Animated storytelling about the possibilities provided by remote sensing and computer vision

Bachelor Thesis

Creative Technology

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February 2024

Abstract

This thesis explores how animated storytelling can be used to inform and create awareness about the possibilities of combining satellite imagery with computer vision in order to progress global sustainability goals. In recent years, both the remote sensing and the artificial intelligence research fields have seen rapid developments. Periopsis is a startup that combines these technologies to provide environmetal modelling services to clients like governments, municipalities and companies. In task of Periopsis, this thesis set out to create a video that will convince stakeholders about the possibilities of the technology. To do so, first a literature review about the state of the art of the technology was synthesized to find out what these possibilities are. Secondly, an analysis was conducted on similar purposed videos to distinguish their common practicalities. These then jointly provided the project with enough input to create a video requirements list. Thirdly, after creating plenty draft versions, the video was created and evaluated through use of an online survey. From this evaluation it is concluded that the approach this research took on creating an animated story to inform and create awareness, is indeed effective. This thesis contributes to the field by demonstrating the power of animated storytelling in simplifying and disseminating complex technologies, thus fostering a broader understanding and appreciation of the role of remote sensing and computer vision in achieving a more sustainable way of living.

Video link:
https://youtu.be/gHSzG_M2rwo

Acknowledgement

I would like to express my thanks and gratitude to dr. Andreas Kamilaris for being a helpful supervisor of this project. Furthermore, I would like to thank Jeroen Klein Brinke for being a critical observer for this project.

I would like to thank the team at Periopsis for providing me with this project and all the resources I needed for it. I would like to specifically thank Marios Zittis for being my very helpful contact person within Periopsis.

Lastly, I would like to thank Wendy Tollenaar for her help on making the literature review more goal-oriented and effective in its contribution to the project.

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Chapter 1 - Introduction

Socrates allegedly stated that : *“Man must rise above the earth to the top of the atmosphere and beyond for only thus will he fully understand the world in which he lives”* [1] . In the 19th century people started strapping cameras to airplanes, kites, balloons and even pigeons. The first people to take a picture from beyond our planet’s atmosphere were American scientists in 1946. They strapped a camera to a captured Nazi rocket, hereby successfully taking the first picture from space. Then came the first satellite, the Landsat I that launched in 1972. Following up on Socrates’ advice, currently there are more than 8500 active satellites orbiting the earth [2]. To give an indication of the growth of this metric, in 2018 the number of active satellites was around 2000 [3]. Besides the rapid increase in the amount of active satellites, the technology aboard has been improving as well. These two elements allow for a rapid improvement of earth observation practices.

In recent years a lot of development has happened in the field of artificial intelligence (AI) technology, such as the increased usability of machine learning and deep learning in computer vision. Improvements in this technology mean more applications in various fields such as multiple research fields, health care, agriculture, psychology and many more.

Combining satellite imagery with AI in computer vision is a way of looking at, and understanding, what happens on Earth that Socrates could not have imagined. Using the power of AI to analyze vast amounts of satellite imagery data in a relatively short amount of time allows for a wide range of possibilities in achieving a multitude of different goals, including sustainability goals.

In 2015 the United Nations issued the use of the 17 Sustainable Development Goals (SDGs) in order to act as an actionable framework for countries all over the world to tackle global sustainability challenges. The goal of this plan is to encourage development that goes hand-in-hand with global challenges such as ending poverty, improving health, improving education, reducing inequalities, tackling climate change, preserving oceans and forests and more.

Periopsis LTD is a European Union-funded startup that provides satellite imagery computer vision services such as detecting illegal garbage dumping, counting trees in a certain area, detecting swimming pools, detecting buildings’ area coverage and detecting and counting cars. They provide these services to clients ranging from the industrial and commercial world to governments and governmental entities, focusing on municipalities

and local communities. Periopsis is constantly looking to expand on its current services by actively researching new use cases of the technology.

This research aims to create more awareness around the possibilities of computer vision technology applied to satellite imagery in supporting sustainability goals by creating an animated story. Hence the main research question is:

RQ: "*How can we use animated storytelling to raise awareness among stakeholders of the possibilities of combining satellite imagery with artificial intelligence technology?"*

This research question comprises two elements. The first one being the element of the content of the animated story. In other words, what are the possibilities of this technology for sustainability? Formulating this into a sub research questions gives:

Sub-RQ1: "*What are the possibilities of combining satellite imagery with artificial intelligence technology for sustainability purposes?"*

Answering this question gives insight into what the animated story should tell about. In other words, what is the content of the video? This leads us to element number two, which is how to effectively tell this story? Which leads to subquestion number 2:

Sub-RQ2: *"How are animated stories already being used for similar projects?"*

Answering this subquestion gives insight into what is the best way to tell the story formulated in subquestion 1.

To answer subquestion 1, a scientific literature review will be done on the current state of the art of this field. After this, an analysis of similar purposed videos will be done. After the subquestions have been answered, a rough structure and ideation of the video will be ready to be pitched to the client to make sure expectations are aligned. Finally, a script can be made, after which a first draft of the video will be shown to the client. The final step of the research is to evaluate the effectiveness of the video in creating awareness on the topic among stakeholders by use of an online survey.

