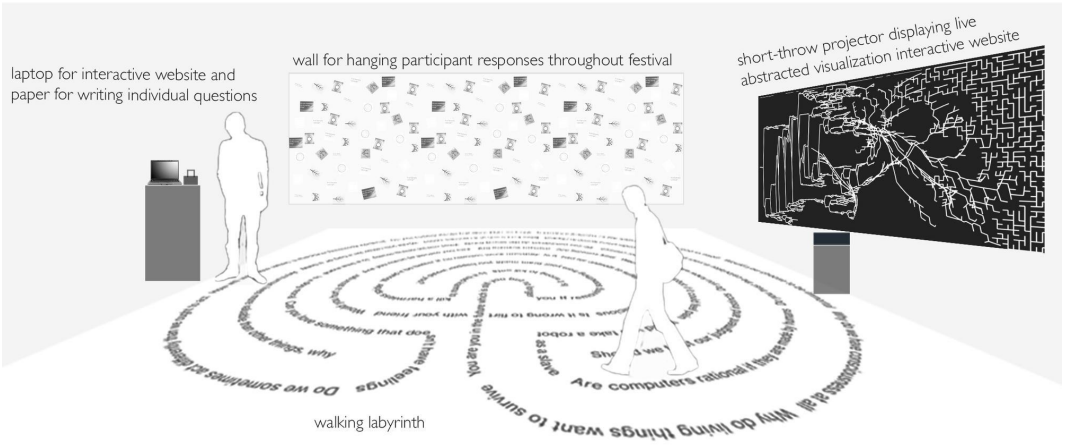


Figure 2.4.1a: Moral Labyrinth installation sketch, 2018
Courtesy of: https://sarahwnewman.com/Moral-Labyrinth-installation

2.4.1b The Future of Secrets

This installation creates an immersive experience where individuals are asked to anonymously share secrets with technology. In doing this, it makes participants automatically question if they should trust the machine, and machine in general, with their sensitive information. It relates to privacy and protection of data by evaluating the trust placed in complex technical systems and digitally distributed networks.

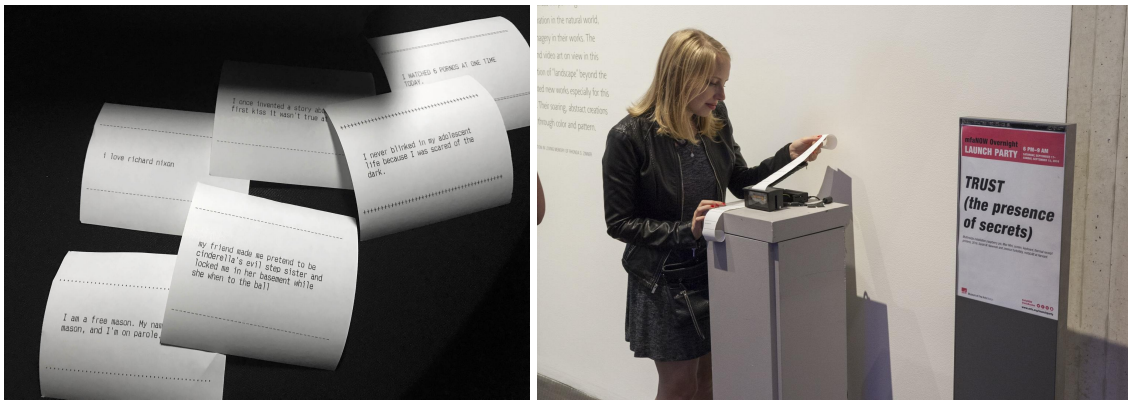


Figure 2.4.1b: The Future of Secrets, exhibitions 2016-2019
Courtesy of: https://sarahwnewman.com/The-Future-of-Secrets

2.4.2 Dries Depoorter

Dries Depoorter is an artist, public speaker, and freelance concept provider. His work addresses themes such as privacy, artificial intelligence, surveillance, and social media. As a speaker, he has been hosted by MoMa, TEDx Brussels, SXSW Austin, and many more. Specifically, he creates interactive installations, apps, and games.

2.4.2a The Follower

This interactive installation uses openly available public cameras and artificial intelligence to track and locate instagram photos. Depoorter recorded a selection of open-access cameras for multiple weeks, scraped instagram photos geotagged to the location of his cameras, and wrote software which compares the photo with the recorded footage. With this he is able to alert the general public of the fears and dangers surrounding widespread social media use. At its core, it addresses the integrity of online privacy, collection of personal data, and confrontation of online surveillance.

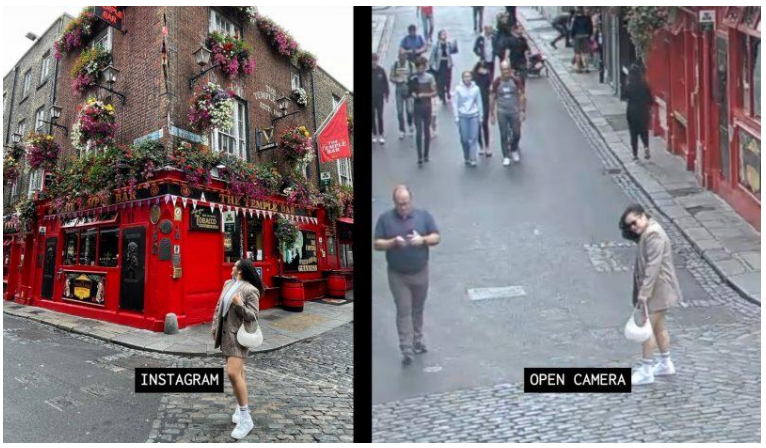


Figure 2.4.2a: The Follower, 2022
Courtesy of: https://driesdepoorter.be/thefollower/

2.4.2b The Flemish Scrollers

This installation uses analysis by an artificial intelligence to monitor the phone usage of members of the Flemish government. This analysing agent is applied to a livestream which broadcasts every meeting on Youtube. Through facial recognition and task analysis, the software is able to determine when the politicians are distracted. The installation then automatically posts a photo to their Twitter timeline with the message: “Dear distracted @Politician, pls stay focused!” along with a video capturing their behaviour.

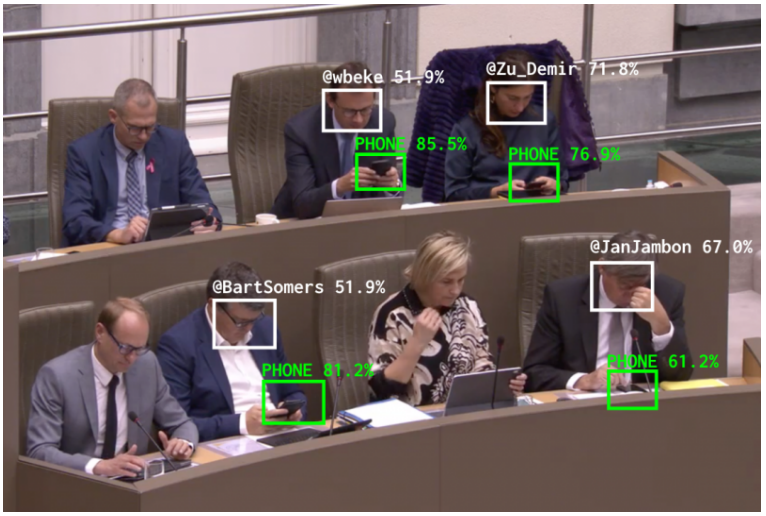


Figure 2.4.2b: The Flemish Scrollers, 2021-2022
Courtesy of: https://driesdepoorter.be/theflemishscrollers/

2.4.2c The Lookout

This interactive installation allows the general public to access and control unsecured cameras connected to the internet in real time. The user can access over 1500 real life unsecured CCTV cameras. Using a gamepad, they can use zoom, pan and tilt controls to physically move the camera somewhere else in the world. This installation plays into the idea of public access to information, in this case live CCTV camera footage. It presents the user with moral conflict in the sense that a similar or more complex concept could access cameras near them and affect their privacy.

Figures 2.4.2c I & II: The Lookout, 2021-2022, photos by Henk Deleu
Courtesy of: https://driesdepoorter.be/thelookout/

2.4.2d Jaywalking Frames

This installation presents a collection of images displaying people from all over the world breaking traffic laws by walking through a red light. These images were captured through unprotected surveillance cameras. Each photo frame is available for the price equal to the fine the individual in the image was awarded. This again plays into these individuals' rights to privacy. Moreover, it confronts the audience with the privacy violations that are present in a surveillance society.

Figure 2.4.2d: Jaywalking Frames, 2018-2022
Courtesy of: https://driesdepoorter.be/jaywalkingframes/

2.4.2e Surveillance Speaker

This interactive installation concerns surveillance technology and artificial intelligence. It uses breakthrough software pertaining to computer vision and identification. The setup consists of a camera, a computer and a speaker. The speaker calls out sentences identified by the computer as seen through the camera. These sentences start with “I see…” which hints towards some form of intelligence within the concept. In this way, the audience can experience serious surveillance technology in a playful manner. Ultimately, it addresses the advancements made in the software and hardware of technologies which have ethical implications on privacy.

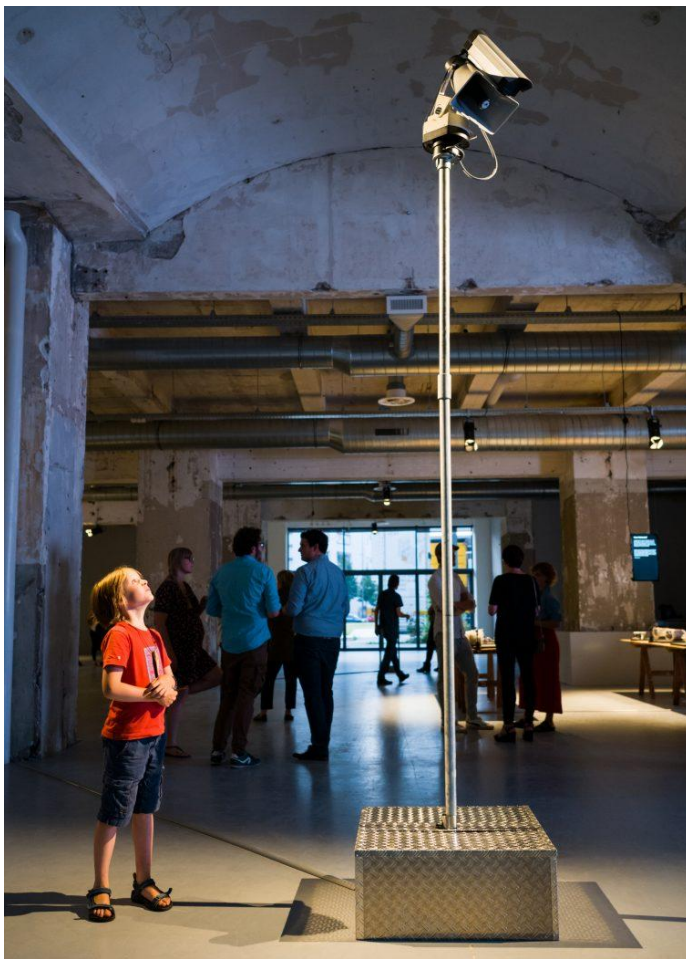


Figure 2.4.2e: Surveillance Speaker, 2018-2022
Courtesy of: https://driesdepoorter.be/surveillancespeaker/

2.4.3 The Truman Show

The Truman Show (1998) is an American psychological satirical comedy-drama by writer Andrew Niccol and director Peter Weir, starring Jim Carrey. The movie encompasses Truman, who was born with the sole purpose for his entire life to be fabricated and broadcast on television for the entire world to see from the point of his birth. Every viewer in the world knows Truman’s reality is fabricated, from the people to the weather. The only one unaware is Truman himself, who is not even aware there are hidden cameras surveilling his every move. The movie breaks down issues of identity associated with the concept of the self, while also shining a light on the automatic functions of power in a surveillance society.

This film associates itself with the dangers of surveillance society and draws varying connections to the panopticon established by Jeremy Bentham. It truly does a good job in demonstrating the power of surveillance in controlling a subject's behaviour, actions, and identity. However, a key difference is found as Truman does not know that he is being surveilled which is central to the concept of the panopticon and to the theory of panopticism. Conversely, the film flips this concept on its head by including the entire population watching his life, along with those tasked with fabricating his reality, part of the surveillance system. In this sense, it is the watchful eyes of the actors in the show which shape his behaviour. Interestingly, this brings up the moral question of Truman's free will. This is a concept which is included in panopticism, but is not presented on the forefront of the theory.

Figure 2.4.3: The Truman Show theatrical release poster, 1998
Courtesy of: Paramount Pictures

2.4.4 Team Toxic

Team toxic consists of artists which work together in the aim of bringing interdimensional creatures into everyone's everyday lives through art. Their work often focuses around themes of privacy, robotics, artificial intelligence, and surveillance capitalism.

2.4.4a PanoptiBot I

Their first iteration on an interactive installation focused on the modern panopticon of surveillance capitalism, PanoptiBot, involved a series of robotic faces consisting of lights, tubes, and technology. The installation aims to reveal how people's actions are being recorded and misused. Viewers are able to interact with CCTV cameras mounted around the installation and monitors displaying the footage live. The monstrous creature consisting of electronic waste is meant to represent the inevitable capability of mass destruction the developments and trappings of surveillance capitalism will bring.

Figure 2.4.4a: PanoptiBot I presented by 'Illuminate the Night', Nuit Blanche Winnipeg 2021
Courtesy of: https://culturedays.ca/en/events/c27c0a4f-4548-408f-b5a2-084ea30037f8

2.4.4b PanoptiBot II

The second iteration of this interactive installation, PanoptiBot II, serves as a continuation of the ideas and concepts tackled by the first iteration. However, it more so focuses on the manner in which the public thoughtlessly interacts with the system of surveillance capitalism. The installation displays distorted versions of the images it captures, resulting in a shareable photo opportunity.

Both iterations of the PanoptiBot interactive installation draw closer comparisons to works that try to fully encapsulate and educate the audience on the concept of the panopticon and the dangers associated with panoptic power structures than previous paragraphs.

Figure 2.4.4b I: PanoptiBot II presented at 'Manitoba', Nuit Blanche Winnipeg 2022
Courtesy of: https://culturedays.ca/en/events/1f7e43e3-d869-40ed-a957-a912e8eb235b

Figure 2.4.4b II: PanoptiBot II presented at 'Manitoba', Nuit Blanche Winnipeg 2022
Courtesy of: https://culturedays.ca/en/events/1f7e43e3-d869-40ed-a957-a912e8eb235b

2.4.5 Team Panoptes

Team Panoptes is a game developer with a focus on Virtual Reality gaming. Their games are receptors of high praise, with their first game in 'Panoptic' receiving very positive reviews and being prized with a multitude of awards. Their second release is set to be published in 2023 and features a puzzle game with high audience anticipation.

2.4.5a Panoptic

The game is played by two people, where one plays as the Overseer and the other as the Challenger. It is the aim for the Challenger to remain anonymous in a crowd and escape each level undetected, while the Overseer seeks out to identify and destroy the Challenger. It creates a cat and mouse display, where the Challenger must take advantage of disguise, stealth, and hiding. This game effectively gamifies the architectural structure of the panopticon, creating a virtual environment where both the role of the Prisoner and the Guard can be easily identified and imitated. However, the game remains quite surface level in this regard as key elements are negated, failing to inhibit a sense of panopticism in the process.

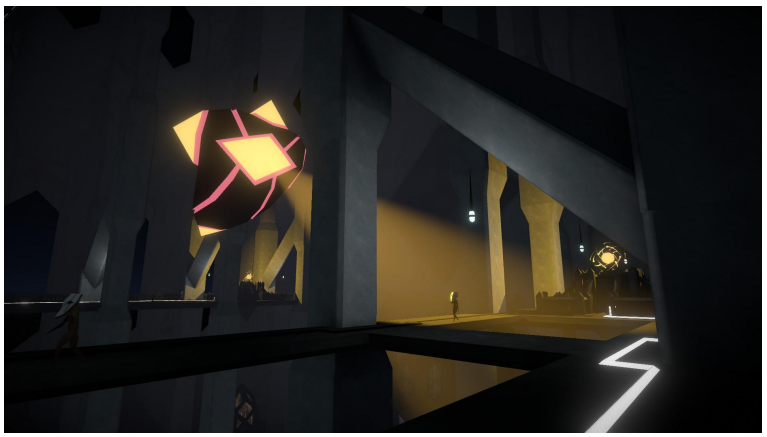


Figure 2.4.5a: A screenshot of Panoptic (2019) gameplay

2.5 Conclusions for Project

From the analysis performed in the previous section, certain conclusions can be drawn about aspects which should be applied to the ideation and specification phases of this project. In other words, in order to effectively meet the design challenge posed by the client, inspiration can be drawn from existing works with regard to formation and functionality. As found through analysis of state of the art interactive installations, it is important to carefully configure the role of the audience. Specifically, the experience harboured by the installation should intend to both inform and guide the user through the complex issues that underlie the concept. As such, it would be beneficial to be guided by the use of physicality of the PanoptiBot in Section 2.4.4. Furthermore, it would serve the experience to draw inspiration from the panoptic structure that is facilitated by Team Panoptes in their game Panoptic from Section 2.4.5. Similarly, the fabrication of this structure and the connection from the metaphoric concepts insinuated by the panopticon can be derived from works by Dries Depoorter. Additionally, the scene and environment created by The Truman Show lends itself well to establish the panoptic structure in a real-life setting. Through configuration, this connection could be applied to the design of the interactive installation resulting from this project. Finally, as predetermined by the design context, a clear distinction in the ethical purpose of the installation as found in installations by Sarah W. Newman would solidify the intentions and educational nature of the experience. This would hopefully lead to the intended outcome established in Section 2.6 below.

2.6 Preliminary Requirements

This section will detail a list of preliminary requirements based on the conducted background research and the thereupon drawn conclusions toward further research and design. The first set of requirements will centre around the form or shape of the installation, whereas the second set of requirements concentrate on the functionality.

2.6.1 Non-functional

The interactive installation should include:

1. Efficient use of physicality to enhance the experience
2. Inclusivity to different academic levels
3. A direct educational nature
4. Distinguished ethical or moral purpose
5. Effectively inform about and address the ethical issues presented

2.6.2 Functional

The interactive installation must:

1. Make use of technology to facilitate the theory of panopticism
2. Effectively use technology to enhance the user experience
3. Present technology from a base level of moral neutrality
4. Use innovative ideas in technology to create an impressive experience

3 Methodology

The methodology applied to this project is the iterative design process by Mader and Eggink (2014), created for the Creative Technology Bachelor study at the University of Twente. It encapsulates design steps, starting with the ideation phase in Chapter 4. Firstly, this phase involves the formation and analysis of the design context of the defined problem. Secondly, it goes on to acquire information that is relevant to the generation of a design solution, which can be inquired from various sources such as potential users, existing work, and stakeholders. This is usually formalised as a set of design requirements. Eventually, this phase involves the generation of design solutions based on information from background research and exploratory methods. The next phase is the specification phase, which can be found in Chapter 5. This phase features the creation and detailing of a concept specification aimed at capturing both the experience for the user and the functionality of the solution. The concept is sketched out and the phase is finalised by concluding on the functional and non-functional specifications and aspects of the design solution. The process then moves on to the Realisation phase where the specified design solution is transformed into a prototype. Following up, this prototype is evaluated in the evaluation phase with regard to the previously established functional and non-functional requirements set for the design solution. These two steps establish the brunt of the iterative process, as it is common for the realised prototypes to be improved based on evaluation. Finally, the process is capped off by concluding on the outcome of the project in relation to the previously determined purpose and research questions, which is complemented by a recommendation for future work.

4 Ideation

The following chapter encapsulates the ideation process and the corresponding methods applied in order to develop the design solution. The upcoming sections will first outline the methodology behind the conducted interviews with a potential user group in Section 4.1, and the results and conclusions on the interviews in Section 4.2. Subsequently, Section 4.3 will manifest the start of the rapportation on the methods used toward the task of ideation and the results thereof. The chapter will be concluded with an outline of the final concept and a final set of requirements to take into the specification phase.

4.1 Target Audience Interviews

Interviews were conducted with a group of individuals who aim to be representative of the eventual end-user of the interactive installation. This end-user can be described as a design engineering student with permeable ethical preparation through their engineering education. Five individuals were contacted through familiar channels such as text message and phone calls. The interviews took place in-person and the proceedings were recorded toward the purpose of transcribing. The participants were asked to provide auditory consent and were promised their anonymity and the anonymity of their data. They were informed of the purpose of the interview and the extent of the study. Additionally, they were presented with the possibility of retracting their participancy from the study at any time.

4.1.1 Interview Plan

The interviews in practice followed a semi-structured qualitative approach, meaning the participants were asked to respond to questions as per usual, but they or the interviewer could interject the interviewing process to either ask follow-up questions or ask for clarification, directing the interview away from the structured path. This approach was selected as it often offers a higher chance of coming across unexpected results and unique perspectives.

The focus of the questions was firstly put on the interviewees' definitions and perspectives on ethics in engineering, followed by their experiences and opinions of representation of the ethical dimension in their respective programs. This starting point allows for an upfront understanding of the ethical background and preparation of each interviewee, which might in any case provide clarity to their answers concerning ethical knowledge and analysis skills. Building on this, the next set of questions centred around their programs approach to ethics, inquiring on the interviewees' experiences in ethics education and their exposure to ethical issues through the curricula and outside of the curricula. Finally, the concluding questions sought out to probe the interviewees' knowledge on specific ethical ideas and the extent of their ethical proficiency.

4.2 Interview Results & Conclusions

The synthesis of the results from interviews generally aligns with the background research on ethics in education. However, as some of the interviewees experienced the ethics education of the Creative Technology Bachelor, which features a more prevalent focus on ethics than other contemporary engineering programs, the synthesis is believed to paint a slightly more innovative picture of ethics education than the generalist view found through the background research, which encompassed a broader range of engineering programs.

4.2.1 Ethics and Engineering

Firstly, from initial questions it became clear that the interviewees' general perception of the relationship between ethics and engineering was that they were closely interrelated. However, this interrelation was in most cases derived from principle under business ethics and research ethics, referring to concepts such as fraud, plagiarism, and ethical committees. Nonetheless, the definitions provided by the participants never failed to incorporate the importance of ethics to engineering and/or design. Furthermore, some participants quoted the importance of committees, strict rules surrounding ethics, and general compliance to professional ethical standards. Others linked the importance of ethics to the interests of users and stakeholders. Some participants associated the importance of ethics to be connected to evaluation at the finalisation of a project or publishing processes, whereas others noted that ethical evaluation becomes most important in the middle of the design process. Generally, interviewees placed the most ethical analyses around the specification phase.

4.2.2 Ethics Approaches

Secondly, the questions posed toward the approaches to ethics found in engineering programs continued the trend found throughout the first set of questions. Namely, the notion that ethics is important, and the recognition that ethics applies to more than just a single stage of the design process, but the recurring delegation to business ethics and research ethics principles. This seemingly indicates a lack of practical understanding of ethics in the design process and low analysis skills concerning the identification of design ethics principles, along with low practical ethical proficiency.

This second set of questions found that the participants' positive experiences around ethics education in their engineering programs failed to make up for the negative experiences. Generally, the students appreciated the role ethics played in their courses and valued the development of their ethical consciousness and analysis skills. Regardless of this positive stance towards ethics, a substantiated lack of interest was found among participants. This was largely attributed to a lack of interest of the students and the faculty, a scattered focus in the program, meaningless and baseless ethics assignments, low transferal of understanding, and most notably the omission of practical application of the concepts. The students reported that faculty mainly stress the importance of ethics to technology and innovation in their lectures, and that they generally leave the students with assignments, coursework, and self-study to develop their ethical proficiency. Outside of this, methods toward expanding ethical literacy or developing ethical consideration skills were not reported, with the exception of case studies and stakeholder analysis.

Excerpt:

Interviewer:	Which methods do you remember being used to aid in developing your ethical skills?
Student 1:	Like the cases I said before, so looking at what companies did in the past and analysing them.
Interviewer:	Could you elaborate on the type of analysis?
Student 1:	Yeah, like what they should have done or how to avoid the mistakes in our projects. But not through discussion, just questions and answers.

Case studies, however, naturally experience some limitations, like the commonly found abstract nature of complex ethical issues and the lack of practical comparison: “The cases we see are sometimes a little out there I guess, so maybe something, like, that comes closer to what we work on with our projects” (P1). Importantly, this same issue was reportedly also found in literature from the background research, coinciding with findings by Keefer et al. (2014) from Section 2.2.2. Alternatively, stakeholder analysis contributes little to ethical consideration and should not be considered as a method to further ethical competency. Rather, on a positive note, one student did mention the use of reflective assignments and engaged discussion with peers about their respective project: “I think we get some lessons for ethics in which we look at the cases and like that we can maybe develop our skills. Sometimes the professors do like assignments in which we have to analyse our project with ethics and look from an ethical lens, I guess. There are also sometimes, like, some moments during the lecture when we have to discuss about an ethical issue or the ethics of our project with our neighbours” (P2). However, most of the students did not remember any methods pertaining to the advancement of their ethical competence from within or outside of the curriculum, pointing to a general lack in application of methods which aim to aid the students in developing skills related to ethics.

4.2.3 Ethical Proficiency

Lastly, the concluding set of questions, which focused on the interviewees’ knowledge on ethical ideas to gauge the extent of their ethical proficiency, notably reported that none of the students were familiar with the concept of the panopticon and theory of panopticism. When asked to rate their perception of their own ethical skills, most of the students concluded on average, with two students noting they found their skills insufficient. In order to improve this, the students argued for more practical analysis and relatability in the course material. Additionally, they insisted that, specifically, social methods toward development of ethical deliberation and awareness should be considered for integration into curricula. The main method that was sourced from this category was discussion: “Discussion mostly. I feel it works best to find out what ethical boundaries are, and how you find ethical issues to tackle them before you run into them and it’s too late” (P2). Another argument was made towards relatability, like including “more examples of ethical flaws within your specific field. It makes for better imagination of what can go wrong and how to solve it” (P1). And similarly, addressing practical application: “maybe a little more on how ethics works in jobs, like how people deal with the issues that come up and how to find that it is not right to prevent the things we see in the cases and stuff” (P3).

4.3 Mind map

Mind-mapping is a creative tool that was chosen to associate concepts related to the panopticon through categorisation. It was used to effectively highlight aspects related to the panopticon, and its metaphorical relevance through time, converging these concepts into initial ideas. This process resulted in the output of another set of mind maps, where coloured nodes highlight the core concepts related to the idea in question.

Figure 4.3: Mind *map relating to the panopticon*

4.4 Initial Ideas

The following paragraphs try to convey the inspirations, practicalities, and surrounding concepts of the initial ideas that were generated in the ideation phase. Through the explanation of these ideas, and their connectivity to the core elements of the panopticon extrapolated from the mind maps, the foundational basis was cemented for further development and guided ideation following the previously mentioned requirements from Section 2.6. In this sense, these initial ideas, several of which were inspired by existing work, serve as a jump-start into the creative possibilities surrounding the practical foundation of the panopticon, the metaphorical meaning and functions behind the idea, and societally relevant commentary associated with the panopticon.

4.4.1 Card game

The first concept that was thought up encumbered a card game which would aim to reveal the inherent power struggle associated with the panopticon as it was imagined by Foucault. This power struggle is verbalised by metaphorically comparing the panopticon to the possession of power in society, equating the prisoners to the working class and the guardstower to the bourgeois. Through Foucaults' imagination of the panopticon as an utmost effective business model, the bourgeois possess the overwhelming capacity of power over the working class. Through the benefit of this struggle they are capable of extorting the working class for extreme profits, as is true under capitalism. This metaphor holds true in modern times, as we, the working class, experience the gripes of late stage capitalism. Ultimately, this concept for a card game brings to light the power struggle experienced through the inequality of wealth distribution by effectively equating data, or information, to wealth. This comparison finds relevant contemporary value in society, as it is commonly expressed that data is the new gold. The game is played by a minimum of four people, where one player takes on the role of prison guard and the rest of the players are prisoners each locked in a different cell. The prison guard, positioned in the centre of the panopticon, holds all of the cards in the game as they are able to observe each and every prison cell from the central tower. Each card represents a prison cell, containing one piece of information. At each of their turns, the prisoners can request a card from the guard by naming the number of the cell. Once the prison guard's turn comes around, they may either remove a card from the game or demand a card to be returned to them from one prisoner per turn. The aim for the prisoners is to collect the necessary information to escape the panopticon, achieved by combining their information through a points system made clear from the cards. The aim for the prison guard is to prevent the majority of the prisoners from escaping the prison by putting the necessary amount of cards out of play. Once a player escapes, the information they collected escapes with them and is put out of play. Through playing the game, players are confronted with the value of information, as well as the built in power dynamics between the prison guard and the prisoners.

Figure 4.4.1: Mind map highlighting aspects relating to idea one

4.4.2 Website

The second concept mainly revolves around the open stream of information, and the restriction of access thereof, modelled after the extreme interpretation of the second theoretical society proposed in Paragraph 2.1.2 first exploring the panopticon. To recap, in this theoretical society all information that can and has been collected is public to any individual. In this sense, any person or company could access the vast stream of information available about anyone and anything, possibly through a tool similar to the internet which facilitates the free flow of information and data. However, this installation, initialised through a website, reforms this theoretical society by introducing a barrier of entry based on hierarchy to the stream of information. The website would ask for personal information and credentials in order to determine the degree of access granted to the user of the portal. In any case it would grant the user with the lowest level of access while confronting them with the higher levels containing more information, which are presumably available to those with better credentials and more status in the societal hierarchy. Through this initial confrontation, the user is presented with the inherent power struggle embedded in this theoretical society. Naturally, This would alert the user of the advantage the supposed bourgeois of this world have over them, the working class, as they can only imagine the facets of information available to those with access to the databases they do not. Subsequently, through the portal they would be allowed to view the data made available to the public about them. In this process, the algorithm behind the portal would collect public data about the user from the internet based on the personal information and credentials requested earlier to enter the site. This data would be presented to the user with the aim of creating some form of shock at the nature and extent of the data available at the lowest level of access. This second confrontation should further alert the user to the possibilities of the data that is available about them, and many more members of the working class, to more powerful individuals who represent the bourgeois or, in more practical terms, the elitist governing class of people.

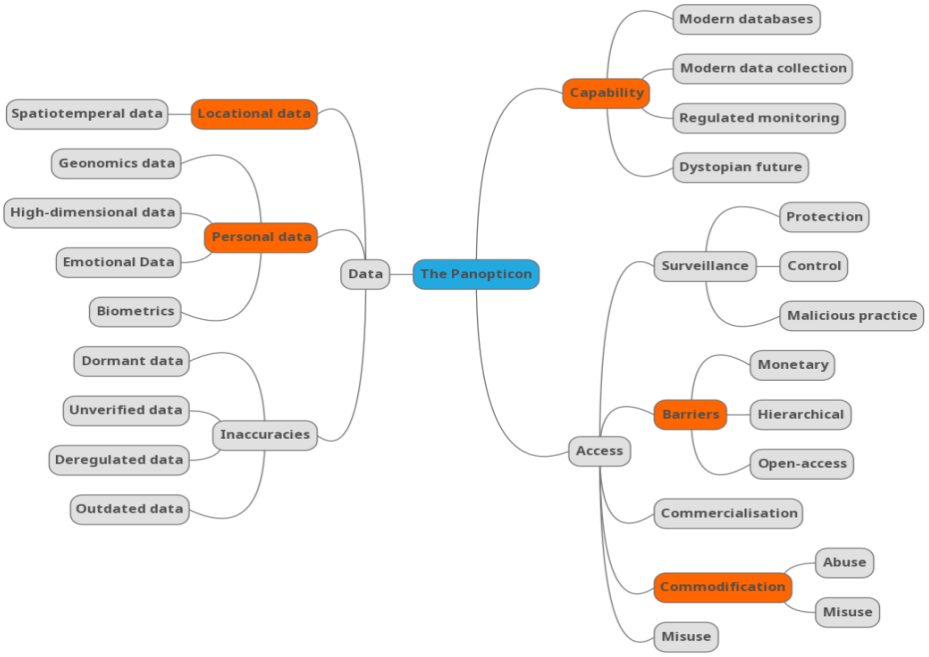


Figure 4.4.2: Mind map highlighting aspects relating to idea two

4.4.3 CCT-E

The third concept incorporates the extreme level of surveillance that is prominent in any interpretation of the panopticon. Inherently, the degree of surveillance found through analysis of the panopticon when applying its values to society should be deemed unethical. Such a practice in effect crosses fundamental rights to personal data and the right to privacy. However, through the inevitable development and integration of technology, eventually becoming synonymous with many facets of society, it is not hard to imagine such a dystopian future should the powers that be allow it to form. Many of the fears speculated around this scenario are already present, however not fully substantiated, in the western view of the Social Credit System undergoing technological development in The People's Republic of China.

In order to stem awareness and wariness to the violation of personal data and privacy rights, this installation aims to present people with an AI which draws from CCTV imagery to conjure up situations they input into a machine. Using openAI software similar to the Dall-E project, it will ask users for an input and manufacture their scenario from the perspective of a public access CCTV camera. In this sense, CCT-E would create the illusion to the user that it is drawing from a global database of public access cameras in order to fulfil their request. Additionally, it will add made up information to the picture, concerning locational and genomics data, in order to legitimise the request and continue the illusion that the scenario they have requested actually occurred and was captured on CCTV. Ultimately, this experience should confront the user with their illusioned lack of privacy, realising that imagery of themselves or their loved-ones might also be readily available through the internet for free. It should provide them with a newfound perspective on the world of surveillance around them in society and the protection of their personal data, as well as create a more profound sense of importance for the current and future privacy laws which are in place to protect the rights to their personal data and rights to their privacy.

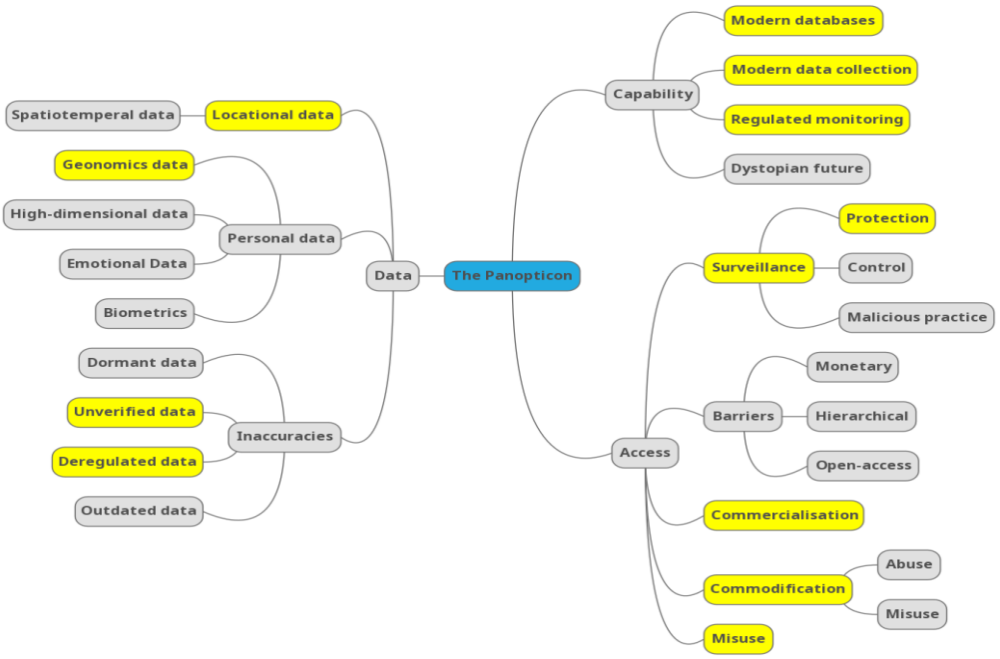


Figure 4.4.3: Mind map highlighting aspects relating to idea three

4.4.4 Panopt-icon

The final idea dives deeper into the economic aspect tied to the concept of surveillance found in Foucault's imagination of the panopticon. In this regard, this idea aims to confront the user with the contemporary and probabilistic state of surveillance capitalism. Whereas surveillance in the public sector is commonly associated with the greater public good of society, surveillance in the private sector, undertaken by any one powerful enough individual or organisation, more easily draws parallels and comparisons to dystopian foreshadowings of society. Therefore, this installation aims to reveal to the user the reach surveillance capitalism could and may already have over them. To this extent, it will address topics such as online profiling, targeted advertising, and analysis of online habits. Essentially, the purpose of the installation is to confront the user with the private sector of surveillance that feeds off of the inner workings of the internet. Subsequently, this forces them to contemplate on the extent of this data collection going forward and alerts them of possible negative effects to society if this sector is left unregulated or not properly watched over.

It will try to actualise this by placing the user in front of a screen that acts like a mirror. Their likeness will be captured through a camera and displayed to them in real time. Based on the input of the user through speech, touch, and emotions, the display of their person will be altered. After some time, the screen will start to be slowly cluttered with pop-up notifications which an algorithm pulls from the internet. These notifications will be catered specifically to different users based on the input they put into the machine. This experience should create an overwhelming feeling as the user is being bombarded with advertisements without fair warning nor request. As more notifications are pushed away, minimised or closed by the user, the rate at which they appear will increase leading to the eventual total concealment of the previously confrontational mirror. Abstractively, the user will then be confronted by a mirror of society under late stage capitalism, where out of control surveillance capitalism pushes consumerism to all, enormously impacting the human experience.

Figure 4.4.4: Mind map highlighting aspects relating to idea four

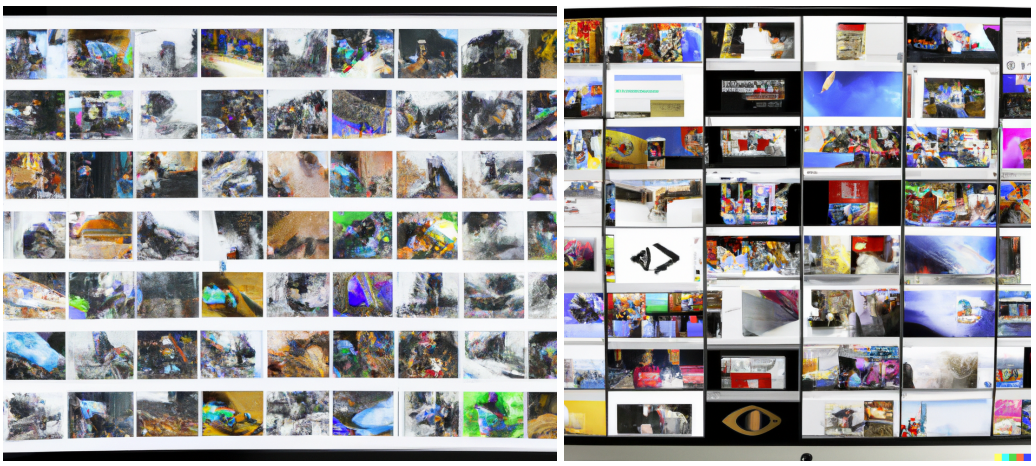
4.5 Final Concept

This section represents the end of the ideation process and will be complemented by design requirements presented in Section 4.6, before moving onto the specification phase. The final concept is formed out of an amalgamation of the underlying concept of Paragraph 4.4.2, ideas and concepts taken from the installation in Paragraph 4.4.3, and technical aspects inspired by the final idea detailed in Paragraph 4.4.4.

The experience created by the interactive installation takes place inside the closed-off environment of a box, which the user must stick their head into from the underside. Inside the box, various technical elements are present. Firstly, an array of computer screens is aligned along the walls of the box to encircle the user, presenting a 360 view of digital media. This setup can be envisioned by considering Figure 4.5 I. Secondly, each of the upper corners of the box is filled by a CCTV camera pointed at the centre where the user is situated. Lastly, the box is equipped with a microphone and a set of speakers.

Figure 4.5 I: Array of computer screens aligned to encircle, generated by DALL-E

When the user pokes their head into the secluded environment they are presented with a load of CCTV images displayed on all computer screens inside the box. As a visual representation, one might imagine each computer screen to be filled similar to Figures 4.5 II & III. At this stage, the user is illusioned that they are viewing real-time public access cameras. Consequently, they are able to interact with the display through voice commands. The commands they say, like: “Zoom in on image 34”, “Isolate image 34” or “Play audio 34” are captured by the microphone and processed by a speech recognition algorithm. The installation will then follow the command. Depending on the file they select to interact with, the installation will save the actions undertaken.



Figures 4.5 II & III: Computer screens displaying and overview of CCTV footage, by DALL-E

When displaying an individual camera, the user will also be confronted with data about the time, location and situation of the camera. Additionally, this informational page will feature basic information about the content of the screen, like the environment, people, etc.

After a while, when the user has interacted with a specific amount of files, the display will flip to a live image of the user inside the box. It will firstly relay data about the situation and try to follow up with personal information about the user. Once the user has comprehended this, a second confrontation will ensue. Live webcam video will pop up on top of the user in the display. These videos feature people from files the user had previously accessed. They will confront the user about their privacy and press them about why they accessed their camera. At this stage, the experience comes to a close as all images fade to black. The user is left in a dark box along with a mirage of feelings from the experience.

4.6 Requirements

The following section entails two sets of requirements divided into non-functional and functional. These requirements are in place to effectively guide the ideation phase into the specification phase. They allow the design process to be instilled with a set of core values which can be evaluated at any time, supporting an iterative process which pushes for active development of the design solution.

4.6.1 Non-functional Requirements

1. The installation should be visually appealing and entice the user to interact
2. The installation should elicit an emotional and thoughtful response from the user
3. The installation should clearly draw connections to the panopticon and panopticism
4. The installation should lead to ethical discussion and stimulate ethical consideration

4.6.2 Functional Requirements

1. The installation should present meaningful interaction
2. The installation should physically draw connection to the concept of the panopticon
3. The technology should behave unfalteringly, progressing the experience seamlessly
4. The design should be constructable and effective in any environment

5 Specification

The following chapter aims to develop and specify the make-up, structure, and details of the concept outlined in Section 4.5. The upcoming section below will include a MoSCoW analysis. Following, Section 5.2 will firstly consider non-functional elements which relate themselves to the experience design of the interactive installation. Building on this specification, Section 5.3 will envelop the functional aspects of the installation. Overall, this chapter builds on the ideation phase outlined in the previous chapter. In doing this, the sets of non-functional and functional requirements will serve as a guideline by which to further detail the final concept. Additionally, the conclusions and requirements taken from the previous chapters embody a foothold with which to maintain and uphold the design direction facilitated throughout the previous chapters.

5.1 MoSCoW Analysis

The Moscow Analysis method was used early on to prioritise and manage requirements for the installation. The following paragraph will outline the specifications of the prototypical interactive installation. The image below, Figure 5.1.1, provides further explanation on the different sections of the analysis. Importantly, different from Section 4.6 above, this section will build on the Moscow Analysis to construct a detailed specification of the interactive ethics installation described in Section 4.5.

Figure 5.1.1: MoSCoW template
Courtesy of:
https://online.visual-paradigm.com/diagrams/templates/moscow-method/moscow-prioritization-and-scoping/

Must Have:	Video display, physically encasing structure, confrontational climax, meaningful interaction
Should Have:	Wide variety in video display, speech commands, parallel running programming, idle running state
Could Have:	Randomisation in video display, variety in speech commands, personalised interactive effects, adaptive confrontation
Won't Have:	Physical interactive elements, saved personal data, true accessible surveillance footage

5.2 Non-functional Specification

The following part of the specification will focus on non-functional elements attributed to the design of the interactive installation. It will entail the experience design of the installation and the designed proceedings for any participant. In this, it will keep in mind the non-functional requirements for the design of the installation defined in Paragraph 4.6.1. Furthermore, it will aim to elaborate on the thematic application of the elements highlighted through Moscow Analysis in the previous section. In essence, this section aims to outline the goals for the installation, whereas the upcoming Section 5.3 Functional Specification will describe how these goals will be accomplished.

5.2.1 Experience Design

In order for the interactive installation to elicit the desired effects, not only the physical design of the prototype must be carefully considered, attention must also be put towards the procedural design of the experience, the themes and metaphors included, and how ideas are presented to the user. The following section aims to detail the latter two, whereas the proceedings of the experience are outlined in the next Section 5.2.2.

5.2.1a Experience Themes

Through the imagining of the experience as described in Section 4.5 which firstly describes the concept, different themes associated with the panopticon and privacy can be related to specific parts of the experience.

Firstly, the main visual part firstly introduces the user to the heavily relevant theme of privacy and the ease around image accessing. The user is told the 'surveillance footage' is real-time and procured through unprotected networks, prompting the idea that observing the media inside the installation is not morally good and might actually involve the invasion of privacy.

Secondly, the concluding confrontation part removes any sense of online anonymity, this aims to introduce themes of vulnerability and subjection to judgement. The user is projected to themselves and they are forced to reflect upon their actions undermining personal privacy.

5.2.1b Preferential Outcome

The eventual goal of the interactive installation is to introduce the user to the themes and ideas present in the experience and place them within the context of their technical education or field of study. Subsequently, the preferred outcome is that experience with the installation sparks or inspires some form of ethical reflection, or creates a sense of ethical awareness within the users. The installation exists to introduce the concept of panopticism and to expand an individual's perspective on panopticism's societal relevance and impact. It serves to get the individual to ponder how this might affect their environment and how these themes and ideas might be present and related to their field of study.