Chapter 2 - Background Research

2.1 About Periopsis

Periopsis LTD is a start-up that aims to become established in Europe as a highly innovative company engaged in the use of emerging IT technologies with the objective of large-scale environmental observation and modeling for sustainability purposes.

It is one of the spin-offs of CYENS Centre of Excellence, which is a research and innovation center located in Cyprus that focuses on Interactive Media, Smart Systems, and Emerging technologies aiming to empower knowledge and technology transfer in the region. CYENS is a joint venture between the three public universities of Cyprus and works together with renowned international partners such as the Max Planck Institute for Informatics (Germany) and University College London (UK). With more than a hundred forward-looking people diversely experienced in multiple fields and disciplines, CYENS aims to *"produce world-class research that drives innovation towards social and economic benefit while conducting excellent, internationally competitive scientific research in the areas of visual sciences, human factors, design, communication, and artificial intelligence*" [4]

As a spin-off of CYENS, Periopsis is a representation of CYENS' goals to commercially exploit the emerging technologies of artificial intelligence and remote sensing, to drive innovation towards social and economic benefit, with environmental protection and ethical research in mind. Potential clients range from the industrial and commercial world to governments and governmental entities, focusing on municipalities and local communities. Currently, Periopsis offers services such as detecting illegal garbage dumping, counting trees in a certain area, detecting swimming pools, detecting buildings' area coverage, detecting and counting cars, etc. Besides this, research is being done on the use cases of prospecting how effective a photovoltaic system (solar panels) will be for certain buildings into an easy-to-use tool, monitoring wildlife populations and inferring height from aerial imagery.

2.2 Literature Review

The goal of this research is to create a video that generates awareness around the possibilities of combining AI and satellite imagery for sustainability purposes. A critical component of this process is to gain insight into what these possibilities are. However, as mentioning all of the possibilities would be too much for a single video, this literature review will attempt to select the best ones. The “best ones” in this context are the ones that, together, form the best overall understanding of the potential of this technology.

This will be done by 1) defining what is meant by sustainability and 2) choosing a framework to determine whether something is sustainable or not. By reviewing the literature, 3) underpinned arguments can be made on what use cases are the best ones to feature in the video. Criteria that will be looked at are: a) how does the use case contribute to the video and b) how does this use case improve sustainability according to the chosen framework. In Appendix A, a table can be seen that was used to understand what use cases are mentioned how many times in the reviewed literature.

2.2.1 Sustainability

“Sustainability” is a broad and (in literature) often undefined term that needs a framework to be able to work with. Moore et al. [5] researched 209 scientific articles that mention “sustainability” and found that only 24 (11.5%) of them gave a definition. Because multiple disciplines have started using the term “sustainability”, the definition of the term has become ambiguous [5]. Therefore this literature review introduces the framework that is used by the United Nations (UN) and upheld by many countries and organisations worldwide.

The 17 Sustainable Development Goals (SDGs) adopted by the United Nations in 2015 aim to provide a framework of actionable points to face global challenges. UN Secretary-General Ban Ki-moon said, “*They are a to-do list for people and planet, and a blueprint for success”* [6]. The SDGs can be subdivided into three dimensions: environmental, economical and social [6]. The 17 SDGs are further divided into 169 targets set to battle poverty, inequality, climate change, environmental degradation, peace, and justice on a global scale by 2030 [7]. The United Nations recognizes that beneficial action in one dimension might mean negative side effects in another dimension, which is why they aim to balance the 3 dimensions. Therefore, participating countries have agreed to prioritize goals that need improvement the most. To summarize, the 17 SDGs provide a framework of

actionable targets that aim to battle the biggest global challenges, starting with the most urgent ones.

Along with this workable framework, this research will use the following definition of sustainability: *“meeting the needs of the present without compromising the ability of future generations to meet their own needs”* as stated by the United Nations in 1987 [8]. The “*needs*” this definition talks about are the 17 SDGs.

2.2.2 Use cases

Precision farming

Precision farming is a good use case to mention in the video as it is an activity that combines multiple agricultural use cases. Precision farming (or precision agriculture) can be explained as using technology to guide crop management. For example, Mahlein et al. [9] argue that this technology can detect plant diseases and insect pests in crops. This is useful as it allows for early intervention and prevention of crop loss. Additionally, Weiss et al. [10] reviewed multiple researches and documented the way they use the technology to predict crop yield. They found simple methods such as quantifying total crop area, as well as more complex methods that also factor in temperature and soil condition data. By combining data from the aforementioned use cases, farmers get a holistic view of crop production. This allows them to manage their crop production more sustainably. Concluding, by describing how the technology aids farmers in precision farming, the video shows how multiple use cases can work together to create an even stronger impact on sustainability.

This impact on sustainability can be seen in SDG 2: End Hunger. As mentioned by Ferreira et al. [11] and Holloway and Mengersen [12], this use case most prominently tackles SDG target 2.4. This target is about encouraging sustainable food production practices and about implementing resilient agricultural systems that increase crop productivity [7]. As using this technology for precision farming is a non-destructive and cost-effective way of ensuring sustainable crop management [11], it should be a viable tool for tackling SDG target 2.4.