5.2.2 Experience Proceedings

The experience with the interactive installation is carefully designed in order to best elicit the desired effects with the user. It can be divided into four different phases, outlined in the paragraphs below. The following paragraphs will outline which ideas are present in each phase, the practical elements to the experience within each phase, and the main emotional expectation caused by each phase.

5.2.2a Prefacing Phase

Before any interaction with the installation, the individual will observe the installation within the encompassing space. The physical stature of the structure should serve to intrigue an individual and could instigate conversation and preliminary discussion. Its physical attributes, like the broadness and brazenness of the upper side of the installation or the nimble supporting structure which resemble prison bars, should entice an individual and provide the first hints about the nature of the installation and possible themes associated with it.

5.2.2b Introductory Phase

Stepping into the installation might be easier to some than to others. The individual ducks down and steps up, sticking their head and shoulders into the wooden box which fits only one person at a time. This slight barrier to entry provides a sense of solitude to the experience. The individual is alone. Only they can see what is displayed within the secluded environment. Sequentially, the inside of the box seems foreign, and the natural response is to look around, inspecting the environment and taking in its characteristics.

5.2.2c Interactive Phase

As the individual observes the displays inside the box, it becomes clear how to interact with the screens. A visual reads the type of speech commands available. The individual speaks into the microphone and selects any video from the array they find interesting. This part of the experience should create intrigue. However, it should not be confrontational or spark any controversial feelings. The interactive phase essentially places an individual in the metaphorical role of the prison guard inside the panoptic prison. The idea is that with each interaction, an individual unknowingly invades the privacy of the owner of the video. It is expected that this phase indeed does not feel alien to an individual, and could possibly even be equated to normalised interaction through Google or social media platforms.

5.2.2d Confrontational Phase

After a certain amount of interactions with the installation, the second part of the experience commences. The individual is put on video and their likeness is portrayed back to them. The confrontational phase essentially places the individual into the role of the prisoner, having experienced the perspective of the prison guard in the previous phase. This part of the experience comes unexpectedly and aims to be confrontational through shock and reflection. Their image will then be littered with video elements on the screen, furthering the confrontation using direct engagement. The confrontation aims to elicit distraught and discomfort. The individual should leave the installation with an uneasy feeling. This apparent shock or confrontation should ideally lead to ethical reflection and an increase in ethical awareness surrounding the topic of privacy and the application of panopticism to society.

5.3 Functional Specification

This part of the specification will focus on functional elements to the design of the interactive installation. It will discuss the choices for hardware components and the demands of the software components. In this, it will keep in mind the functional requirements for the design of the installation defined in Paragraph 4.6.2. Furthermore, it will aim to elaborate on the practical application of the elements highlighted through the Moscow Analysis. In essence, this section aims to describe how the goals for the installation, which have been outlined throughout Section 5.2, will be accomplished.

5.3.1 Hardware

The following section aims to put detail into a basic manual for constructing the interactive installation which is to be realised in the next Chapter 6. Should the installation ever be reconstructed or reiterated upon, these elements form the basis for the physical appearance of the installation and experience from first glance. It is important to first confirm the physical attributes to the installation before the software component, as the latter is more easily adapted to comply with the needs or complications raised from the former. The paragraphs below discuss diverse elements of the hardware aspect of the installation. Namely, the descriptions below are in place to facilitate elements of the Moscow Analysis.

5.3.1a Display

Four monitors make up the main visual display and digital appearance of the installation. Inside the enclosed environment created by the installation, these screens squarely encircle the individual and aim to take up their entire perspective of vision. As the confrontational part of the experience will be facilitated by live camera footage taken from inside the box, the installation requires at least one camera to be installed in one of the upper corners of the boxed off environment.

5.3.1b Interaction

An individual is able to vocalise commands into a microphone placed among the monitors in the enclosed space. This microphone is the main facilitator for interaction with the displays on the screens. Through specific voice commands, they can control the visuals on the screens and possibly even request information about the media presented to them. This way

the installation creates a meaningful interaction, while negating the need for physical interactive elements.

5.3.1c Structure

The entire experience takes place in a closed off environment which an individual merely pokes their head or perhaps their shoulders into. Therefore, the construction must facilitate this secluded environment and place it onto a support structure.

5.3.2 Software

This section discusses the software specifications for the installation. As noted above, the software element to the installation is more malleable than the selection of hardware components. Essentially, the code behind the interactive installation embodies the driving force behind the experience, whereas the hardware facilitates its physical appearance and interactive nature. Therefore, the upcoming paragraphs discuss demands for the code in order to harbour the desired themes and interactions.

5.3.2a Display

Firstly, the programme should incorporate a varied array of videos into a grid of content. Each monitor included in the experience must be able to display multiple videos at a time and, as to not create repetitive experiences, the selection or placement of these videos in the display could be randomised between experiences. Additionally, as the programme requires at least one driver core at all times in order to display all video footage in perpetuity, the code should allow for parallel running in order to seamlessly incorporate different functions into the experience. Furthermore, in order to continuously maximise on the intrigue of the introductory phase of the experience, the programme should be able to run at an idle state. This is important as it makes the installation appear as active before an individual peers into the video display and starts any interaction.

The installation must not run off actual accessible surveillance footage as to not introduce any actual privacy concerns. Conversely, it should be supported by carefully selected stock footage, creating the illusion that the videos have been pulled from the web through unsecure channels and networks.

5.3.2b Interaction

Secondly, the programme should support a seamless interaction without the use of physical interactive components. To this aim, the interaction should run off speech commands, with the code supporting speech recognition in order to respond to these commands in the display. At the minimum, these speech commands should serve to progress the experience, providing sufficient intrigue and satisfaction before commencing the confrontational phase. In order to create a more responsive and malleable environment for the individual, a larger variety in speech commands could be presented which link into various functions of the programme. Additionally, towards the same aim, the programme could introduce personalised interactive effects, possibly to do with pattern recognition, personal physical attributes, or personal online information.

5.3.2c Confrontation

Lastly, the confrontational part of the installation must present the climax of the experience. The interactions running up to the visual display from the perspective of the camera should amount unexpectedly to the reveal of the confrontation. The confrontation could present some adaptability or personalisation based on a specific individual's interactions or a personal profile. This would increase the desired effect of the confrontation and assert a more pronounced element of uneasiness. Importantly, the code behind the installation must not save any personal data, nor collect and save any visual data from the cameras.

5.4 Design

The following section presents the interactive installation through visual representations. The installation as it is visualised and described through the upcoming paragraphs forms the basis for the realisation process in the upcoming Chapter 6. It will first address the physical form of the installation. In doing this, explanations will be given towards design decisions. Second, the software side of the installation will be structured and explained. This will be more closely tied to the experience design.

5.4.1 Physical

The closed off environment, as specified earlier in this chapter, was envisioned through the construction of a wooden box of which the inside would be at eye level. Naturally, not all users of the installation will be the same height. Subsequently, the decision was made to value structural integrity above adaptability in size. Essentially, the structure needed to ring true to the phrase 'one size fits all'. Therefore, the frame was designed to support the box at the approximate eye level of the average height of a person in The Netherlands. The figure below shows a design of the side plane of the installation next to an average sized man. This figure accurately shows that positioning oneself into the installation becomes quite the cramped endeavour. This was done intentionally, both to limit the size of the installation, but also to confine the environment and create a seemingly inescapable perspective.

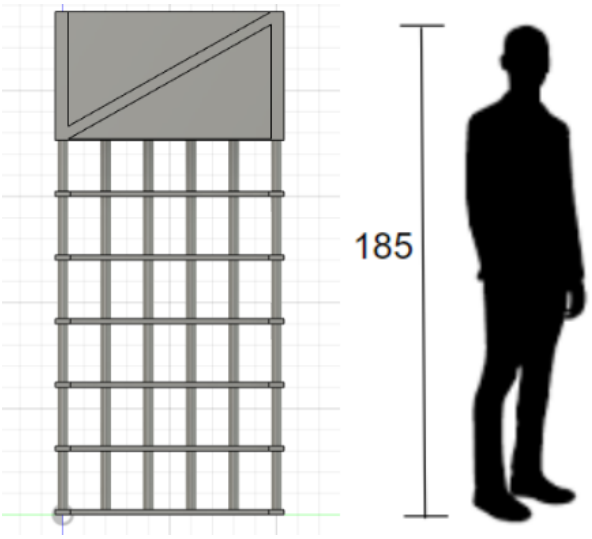


Figure 5.4.1 I: Front profile of the installation, compiled in Autodesk Fusion 360

Figure 5.4.1 II shows a more opened up view of the design, in which it becomes imaginable how being placed inside the installation does create this environment where you are presented an inescapable broadcast of media surrounding you. This figure relays how the screens inside the box quite forcefully capture the attention of an individual upon entry. It is the aim that an individual who enters the installation is immediately intrigued and captivated by the displays surrounding them. The figure below further entails how the camera inside the enclosed environment is mounted to the roof of the box.

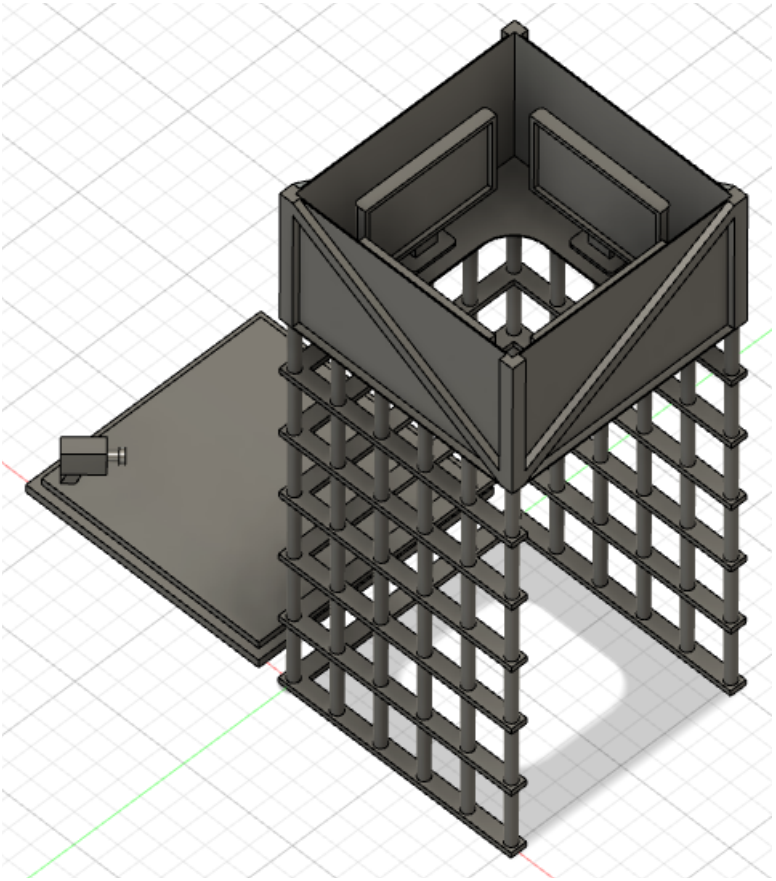


Figure 5.4.1 II: Aerial view of the installation, compiled in Autodesk Fusion 360

The following figure displays a top-down view of the box, revealing how an individual would only be allowed ample space to move and explore the media surrounding them. Essentially, they are confined to rotation along a single axis. This confining and controlling feeling imposed by the physical design of the installation hints towards the themes also presented in its prison-like form. Visually and subconsciously, the design incorporates the concept of the panoptic prison and themes surrounding it. Lastly, the top-down view reveals the location of the microphone inside the box.

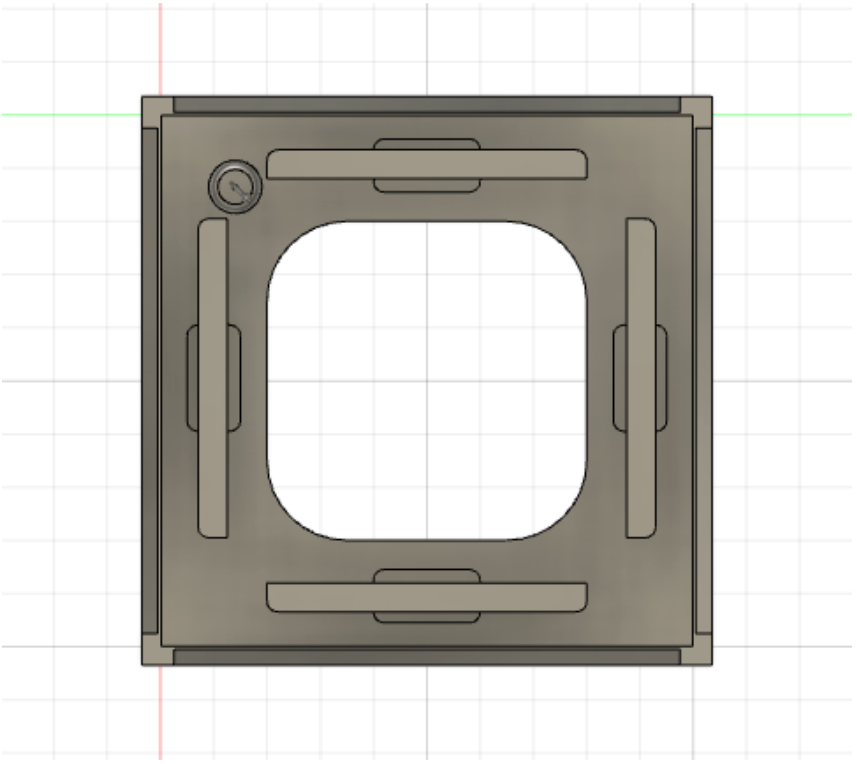


Figure 5.4.1 III: Top view of the installation, no top cover, compiled in Autodesk Fusion 360

5.4.2 Programming

The Python code used by the installation can be found in Appendix B. The computational side of the installation takes in stock footage imagery which will be presented as openaccess video taken from unsecured places on the internet. These videos can be swapped out to differentiate the atmosphere created in the installation by the chosen media. The input folder of videos parse through the initial stage of the code and get merged into placeholder displays. The figure below shows how the videos will be titled and aligned in a four by four grid. With four screens and sixteen videos per grid, the folder consists of 64 unique videos which can be interacted with. Subsequently, since each screen display will display a different set of videos, the physical, dynamic, and explorative aspects of the design will be enhanced as an individual is forced to rotate to fulfil their intrigue of the screen around them. Sequentially, after having inspected the media display around them, individuals will be able to isolate a video of their interest onto the full screen of a monitor. This isolation will be possible through voice commands picked up by the microphone, which are then processed into text by a speech recognition algorithm. Any command or request which matches specified interactive phrasing will set specific functions in motion. For instance, the individual can call a command like “Isolate video four” or “Show me video four”. This will trigger the programme to take Video4 from the merged grid and display it full size to the user. Once a video has been called, further commands can be used to find out details about this video, which should further satiate the interest of the person. These details could embody specifics about time and place, mediatype, accessibility type, original owner of the file, or others depending what the time limitations of the project allow. Any information that is requested is presented in the form of text overlaid over the video while it is playing. Importantly, the information will be framed as being true, but it is fabricated in order to enhance the experience.

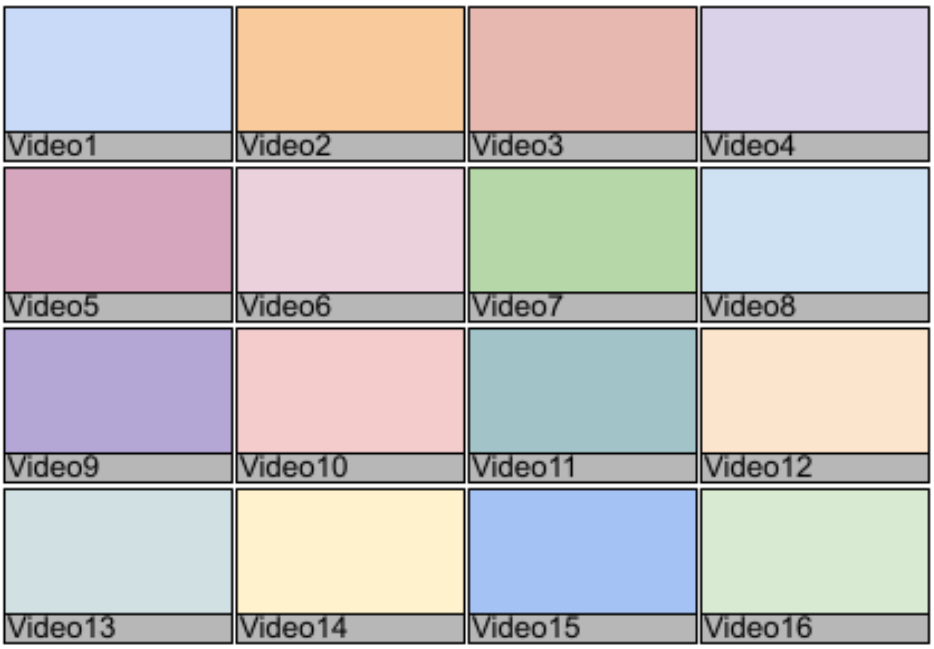


Figure 5.4.2: Visualisation for grid display of merged videos

Up until this point, this section describes the interactive element of the installation. These interactions, however, mainly serve the purpose of building up the climax which is created in the confrontational phase. After a set amount of interactions the programme switches out the video display for a real-time video stream captured by the camera in the box. The individual is now presented by their likeness on all monitors surrounding them. Gradually, this image will be distorted and covered by confrontational text, photos and videos relating to the videos they accessed in the interactive phase. Once the original image is no longer in view, the distortion and general confrontation will stop, which marks the end of the experience.

6 Realisation

The following chapter reveals the realisation process of the interactive ethics installation. It will sequentially highlight aspects mentioned throughout the previous Chapter 5 and it will deliberate how different components were constructed, integrated, and in some cases adapted to fit the prototype. The sections below will firstly discuss the hardware side of the design, followed by the adaptation and integration of these components. Subsequently, a future section will detail the construction and integration of the code supporting the experience. The software section will describe which alterations were made to uphold the experience while complying to the demands of the physical prototype. Finally, this chapter will be rounded out by a concluding description of the interactive ethics installation as a prototype.

6.1 Hardware Components

The paragraphs below outline the components used in the installation. This is followed by a description of how these components come together to form the eventual physicality and hardware of the installation. Finally, any alterations in realisation to the design specified in Section 5.4 due to physical limitation or time constraints are outlined, paired with the complications which caused these changes.

6.1.1 Structure

Firstly, the entire installation is supported by wooden components. The support structure underneath the box consists of three interlocked barred panels. Each panel features five horizontal beams and four vertical bars. These panels interlink at the backside corners. In order to increase the structural integrity of the support structure, four diagonal brace beams were later added as the installation appeared more top-heavy than envisioned during the design process. The box simply consists of six boards and a skeleton which keeps these boards in place. Every board is fastened to the skeleton except for the top board, which was deliberately left to be detachable. Additionally, the bottom plate features a rounded square hole to allow entry.

6.1.2 Video

Secondly, the interactive phase of the installation is facilitated by four standard monitors connected by HDMI cables to a laptop running the programme. These cables come together through a splitter, which converts a single output from the laptop to 4 outputs to the monitors. Additionally, the confrontational phase is actuated by a webcam mounted on the edge of the top-cover board. This webcam links to the aforementioned laptop through a USB connection.

6.1.3 Audio

Lastly, the interaction is aided by a microphone on a mini-tripod. This microphone is placed inside the box and links to the laptop through a USB connection. The resolution of the webcam is 1024px by 768px.

6.1.4 Hardware Integration

The hardware components can essentially be classified as two sensors and four actuators. The four monitors connected to the system resemble the actuators as they produce the visuals for the experience. The two sensors consist of the microphone and the camera. Firstly, the microphone actively takes an auditory input and delivers this to the system to be processed. And secondly, the webcam captures the likeness of an individual from inside the box and sends this data through the system, which in return forwards it to the monitors inside the box.

6.1.5 Complications

The realisation phase encountered a number of issues during construction. Unfortunately, these issues largely revealed themselves towards the end of the realisation period, close to the planned evaluations.

Firstly, a minor issue arose when the monitors used in the installation appeared to be larger and bulkier than the monitors used during the design phase. The main cause for this issue was the difficulty in finding four monitors for an acceptable price. Consequently, the box contained an abundance of weight and the ledges of the bottom board could not support the bulky monitors. As a quick solution, the monitors were moved from the edges of the box to the corners of the box, supported by additional circular pieces of wooden board. These fixes largely alleviated this issue.

And secondly, far into the construction it became clear that the envisioned experience could not be accomplished through the use of an HDMI splitter, as the splitter device is not designed to output four different signals. Additional research was done in order to maintain the design of the installation with four different visual displays, however, no solution was found to be applicable to the situation. The HDMI splitter was the only available device which could output to four monitors. Therefore, the design of the experience was altered slightly, accounting for the fact that each monitor was forced to mirror the rest. The standing solution was eventually applied through modifications to the software. These adaptations are further explained in Paragraph 6.2.3 in the upcoming section.

6.2 Software Integration

The following section aims to provide a well-rounded description of the Python programme used to run the installation. The entirety of the code is presented in Appendix B. The different components which are present in the code are firstly detailed and their applications are explained. Subsequently, the structure of the code is outlined and coding decisions are explained. Lastly, the modifications caused by the abovementioned hardware complications are described and supported.

6.2.1 Components

The programme essentially runs off five main components; a video display function, a speech recognition library, a webcam display function, a video isolation function, and an overlay function. A separate function can be identified in the merging function used to initialise the media folder, however, this script is not directly tied to the programme and could

essentially be ignored after an initial merger. This is because this merge script saves the video grid as a separate instance to be displayed, after which this saved video remains until it is overrode by another initialisation through the function.

The video display function uses the ‘cv2’ library to read the merged grid videos frame by frame. This way it can use its `cv2.imshow` function to individually display the frames at the computational speed of the programme in a ‘while loop’. This speed lines up on average with about 15 frames per second, which can be altered by either removing computationally heavy sections of code or by adding and removing `cv2.waitKey` functions, as these essentially pause the programme for a short period of time which lowers FPS.

The speech recognition library uses version 3.8.1 and it is able to take input from a microphone and pass it through the library which is powered by Google, meaning it requires an internet connection. It is able to distinguish any English speech and outputs a string from its `sr.recognize_google(audio)` function, for example: “Show me video fourteen”. The programme then parses such strings through text analysis functions in order to figure out the meaning of the string in computational terms.

The webcam display function uses the same library as the video display method. It essentially follows the same process, but incorporates the `cv2.VideoCapture` function which allows the programme to read data from a camera. It then utilises video modulation functions in order to reach the desired effects before the display.

The video isolation function embodies the main interactive factor for the installation. It takes the processed output of the speech recognition function, in order to single out a single video which will take over the display function. Once a valid voice command has been called, such as the example given above, it will instigate a separate video display function designed to override the display of the grid video. This isolation display function takes a single video file from the media folder and displays it fullscreen.

Lastly, the overlay function is in place to use drawing functions in order to add information to the different video displays. It uses functions such as `cv2.putText` in order to position text over individual frames, and additional functions and input parameters to specify and modulate the text to the desired output.

6.2.2 Structure

A minimal amount of information travels between the different components of the code. In order to sustain the interaction, a voice command firstly needs to be processed. It is then checked for validity, and subsequently acted upon. An initial voice command can only trigger the video isolation function, whereas different voice commands can be triggered during the isolation function. The isolation function will run off of the input it receives for calling a specific video from the video grid. Each time this function is successfully called an interaction counter is increased by one. After a tally of four total interactions, a timer is started during the duration of which the video grid is idly displayed as a buffer. This timer reaches completion after an uncertain amount of time. At this point the interactive phase unexpectedly makes way for the confrontational phase at an instance. This process triggers the webcam display function. Gradually, the overlay function clutters this display at random.

6.2.3 Adaptations

Firstly, as mentioned in Paragraph 6.1.5, limitations to the hardware of the installation resulted in the input for the four monitor displays to be the same. As a consequence, the installation could not display 64 videos across four grids simultaneously as envisioned by the experience design, but was only able to display the same 16-video grid across the four screens.

The solution that was adapted in order to still incorporate all video material was to switch out which video grid was being output to the display. This meant that after each interaction, meaning each request to isolate and inspect a single video, the set of videos exposed to the user would change. An unforeseen result from this solution was that the experience turned out to seem more sequential, as the first grid displayed videos 1 through 16, the second batch showed 17 through 32, and so on. The downside, however, is that this change in the experience design should negate part of the physical design, seeing as the need for the individual inside to rotate in order to see different videos is removed.

And secondly, the original design of the prototype installation envisioned the interactive component to run continuously during the display of media material. It was imagined that this could be accomplished through Python threading or multiprocessing. These functions, however, are not able to continuously run code in parallel, which is the only possible solution for the original design of the experience. Since these functions failed, a workaround had to be developed which as a consequence forcefully altered the design of the experience.

The solution that was eventually adapted was to initiate the microphone at the end of the duration of each video. Before repeating the runtime of the video and returning it to its first frame, an overlay would appear on top of the last frame of the video. This overlay alerts the individual that the microphone is live and allows them some time to enter a voice command. If no distinguishable command was captured from the microphone or the input processing algorithm, the subsequent functions would be ignored and the video would start from its beginning. This re-run of the video would give an individual more time to deliberate on which video to choose or which voice command to call.

6.3 Concluding Prototype

The following section considers the prototypical installation that resulted from the previous phases of the project. It aims to provide a general description of the physical structure and designed experience. Additionally, it presents figures and subsequent explanations which hope to construct a detailed picture of the interactive ethics installation on paper. Generally, it aims to reflect on the requirements for the installation at the end of the ideation phase.

The concluding prototype for the interactive ethical installation successfully focuses on incorporating the concept of the panopticon and themes of panopticism, surveillance, and privacy. The structure consists mainly of wood and hardware elements. The experience is designed to sequentially follow two phases, starting with the interactive phase and ending with the confrontational phase. The process embraces physicality in order to maintain the connection to the panopticon.

The figures below show the interactive ethics installation in its eventual educational environment. These pictures were taken at the ethics lab at the Saxion College in Deventer.

Figures 6.3 I & II: Pictures of the installation

Figures 6.3 III and IV below show the merged gird videos which are displayed on the monitors inside of the installation. It is visible that the videos in the grid are labelled in order to distinguish them through voice commands. These grids are shown sequentially between interactions by an individual, namely they are separated by the process of isolating a single video from the grid. Merged grid videos do not complete an entire runtime, but are displayed on a shorter loop which teases the extended content of each video.

Figure 6.3 III: Screenshot showing a merged grid, videos 1 through 16

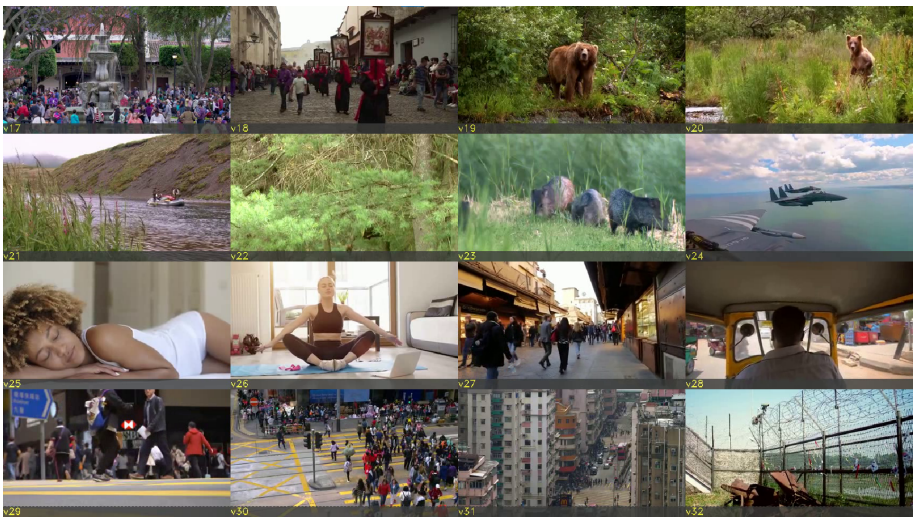


Figure 6.3 IV: Screenshot showing a merged grid, videos 17 through 32

The figure below features a screenshot of the informational overlay that appears at the end of each video. This overlay informs the individual that the microphone is now in use and voice commands can be used to interact with the installation. By calling the example request, the respective vocalised video will be isolated. It will be displayed fullscreen and complete its entire runtime. The specification detailed how varied functions could be called during the isolation process, however, time constraints of the project did not allow for such functions to be implemented. Alternatively, after completing a full runtime of an isolated video, the programme breaks from the process and displays the following grid. Interestingly, this positively shortens the time spent interacting with a single video and prevents individuals from getting caught up by a single interaction. This limitation features the side-effect of hurrying along the experience, better catering to a short attention span.

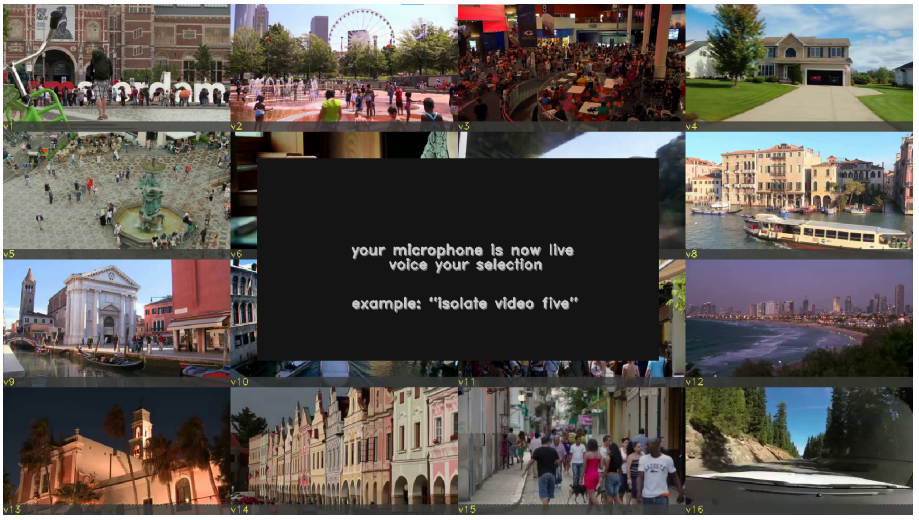


Figure 6.3 V: Screenshot showing a merged grid with the interaction overlay information

The following figures show two individuals during the confrontational phase of the experience. It shows them being revealed to their own likeness inside the installation, while being confronted with the fact that they are now the ones being observed. Aside from the fact that they now fully realise they are on camera, this fact is additionally emphasised by a steadily increasing counter of live viewers in the top left corner of the display.

Figures 6.3 VI & VII: Two individuals captured from webcam footage during confrontation

Unfortunately, due to budgetary and timely constraints of the project, in addition to the complications encountered during the realisation process, the confrontational phase could not be worked out further. Previously, the specification of the confrontation mentions distressing information and confrontational images that were to be overlaid on top of the webcam display. These functions could not be developed in time before the evaluation of the installation. However, the programme in its current state completes the confrontational element that was specified and required in an earlier chapter, albeit through minimal exposure and a preference of discomfort over distress.

7 Evaluation

With the concluding prototype for the interactive ethics installation completed, the following section will discuss the evaluation procedure of the installation. Section 7.1 will firstly outline the manner in which the prototype was evaluated, focusing on the structure of the evaluation session, including the inclusion and exclusion criteria for test participants, and the nature of the procedure. Next, Section 7.2 will share the results found during different phases of the evaluation procedure. Additionally, it will reflect in detail on the non-functional requirements set for the installation at the end of the ideation phase. Lastly, Section 7.3 evaluates the construction of the prototype and highlights which improvement could be made if limitations allowed, along with improvement in the approach should the project be repeated. Finally, it will reflect in detail on the functional requirements set for the installation at the end of the ideation phase before moving onto Chapter 8.

7.1 Evaluation Plan

The three paragraphs in this section basically embody the divisions that exist in the structure of the evaluation procedure. The evaluation process was designed to feature three sections, prefaced by a formal introduction to the research through an information letter and the procurement of consent through a consent form, both of which are found in Appendix C. The first active section was not too dissimilar to the interviews conducted with the target audience in Chapter 4. This introductory phase was followed by an introduction to the interactive ethics installation and the topic at hand. The participants then went through the designed experience with the installation, after which they were once again interviewed. This final interview aimed to evaluate the experience and spark discussion among the participants in the room about topics and themes related to the installation. To concisely summarise, the evaluation procedure embodied a starting interview, followed by experience with the interactive ethics installation, and was finished by an evaluative interview.

7.1.1 Introductory Phase

The preliminary interview was mainly put in place to configure the level of ethical proficiency of the participants and to gauge their familiarity with the topic at hand. Additionally, it was able to function as a test to confirm their inclusion into the research, seeing as each participant had to conform to certain inclusion and exclusion criteria. These criteria revolved around the progression and level of their education, and their field of study. The main inclusion criterion was for the participant to be following, or to have recently followed, a technical design study at an academic institution.

The starting interview was designed to be a formal, one-on-one interview between the participant and the researcher. The interview effectively used open-ended questions to inquire about the participant's prior experience with ethics in their education. For instance their encounters with ethical case studies or ethical frameworks. Similarly, it featured carefully constructed questions which aimed to outline a participant's personal perspective on the relationship between ethics and technology. Furthermore, this interview found additional purpose in configuring the participants prior knowledge of, and experience with, classical ethical dilemmas and the panopticon in particular.

7.1.2 Interaction

Before commencing the experience and entering the interactive installation, participants were allowed to inquire with the researcher about the topic if there were any remaining uncertainties or curiosities. Any questions would expectedly revolve around either the session's procedure, the installation's topic, or possibly any remaining uncertainties raised from the research and their rights as a participant.

Upon starting the designed experience, the researcher stood by to assist the process and make sure the experience ran smoothly. All the while the participant interacted with the installation and went along with the designed experience, the researcher had the possibility to observe the participant through their actions in the underlying programme and their reactions through the camera inside the enclosed environment.

7.1.3 Resulting Interviews

The purpose of the resulting interviews was to evaluate the use, effectiveness and possible application of the interactive ethics installation when displayed in the context of a dedicated ethics space. The interview inquired about the participant's perception of the installation, their experience with the installation, and their opinions and critiques of the installation in the context of ethics education and dedicated ethics spaces. Specifically, after the experience, the participants were asked to reflect on the installation, subject or topic, and the concept. This was guided through the structure of a semi-structured interview and discussion driven by open-ended questions. In this sense, the interview questions served to spark dialogue or discussion between participants in the room. During these conversations, the researcher aimed to direct the topic of the conversation in order to keep the participants on track. Furthermore, the researcher aimed to interject into the conversation a minimal amount, but would convey any underlying concepts and insights from the experience which the participants might have missed. This was mainly done to aid their ethical vocabulary and stimulate further discussion. To end the procedure, the participants were fully debriefed.

7.2 Experience Evaluation

The following section will elaborate on results found during the evaluation procedure. These results were collected from the abovementioned interviews and observations made by the researcher during the participants' experiences. The conclusions are derived from the experiences of the participants and their reflection on the interactive ethics installation, both ethically and practically. The paragraphs below will firstly describe the setting of the evaluation session, followed by results gathered throughout the varying phases of the experience, and finally a reflection on the non-functional requirements set during ideation.

7.2.1 Evaluation Settings

The evaluation session was conducted in the ethics lab at the Saxion University of Applied Sciences. Four persons who succeeded the inclusion and exclusion criteria were invited to take part in the session as participants. These students were firstly informed of the research and asked to provide informed consent. They were then briefed on the procedure and, subsequently, individually interviewed. Once all participants had gone through the first interviewing round, they were introduced to the interactive ethics installation and separately

engaged with the installation. After each participant had gone through the experience, they were individually posed questions, which after answering other participants were stimulated to engage with and submit their personal opinion on the matter. During both the preluding interview and the evaluative interview, a mobile phone was used to record the audio of all interviews. Once the interviewing structure cleared up for the participants, it was indeed able to quickly and effectively spark conversation and discussion between the participants. The topics for discussion firstly encumbered themes of privacy, surveillance, the internet and advertising, and other topics which relate closely to the themes presented in the installation. However, as conversation continued, participants found that expressing their ideas through more personally related topics came easier. In this fashion, applying their opinions on the themes presented in the experience to their personal research, designs, studies, or morality in general delivered more honest responses.

7.2.2 Evaluation Results

The paragraphs below detail the findings of the evaluation procedure described in the previous section. It follows the structure outlined above and includes an additional focus on the discussions which arose from the session.

7.2.2a Introductory Phase

The introductory phase found echoes of the results contrived from the interviews conducted during Chapter 4 as the subject matter contained a similar focus. The participants very similarly noted the importance of ethics when pertaining to stakeholders and when approving research procedures. They also identified that ethics and technology were closely related, but noted few positive experiences with ethics education, identical to the target audience interviews from Section 4.1. Generally, answers by the participants indicated the same lack of practical understanding of ethical principles related to the design process as found before. Furthermore, their answers pointed towards low ethical vocabulary and low proficiency as found by the analysis skills they related or were able to describe. However, dissimilar to the interviewees from the target audience interviews, the participants of the evaluative session did not lack enthusiasm, nor interest. The target audience interviews found that this lack of interest could for the most part be attributed to low focus, purposeless ethics assignment, low general understanding of the course material, and a lack of practical application of the methods and concepts discussed in ethics education. Therefore, the preemptive conclusion may be presented that the participants of the evaluative session were instantly more engaged with the subject matter because of the practical nature of the project, using an interactive installation to convey ethics. Naturally and consequently, further questions arise from this claim as other factors aside from the practical approach presented by the session might have positive effects on participants' engagement. Optimistically, the additional factors could present even further proof for the application of such practical approaches, which embodies the purpose of this exploratory research as a whole. For instance, further research could show that participant consensus finds assignments related to such a practical approach to be more effective than contemporary ethics assignments, which were deemed meaningless and baseless by the target audience interviewees.

7.2.2b Experience Observations

The possibility of observing the participants during their experiences was limited at best, as they took place in an enclosed environment. Beforehand however, it was clear that each participant took a brief moment to tentatively scope out the structure of the installation in order to figure out what was going on and how to easily get inside. Once inside, the natural inquisitive response for all participants was to navigate their sight around the installation by rotating before specifically focusing on the videos displayed on the monitors. Therefore, most participants located the camera inside the environment before starting any interaction, whereas the rest identified its presence before the confrontation phase of the designed experience. When the designed experience was underway and participants were interacting with the installation, their need to rotate themselves in order to acquire different perspectives diminished. This was predicted in Paragraph 6.2.3 when reflecting on the changes the complications from Chapter 6 would have on the physicality of the designed experience. Therefore, no significant observations were made during most of the interactive phase. Opposingly, the confrontational phase of the designed experience presented the best opportunity for observation, as the participants were exposed to their own likeness through camera footage. All of the participants subconsciously output a slight visceral reaction as initial reflex. Once they seemed to find further grasp on the situation, they again began to explore the enclosed environment by rotating in the same fashion as before. Interestingly, the results from the evaluative interviews presented in the next paragraph reveal a differentiation in reasoning for the rotational movement.

7.2.2c Reflective Phase

The evaluative interviews presented insights into participants' opinions on the installation. The questions constructed to start the interviewing process generally inquired about the experience the participants went through and what their perspective was on it. All participants noted that the interactive phase of the experience felt quite normal. They generally understood that they were essentially unobstructedly observing personal data from varying places around the world, but they equated this with scrolling on social media. This was an expected effect, first described in Paragraph 5.2.2.c.

Excerpts:

Participant 1: Well, it starts with the different movies from around the world of other random people, and it feels kind of normal to observe because you experience that every day on the internet.

Participant 2: The first movies feel normal, the same feeling as being on instagram and seeing a random story come by on some street. Very normal feeling.

Furthermore, it gauged the extent to which the participants understood how the installation relayed the concept of the panopticon. Most participants were able to describe this relation with some accuracy, but they generally lacked the ethical vocabulary to construct valid descriptions. This corroborates the findings of the target audience interviews and the introductory phase of the evaluation procedure. After ample explanation on how the installation conveys the concepts of the panopticon and panopticism, some participants were able to better shape this relation through their words and found new insights on the experience they underwent. Once this clicked for all participants, they all found their

individual discrepancies in the meaning of the confrontational phase. However, their descriptions of the feelings encountered during this part of the experience lined up. Each participant noted that being exposed to your own image in such a confrontational manner harboured uncomfortable emotions. One account stated the following: “Then you see your own person and you can't really get away from it, because when you turn away you still see yourself. It’s not claustrophobic or anything, but because you can’t get away, it’s not a welcomed feeling” (P2). When asked if the confrontation relayed the feeling that the participants were being watched, they argued that this feeling did come up, but was quickly invalidated as they remembered that they were in a “safe” educational space.

As found in the quote above, some participants specifically mentioned physical movement. When inquiring about their motivations for trying to “turn away”, it was revealed that, contrastingly to the first segment of the experience where participants moved around their sights to inspect the environment and curiously explore the installation, the confrontational segment of the installation prompted them to try to escape the vision of the camera and evade being exposed to themselves. The interview went on to question the participants if their perspectives on the ethical themes of the installation, such as privacy, had changed in any way, and if the physical experience had set in motion any ethical deliberation. The excerpts below reveal two varying opinions on this matter which come together to find the same conclusion.

Excerpts:

Participant 2: So I think it is important that every study spends some time on this, even if it is just a spark of awareness. And through this installation, the awareness comes very easily because all of the sudden it applies to you specifically. And that’s very different from just reading about it or finding a case study.

Participant 4: I think that the contrast that you find between the videos and the part where you are put on camera makes you kind of wonder more about the experience. In that way maybe it could make you change behaviour or something if you do not like this feeling it gives, because I don't like it myself.

Both participants in the instance above essentially form arguments in favour of the practical approach to teaching ethics presented by the interactive installation. They relay that such an experience would give an individual additional insights on ethical concepts and topics, as “through this installation, the awareness comes very easily because all of the sudden it applies to you specifically. And that’s very different from just reading about it or finding a case study” (P2).

Interestingly, supported by the apparent personalised ethical weight that the experience was able to put on participants, as contrived from the quote above, participants more handily applied the concepts and ideas related to the subject matter of the installation to their personal fields and studies, as previously described in Paragraph 7.2.1. Most conversations and discussions originated from this fact, engaging participants amongst each other.

7.2.2d Participant Discussions

The first conversation that was sparked from the application of ideas taken from the installation to personal topics revolved around cultural directness. During informal group discussion, participant 2 raised this issue out of interest. They wondered how, in the setting of a society or environment where the concept of panopticism was highly prevalent, cultural differences between the populations exposed to this environment would have an impact on the identification of homogenous rules which form the foundation for the social aspect of panopticism. Furthermore, if these populations would react differently to such an internalised effect. Information was added by other participants that the panopticism in this case would be mainly based on personal values and morals, and that people with widely different values and morals, from different backgrounds, might interpret ethical issues differently, especially something like privacy. The conversation then evolved towards dominance relations in the construction of the definition of normality and behavioural norms. This discussion quoted questions such as: “Where Japanese people might comply, Dutch people might more easily abstain and object. So in that sense, when you’d have to follow societal norms, what would the common consensus on normality be?” (P4). Answered as follows: “[Because] Europeans would in theory be more vocal and louder in defining that definition, dominantly projecting our ‘normal’ onto others, who might identify with a different view on normality” (P3).

The ending passages of the previous discussion sparked the start of the second topic, namely social behavioural norms. As this conversation contracted towards being overly technical and theoretical, the researcher stepped in to provide further details about panopticism. It was explained how through this internalised process, a prisoner would in some sense take on the role of the prison guard. This sparked discussion about YouTube videos which deal with similar topics, presented in Appendix D. Attention was diverted back to the topic at hand through the introduction of a theoretical case study based on a fact about phones in prison. The situation was introduced in a manner that applies to the participants specifically as follows: “If you saw someone in prison with a phone, which is not allowed, you would not necessarily alert the guard or snitch. So in that sense, within panopticism, if you see someone break the rules: do you vocalise your concern or opinion, and to whom?” (Researcher). The participants found that whether you confront anyone in this scenario was irrelevant to the idea. They found that even the formation of this judgement about the rules creates enough of a barrier for the self to stay within bounds, essentially touching on the fact that individuals within panopticism guard themselves as much or more than one another. They argued: “the fact that you form this judgement means you attribute the issue you’re forming an opinion on to some definition of ‘moral good’ or justice” (P1). The discussion then circled back on itself as it was alerted that individuals with different backgrounds experience different definitions of moral good and justice, arguing how different cultures behave around the issue of public waste. The conversation was concluded as participants agreed on the consensus that enough time spent in a “panoptic environment” would uniformly mould these perceptions of moral good, and how these perceptions could be influenced by governmental structures and laws.