Forest mapping and monitoring

The forest monitoring use case has been selected because of its simplicity and its great impact on forest preservation. Simplicity in this context means how easy it is to understand

this use case when it is explained in the video. The reason for this simplicity is that the AI technique behind this use case is simple detection and classification, which is the most simplistic form of computer vision. In other words, almost everybody should be able to imagine how AI can help count trees on images. Besides simplicity, another great motivator for using it in the video is the importance of maintaining forests for our ecosystems. "*Forests are biodiverse ecosystems, providing habitats to over four-fifths of all terrestrial species, as well as sources of clean air and water"* [13]. "*Further, an estimated 1.6 billion people depend on forests for their livelihood*" [13]. The importance of forests to our ecosystem cannot be stressed enough. Luckily, forest mapping and monitoring with remote sensing can help. For example, Mayfield et al. [14] used artificial neural networks to create deforestation risk maps in Madagascar and Mexico. They found that machine-learning methods mostly outperform simpler statistical methods in modeling deforestation. All-in-all, forest mapping is essential for the video because of its simplicity and because it tackles a critical sustainability problem.

As forests contribute so much to our ecosystems and our carbon storage, it is well-represented in SDG 15: Life on Land. This goal is all about encouraging the protection, restoration, and sustainable use of terrestrial ecosystems [7]. Besides this, it is about stopping and reversing land degradation and biodiversity loss, combatting desertification, and sustainably managing forests [7]. As agreed upon by Li et al. [15], this use case mostly addresses targets 15.1 and 15.2. Target 15.1 is focused on ensuring the conservation, restoration, and sustainable use of (among others) forests [7]. Target 15.2 on the other hand focuses on the implementation of sustainable forest management [7]. This includes stopping deforestation, restoring lost forests, and increasing afforestation and reforestation on a global scale [7]. Mapping deforestation risk allows for informed decision-making on how to battle deforestation. Forests are a critical component to the preservation of countless ecosystems, which is why monitoring them is essential for sustainability.

Renewable energies

The renewable energies use case has been selected for the video because of its strong association with sustainability. In other words, the term sustainability can be associated with images of, for example, wind turbines and solar panels. Use cases to support renewable energy do not appear often in the reviewed literature. However, Kadhim et al. [16] and Ferreira et al. [11] both agree that remote sensing can be used to predict wind power output and to predict solar irradiation. For example, Jiang et al. [17] used AI on satellite

imagery to map potential wind resources in coastal areas. By looking at the roughness of the sea they managed to map wind potential on a large scale in China. They developed a system that can detect wind speeds of 2-24m/s with an accuracy of approximately ±2m/s. With this creative way of gathering information, informed decisions can be made on where to most effectively install wind turbines for maximum return. Secondly, Jakubiec and Reinhart [18] and Gooding et al. [19] used LiDAR to map photovoltaic potential in certain urban areas. Gooding et al. [19] researched which of the cities in the UK have the greatest potential for PV installations while Jakubiec and Reinhart [18] took it a step further by generating predictions for individual buildings. These use cases are a valuable contribution to the effective placement of renewable energy systems, which in turn is a great contributor to sustainability; therefore making it a worthwhile contribution to the video.

The specific SDG goal this use case targets is SDG Goal 7: Affordable and Clean Energy. As Weiss et al. [6] agree, specifically target 7.2 can be tackled with this use case. Target 7.2 states: *"By 2030, increase substantially the share of renewable energy in the global energy mix"* [7]. This means that the target is to generate as much renewable energy as possible. Logically, a restrictive factor in achieving this goal is not having the resources to install renewable energy systems. Because resources for building renewable energy systems are limited, it is essential to have information on where they can be placed for maximum efficiency.

Detecting modern-day slavery

The use case of detecting where modern-day slavery is happening provides a valuable contribution to the video because it is a direct example of how this technology can address the social dimension of sustainability. Although efforts have been made to end modern slavery, a challenge in successfully doing so is having reliable and timely data on where slavery is occurring [20]. Foody et al. [20] used convolutional neural networks to map brick kiln locations. This is done because these kilns are known indicators of modern-day slavery. Their research was done in a region of India and reported an incredible overall accuracy of 99.6%.

Although this use case is only mentioned once in the reviewed literature, it is still a good contribution to the video as it is a concrete example of how the social pillar of sustainability can be addressed with this technology. More specifically, this use case addresses SDG target 8.7. Target 8.7 focuses, among others, on measures to eradicate forced labor and modern slavery[7].

To summarize, although the detection of modern-day slavery is only mentioned once in the reviewed literature, it is still a good contribution to the video as it shows a concrete and understandable example of how this technology can address the social side of sustainability.