7.2.3 Requirement Evaluation

This paragraph observes the results outlined in the section above and aims to draw conclusions in order to evaluate the non-functional requirements set in Paragraph 4.6.1. At first glance the installation does not exactly appear visually appealing, however, as denoted from the observations and opinions of participants, the physical structure does create intrigue and interest. Additionally, the participants were impressed with the mechanics of the installation once inside and visibly inspected the enclosed environment before interacting. Secondly, the designed experience was then able to elicit clear visceral reactions with all participants when the confrontational phase started. The evaluative interviews further reported how the confrontation and exposure brought upon uncomfortable and unwelcome feelings. Paired with further explanation of the concept of the panopticon and panopticism, participants were able to construct thoughtful responses, especially when applying their ideas to their personal background and studies. Thirdly, the interactive installation was able to successfully cement the connection to the subject matter of the panopticon and the concept of panopticism. The participants were able to describe the relation to the topic and could point out different facets of the experience related to the idea. However, the connection came into full force when coupled with further explanation of the topic and ties to modern relevance. Lastly, the experience instrumentally resulted in ethical dialogue and discussion. It succeeded in sparking ethical consideration relating to topics and themes represented in the installation.

7.3 Practical Evaluation

The following section will evaluate the construction of the prototypical interactive ethics installation based on judgement from the researcher and insights from the evaluation procedure. The conclusions are derived from the opinions of the participants and their reflection on the installation, both physically and technically. The paragraphs below will firstly discuss different facets of the realised design. Afterwards, potential improvements to the prototype based on limitations and constraints are highlighted, in case the project is resumed or repeated. Finally, a reflection on the functional requirements set for the installation at the end of the ideation phase is presented.

7.3.1 Functionality

The eventual prototype for the interactive ethics installation experienced some deviations from the original design, in part due to complications throughout the realisation process and constraints to the project. The paragraphs below will evaluate the concluding installation along with the changes made under the circumstances. Firstly, the overall structure of the installation will be observed and judged. Secondly, the hardware and surrounding complications are evaluated based on the resulting changes to the experience and opinions and observations from the evaluation session. Lastly, the software and eventual adaptations are reflected upon.

7.3.1a Structure

The shape of the installation coincided well with the reference of the design. However, the design might have been overly optimistic concerning the support structure. The immense weight of the box on top of the prison bar-like support structure resulted in the installation being quite topheavy. This effect was minorly exacerbated by the complications caused by the hardware of the installation and its subsequent changes. Since the structure is able to stand without additional support, the issue of structural integrity is not seen as a major detriment to the prototypical installation, but is a noteworthy example for improvement. Furthermore, the installation handily succeeds in creating an enclosed environment in which an individual is free to navigate multiple monitor displays.

7.3.1b Hardware

In general, the hardware of the installation experiences simple integration and is easy to grasp. In this sense, it performs on good terms and creates the necessary experience. However, the complications presented in Paragraph 6.1.5 show the extent to which the concluding prototype differs from the finalised design. More importantly, further down Paragraph 6.2.3 details the effects that these variations to the design had on the design of the experience. When observing this broader scope, although the hardware eventually performs to effectively construct the interactive installation, it did force the main design shift in terms of the designed interaction and concluding experience. However, the evaluative interviews did reveal that the participants were impressed by the interactive element of the design, albeit less intuitive than the original design. Additionally, the resulting changes to the design of the experience, as found in Section 6.3, do positively force an individual to proceed with the timeline of the experience, even though it removes aspects of freedom and intuitiveness in the interaction.

7.3.1c Software

Following the complications to the code caused by the hardware, and the subsequent limitations regarding time constraints, the programme eventually performs a version of the bare minimum when compared to the originally envisioned features. Regardless, the programme manages to run smoothly and accomplishes meaningful interaction between the system and the individual. It succeeds in its purpose for creating the experience and presents a confrontation which achieves the necessary effect. That being said, additional features and functions to aid the experience as described in Section 5.3.2 would improve the effectiveness of the desired effect and further strengthen the relationship to the panopticon.

7.3.2 Improvements After Evaluation

The main detriments to the interactive ethics installation should be improved if the project were to be continued, repeated, or generally enhanced. As derived from the previous paragraphs, the main detriments to the installation are its structural integrity and hardware composition. Additionally, in order to benefit the designed experience and increase the desired effect of the installation, more interactive functions and confrontational features could be integrated into the software.

7.3.3 Requirement Evaluation

This paragraph observes the conclusions outlined in the sections above and aims to evaluate the functional requirements set in Paragraph 4.6.2. Most importantly, the prototypical installation does succeed in presenting meaningful interaction to an individual. The eventual combination of hardware components and integration of software proved to accomplish a smooth programme which impressed participants in its nature. Secondly, the installation draws a metaphorical connection to a panoptic prison structure in its physicality and positioning of hardware. Participants easily identified the relation to the subject matter of the panopticon and additionally liked the use of prison bars in construction. Thirdly, the programme succeeds in behaving unfalteringly, being able to manage any errors to the system and present an experience which is able to run idly between interactions. However, due to the changes to the designed experience, the argument can be made that the process is not completely smooth or intuitive when compared to the experience of the finalised design. It can be seen as segmented and staccato, however, participants noted that the proceedings of the experience feel natural and more smooth than it appears. Lastly, the installation is in theory deconstructable and able to be relocated to be effective in any environment. The integration of the hardware components is simple and easily understood and the wooden components can be separated into components. However, this is not advised and any attempt at relocation if necessary should be undertaken carefully.

8 Discussion

This research project was developed to explore the applicational validity of practical pedagogical approaches in the context of a dedicated educational space designed to aid design students in applying ethical thought to their design processes. An interactive installation designed around the classical ethical dilemma of the panopticon was used as the practical pedagogical method. The designed experience for the interactive ethics installation made use of physicality and confrontation to relate the concept of panopticism. The installation serves to be used as a tool to stimulate ethical consideration and dialogue surrounding the themes presented by the subject matter.

The following section will concisely present the findings of the research and conclusions to the research questions set up at the beginning of the project. Afterwards, supported by the conclusions of the exploratory research, directions for future research will be suggested.

8.1 Conclusions to the Exploratory Research

Within the context of the research, the evaluation results of the interactive installation are allocated the purpose of serving as validation, or proof, for the continuation of research into dedicated educational spaces for ethics and the further development of practical pedagogical approaches. The positive results collected through the evaluation procedure presented in Section 7.2 should therefore be considered as a solid foundation to base further research on. Furthermore, the constructive criticism collected through Section 7.3 should be applied to any practical continuation or iteration of this particular project or similar projects in future. In a similar vein, insights gathered from literature research and state of the art portion of this project, presented in Section 2.3 and Section 2.5 respectively, should be considered during design decisions regarding any additional practical pedagogical methods.

8.2 Research Questions

The initial, main research question for this project was answered by the construction of the interactive ethics installation abiding by the Creative Technology Design Process. The subsequent conclusion was reached through evaluation of this installation. The research questions that arose throughout the entire process are answered as follows:

> *“How can an ethics installation stimulate young designers to make dialogue exploring ethics in design?”*

An interactive ethics installation which engages its target audience through physicality, meaningful interaction, and impactful confrontation can stimulate students inside a dedicated educational space for ethics to partake in ethical dialogue and guided discussion. More specifically, the application of such a practical pedagogical method prompts students to ethically consider the subject matter of the installation, find relations to their personal experiences, and constructively apply themes presented by the experience to familiar design frameworks. Most interestingly, the exposure to a practical pedagogical method, such as an interactive installation, sparks interest and intrigue in the populace, potentially making them more likely to engage with ethical subject matter.

“What are current practices of educating students in design programs on ethics in design?”

The first sub-question is mostly answered by the literature study performed by this project and its findings find support from the interviews conducted by this study. Firstly, the most prominent approach for teaching design students about ethics is to inform them on codes of conduct and business ethics principles. However, literature research reveals that this barely does anything in regard to raising the ethical literacy of designers, increasing their ethical proficiency, or improving their ethical consideration skills. Sparsely associated with the education of ethics in design programmes are case studies, however, interviewees note that the ethical dimension of the case is in most cases overlooked and minimally discussed in favour of the technical aspects of the situation. This issue is reciprocated by literature research, as academic institutions reportedly experience a disregarding culture towards ethics, instead favouring the ethical dimension in course design and curricula.

“Which problems are reflected in research on the educational quality of ethics in design?”

The second sub-question is answered in part by the literature study performed by this project. Additionally, two separate interview rounds attempted to find an answer to this question, which presents firsthand accounts from the specified target audience. Literature found that ethics in design education is majorly overlooked, which this research supports by account of the interviewing populace. Interviewees reported across both sessions that too little attention or focus is put on ethics in the curriculum. Furthermore, they noted that most faculty lack adequate ethical proficiency to engage students and supply them with the appropriate ethical skillset to prepare them as young professionals. This fact is also corroborated by literature. Hence, it can be stated that both the literature findings and conclusions from the interviews conducted for the research support one another, solidifying ethics in design education as a noteworthy field to be further explored and developed.

“What are the possible avenues of teaching young designers to incorporate ethical consideration into their design process?”

The next sub-question is mainly answered through literature research and in part by the research study. Firstly, the literature research revealed cultural and systematic approaches to improve the general quality of ethics education in technical curricula. The main notable cultural approach featured a fundamental shift directed towards virtue-ethics. Approaches focused towards more systematic changes included improving the ethical proficiency of faculty or co-teaching on case studies featuring a split focus on both the technical dimension and the ethical. Another systematic approach focused on co-curricular ethical experiences in order to aid students in developing the necessary ethical skillset and perspective outside of the curriculum. This last approach is most important to the foundation and context of this research study, as it focuses on dedicated ethics spaces to be employed outside of the curriculum.

“How can this project take steps to improve the ethical proficiency of design students?”

The answer to the penultimate sub-question is mainly derived from the evaluation procedure. From both the starting and evaluative interviews from the evaluation procedure for the installation, it can be derived that students experience difficulties in identifying, recognising and vocalising ethical concerns and ethical issues. The evaluation concluded that the practical approach in the form of an interactive installation lowers the boundary for discussion of ethical issues and allows students a more inclusive and open pathway into starting ethical conversations with their peers. This environment is made possible by the environment created for the installation, namely a designated educational space focused towards developing ethical skills. Therefore, spaces such as these should be developed outside of curricular influences to facilitate an inclusive and approachable environment in which the focus lies on ethical reflection and consideration.

“How does an ethics installation used to increase the consideration of ethics with young designers affect varying educational levels?”

Unfortunately, the sub-question above fell outside of the scope of this research project. The section below argues for future research into this issue, as it might provide important insights on the widespread applicational feasibility of practical pedagogical methods.

8.3 Future Work

The exploratory research presented in this paper effectively opens up the door for the development of practical pedagogical approaches to ethics education and further research into effective applications of these methods. Furthermore, it urges for further research into effective shaping and correct adaptation of designated educational environments focused on transferring ethical competence and furthering ethical proficiency in students.

Specifically, future research into practical pedagogical approaches to ethics education could configure the most effective methods for applying artefacts such as interactive installations. This could be done through evaluative workshop design and should provide quantitative results in order to further solidify the research direction as a potential solution for improving ethics education in design programs. Alternatively, future research could additively explore other practical facets for ethics education, such as film, assignment design, debate, and similar practical methods.

Furthermore, future research in this educational research direction could observe and analyse existing, proven designated educational environments which focus on different educational fields in order to gain insights on how to effectively design such spaces, which features are most successful, and which functions to cater to.

Outside of this research direction, looking at the broader context of the problems found with ethics education in academic institutions, systematic evaluations of the educational structure, biases and preferences could be beneficial to potential reorganisation of curricula to better cater to ethics in design.

References

Agamben, G., & Hardt, M. (1993). The Coming Community (Theory Out of Bounds, Vol. 1) (Theory Out of Bounds Series). Univ Of Minnesota Press.

Barry, B. E., & Ohland, M. W. (2012). ABET Criterion 3.f: How Much Curriculum Content is Enough? Science and Engineering Ethics, 18(2), 369–392. https://doi.org/10.1007/s11948-011-9255-5

Borrett, D. S., Sampson, H., & Cavoukian, A. (2016, October 5). Research ethics by design: A collaborative research design proposal. Research Ethics, 13(2), 84–91. https://doi.org/10.1177/1747016116673135

Bowden, P. (2010). Teaching ethics to engineers – a research-based perspective. European Journal of Engineering Education, 35(5), 563–572. https://doi.org/10.1080/03043797.2010.497549

Briones, E., & Lara, L. (2016, April 1). Teaching ethics in the university through multicultural online dialogue. Comunicar, 24(47), 99–107. https://doi.org/10.3916/c47-2016-10

Burr, V., & King, N. (2012, January 1). 'You're in Cruel England Now!': Teaching Research Ethics through Reality Television. Psychology Learning &Amp; Teaching, 11(1), 22–29. https://doi.org/10.2304/plat.2012.11.1.22

Buwert, P. (2017, July 28). Potentiality: the ethical foundation of design. The Design Journal, 20(sup1), S4459–S4467. https://doi.org/10.1080/14606925.2017.1352942

Cassim, F. (2013, June). Hands On, Hearts On, Minds On: Design Thinking within an Education Context. International Journal of Art &Amp; Design Education, 32(2), 190–202. https://doi.org/10.1111/j.1476-8070.2013.01752.x

Colby, A., & Sullivan, W. M. (2008). Ethics Teaching in Undergraduate Engineering Education. Journal of Engineering Education, 97(3), 327–338. https://doi.org/10.1002/j.2168-9830.2008.tb00982.x

Corple, D. J., Zoltowski, C. B., Kenny Feister, M., & Buzzanell, P. M. (2020, March 11). Understanding ethical decision‐making in design. Journal of Engineering Education, 109(2), 262–280. https://doi.org/10.1002/jee.20312

Donia, J., & Shaw, J. A. (2021, August 19). Ethics and Values in Design: A Structured Review and Theoretical Critique. Science and Engineering Ethics, 27(5). https://doi.org/10.1007/s11948-021-00329-2

Eggink, W., Dorrestijn, S., Heijden, K.v.d., & Ouwens, I. (2022). Ethics, design, and creativity: A fruitful combination. Proceedings of DRS. https://doi.org/10.21606/drs.2022.158

Ehrlich, T. (2000). Civic Responsibility And Higher Education: (American Council on Education Oryx Press Series on Higher Education). Greenwood.

Finelli, C. J., Holsapple, M. A., Ra, E., Bielby, R. M., Burt, B. A., Carpenter, D. D., Harding, T. S., & Sutkus, J. A. (2012, July). An Assessment of Engineering Students' Curricular and Co-Curricular Experiences and Their Ethical Development. Journal of Engineering Education, 101(3), 469–494. https://doi.org/10.1002/j.2168-9830.2012.tb00058.xkeefer

Guillemin, M., & Gillam, L. (2004). Ethics, Reflexivity, and "Ethically Important Moments" in Research. Qualitative Inquiry, 10(2), 261–280. https://doi.org/10.1177/1077800403262360

Hanna, L. A., Barry, J., Donnelly, R., Hughes, F., Jones, D., Laverty, G., Parsons, C., & Ryan, C. (2014, April 17). Using Debate to Teach Pharmacy Students About Ethical Issues. American Journal of Pharmaceutical Education, 78(3), 57. https://doi.org/10.5688/ajpe78357

Herkert., J. R. (2002). Continuing and Emerging Issues in Engineering Ethics Education. The Bridge, 22(3), 8–13. https://ci.nii.ac.jp/naid/10017257312

Hess, J. L., & Fore, G. (2018). A Systematic Literature Review of US Engineering Ethics Interventions. Science and Engineering Ethics. https://doi.org/10.1007/s11948-017-9910-6

Hitt, S. J., & Lennerfors, T. T. (2022, September 13). Fictional Film in Engineering Ethics Education: With Miyazaki's The Wind Rises as Exemplar. Science and Engineering Ethics, 28(5). https://doi.org/10.1007/s11948-022-00399-w

Hollander, R. D., Johnson, D. G., Beckwith, J. R., & Fader, B. (1995). Why teach ethics in science and engineering? Science and Engineering Ethics, 1(1), 83–87. https://doi.org/10.1007/bf02628702

Holsapple, M. A., Carpenter, D. D., Sutkus, J. A., Finelli, C. J., & Harding, T. S. (2012, April). Framing Faculty and Student Discrepancies in Engineering Ethics Education Delivery. Journal of Engineering Education, 101(2), 169–186. https://doi.org/10.1002/j.2168-9830.2012.tb00047.x

Hughes, J., Plaut, E., Wang, F., von Briesen, E., Brown, C., Cross, G., Kumar, V., & Myers, P. (2020). Global and Local Agendas of Computing Ethics Education. Proceedings of the 2020 ACM Conference on Innovation and Technology in Computer Science Education. https://doi.org/10.1145/3341525.3387423

Keefer, M. W., Wilson, S. E., Dankowicz, H., & Loui, M. C. (2014). The Importance of Formative Assessment in Science and Engineering Ethics Education: Some Evidence and Practical Advice. Science and Engineering Ethics, 20(1), 249–260. https://doi.org/10.1007/s11948-013-9428-5

Mader, A., & Eggink, W. (2014, September 4-5). A design process for creative technology. International Conference on Engineering and Product Design Education, University of Twente, Enschede, The Netherlands

https://www.researchgate.net/publication/265755092_A_DESIGN_PROCESS_FOR_CREATIVE_TECHNOLOGY

McBride, K. N. (2014, March 4). ACTIVE ethics: an information systems ethics for the internet age. Journal of Information, Communication and Ethics in Society, 12(1), 21–44. https://doi.org/10.1108/jices-06-2013-0017

Lim, J. H., Hunt, B. D., Findlater, N., Tkacik, P. T., & Dahlberg, J. L. (2021, December). "In Our Own Little World": Invisibility of the Social and Ethical Dimension of Engineering Among Undergraduate Students. Science and Engineering Ethics, 27(6). https://doi.org/10.1007/s11948-021-00355-0

Lönngren, J. (2021). Exploring the discursive construction of ethics in an introductory engineering course. Journal of Engineering Education, 110(1), 44–69. https://doi.org/10.1002/jee.20367

MacIntyre, A. (2007). After Virtue: A Study in Moral Theory, Third Edition (3rd ed.). University of Notre Dame Press.

Martin, D. A., Conlon, E., & Bowe, B. (2021, August 24). A Multi-level Review of Engineering Ethics Education: Towards a Socio-technical Orientation of Engineering Education for Ethics. Science and Engineering Ethics, 27(5). https://doi.org/10.1007/s11948-021-00333-6

Mitcham, C. (2009). A historico-ethical perspective on engineering education: from use and convenience to policy engagement. Engineering Studies, 1(1), 35–53. https://doi.org/10.1080/19378620902725166

Moor, J. H. (1985). What is computer ethics? Metaphilosophy, 16(4), 266–275. https://doi.org/10.1111/j.1467-9973.1985.tb00173.x

Roeser, S. (2012). Emotional Engineers: Toward Morally Responsible Design. Science and Engineering Ethics, 18(1), 103–115. https://doi.org/10.1007/s11948-010-9236-0

Sheppard, S., Macatangay, K., Colby, A., & Sullivan., W. M. (2009). Educating engineers: designing for the future of the field. Choice Reviews Online, 47(01), 47–0304. https://doi.org/10.5860/choice.47-0304

Skirpan, M., Beard, N., Bhaduri, S., Fiesler, C., & Yeh, T. (2018). Ethics Education in Context. Proceedings of the 49th ACM Technical Symposium on Computer Science Education. https://doi.org/10.1145/3159450.3159573

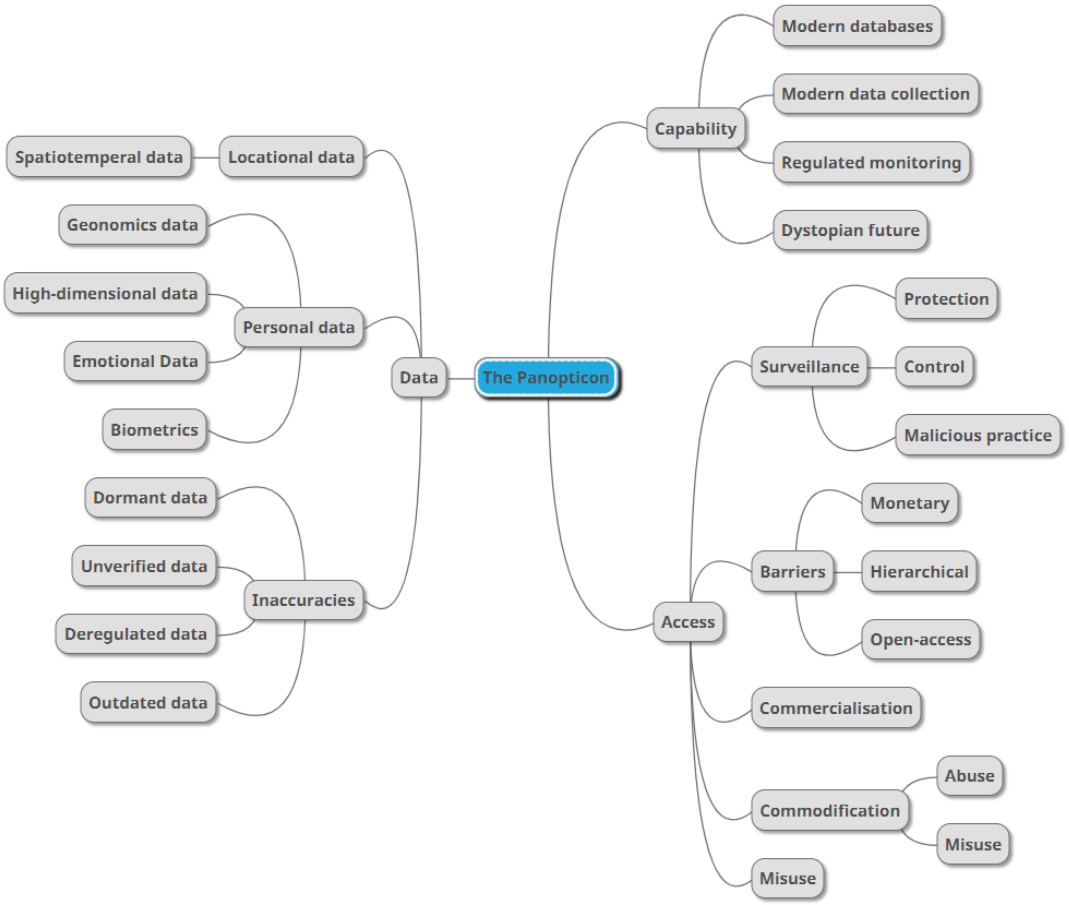
Sochacka, N. W., Walther, J., & Pawley, A. L. (2018, July). Ethical Validation: Reframing Research Ethics in Engineering Education Research To Improve Research Quality. Journal of Engineering Education, 107(3), 362–379. https://doi.org/10.1002/jee.20222

Tracy, S. J. (2010). Qualitative Quality: Eight "Big-Tent" Criteria for Excellent Qualitative Research. Qualitative Inquiry, 16(10), 837–851. https://doi.org/10.1177/1077800410383121