Natural disaster prevention

Climate change increases the risk of several types of natural disasters, causing countless fatalities all over the world. Van Aalst [21] researched climate change and the impact it has on several natural disasters. They found that climate change increases overall temperature, creates more intense precipitation (rain, hail, snow, etc.), increases dryness and droughts, increases the severity of storms and heightens flood risk. These changes result in the loss of countless human lives at all social and demographic levels. Elderly people will have a higher death or illness risk due to higher temperatures, people living in tropical countries will experience more and more extreme tropical storms, people living in mid-latitude countries will have to endure severe droughts and wildfires and many regions will face intense flooding. Besides these, worldwide impact can be seen in food insecurity due to damage to certain crops that cannot cope with the changing environmental conditions [21]. Having a way to predict and prevent these disasters is key to reducing the loss of life resulting from these catastrophes.

Remote sensing technologies can help prevent this loss of life, which is why it is a valuable contribution to the video. For example, Pradhan and Lee [22] found that using satellite imagery and a Back Propagation Neural Network resulted in a 94% accuracy in predicting landslide susceptible zones caused by earthquakes. They did this by analyzing landslide occurrence factors such as slope angle, soil type, altitude, and distance to rivers. Besides predicting landslides, Li et al. [23] used a Generalized Regression Neural Network to achieve an accuracy of more than 85% in mapping urban flooding. In doing so, their research can help in preventing and managing urban floods. Lastly, Kong and Wu [24] used a Long Short-Term Memory Neural Network to assess the vegetation index of certain areas over time to be able to map wildfire susceptibility. Predicting landslide susceptibility from earthquakes and mapping both urban flooding- and wildfire susceptibility are examples of how this technology can help in preventing loss of life from natural disasters, making it a valuable contribution to the video.

However, prediction is not the only aspect of natural disasters that remote sensing can address, disaster response coordination and the assessment of disaster aftermath are

also well-researched use cases that sketch a broader picture of what this technology can do concerning natural disasters. For example, Frank et al. [25] and Wang et al. [26] used an already existing machine learning model and improved it to be able to assess earthquake damage and to specifically locate damaged buildings from satellite images. Having large spatial information on what areas (buildings) are damaged most, helps efficiently target emergency resources.

Besides this, studies done by Geiss et al. [27] and Liuzzi et al. [28] used high-resolution satellite imagery to estimate the load-bearing capacity of buildings during an earthquake. This should allow policymakers and researchers to predict what damage could be caused by potential earthquakes in a certain area. Including disaster response coordination and disaster aftermath assessment in the video sketches a broad picture of how the technology can help battle natural disasters and their consequences.

The sustainability goals these use cases tackle are SDG 1: No Poverty, SDG 11: Sustainable Cities and Communities and SDG 13: Climate Action. Li et al. [15] state: "*SDG 1 (No Poverty) emphasizes the need to identify vulnerable populations and improve disaster response efforts in areas prone to various disasters. Indicators 1.5.1 and 1.5.2 specifically help monitor the impact of disasters on communities and the economy, highlighting the importance of investing in disaster risk reduction strategies and resilient infrastructure.*" In other words, target 1.5 aims among others, to encourage investments in disaster risk reduction plans. One such investment could be in the remote sensing technology that maps disaster risk. Besides this, Li et al. [15] also state that this use case addresses target 11.5. This target is similar to 1.5 in the way that it encourages disaster risk reduction plans. However, unlike target 1.5, 11.5 addresses the disasters specifically occurring in urban areas, such as flooding [7]. Even though these targets are very applicable to this use case, Li et al. [15] did not mention target 13.1. Target 13.1 should be included as it is about strengthening resilience to climate-related hazards and natural disasters [7]. Given how well-represented this issue is among the sustainability targets, it is clear how important this use case is for sustainability. Target 1.5, 11.5, and 13.1 all focus on minimizing the number of people affected by natural disasters, the technology can help in minimizing casualties through both prevention- and aftermath response coordination -activities.

Marine habitat

Marine habitat monitoring has been selected for the video because it shows how the technology works in sustaining oceanic ecosystems. Imen et al. [29] used high-resolution

satellite imagery to measure water quality. They did this by detecting several key water quality elements such as nitrogen levels, bacteria, water transparency, and water temperature. Besides analyzing water itself, satellite imagery can also be used to look through water bodies to analyze the seabed. For example, Poursanidis et al. [30] show that very high-resolution satellite imagery is capable of mapping seagrass and other coastal marine habitats. They can differentiate deep sea, seagrass meadow, reef, and soft bottom from each other with over 90% accuracy up to an incredible 38 meters deep. Assessing water quality and the mapping of seabeds are use cases that have been selected for the video as they show the power of the technology in oceanic ecosystems.

Besides measuring the health of these oceanic ecosystems, the technology can also be used to detect and map damaging factors such as marine litter. Garcia-Garin et al. [31] used Convolutional Neural Network-Based Deep-Learning models to detect marine litter with up to 85% accuracy. Although they used drone and aircraft surveys instead of satellite imagery, they state that using both passive (RGB, multispectral, hyperspectral) or active (LiDAR and RADAR) sensors on satellite imagery should work well. Despite satellite imagery having a smaller accuracy, it still outperforms traditional marine litter classification methods (manta trawl nets, indicator species, and observer-based methods) in usefulness because these are way more time-consuming and expensive. Besides, remote sensing makes the detection of marine litter reproducible and more easily allows for analysis over time. Besides informing on the health of our oceans, damaging influences such as marine litter can also be mapped with the technology.