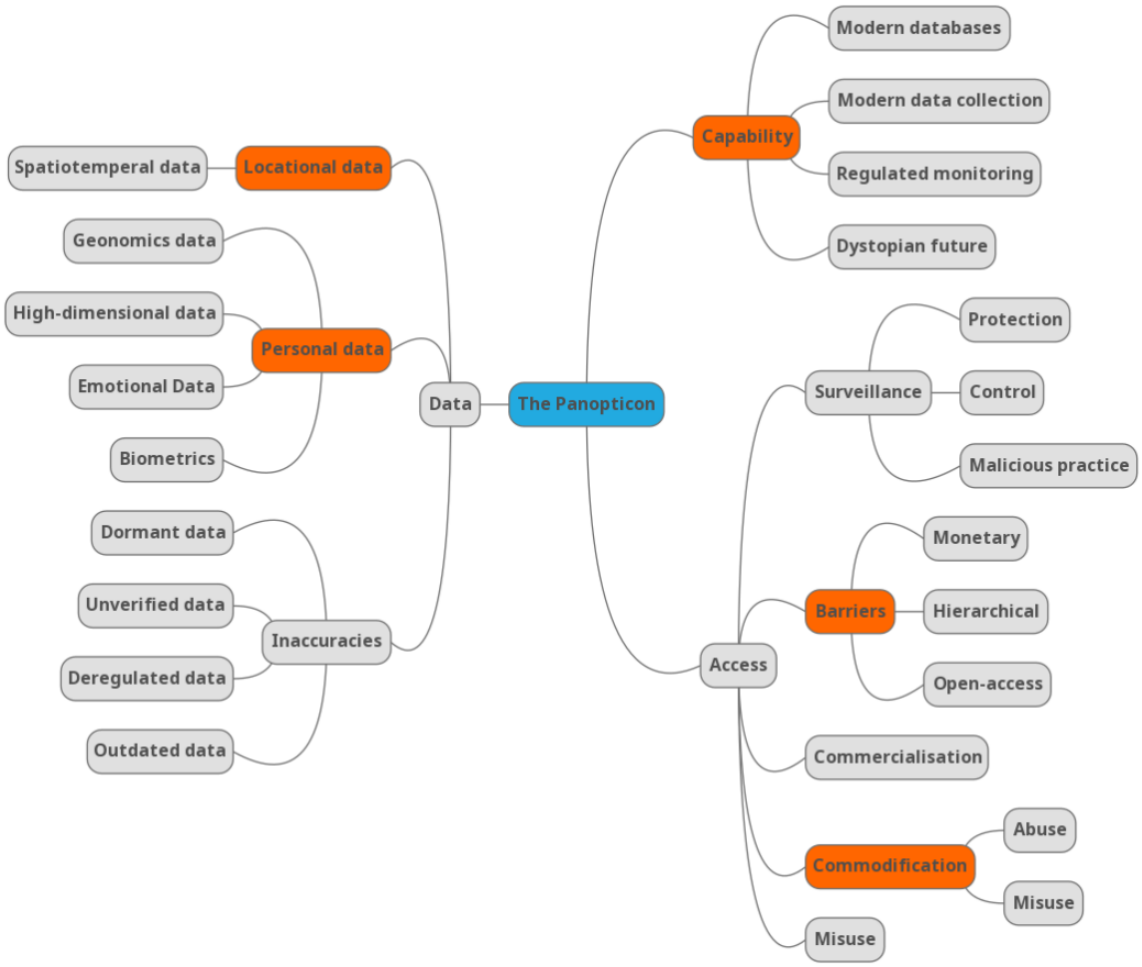
Vilaza, G. N., & Bækgaard, P. (2022). Teaching User Experience Design Ethics to Engineering Students: Lessons Learned. Frontiers in Computer Science, 4. https://doi.org/10.3389/fcomp.2022.793879

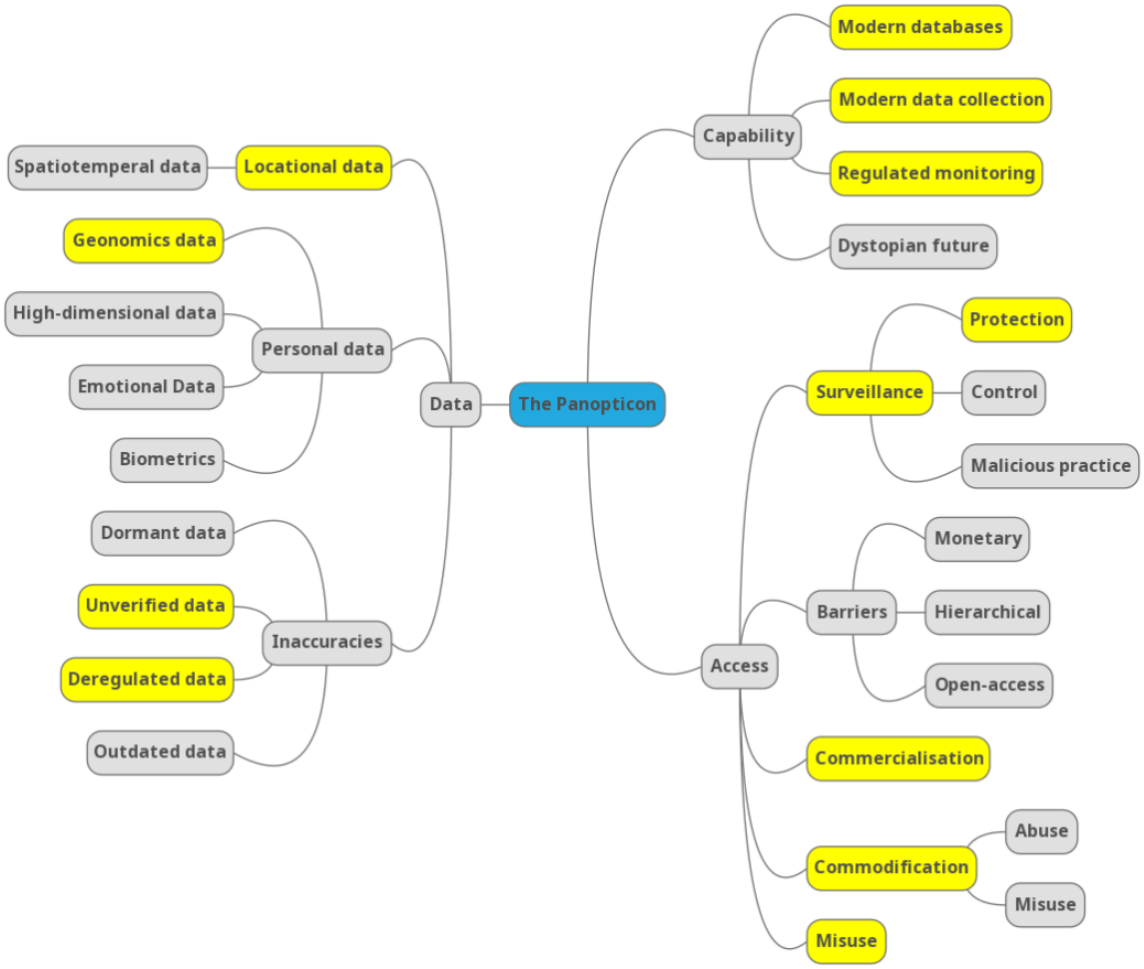
Winner, L. (1980). Do Artifacts Have Politics? Daedalus, 109(1), 121–136. http://www.jstor.org/stable/20024652

Appendix A: Mind Maps




The Panopticon
Data
Locational data
Spatiotemperal data
Personal data
Genomics data
High-dimensional data
Emotional Data
Biometrics
Inaccuracies
Dormant data
Unverified data
Deregulated data
Outdated data
Capability
Modern databases
Modern data collection
Regulated monitoring
Dystopian future
Access
Surveillance
Protection
Control
Malicious practice
Barriers
Monetary
Hierarchical
Open-access
Commercialisation
Commodification
Abuse
Misuse
Misuse


The Panopticon
Data
Locational data
Spatiotemperal data
Personal data
Geonomics data
High-dimensional data
Emotional Data
Biometrics
Inaccuracies
Dormant data
Unverified data
Deregulated data
Outdated data
Access
Capability
Modern databases
Modern data collection
Regulated monitoring
Dystopian future
Surveillance
Protection
Control
Malicious practice
Barriers
Monetary
Hierarchical
Open-access
Commercialisation
Commodification
Abuse
Misuse
Misuse


The Panopticon
Data
Locational data
Spatiotemperal data
Personal data
Geonomics data
High-dimensional data
Emotional Data
Biometrics
Inaccuracies
Dormant data
Unverified data
Deregulated data
Outdated data
Capability
Modern databases
Modern data collection
Regulated monitoring
Dystopian future
Access
Surveillance
Protection
Control
Malicious practice
Barriers
Monetary
Hierarchical
Open-access
Commercialisation
Commodification
Abuse
Misuse
Misuse

Appendix B: Code

Main script:

```
import displayVideos
import displayWebcam
import media.test1 as test
import videoGrid
import threading

def main(): #control class
   print('this is main')

def mergeDetails():
   nameint = 0
   framesMax = 120 # how many frames to merge into loop
   textPos = (0.0, 0.98) # text poistion is (0.1 * w, 0.5 * h) from bottomleft
textbox
   # displayWebcam.run() # >runs
   # main()
   # cheat with the aspect ratio of this first video as it is read in the init
and adopted throughout
   videos_to_merge1 = [
```

```
        'media/1LD.mp4', 'media/2LD.mp4', 'media/3LD.mp4', 'media/4LD.mp4',
'media/5LD.mp4', 'media/6LD.mp4',
        'media/7LD.mp4', 'media/8LD.mp4', 'media/9LD.mp4', 'media/10LD.mp4',
'media/11LD.mp4', 'media/12LD.mp4',
        'media/13LD.mp4', 'media/14LD.mp4', 'media/15LD.mp4', 'media/16LD.mp4'
    ]
    titles1 = []
    for x in videos_to_merge1:
        nameint += 1
        titles1.append('v' + str(nameint))

    videos_to_merge2 = [
        'media/17LD.mp4', 'media/18LD.mp4', 'media/19LD.mp4', 'media/20LD.mp4',
'media/21LD.mp4', 'media/22LD.mp4',
        'media/23LD.mp4', 'media/24LD.mp4', 'media/25LD.mp4', 'media/26LD.mp4',
'media/27LD.mp4', 'media/28LD.mp4',
        'media/29LD.mp4', 'media/30LD.mp4', 'media/31LD.mp4', 'media/32LD.mp4'
    ]
    titles2 = []
    for x in videos_to_merge2:
        nameint += 1
        titles2.append('v' + str(nameint))

    videos_to_merge3 = [
        'media/33LD.mp4', 'media/34LD.mp4', 'media/35LD.mp4', 'media/36LD.mp4',
'media/37LD.mp4', 'media/38LD.mp4',
        'media/39LD.mp4', 'media/40LD.mp4', 'media/41LD.mp4', 'media/42LD.mp4',
'media/43LD.mp4', 'media/44LD.mp4',
        'media/45LD.mp4', 'media/46LD.mp4', 'media/47LD.mp4', 'media/48LD.mp4'
    ]
    titles3 = []
    for x in videos_to_merge3:
        nameint += 1
        titles3.append('v' + str(nameint))

    videos_to_merge4 = [
        'media/49LD.mp4', 'media/50LD.mp4', 'media/51LD.mp4', 'media/52LD.mp4',
'media/53LD.mp4', 'media/54LD.mp4',
        'media/55LD.mp4', 'media/56LD.mp4', 'media/57LD.mp4', 'media/58LD.mp4',
'media/59LD.mp4', 'media/60LD.mp4',
        'media/61LD.mp4', 'media/62LD.mp4', 'media/63LD.mp4', 'media/64LD.mp4'
    ]
    titles4 = []
    for x in videos_to_merge4:
        nameint += 1
        titles4.append('v' + str(nameint))

    videoGrid.merge_videos(
        videos_to_merge1,
        'merged1.mp4',
        grid_size=(4, 4),  # row, cols
        titles=titles1,
        title_position=textPos,
        max_frames=framesMax)

    videoGrid.merge_videos(
        videos_to_merge2,
        'merged2.mp4',
```

```
        grid_size=(4, 4),
        titles=titles2,
        title_position=textPos,
        max_frames=framesMax)

    videoGrid.merge_videos(
        videos_to_merge3,
        'merged3.mp4',
        grid_size=(4, 4),
        titles=titles3,
        title_position=textPos,
        max_frames=framesMax)

    videoGrid.merge_videos(
        videos_to_merge4,
        'merged4.mp4',
        grid_size=(4, 4),
        titles=titles4,
        title_position=textPos,
        max_frames=framesMax)

    # General Check:::
    # print(videos_to_merge1)
    # print(len(videos_to_merge1))
    # print(titles1)
    #
    # print(videos_to_merge2)
    # print(len(videos_to_merge2))
    # print(titles2)
    #
    # print(videos_to_merge3)
    # print(len(videos_to_merge3))
    # print(titles3)
    #
    # print(videos_to_merge4)
    # print(len(videos_to_merge4))
    # print(titles4)

# Press the green button in the gutter to run the script.
if __name__ == '__main__':
    # Create thread >whichever thread is created first will be the one where the
program gets stuck in its while loop
    # p2 = threading.Thread(target=test.SR())
    # p1 = threading.Thread(target=displayVideos.fps())
    # # Start task execution
    # p2.start()
    # p1.start()
    # # Wait for thread to complete execution
    # p1.join()
    # p2.join()

    # mergeDetails() # Reruns entire merge sequence to output newly created video
sets
    displayVideos.fps() # Only displays four windows with grid video sets atm
    # displayWebcam.run()
    # test.SR()
    # test.test()
```

Webcam Script:

```
import cv2
import media.test1 as test
import random
import textOverlay

cap = cv2.VideoCapture(0)
# try:
#     cap = cv2.VideoCapture(1)
# except cv2.error:
#     cap = cv2.VideoCapture(0)

def run():
    window_title = 'monitor one'
    viewerCount = 21
    text = None

    # cv2.namedWindow(window_titles[0], cv2.WND_PROP_FULLSCREEN)
    # cv2.namedWindow(window_titles[1], cv2.WND_PROP_FULLSCREEN)
    # cv2.namedWindow(window_titles[2], cv2.WND_PROP_FULLSCREEN)
    # cv2.namedWindow(window_titles[3], cv2.WND_PROP_FULLSCREEN)
    # cv2.setWindowProperty('name', cv2.WND_PROP_FULLSCREEN,
cv2.WINDOW_FULLSCREEN) X4 removes window name

    while (True):
        text = 'Live viewers: ' + str(viewerCount)
        ret, frame = cap.read()
        flip = cv2.flip(frame, 0)
        gray = cv2.cvtColor(flip, cv2.COLOR_BGR2GRAY)
        cv2.putText(gray, text, (0,20), cv2.FONT_HERSHEY_DUPLEX, 0.6, (0, 0, 0),
thickness=1)  # temp title

        # test.confrontation()
        cv2.namedWindow(window_title, cv2.WND_PROP_FULLSCREEN)
        cv2.setWindowProperty(window_title, cv2.WND_PROP_FULLSCREEN,
cv2.WINDOW_FULLSCREEN)

        cv2.imshow(window_title, gray)
        viewerCount += random.randint(0,1)

        # cv2.imshow(window_titles[1], gray)
        # cv2.imshow(window_titles[2], gray)
        # cv2.imshow(window_titles[3], gray)

        if cv2.waitKey(10) & 0xFF == ord('w'):
            cap.release()  # release memory
            cv2.destroyAllWindows()
            break
```

Video display script:

```
import cv2
import textOverlay
import main
import media.test1 as test
import displayWebcam
import time
from word2number import w2n
import re
```

```
activeInput = None
import speech_recognition as sr
sr.__version__
'3.8.1'

def fps():
    window_title = 'monitor one'
    window_size = 1
    pre_timeframe = 0
    new_timeframe = 0
    isolationCounter = 0
    upIsoCounter = False
    endProgram = False
    micHot = False
    liveVideo = None
    time_before_confrontation = 6
    maximum_number_of_isolations = 4
    frameCount = 0

    cap1 = cv2.VideoCapture('merged1.mp4')
    cap2 = cv2.VideoCapture('merged2.mp4')
    cap3 = cv2.VideoCapture('merged3.mp4')
    cap4 = cv2.VideoCapture('merged4.mp4')
    capB = cv2.VideoCapture('merged1.mp4') # B for Buffer between interaction and
confrontation
    r = sr.Recognizer()
    mic = sr.Microphone(device_index=1)

    while True:
        # time1 = time.time()
        frameCount = frameCount + 1
        if isolationCounter == 0:
            success, merged1 = cap1.read()
            liveVideo = merged1
        elif isolationCounter == 1:
            success, merged2 = cap2.read()
            liveVideo = merged2
        elif isolationCounter == 2:
            success, merged3 = cap3.read()
            liveVideo = merged3
        elif isolationCounter == 3:
            success, merged4 = cap4.read()
            liveVideo = merged4
        else:
            success, mergedB = capB.read() # B for Buffer between interaction and
confrontation
            liveVideo = mergedB

        cv2.namedWindow(window_title, cv2.WND_PROP_FULLSCREEN)
        cv2.setWindowProperty(window_title, cv2.WND_PROP_FULLSCREEN,
cv2.WINDOW_FULLSCREEN) # removes window name
        activeInput = None

        # this tests how well the progression runs by inputting isolation 1 by
pressing 'x'
        if cv2.waitKey(10) & 0xFF == ord('x'):
            print('old iso counter = ' + str(isolationCounter))
            activeInput = 1
```

```
            print('input = ' + str(activeInput))
            upIsoCounter = True
            test.runInput(isoInput=activeInput)
            activeInput = None

        # this triggers the speech recognition to start
        if cv2.waitKey(10) & 0xFF == ord('z'):
            micHot = True

            overlayLiveVideo = liveVideo.copy()
            cv2.waitKey(10)
            textOverlay.test(passingArgument=overlayLiveVideo)
            alpha = 0.8
            mask = overlayLiveVideo.astype(bool)
            overlayLiveVideo[mask] = cv2.addWeighted(overlayLiveVideo, alpha,
liveVideo, 1 - alpha, 0)[mask]
            cv2.imshow(window_title, overlayLiveVideo)
            cv2.waitKey(10)

            if micHot:
                print('Bool micHot = ' + str(micHot))
                try:
                    with mic as source:
                        r.adjust_for_ambient_noise(source) # input this if in
noisy environment
                        print('mic is go')
                        audio = r.listen(source, timeout=3000)
                        voice_command = r.recognize_google(audio)
                        print('Detected voice command: ' + voice_command)
                except sr.UnknownValueError or sr.WaitTimeoutError:
                    print('except sr.UnknownValueError or sr.WaitTimeoutError')
                    voice_command = None
                    pass

                try:
                    activeInput = voice_command
                    if activeInput is not None:
                        try:
                            processInput = [int(s) for s in activeInput.split() if
s.isdigit()] # this takes all ints from statement
                            activeInput = processInput[0]
                            print('processInput valid')
                        except IndexError:
                            print('IndexError passed to w2n')
                            if type(activeInput) is not int:
                                activeInput =
int(w2n.word_to_num(str(voice_command)))  # converts w2n, does not act if int
                                print(activeInput)

                    if activeInput is not None and activeInput != 0 and
activeInput < 65:
                        isolationCounter += 1
                        print('counter (plus) = ' + str(isolationCounter))
                        test.runInput(isoInput=activeInput)
                        activeInput = None
                    else:
                        print('activeInput out of bounds')
                        activeInput = None
```

```
                except ValueError or TypeError:
                    print('except ValueError or TypeError')
                micHot = False

        # this checks if confrontation needs to commence
        if isolationCounter == maximum_number_of_isolations:
            old_time = time.time()
            while True:
                success, mergedB = capB.read() # B for Buffer between interaction
and confrontation
                cv2.namedWindow(window_title, cv2.WND_PROP_FULLSCREEN)
                cv2.setWindowProperty(window_title, cv2.WND_PROP_FULLSCREEN,
cv2.WINDOW_FULLSCREEN)

                new_time = time.time()
                difference = new_time - old_time

                if success:
                    # cv2.moveWindow(window_title, window_size, 0)
                    cv2.imshow(window_title, mergedB)
                else:
                    capB.set(cv2.CAP_PROP_POS_FRAMES, 0)
                    continue

                if cv2.waitKey(10) & 0xFF == ord('q') or endProgram:
                    break
                if difference > time_before_confrontation:
                    endProgram = True
                    displayWebcam.run()
                    break

        if cv2.waitKey(10) & 0xFF == ord('q') or endProgram:
            break

        # this piece of code displays video's fps
        # new_timeframe = time.time()
        # fps = 1/(new_timeframe - pre_timeframe)
        # pre_timeframe = new_timeframe
        # fps = int(fps)
        # cv2.putText(liveVideo, str(fps), (8, 80), cv2.FONT_HERSHEY_SIMPLEX, 3,
(0, 0, 0), 4)
        if frameCount == 119:
            # overlayLiveVideo = liveVideo.copy()
            # this triggers the speech recognition to start automatically after
each loop
            micHot = True
            textOverlay.test(passingArgument=liveVideo)
            # alpha = 0.2
            # mask = overlayLiveVideo.astype(bool)
            # overlayLiveVideo[mask] = cv2.addWeighted(overlayLiveVideo, alpha,
liveVideo, 1 - alpha, 0)[mask]
            # cv2.imshow(window_title, overlayLiveVideo)

            cv2.imshow(window_title, liveVideo)
            cv2.waitKey(10)

            # if isolationCounter == 0:
            #     success, merged1 = cap1.read()
```

```
            #     liveVideo = merged1
            # elif isolationCounter == 1:
            #     success, merged2 = cap2.read()
            #     liveVideo = merged2
            # elif isolationCounter == 2:
            #     success, merged3 = cap3.read()
            #     liveVideo = merged3
            # elif isolationCounter == 3:
            #     success, merged4 = cap4.read()
            #     liveVideo = merged4
            # else:
            #     success, mergedB = capB.read() # B for Buffer between
interaction and confrontation
            #     liveVideo = mergedB

            if micHot:
                print('Bool micHot = ' + str(micHot))
                try:
                    with mic as source:
                        r.adjust_for_ambient_noise(source)  # input this if in
noisy environment
                        print('mic is go')
                        audio = r.listen(source, timeout=1000)
                        cv2.waitKey(10)
                        voice_command = r.recognize_google(audio) # try will break
here if no voice input
                        print('Detected voice command: ' + voice_command) # only
prints if voice command real
                except sr.UnknownValueError or sr.WaitTimeoutError or
sr.RequestError:
                    print('except: sr.UnknownValueError or sr.WaitTimeoutError')
                    voice_command = None
                    pass

                try:
                    activeInput = voice_command
                    if activeInput is not None:
                        try:
                            processInput = [int(s) for s in activeInput.split() if
s.isdigit()]  # this takes all ints from statement
                            activeInput = processInput[0]
                            print('processInput valid')
                        except IndexError:
                            print('IndexError passed to w2n')
                            if type(activeInput) is not int:
                                activeInput = int(
                                    w2n.word_to_num(str(voice_command)))  #
converts w2n, does not act if int
                                print(activeInput)

                    if activeInput is not None and activeInput != 0 and
activeInput < 65:
                        isolationCounter += 1
                        print('counter (plus) = ' + str(isolationCounter))
                        test.runInput(isoInput=activeInput)
                        activeInput = None
                    else:
                        print('activeInput out of bounds')
```

```
                    activeInput = None
                except ValueError or TypeError:
                    print('except: ValueError or TypeError')
                micHot = False
            frameCount = 0

        if success:
            if isolationCounter == 0 and not upIsoCounter:
                # cv2.moveWindow(window_title, window_size, 0)  # X4 push each
named window to different monitor
                # cv2.imshow(window_title, merged1)
                cv2.imshow(window_title, liveVideo)

            elif isolationCounter == 1 and not upIsoCounter:
                # cv2.moveWindow(window_title, window_size, 0)  # X4 push each
named window to different monitor
                # cv2.imshow(window_title, merged2)
                cv2.imshow(window_title, liveVideo)
            elif isolationCounter == 2 and not upIsoCounter:
                # cv2.moveWindow(window_title, window_size, 0)  # X4 push each
named window to different monitor
                # cv2.imshow(window_title, merged3)
                cv2.imshow(window_title, liveVideo)
            elif isolationCounter == 3 and not upIsoCounter:
                # cv2.moveWindow(window_title, window_size, 0)  # X4 push each
named window to different monitor
                # cv2.imshow(window_title, merged4)
                cv2.imshow(window_title, liveVideo)
            print('amount of frames = ' + str(frameCount))
            # else:
            #     cv2.moveWindow(window_title, window_size, 0)  # X4 push each
named window to different monitor
            #     cv2.imshow(window_title, merged1)
        elif not success:
            cap1.set(cv2.CAP_PROP_POS_FRAMES, 0)
            cap2.set(cv2.CAP_PROP_POS_FRAMES, 0)
            cap3.set(cv2.CAP_PROP_POS_FRAMES, 0)
            cap4.set(cv2.CAP_PROP_POS_FRAMES, 0)

        if upIsoCounter:
            isolationCounter += 1
            print('new iso counter = ' + str(isolationCounter))
            upIsoCounter = False

        # time2 = time.time()
        # diff = time2 - time1
        # print('single while loop elapse time: ' + str(diff))
    cap1.release()
    cap2.release()
    cap3.release()
    cap4.release()
    cv2.destroyAllWindows()
```