Other dangers to our ocean's ecosystems that can be detected are overfishing and illegal fishing. Burke et al. [32] mention recent work that demonstrates how satellite imagery and deep learning give insight into global fishing activity and illegal fishing. For example, Park et al. [33] used a Convolutional Neural Network to detect where illegal fishery was happening in the waters between the Koreas, Japan and Russia. Because of a lack of truth data on how many vessels are involved in illegal fisheries in this area, it cannot be stated what the accuracy of the system is. However, it can be noted that the system detected at least 796 pair trawlers (fishing activity comprising two vessels) in North Korean waters in 2017 and at least 588 in 2018 that were illegally fishing. Although there is nothing that can be said about the accuracy of the system, it can still be highly effective in informing law-enforcing entities as to what is happening in their area. Being able to get a large-scale

understanding of where vessels are fishing is valuable information in the mission of managing overfishing and eliminating illegal fishery.

Water quality measuring, mapping seabeds, detecting marine litter and mapping fishing activities are use cases that jointly contribute to SDG goal 14: Life Below Water. Water quality and detecting marine litter are use cases that address target 14.1. This target states that by 2025 the amount of marine pollution of any sort should be significantly reduced [7]. These use cases make it possible to cost-effectively measure water quality on a large scale as well as to help battle marine litter pollution. On the other hand, mapping fishing activities directly addresses target 14.4. This target aims to end overfishing and illegal fishing with the help of science-based management plans [7]. Logically, a key element of these management plans is knowing where the problem occurs. Which is where this technology comes into play. Finally, the mapping of seabeds is a use case that helps reach target 14.5. This target states that at least 10 percent of coastal- and marine areas should be conserved [7]. Being able to map different types of seabed and their change over time helps quantify the progress toward this target. Together, these use cases offer a valuable contribution to multiple targets within SDG goal 14: Life Below Water.

Measuring progress toward global sustainability goals

A final use case that has to be mentioned in the video is measuring progress toward global sustainability goals because it directly plays to the technology's strengths of being non-destructive, cost-effective, and applicable on a large scale (globally). The United Nations reported that using earth observation techniques such as AI and satellite imagery are good for producing official statistics for agricultural, urban planning, land cover planning, and food-related SDG targets [11]. Developing countries often do not have the same quality data on SDG indicators as developed countries do. As earth observation is a non-destructive and cost-effective way to gain quality data, it is a great tool to reduce discrepancies between developing- and developed countries [11]. Which supports the UN's goal of prioritizing countries that need help the most. Setting goals is important, but being able to measure progress toward these goals is just as important. Besides reducing inequality between developing- and developed countries, this technology also offers a sustainable way of assessing SDG indicators on a global scale.

Using the technology to measure progress toward SDG targets relates to almost all SDGs. SDG indicators that can be quantified with the technology are for example 2.4.1: "Proportion of agricultural area under productive and sustainable agriculture", 6.3.2:

“Proportion of bodies of water with good ambient water quality”, 11.1.1: “Proportion of urban population living in slums, informal settlements or inadequate housing”, 11.3.1: “Ratio of land consumption rate to population growth rate”, 14.5.1: “Coverage of protected areas in relation to marine areas”, 14.1.1(b): “Index of plastic debris density”, 15.1.1: “Forest area as a proportion of total land area” [7]. Lastly, the goal of Ferreira et al. [11] was to assess how earth observation and machine learning can aid in sustainable development. They found that this technology can be of significant use in cost-effectively creating a global perspective of the progress toward several SDGs. Because this use case directly addresses so many SDG indicators, it is a must-have contribution to the video.

2.2.3 Conclusions

The goal of this literature review was to gain insight into the possibilities of combining AI with satellite imagery for sustainability purposes. With the knowledge attained, a motivated selection of use cases was made that, in the format of a video, are deemed to jointly provide a well-rounded understanding of what the sustainability potential of this technology is. To do this, first a definition and framework of sustainability was given. Afterwards, the selected use cases were explained at the hand of example studies as well as how they contribute to the video and to sustainability. Based on these criteria, the research suggests 7 use cases to be used in the video.

Precision farming is a use case that is often mentioned in the reviewed literature. Additionally, it contributes to the video because it comprises several interesting agricultural use cases. Lastly, it directly addresses SDG 2: End Hunger as it helps ensure sustainable crop management.

Forest mapping and monitoring is also mentioned often in the reviewed literature. Besides this, it has to be in the video because of its simplicity and its great impact on forest preservation. Which is an important contributor to sustainability as forests are a critical component to the preservation of countless ecosystems.

The renewable energy use case has been selected for the video because of its strong association with sustainability, which is already reason enough to include it in the video. However, using the research where they predicted wind power output by analyzing the roughness of the sea, this use case shows how creativity and cleverness can open up a wide array of possibilities. Additionally, because clean and renewable energy resources are

limited, it is essential to have information on where these systems are placed most effectively.