Video merge script:

```
import cv2
import os
import numpy as np
import displayVideos
```

```
class ExtractImageFromVideo(object):
    def __init__(self, path, frame_range=None, debug=False):
        assert os.path.exists(path)

        self._p = path
        self._vc = cv2.VideoCapture(self._p)

        self.size = int(self._vc.get(cv2.CAP_PROP_FRAME_WIDTH)),
int(self._vc.get(cv2.CAP_PROP_FRAME_HEIGHT))
        self.fps = int(self._vc.get(cv2.CAP_PROP_FPS))
        self.total_frames = int(self._vc.get(cv2.CAP_PROP_FRAME_COUNT))

        self._start = 0
        self._count = self.total_frames

        self._debug = debug

        if frame_range is not None:
            self.set_frames_range(frame_range)

        if self._debug:
            print(f"video size( W x H ) : {self.size[0]} x {self.size[1]}")
        # print('init size test=', self.size)

    def __del__(self):
        self.release()

    def set_frames_range(self, frame_range=None):
        if frame_range is None:
            self._start = 0
            self._count = self.total_frames
        else:
            assert isinstance(frame_range, (list, tuple, range))
            if isinstance(frame_range, (list, tuple)):
                assert len(frame_range) == 2

            start, end = frame_range[0], frame_range[-1]
            if end is None \
                    or end == -1 \
                    or end >= self.total_frames:
                end = self.total_frames
            assert end >= start

            self._start = start
            self._count = end - start
            assert self._count <= self.total_frames

        self._vc.set(cv2.CAP_PROP_POS_FRAMES, self._start)

    def extract(self, path=None, bgr2rgb=False, target_size=None, text=None,
text_position=None):
        if path is not None and not os.path.exists(path):
            os.makedirs(path)

        for i in range(0, self._count):
            success, frame = self._vc.read()
            if not success:
```

```
                print(f"index {i} exceeded.")
                break
            if self._debug:
                print(f"frame {self._start + i}")
            if path is not None:
                cv2.imwrite(os.path.join(path, f"{self._start + i}.jpg"), frame)
            if bgr2rgb:
                frame = cv2.cvtColor(frame, cv2.COLOR_BGR2RGB)
            if target_size is not None:
                assert len(target_size) == 2
                assert isinstance(target_size, (list, tuple))
                frame = cv2.resize(frame, tuple(target_size))
            if text is not None:
                if text_position is not None:
                    w_scale, h_scale = text_position
                else:
                    w_scale, h_scale = 1 / 10, 1 / 10
                pos = int(self.size[0] * w_scale), int(self.size[1] * h_scale)  # 
text position in relation to video size
                # any permanent text on the merged video is masked as permOverlay
                permOverlay = np.zeros_like(frame, np.uint8)
                cv2.rectangle(permOverlay, (0, 220), (426, 240), (60, 60, 60), 
cv2.FILLED)
                cv2.putText(permOverlay, text, pos, cv2.FONT_HERSHEY_DUPLEX, 0.6, 
(50, 255, 255), thickness=1) # permanent title
                out = frame.copy()
                alpha = 0.2
                mask = permOverlay.astype(bool)
                out[mask] = cv2.addWeighted(frame, alpha, permOverlay, 1 - alpha, 
0)[mask]
            yield out

    def release(self):
        if self._vc is not None:
            self._vc.release()


def create_image_grid(images, grid_size=None):
    assert images.ndim == 3 or images.ndim == 4
    num, img_w, img_h = images.shape[0], images.shape[-2], images.shape[-3]

    if grid_size is not None:
        grid_h, grid_w = tuple(grid_size)
    else:
        grid_w = max(int(np.ceil(np.sqrt(num))), 1)
        grid_h = max((num - 1) // grid_w + 1, 1)

    grid = np.zeros([grid_h * img_h, grid_w * img_w] + list(images.shape[-1:]), 
dtype=images.dtype)
    for idx in range(num):
        x = (idx % grid_w) * img_w
        y = (idx // grid_w) * img_h
        grid[y: y + img_h, x: x + img_w, ...] = images[idx]
    return grid


def merge_videos(videos_in, video_out, grid_size=None, titles=None, 
title_position=(0.5, 0.5), max_frames: int = None):
```

```
    """
    Args:
        videos_in: List/Tuple
            List of input video paths. e.g.
                ('path/to/v1.mp4', 'path/to/v2.mp4', 'path/to/v3.mp4')
        video_out: String
            Path of output video. e.g.
                'path/to/output.mp4'
        grid_size: List/Tuple.
            Row and Column respectively. e.g.
                (1, 3)
        titles: List/Tuple
            The title of each video will be displayed in the video grid,
            the same length as the input video. e.g.
                ('v1', 'v2', 'v3')
        title_position: List/Tuple
            The position(width and height) where the title is displayed, and the
value range is (0, 1).
            e.g. If we want display text in the center of the video, the position
is
                (0.5, 0.5)
        max_frames: Int
            Maximum number of frames per input video will be merge, e.g.
                200
    Returns:
        None
    """
    texts = titles
    if texts is None:
        texts = [None] * len(videos_in)
    assert len(videos_in) == len(texts)

    dir_name = os.path.dirname(video_out)
    if dir_name and not os.path.exists(dir_name):
        os.makedirs(dir_name, exist_ok=True)

    video_handles = []
    for v, text in zip(videos_in, texts):
        assert os.path.exists(v), f'{v} not exists!'
        video_handles.append((ExtractImageFromVideo(v), text))

    if max_frames is not None:
        assert max_frames > 0
        least_frames = max_frames # how many frames are run in grid mode
    else:
        least_frames = sorted([e.total_frames for e, _t in video_handles])[0]  #
all with same number of frames

    least_size = sorted([e.size for e, _t in video_handles])[0]  # all with same
size WH
    # modified_least_size = (pix / 2 for pix in least_size)
    # temp_size = (200, 100)
    generators = [e.extract(text=t, text_position=title_position) for e, t in
video_handles]

    # read one frame and resize for each generator, then get the output video size
    cur_frames = np.array([cv2.resize(next(g), least_size) for g in generators])
    frames_grid = create_image_grid(cur_frames, grid_size=grid_size)  # HWC
```

```
    fps = video_handles[0][0].fps  # use the fps of first video
    out_size = frames_grid.shape[0:2]  # HWC to HW
    out_size = out_size[::-1]  # reverse HW to WH, as VideoWriter need that format
    video_writer = cv2.VideoWriter(video_out,
                                   cv2.VideoWriter_fourcc(*'mp4v'),
                                   fps,
                                   out_size) # out_size is total pixel in window
x.y
    video_writer.set(cv2.CAP_PROP_FRAME_WIDTH, 200)
    video_writer.set(cv2.CAP_PROP_FRAME_HEIGHT, 100)

    for n in range(least_frames - 1):
        if n % 100 == 0:
            print(f'{n}: {len(cur_frames)} frames merge into grid with
size={frames_grid.shape}') # frames_grid.shape gives x.y frame def.
            print(out_size)
            print(least_size)
            # print(modified_least_size)
        # dim = (200, 100)
        # frames_grid = cv2.resize(video_handles, dim, cv2.WND_PROP_FULLSCREEN)

        video_writer.write(frames_grid)
        cur_frames = np.array([cv2.resize(next(g), least_size) for g in
generators])
        frames_grid = create_image_grid(cur_frames, grid_size=grid_size)

    video_writer.release()
    print(f'Output video saved... {video_out}')
```

Text overlay script:

```
import numpy as np
import cv2

def run(img):
    # Create a black image
    # img = np.zeros((512, 512, 3), np.uint8)

    font = cv2.FONT_HERSHEY_SIMPLEX
    bottomLeftCornerOfText = (100, 100)
    fontScale = 1
    fontColor = (0, 0, 0)
    thickness = 3
    lineType = 2

    cv2.putText(img, 'Hello World!',
                bottomLeftCornerOfText,
                font,
                fontScale,
                fontColor,
                thickness,
                lineType)

    # Display the image
    # cv2.imshow("img", img)
    # Save image, can save an image and place it in directory (see out.jpg)
    # cv2.imwrite("out.jpg", img)
    # cv2.waitKey(0)
```

```
def test(passingArgument):
   micOverlay = passingArgument
   text = 'your microphone is now live'
   text2 = 'voice your selection'
   textEx = 'example: "isolate video five"'
   cv2.rectangle(micOverlay, (476, 290), (1227, 669), (20, 20, 20), cv2.FILLED)
   cv2.putText(micOverlay, text, (654, 472), cv2.FONT_HERSHEY_DUPLEX, 0.9, (120,
120, 120), thickness=2)
   cv2.putText(micOverlay, text2, (724, 499), cv2.FONT_HERSHEY_DUPLEX, 0.9, (120,
120, 120), thickness=2)
   cv2.putText(micOverlay, textEx, (654, 572), cv2.FONT_HERSHEY_DUPLEX, 0.9,
(120, 120, 120), thickness=2)
   cv2.putText(micOverlay, text, (652, 470), cv2.FONT_HERSHEY_DUPLEX, 0.9, (200,
200, 200), thickness=2)
   cv2.putText(micOverlay, text2, (722, 497), cv2.FONT_HERSHEY_DUPLEX, 0.9, (200,
200, 200), thickness=2)
   cv2.putText(micOverlay, textEx, (652, 570), cv2.FONT_HERSHEY_DUPLEX, 0.9,
(200, 200, 200), thickness=2)
```

Microphone/ test script:

```
import numpy as np
import cv2
import time
import random
import displayVideos
import speech_recognition as sr
sr.__version__
'3.8.1'

isoInput = None

if __name__ == '__main__':
  print('this is test1')

def confrontation():
   print('spooky')

def SR():
   # if micHot:
   while True:
       print('SR start')
       r = sr.Recognizer()
       mic = sr.Microphone(device_index=1)

       with mic as source:
           r.adjust_for_ambient_noise(source)
           print('go')
           audio = r.listen(source)

       voice_command = r.recognize_google(audio)
       print('Detected voice command: ' + voice_command)
       break

   # READ OFF THE WORD (ISOLATE) OR (SHOW) AND NUMBERS FROM USER SPEECH
   # print(sr.Microphone.list_microphone_names())
   #    # vvv print vvv
   # mic = sr.Microphone(device_index=1)
```

```
    '''
    ['Microsoft Sound Mapper - Input',
    'Microphone (USB PnP Sound Devic',
    'Microphone Array (Realtek High ',
    'Microsoft Sound Mapper - Output',
    'Speakers (Realtek High Definiti',
    'Speakers (7.1 Surround Sound)',
    'Primary Sound Capture Driver',
    'Microphone (USB PnP Sound Device)',
    'Microphone Array (Realtek High Definition Audio)',
    'Primary Sound Driver',
    'Speakers (Realtek High Definition Audio)',
    'Speakers (7.1 Surround Sound)',
    'Speakers (Realtek High Definition Audio)',
    'Speakers (7.1 Surround Sound)',
    'Microphone (USB PnP Sound Device)',
    'Microphone Array (Realtek High Definition Audio)',
    'Stereo Mix (Realtek HD Audio Stereo input)',
    'Microphone Array (Realtek HD Audio Mic Array input)',
    'Speakers (Realtek HD Audio output)', 'Headphones ()',
    'Headset (@System32\\drivers\\bthhfenum.sys,#2;%1 Hands-Free AG
Audio%0\r\n;(F8))',
    'Headset (@System32\\drivers\\bthhfenum.sys,#2;%1 Hands-Free AG
Audio%0\r\n;(F8))',
    'Line ()',
    'Output (@System32\\drivers\\bthhfenum.sys,#4;%1 Hands-Free HF
Audio%0\r\n;(Taleâ€™s iPhone))',
    'Input (@System32\\drivers\\bthhfenum.sys,#4;%1 Hands-Free HF
Audio%0\r\n;(Taleâ€™s iPhone))',
    'Speakers 1 (7.1 Surround Sound Wave Speaker Headphone)',
    'Speakers 2 (7.1 Surround Sound Wave Speaker Headphone)',
    'Input (7.1 Surround Sound Wave Speaker Headphone)',
    'Headset (@System32\\drivers\\bthhfenum.sys,#2;%1 Hands-Free AG
Audio%0\r\n;(AWEI MUSIC))',
    'Headset (@System32\\drivers\\bthhfenum.sys,#2;%1 Hands-Free AG
Audio%0\r\n;(AWEI MUSIC))',
    'Headset (@System32\\drivers\\bthhfenum.sys,#2;%1 Hands-Free AG
Audio%0\r\n;(moiâ€™s AirPods))',
    'Headset (@System32\\drivers\\bthhfenum.sys,#2;%1 Hands-Free AG
Audio%0\r\n;(moiâ€™s AirPods))',
    'Headphones ()',
    'Headphones ()',
    'Microphone (USB PnP Sound Device)']

    with mic as source:
        # r.adjust_for_ambient_noise(source) youre able to add the duratio=0.5xx
function
        audio = r.listen(source)
    r.recognize_google(audio)
    '''

def runInput(isoInput):
    breakIso = False
    pre_timeframe = 0
    new_timeframe = 0
    viewerCount = random.randint(4, 376)
    tempVid = None
    text = str(viewerCount)
```

```
    if isoInput is not None:
        tempVid = isoInput

    tempCap = cv2.VideoCapture('media/' + str(tempVid) + '.mp4')

    while tempCap.isOpened():
        success, frame = tempCap.read()
        # cv2.waitKey(20) # lower the pc capabilities of the read function to cap
off video fps

        # this piece of code displays video's fps
        # new_timeframe = time.time()
        # fps = 1 / (new_timeframe - pre_timeframe)
        # pre_timeframe = new_timeframe
        # fps = int(fps)
        # cv2.putText(frame, str(fps), (8, 80), cv2.FONT_HERSHEY_SIMPLEX, 3, (0,
0, 0), 4)

        # textOverlay.test(passingArgument=liveVideo)
        # tempCap = cv2.putText(tempCap, text, (0, 20), cv2.FONT_HERSHEY_DUPLEX,
0.6, (0, 0, 0), thickness=1)

        viewerCount += random.randint((-1), 1)

        if success:
            cv2.namedWindow('isolation', cv2.WND_PROP_FULLSCREEN)
            cv2.setWindowProperty('isolation', cv2.WND_PROP_FULLSCREEN,
cv2.WINDOW_FULLSCREEN)
            cv2.imshow('isolation', frame)
        #   displayVideos.window_titles[currentWindow]
        else:
            tempCap.set(cv2.CAP_PROP_POS_FRAMES, 0) # replay
            breakIso = True

        if cv2.waitKey(1) & 0xFF == ord('q') or breakIso:
            tempCap.release()
            cv2.destroyAllWindows()
            print('iso break')
            break
```

Appendix C: Information Letter & Consent Form

Information Letter for Interactive Ethics Installation

The purpose of the research is to evaluate the use, effectiveness and application of an interactive ethics installation in a dedicated ethics space. The evaluation is separated into three distinct segments. The experience in question involves exposure to an interactive ethical installation which aims to relate the concept of panopticism posed by Michel Foucault. Please be advised that the experience presents a risk to those who are prone to claustrophobia. Specifically, it attempts this by placing the participant's upper body inside an enclosed wooden box with four screens inside. These screens portray regular surveillance streams which the participant can interact with, placing the participant in the metaphorical role of the prison guard inside a panoptical prison facility as advocated by Jeremy Bentham.

Firstly, procedures will be taken to inform participants on the purpose and meaning of the evaluation (partly by use of this information letter) and a signed consent statement will be requested from participants on paper. This will be paired with a brief introduction to the following period where participants are presented with the opportunity to clear up any questions before taking part in the research. Within this period, participants are explained that they maintain the right to withdraw from the session at any time, afterwhich their data will not be used or saved. Finishing this prelude is a short starter interview of approximately five minutes where the prior knowledge and competency of the participants is formalised.
Secondly, after an information session, consent procedure, and preluding interview, the participants are invited to approach the interactive ethics installation. Shortly before and throughout the experience, they are assisted when necessary. The experience itself varies in time, but is designed to take up no longer than 10 minutes.
Thirdly, to finalise the session, the participants are presented with an evaluating interview. This interview inquires about the participants perception of the installation, their experience with the installation, and their opinions and critiques of the installation in the context of ethics education and dedicated ethics spaces. It will take approximately 10 minutes.
The session experiences no benefits to the participants and the evaluation procedure has been reviewed by the Ethics Committee Information and Computer Science. Personal information about participants will be required and will be saved up until the end of the research (03-02-2023). The personal data that is collected consists of audio and/or video recordings, study background, and contact information. This information is collected in order to form a comprehensive evaluation of the prototype installation. Through contact with the researcher, all participants reserve the right to access and rectify or erase personal data from their session.

The data and insights that are collected are fully anonymised by the researcher, and no personal information pertaining to the participants will be recognisable in the reporting thesis. For the duration that the data is archived, before the research concludes, it will be shared only to those with implications on the research and it will not be reused in future studies. To finally clarify the retention period of the data, any and all personal data will be terminated with the conclusion of the research period. The research period is set to end on the third of February 2023, but can be subject to extension in which case the participants will be notified of the extension of the retention period.

Finally, contact information pertaining to the researcher in this study or the research institution are included on the consent form which is attached to this information letter.

Consent Form for Interactive Ethics Installation

YOU WILL BE GIVEN A COPY OF THIS INFORMED CONSENT FORM

Taking part in this evaluation		
Please tick the appropriate boxes	**Yes**	**No**
I have read and understood the study information dated [03-02-2023], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
I understand the risks and benefits involved with partaking in this study. Notably, the considered risk of claustrophobia during the experience.	☐	☐
I understand that taking part in the study involves a two part audio recorded interview. That the audio will be recorded by use of a mobile phone spread across two subsequent sessions. The first interview will take place before any interaction with the installation and the second interview will take place after experience with the installation.	☐	☐
I understand that the audio recording will be used toward transcription purposes. The conversations will be transcribed as soon as possible, afterwhich the recordings will be deleted.	☐	☐
I understand the purpose of video or image captures of participants' interaction with the installation is to feature this in the final thesis and/or presentation.	☐	☐
I agree to be audio recorded.	☐	☐
I give permission to be video recorded and/or photographed during my interaction with the installation.	☐	☐

Signatures
Name of participant: Signature: Date:
I (researcher) have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting. Researcher name: Tale Nap Signature:    Date:
Study contact details for further information ***Name: Tale Nap*** ***E-mail address*: t.e.nap@student.utwente.nl** **Contact Information for Questions about Your Rights as a Research Participant** If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee Information & Computer Science: ethicscommittee-CIS@utwente.nl

Appendix D: Media in conversation

https://www.youtube.com/watch?v=Fzhkwyoe5vI

Appendix E: Reflection Report

Author: Tale Nap
Program: Creative Technology BSc.
Date of submission: 13-01-2023
Course: Reflection II
Project: Interactive Installation for an Ethics Lab
Report title: Reflecting on Shifts in Ethics Education in Academic Design Spaces

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Section 1: Description of the Project and Vision Statement

The project was proposed by the Professorship of Ethics and Technology at the Saxion University of Applied Sciences in Deventer, chaired by Steven Dorrestijn. Their team maintains the objective of exploring the ethical consequences of technology from a practical standpoint. Coincidingly, the research group's vision is to educate students on practical approaches to ethics. Towards this, they aim to facilitate a physical space dedicated to ethical reflection of technology. Distinctively, the research group directs focus on exhibiting the historical background of ethics through the creation of a museum presenting 'the canon of ethics and technology'. The design assignment captures this through the development of an interactive installation encapsulating a classical ethical dilemma through a physical experience. The ethical dilemma/problem chosen to substantiate the installation was the panopticon, advocated by Jeremy Bentham, and the structure of panopticism, explored by Michel Foucault.

The research project encapsulating the design assignment aims to explore the possibilities surrounding ethics education through a practical pedagogical method focused on classical ethical theory and dilemma. More literally, the researcher aims to facilitate the goal of educating design students using a practical educational approach which helps the students explore the tightly-knit relationship between ethics and technology. Overarchingly, the research stands to address well-argumented issues and challenges found with ethics education in engineering and design fields. Therefore, the developed solution aims to be a step forward in improving the ethical dimension of engineering, and to broaden the scope of ethics education by providing a practical approach to further ethical development. At its current state, the design solution is yet to be evaluated, but the background and problem statement are expounded, structured, and well-argumented.