As the above-mentioned use cases mostly address the environmental dimension of sustainability, detecting modern-day slavery has been selected for the video to show how this technology can address the social dimension of sustainability. Although this use case is very specific, it should be understandable how the technology is used. Combining that with the severity of this problem is what makes it a good option for the video. In other words, people attribute more value to this use case as it helps solve the serious issue of modern-day slavery, giving it an emotional load and therefore increasing the impact the video will have.

The same severity makes the use case of reducing the impact of natural disasters a good option for the video. The technology can be of value in both predicting and preventing natural disasters as well as helping effectively coordinate emergency responses. Hereby, this use case addresses SDG goals 1, 11, and 13, which all focus partly on minimizing the casualties related to natural disasters.

Use case number 6 concerns the monitoring of our marine habitat. This use case has been selected for the video as it shows how this technology can also benefit our oceanic ecosystems. Comprising use cases like assessing water quality, mapping seabeds, and detecting marine litter and illegal fishery; this use case effectively shows how this technology can address SDG 14: Life Below Water.

Lastly, it must be explained in the video that perhaps the biggest contribution of this technology to the Sustainable Development Goals is that it enables a non-destructive, cost-effective, and fast way of understanding global progress toward many sustainable development indicators.

2.3 Similar purposed video analysis

In order to answer subquestion 2 of the research: *“How are animated stories already being used for similar projects?”,* this chapter analyses 8 similar videos. The analysis looked at the content, the visuals, the use of sound, time and timing, and what the goal of the video is. After analyzing the videos, common practicalities could be distinguished that will guide the video ideation process. The selected videos have been found mostly on Youtube, ranging from company project explainer videos to fully environmental awareness videos made to be seen by as many people as possible. The full analysis table can be seen in Appendix B.

2.3.1 Content

The structure of the videos was largely the same amongst the analyzed videos. They started out with an interesting statistic to catch attention and to introduce the topic. After this introduction they stated the problem the video addresses. Thirdly, they gave a solution to this problem and then end the video with a call-to-action. For example the video created by Center for Food Safety about Soil Health [34], starts out with mentioning that there are more organisms in a hand full of soil than there are humans on earth, as well as that 95% of what we eat relies on healthy soil. Following on this, they state that we take it for granted and that thousands of years of plowing, deforestation and erosion have left our soil in dire shape (problem). Which is a shame because healthy soil can help us in storing atmospheric carbon dioxide (problem & solution). They continue by explaining more statistics on how healthy soil can help to get rid of atmospheric carbon dioxide (solution) and they finish off with a call-to-action by linking to their website. With this structure you start off by sparking interest, then you tell your audience “we have a problem” and you continue by offering the solution and telling the audience what they can do to help.

Part of the analysis of the content was looking at how they mention numbers. Mentioning numbers happened only in creative ways. For example the aforementioned soil solution video [34] showed the statistic of 95% of healthy soil by showing a table full of vegetables where a hand grabs one of the vegetables, thereby revealing the number “95%” animated onto the table the vegetables are lying on. Besides this, the mentioning of numbers was not overdone. Numbers were only mentioned to place emphasis on certain important numbers.

The call to action was done in one of two ways, either directly saying what the audience should do, or they referenced to the website of the company or project at the end of the video. Furthermore, no sources are referenced in the video itself and subtitles were surprisingly only used once.

2.3.2 Visuals

The visual style was largely dictated by the theme of the video. For example the video about water cleaning by a project group called “H2OForAll” used a fully animated video which included a lot of “watery” animations. In other words, the animations included a lot of water elements such as a wave flooding the screen to transition from one scene to another. A video about cybersecurity on the other hand had a more serious and dramatic visual style.

What all the videos had in common however was the use of bright colors and using a lot of animations. Both these elements make sure that the video is visually appealing and engaging so that the audience keeps watching. One video did not do this and that was also the only video that was not fully animated. Talking about the Soil Solution [34] video, this one made the video engaging by incorporating beautiful looking stock footage of planet earth with subtle animations overtop this footage.

2.3.3 Sound

Just like the visual style, the music was dictated by the theme of the video. Some videos were in a happy mood as they explained about a new exciting project for example, while another one about cybersecurity was a more sinister mood. The music was used to enhance the emotional impact the video needs to have. Therefore, the type of music ranged from happy to spooky and beyond.

The analysis also looked at the use of male versus female voice-overs. Interestingly it was found that the division between male and female voice overs was split a perfect 50/50. Additionally, no apparent factors could be noticed for why the video creators would have chosen either a male of a female voice over.

Lastly, only one voice was used in the videos and there was no, or little use of sound effects.

2.3.4 Time

The duration of the videos ranged from about 2 to 4 minutes. The length of the video depends on the amount of content to be mentioned.

Beside the absolute time a video spans, the analysis also looked at the pacing of the videos. It was found that the explaininer type videos were faster paced than the awareness creating videos. An explanation for this could be that the awareness videos need to take their time to get through to you and make their message stick. On the other hand, explainer videos only need to be able to give you the full information as fast as possible and afterwards link to a website for more information.

2.3.5 Goal

Finally, the goal of the videos was analyzed to see what they were used for. As mentioned before, there are two types of video: explainer and awareness. Some of the videos do not fully fit either explainer or awareness type, but these can be classified as a combination.

Almost all videos have been placed on YouTube as well as having been used on other social media platforms. The intention behind these videos is to reach stakeholders. These included for example policymakers, possible customers, researchers and the general society. Finally, especially the awareness videos want to get through to stakeholders by evoking emotions. Usually this would be to evoke sadness with the problem statement, giving hope in offering the solution and to conclude with motivation in providing a gameplan (call-to-action).

2.4 Interview with the client

After answering subquestion 1 and 2, an interview with the client was conducted. In this meeting the goal was to gauge the expectations of the client and to assess what their thoughts on the video were.

2.4.1 Client interview conclusions

It was agreed that the goal of the video should be to create an understanding among stakeholders of what the possibilities of the technology are to help solve global sustainability challenges. It is an awareness creating video that includes a call to action of going to the website of periopsis at the end of the video.

A consensus was made on the style of the video. Both parties of the meeting liked the style of the Soil Solution video as it was very thorough, minimalistic and included a lot of beautiful stock footage of planet earth combined with animations. With this came agreements on that the video is better if it is slower paced (awareness video style) and that a male voice-over is preferred. Additionally, the idea of using an AI generated voice-over was issued and should be tested out.

The content of the video was a topic of “needs further discussion”, however it was already agreed that the video should not be too technical and should focus on creating as much belief in the technology and its possibilities as possible. As such, the use cases to be used in the video will likely be the most promising and/or interesting ones.

Finally, it was discussed where the video will be shown. The video will be shared on social media platforms such as LinkedIn, Twitter and Youtube. Hereby hoping to reach as many stakeholders as possible.

Chapter 3 - Method

At this stage of the project, all the background research is done. Which means it is time to start thinking about the practicalities of how to actually create the video. This chapter starts off by recapping the video requirements from the background research over 3 aspects of the video: script, visuals and sound. After that, the strategy for ideating on the video is revealed, followed by a breakdown of how the video will be evaluated.

3.1 Realisation

3.1.1 Video requirements

Script

The structure of the video should be to start out with an interesting statistic, then state the problem the video addresses, followed by the mentioning of the solution (use cases) and ending with a call to action. Besides this structure, the mentioning of numbers should only be done in creative ways to place emphasis where it is needed. For example the intro statistic is a place where a number can be creatively used in the correct way.

Given the video should be 2-4 minutes long and the pace should be a slower pace, analyzing the word-per-minute pace of the inspiration video (Soil Solution) gives a range of how many words the script should have. The video totals 408 words over 4 minutes and 9 seconds which gives an approximate word-per-minute of 100. Given a 2-4 minute video, the script should be around 200-400 words in length.

The use cases this video will explain are: precision farming, natural disasters prediction, forest monitoring, oceanic use cases, renewable energies and detecting slavery as these are the ones selected from the literature review.

Visuals

After the first meeting with the client a visual style for the video has been established. The footage used in the video will be stock footage related to the topic. Like the Soil Solution video [34], animations will be placed over top this stock footage. To find stock footage that is properly licensed, the stock footage service of Envato Elements will be used. Envato Elements was selected because of its cost effectiveness while still maintaining a proper library of footage. Additionally, Envato employs a licensing model that allows for use of the

imagery after the subscription is cancelled; thereby making the video futureproof. Besides this stock footage, fully animated shots will also be used to explain certain elements of the video in a more explainer video type style. However, the style of the video should still be minimalistic, no over the top flashy animations.

Sound

As learned from the similar video analysis, the music should fit the theme of the video. Because the video is an awareness creating video that should be slow and inspiring, the music should match this. Music for this video will be downloaded from the music licensing service “Artlist”, for which the author of this paper already has an ongoing subscription. An additional benefit of Artlist is that is allows easy filtering on pace and mood of music.

Concerning the voice-over for the video, an AI male voice over will be tested out as requested by the client. After receiving feedback from the client it will be decided to either go with this voice-over or to find a real person to do it on freelance websites.

Lastly, the use of sound effects will only be done if it suits the video and if it is subtle, these will also be downloaded and licensed from Artlist.

3.1.2 Video creation process

To effectively create a video, a strategy for doing so is needed. Especially when creating a video for somebody else, it is important to communicate intelligently to make sure both sides of the party are content with the end result. This means every time a draft version of the script is finished or (later on in the project) a draft version of the video is finished, both client and supervisor of the project will be asked to provide feedback. After doing so, the suggested changes will be implemented resulting in the next draft and the one after that, until the video is finished. This means that the creation process is iterative, looping over ideation, realisation and feedback as illustrated in the figure below.