This challenge was chosen because of an interest in the relationship between ethics and technology. The proceeding subject matter of the panopticon was chosen to be the driving force of the solution, as it bears close parallels and interesting metaphors to culture, society and government as commented by Michel Foucault. Evidently, it gains further relevance when relating the concept of panopticism to structures in place today in culture, society, and government.

On a more holistic scale, this project and its design challenge are important because of the responsibility that designers have to deliver ethically proficient output, and the duty placed on academic and educational institutions to prepare young designers to act ethically. Based on the issues with ethics education in engineering fields, identified through literature research in the project, this research gains general relevance to society since it recognises the engineer and designer "as an agent of positive social change, capable of affecting both local and global communities" in the ethical consideration of their work [1, p. 86]. This is imperative as, argued by Finellit et al., undergraduate programs should sufficiently prepare students in their ethical development, students should be fully prepared to abide by professional codes of ethics, and they should be able to tackle complex ethical issues upon their graduation [2].

Section 2: Develop a Code of Ethics to Guide Your Project

Two ethical dilemmas are exceptionally prominent regarding the design. The first ethical dilemma sets the ethical landscape by encompassing the general theme and metaphors involved with the interactive installation. Then, more practically, the second dilemma deals with the most ethically significant section of the experience design.

Firstly, the classical ethical dilemma chosen to base the installation on, as per the design assignment, was chosen to be the panopticon. The panopticon was developed by Jeremy Bentham in the 18th century to be a circular prison which supported a full-time surveillance structure. The walls were to be lined with surveillable cells and the centre would feature a guard tower with a panoramic view. The driving element for surveillance would be that the prisoners could not check if they were being observed. Bentham argued this would lead to the prisoners maintaining the feeling of being observed continuously. Michel Foucault later took this concept and coined the term panopticism, with which he argued that an individual placed in such a power structure would go on to surveil themselves, fully abiding by the societal and autocratic rules of the prison, upholding the status quo. This concept of panopticism bears relations and metaphorical value when placed into our modern society and the power structures we endure. Therefore, it is a powerful discussion point, which is used in the installation as a thinkpiece and potential conversation starter, optimistically leading to some sort of ethical consideration where students might consider the power relations and structures in their design projects. In this sense, this dilemma serves to help students think about, and to understand, the nature of ethical issues within their designs.

Secondly, a key ethical issue within the experience design of the installation is the issue of confrontation in the context of education. Specifically, the theme of the installation connects metaphorically to current discussion about surveillance capitalism and privacy of personal data. The installation aims to use these topic by creating a confrontation for the user where they first enjoy the power of intruding other's personal privacy (metaphorically being placed as the guard at the centre of the panoptical structure), and following this position by having their personal data accessed and their 'digital personal space' intruded upon (now taking the place of the prisoner inside the power structure) as stranger observe them through an overhead camera inside of the installation. Generally, because the interactive installation is aimed to be used towards educational purposes, the ethical concern of this confrontational aspect of the experience creates an issue. Naturally, certain bounds exist within education to protect the liberties and rights of students and staff alike. Consequently, this means the experience design as a whole, but especially the confrontational aspect, requires ethical consideration in order to identify and understand ethical issues that form as a byproduct of the nature of the design.

More all-encompassingly, five key moral principles can be placed at the centre of the design process to help conform how ethical issues were addressed and how similar projects could handle these situations in future. These principles can be categorised under professional ethics and applied ethics. Next, the principles will be detailed, accompanied by a formal definition, tie of relevancy, and their specific impacts or influences on the project.

Professional Ethics

Firstly, the following principles fit into the narrative of professional ethics. These principles apply to the practitioner or the researcher in charge of the project and its design choices.

1. Maintain integrity and responsibility in any ethical or professional activities

This principle draws inspiration from the generally accepted IEEE code of conduct. It affirms that the practitioner in any engineering project or research should be held accountable for the effects of their work. This is relevant to all works of engineering within education, which is the reason it is also applicable to this project. This principle was adhered to by upholding the ethical rules of the faculty. It therefore influenced the design through ethical regulation.

2. Treat all individuals involved fairly and with respect

The second principle bears the grounds for safe, fair and respectful accountability towards research participants. It ensures that the participant is kept in mind throughout the design process. This influenced the design by involving them as a serious stakeholder. It served to not disregard the preferences of students, keep in mind their capabilities and their liberties.

3. Fully inform all individuals

The principle above makes sure that no user or participant in engineering research is put in a position where they could be excluded, harmed or mistreated. By informing an individual through the evaluation process, these opportunities do not arise. This principle had effects on the experience design of the installation and on the design of the evaluation procedure. This aspect of consideration is important as to help the researchers conduct safe and regulated testing and evaluation.

Applied Ethics

Secondly, these principles find a more specific relevance within the project itself. They apply to similar projects which might substantiate in future.

1. Control all interaction with the design

This principle describes how interaction with an installation should be controlled so as to not lead to unforeseen circumstances. Especially where interactive installations are driven by diverse or problematic issues, the interaction design should in all cases be deliberate to protect both the installation and the participants of a research study. In the case of this project, it is smart to control how users can enjoy the experience. Therefore, the design was influenced in such a way where an effort was made to limit physical interaction with the installation and control the media the users are subjected to.

2. Ensure that all participants are adequately involved in the themes of the design

This principle tries to account for the fact that individuals might be engaged through different avenues, urging the designer to make sure that, through information and evaluation, all participants are aware of the concept around them. This is important to the effectiveness of the installation, but also to the immersion of the participant, where a better immersion should lead to better research and evaluation results, and a better experience for the individual as a whole. Therefore, through briefing it is made sure that all participants of this project are given proper information to explore the contemporary themes involved in the design.

Section 3: Engaging the Design through Moral Values and Ethical Decision Making

The Ethical Cycle by Van der Poel and Royakkers is an ethical reflection model which was developed to aid in structuring and improving moral decisions [3]. The method allows the decision-maker to complete a systematic moral analysis of the problem statement, working towards the justification of their decisions in moral terms. The following sections chronologically outline each component of the Ethical Cycle as applied to this project. Moral values of the previous section detailing the project's code of conduct are kept in mind.

Case

The case is the project at hand. To reiterate, in short it can be outlined as the development of an interactive ethics installation focused around a classical ethical dilemma, ultimately serving in an educational space dedicated to teaching ethics to design students through practical pedagogical approaches. The dilemma of the installation was chosen to be the issue of panopticism, first detailed by Michel Foucault, and the project entails the design of a physical experience which embodies a panoptical structure in order to involve students in ethical reflection, discussion, or general dialogue. The ethical case with this issue is the matter in which to apply this project as a practical pedagogical method, as it is widely unproven in an educational context and the ethical bounds have not yet been defined.

Moral problem statement

The moral problem statement revolves around the application of this installation in an educational context. Specifically, the project serves an exploratory role, taking the first steps into discovering the benefits and possible drawbacks when committing to a more widespread use of practical pedagogical models. Therefore, keeping in mind the factors in place and the cautious nature of the project, the moral problem statement can be formulated as follows:
'How can practical pedagogical approaches stimulate theoretical ethical reflection throughout a design student's process in a moral way, not impeding on academic regulation or personal liberties?'

Problem analysis

The stakeholders in the development of the interactive ethics installation are the design students, the educators and other faculty. In a broader scope, one could argue that an artefact such as this installation or that improvement of ethics education could have a positive input on the output of future designers or engineers, eventually having an impact on those in society affected by their output. This, however, while part of the bigger picture and problem to be addressed, is far beyond the scope of this analysis. Firstly, the interests of the design student population are generally to receive a complete education, including ethical proficiency, and to be fully prepared to start their professional journey. Secondly, the interests of the educators generally is to teach and give their pupils the complete skills to prepare them for their futures, meaning their interests mainly align with those of the students. Lastly, the interests of the faculty, which is responsible for the curriculum and the output of young professionals, lie with the adequate preparation of the students to become professionals and creating an efficient, contemporary, and proven curriculum. This

information, combined with facts gathered from literature research, allows us to formulate moral standpoints related to the project.

The following moral standpoint relates to the entity held responsible for creative output from designers and the time at which the accountability should be applied:

- If designers are to be held ethically accountable for their output, all young designers should be educated with a morally correct background and prepared with sufficient ethical proficiency; but if designers are tied to the constraints of their professional role or position, the enveloping institutions and companies should be held accountable for the ethical ramifications of their employees' output.

The following moral standpoint relates to the application of methods like interactive installations in ethics education:

- If young designers are more proficient and confident in their ethical reasoning when taught through practical methods of ethics education, academic institutions should work toward integrating such pedagogical methods into their curricula; if however these institutions should not take this position, practical pedagogical models and methods for ethics education should find other paths to reach students.

The final moral standpoint applies specifically to the interactive installation of this project:

- If ethical skills of young designers are improved by classical ethical dilemmas, interactive ethics installations may take moral liberties in conveying the concepts involved; then if the concepts are overly difficult or inflict on personal liberties, the practical approach must be reined back through a larger infusion of ethical theory.

These three statements form a top-down trend, considering the problem in a theoretical light, then from the faculty's perspective at the managerial layer, down to the practical application and the ethical repercussions.

Options for actions

The following stage considers creative solutions which might shed light on the issue and better inform stakeholders on the options ahead of them. Firstly, the most prominent course of action to inform all actors on which way to ethically apply unproven practical pedagogical approaches is to research them. In the wake of the exploratory research achieved by this project, research into their application will be performed and quantitative data will be collected to help decide on the best form of application of interactive ethical installations and similar methods. Additionally, research should be performed on the benefits of dedicated ethics spaces within technical academic institutions. The concluding information would create a pathway for similar projects to emerge to strengthen the space and ultimately work towards improving ethics education. Additionally, in order to find the best place to apply such methods, with the least hurdles, trials can be held where the methods are applied in different formats which complement the existing curriculum, as this might lead to faster application which circumvents some of the integration time needed. Varying practical methods could for instance be part of workshops or design exercises, taking them out of the environment of the

classical ethics course and merging them into existing curricular design processes. Lastly, inspecting similar cases might reveal how practical approaches, like exposure to and experiences with installations or art, reap rewards in other fields. This last course of action might, however, fail to include the past relationship that exists between the engineering principle and ethical and moral theory in analysis.

Ethical judgement

The following paragraph applies the dominant-value framework, based on the moral values signified as core principles to the project context in the previous section as the project's code of conduct. The dominant-value framework aims to take the most dominant moral value associated with the problem and base the course of action accordingly. In the case of this specific moral problem, the most important denominator can be identified as 'the protection of personal liberties'. Since ethics education through practical approaches can rely on a conflict-heavy and problematic nature, it is imperative that the best option for action works to protect all individuals involved in the calibration of the educational layout. Through moral consideration of the available roadmaps, we can determine that the safest way to introduce practical pedagogical methods within ethics education in engineering programs is based on firm exploratory research and, importantly, verifiable protective signifiers which can confirm that the methods are safe, controlled, and manageable.

Reflection

To reflect on and recap the process above, the project in question concentrates on exposure to classical ethical thought which can carry a problematic nature. Therefore, within an educational context, it is highly important to protect personal values and liberties of the stakeholders in the process. Consequently, additional research is imperative before deciding on the application of more practical pedagogical approaches in ethics education in engineering programs, interactive ethics installations in specific. The direction which to focus this research in can be beneficial to stakeholders involved, as more research to determine which method of application is most ethically acceptable and reliable. To make this decision, the dominant-value framework was applied to determine that future research should maintain a focus on exploration of benefits and verification of safety metrics.

The Ethical Cycle and the Creative Technology Design Model

Reflectively, this process acts as a practical and applied way of considering ethical issues associated with case design and the factors involved with the design process. It is slightly different to usual methods used by the Creative Technology program. The Ethical Cycle by Van der Poel and Royakkers is hugely useful in structuring and improving moral decisions that arise throughout the design process in a practical way by examining the broader environment as a case [3]. Similarly, the Creative Technology curriculum manages to include a broad perspective for ethical consideration through case study. The program, however, rarely takes action to instigate students to ethically reflect on projects through practical or applied methods outside of designated courses. Therefore, it would be beneficial to the Creative Technology design model to include periodical moments of ethical reflection, where the Ethical Cycle by Van der Poel and Royakkers could make a beneficial and supportive attribution to the practical construction and expansion of the design context for students by focusing on the ethical dimension and including broad ethical perspectives.

Section 4: Applied Ethics

Throughout the design process, mainly leading up to the realisation phase, applied ethical analysis methods were used in order to create and maintain an informed design space. These tools and methods served distinctive purposes. Their results and conclusions are outlined below.

Firstly, flowcharting was used early on in the process. This is an effective method which creatively solves ethical problems by speculating and determining outcomes to possible scenarios [4]. The following flowchart portrays the ethical issue faced by the project at the start of the process based on the challenges identified with ethics education in design engineering programs by literature research.

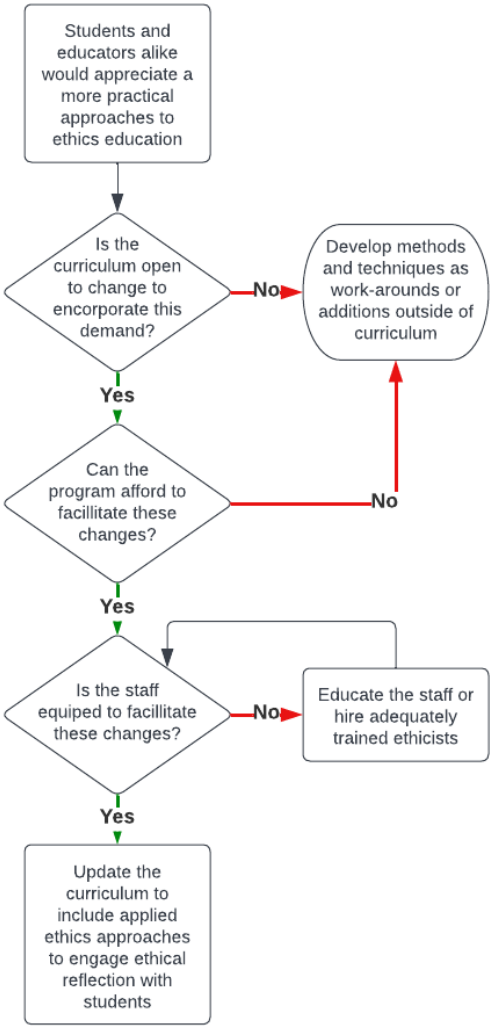

Figure 1: Incorporating applied ethics into the program flow chart
The programme used to create the figure above is called “LucidChart”
https://app.lucidchart.com/

Secondly, stakeholder analysis was conducted throughout the ideation phase. This stakeholder analysis process included the Markkula tool of Ethical Risk Sweeping. Ethical risks associated with individuals involved with the project were identified in order to prevent any cases of ethical negligence.

As a starting point, the relevant stakeholders involved were identified to be students in engineering programs, or young designers to be more specific; professors, seen as the transformative branch of the educational faculty; and administrators, seen as the managerial branch of the educational faculty. Subsequently, their interests were researched. The following list shows an outline of the factors by which a stakeholder might be affected.

- Educational quality
- Educational load
- Stress
- Personal moral values or liberties
    - Religious freedoms
    - Worldviews
    - Privacy issues
    - Discriminatory issues
    - Cultural disagreements

In the case of this project and its evaluation procedure, the regulatory ethical body should prevent any ethical negligence. In the broader case concerning the application of practical pedagogical techniques and the continuation of this project, the code of conduct principles characterised under professional ethics should help serve as a basis for ethical procedure.

Thirdly, ethical theories, as explained by Fleddermann [5], find their relevance in the root of the problem driving this project. A comprehensive literature review considering ethics in design engineering concluded that a key problem found in design engineering institutions was a culture of disregard toward ethics [6, 7, 8, 9]. It noted that the ethical dimension was usually written off by researchers and students as a matter to be handled after the fact [6]. It discovered that, despite positive trends showing that ethics education was improving in engineering fields, this disregard had been reciprocated by the academic curricula. Recent research showed that, for this culture and seeming failure to integrate the ethical dimension effectively, the adaptation of overly formalised ethics checklists was to blame, as they removed ethics from the design process and seemingly only highlighted them in evaluation procedures [10]. The adaptation of ethical checklists is reported to have been a widespread phenomenon across fields [10], some research even going as far as stating that business ethics found more grounds in engineering education than moral study, and claiming that ethics education stood out as the most out-sourced requirement of engineering programs [11]. The stem of this issue was placed on the background of utilitarian ethics and deontological approaches which failed to classify the ethical dimension in engineering and the importance of ethical reflection in design.
One main takeaway from the analysis of literature about the historical effect that utilitarianism and deontology have had on the engineering field is the shift towards virtue ethics that the field is undergoing. As the relation between design engineering and ethics are now well established, more of an ethical responsibility is being put on the designer, leading to a shift toward virtue ethics. This, however, raises an important issue detailed by Fleddermann as personal vs. corporate morality [4]. The code of conduct constructed surrounding this project in a previous section highlights this issue well by having to constitute the divide between applied and professional ethics, communicating how personal and corporate morality might find themselves at an impasse with the designer in the middle.

Section 5: Theoretical Discussion

The following section will discuss how the project and subsequent installation serve as to cause transformation in the framework of a driver of change. Namely, the project aims to improve design students' grasp of complex ethical issues and prepare them with the best ethical literacy possible. The way in which it attempts this is by following a practical approach to teaching ethics which might later benefit their professional life, as they are better prepared with practical ethical skills. Specifically, this project serves society in broad terms. The research might be the start of the introduction of widespread practical pedagogical approaches in design engineering education, which could, optimistically speaking, improve the output of future designers in a moral sense. In a society where designers are adequately prepared to face ethical challenges and issues, fewer cases of ethical negligence should be found, potentially preventing harm on a societal level, indirectly improving the society.

Practically, more ethically proficient and ethically involved designer could for instance output technologies where the issue of discrimination based on non-conformity [12], as described by Wittkower, is less and less prevalent as the awareness of the designer would lead them to sooner design for all instead of the One, eventually finding less cases of ethical neglect with less privileged individuals as a consequence.

In the same manner, when the future generations of designers are more aware of the impact of their output, and they carry the notion of designing for sustainability as highlighted by Tromp, Hekkert & Verbeek [14], the designers will put more thought into the relationship between the user, the product, and the implications of the existence of this relation. With better practical application of ethical thought while following the user as a stakeholder, examining their interests and the benefit a product has to them, the designer should be more competent in deciding upon the nature of how to design this relation and how to design for a specific type of influence.

Section 6: Concluding Remarks, Impact Statement, Limitations, Looking Forward

Knowing the benefits the project could garner and the moral challenges involved with the installation, the research, and the project itself, we can say that the continuation of the research direction is imperative to the improvement of ethics education in engineering programs. The conclusion is to maintain the exploration of practical pedagogical approaches and their application. It is the viewpoint of the research that practical methods would improve the quality of the ethical skills of young designers and amount of ethical reflection in their design process throughout their education and professional careers.

Following the findings of this reflection report, I personally find that I should start my design process with a dose of ethical reflection where I assess the design context and find any places where ethical issues could be critical. This is something I will try to bring with me in my education and professional career.

The project as a whole serves as a driver of change as outlined above. It has good moral objectives in trying to improve ethics education and further integrate ethical consideration into the design processes of future professionals. It aims to explore ways in which education can be improved and to lay the groundwork for a host of practical methods for ethics education and ethical conversation in ethics spaces.

The alley of research that this project opens up should be explored. As argued by the report, the best avenues and formats for the integration and application of practical pedagogical approaches should be determined. Furthermore, it is important to prove the effectiveness of these approaches and to validate within the engineering environment, supporting them by quantitative research metrics and constructive verification.

Section 7: References Cited

[1] - R. D. Hollander, D. G. Johnson, J. R. Beckwith, and B. Fader, “Why teach ethics in science and engineering?,” *Science and Engineering Ethics*, vol. 1, no. 1, pp. 83–87, 1995.

[2] - C. J. Finelli, M. A. Holsapple, E. Ra, R. M. Bielby, B. A. Burt, D. D. Carpenter, T. S. Harding, and J. A. Sutkus, “An assessment of Engineering Students' curricular and co-curricular experiences and their ethical development,” *Journal of Engineering Education*, vol. 101, no. 3, pp. 469–494, 2012.

[3] - I. van de Poel and L. Royakkers, “The ethical cycle,” *Journal of Business Ethics*, vol. 71, no. 1, pp. 1–13, 2006.

[4] - C. B. Fleddermann, “Understanding Ethical Problems,” in *Engineering ethics*, 4th ed., Upper Saddle River, NJ: Prentice Hall, 2012, pp. 37–49.

[5] - C. B. Fleddermann, “Ethical Problem-Solving Techniques,” in *Engineering ethics*, 4th ed., Upper Saddle River, NJ: Prentice Hall, 2012, pp. 56–73.

[6] - D. S. Borrett, H. Sampson, and A. Cavoukian, “Research ethics by design: A collaborative research design proposal,” *Research Ethics*, vol. 13, no. 2, pp. 84–91, 2016.

[7] - J. H. Lim, B. D. Hunt, N. Findlater, P. T. Tkacik, and J. L. Dahlberg, “‘In our own little world’: Invisibility of the social and ethical dimension of engineering among undergraduate students,” *Science and Engineering Ethics*, vol. 27, no. 6, 2021.

[8] - N. Kenneth McBride, “Active ethics: An information systems ethics for the internet age,” *Journal of Information, Communication and Ethics in Society*, vol. 12, no. 1, pp. 21–44, 2014.

[9] - N. W. Sochacka, J. Walther, and A. L. Pawley, “Ethical validation: Reframing research ethics in engineering education research to improve research quality,” *Journal of Engineering Education*, vol. 107, no. 3, pp. 362–379, 2018.

[10] - G. N. Vilaza and P. Bækgaard, “Teaching user experience design ethics to engineering students: Lessons learned,” *Frontiers in Computer Science*, vol. 4, 2022.

[11] - S. Sheppard, K. Macatangay, A. Colby, and W. M. Sullivan, “Educating engineers: Designing for the future of the field,” *Choice Reviews Online*, vol. 47, no. 01, 2009.

[12] - Wittkower, D., 2018. Chapter 2: Discrimination. In: J. Pitt and A. Shew, ed., Spaces for the future. New York: Routledge, pp.14-28.

[13] - N. Tromp, P. Hekkert, and P.-P. Verbeek, “Design for socially responsible behavior: A classification of influence based on intended user experience,” *Design Issues*, vol. 27, no. 3, pp. 3–19, 2011.

[14] - “IEEE code of Ethics,” *IEEE.org*. [Online]. Available: https://www.ieee.org/content/dam/ieee-org/ieee/web/org/about/corporate/ieee-code-of-ethics.pdf