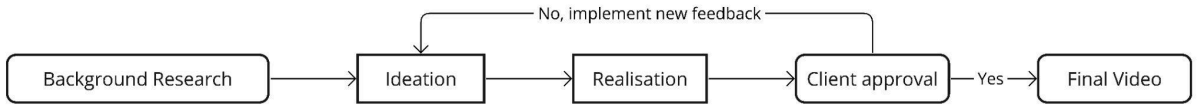

Fig. 1: Iterative design process

Ideation

Content

The ideation process starts off by looking at the requirements for the video. This gives insight into what the video should look- and feel like, as well as to already lay a foundation for the video in terms of structure. With this structure come necessities such as interesting statistics to start off the video with. These statistics will be found by looking at websites with credibility on the topic as well as by looking at similar themed videos.

Visual

The visual part of the ideation consists of two parts, stock footage shots and fully animated shots. The stock footage will be found by using the search engine built into Envato Elements. As the options are limited to Envato only, this part of the visuals is mostly a “selection process” rather than an “ideation process”. On the other hand, the fully animated shots are a full “ideation process”. The ideation for these will be done by taking inspiration from similar videos as well as from previous animation experience of the author of this paper.
The script format that was used in the project can be seen in Appendix C.

Realisation

The montage and editing work of the video will be done in Adobe’s Premiere Pro, while Adobe’s After Effects will be used for all animation work. These programs have been selected because of previous experience from the author of this paper and because these are professional programs that are perfectly capable of creating the professional level of video required for this project.

Feedback

Script drafts

The feedback on the script will be done by use of video meetings for the first versions where a lot of feedback is given, followed by textual e-mail feedback for smaller changes later in the process.

Video drafts

To make it easier to give feedback on the video, a program called Frame.io will be used. Frame.io allows the user to make notes on certain frames (or a range thereof) as well as to draw on the screen to make certain feedback points even more clear in a visual way. Additionally, Frame.io is very accessible and it is free for small projects.

3.2 Evaluation

The video will be evaluated through the use of an online survey. This makes it easier to test the effectiveness of the video among many stakeholders at once.

3.2.1 Goal

The survey has multiple goals. The first is one to make the viewer of the video more aware of our global sustainability issue and what this technology can do to help. Additionally, the respondents will be asked to rate the quality of certain aspects of the video.

3.2.2 Survey structure

To start the survey off, a few questions will be asked to gauge the respondent's knowledge of this sustainability issue and what artificial intelligence applied to satellite imagery can do to help.

Then after answering these "introductory" questions, they will be asked to watch the video. After watching the video comes the part 2 of the introductory questions. Here they will again be asked how urgent they think our sustainability issue is as well as *how,* and *how well* this technology can help. The resulting grades will then be compared with the results from before watching the video.

Finally some more direct questions will be asked to assess how the video and its individual elements were perceived. These include: how convincing the video is, how well executed each part of the video was (problem statement → solutions (use cases) → call to action), how well the footage and animations matched the script, length of the video and the audio (music and voice-over).

3.2.3 Technicalities

To call the survey a success, it will need at least 20 respondents. To create the survey, Google Forms will be used as it allows for quick and accessible creating, sharing and responding.

The full survey can be seen in Appendix D.

Chapter 4 - Realisation

The realisation of the project happened in two phases, the scripting phase and the editing phase. This chapter will break down how the video developed from the first script to the final video version. Over the different drafts, a lot of things have changed. To make the changes as comprehensible as possible, they are represented in the figure below. Within each draft, the changes are organized according to the three previously mentioned video elements: script, visuals and sound. Script draft 1 mentions some interesting information about it, the rest of the draft versions all only show what has changed from the previous version.

4.1 Script drafts

Script Draft 1

Script

- Start with multiple statistics as problem statement
  - *Access to healthy food*
  - *Deforestation numbers*
  - *Deforestation from wildfires*
  - *Animals killed from wildfires*
- Introduce solution
  - *Amount of satellites in orbit increased*
  - *Development of AI as well*
  - *Opens up possibilities*
- Use cases
  - Agriculture
    - *Detect crop diseases*
    - *Predictions on yield*
  - Natural disasters
    - *Forest vegetation levels for wildfire prediction*
    - *Susceptibility of landslide*
  - Modern day slavery detection
  - Marine
    - *Illegal fishery*
    - *Water quality*
  - Renewable energies
    - *Wind turbine placement*
    - *Solar panel placement*
  - Global progress measurement
  - Socrates quote ending

Visuals

- Full animation shot at the beginning with an earth with satellites and a leaf around it
- Another full animation of side view of ocean with radar beam going through it to show depth
- Return to planet animation
- Accompanying stock footage

Sound

-

Script Draft 2

Script
- Script dramatically shortened
- Removed satellite intro part
- Intro more human centered
  - Need 3 planets to sustain ourselves
- Socrates quote at beginning and end
- Mentions Periopsis information
  - Illegal waste dumping
- Changed around use case order
  - Removed for time purposes:
    - Yield prediction
    - Landslide susceptibility
    - Slavery
    - Renewable energies
  - Added deforestation because important

Visuals
-

Sound
-

Script Draft 3-4

Script
- Removed socrates quote from intro
- Trying out different order of use cases and changing intro to be more impactful
- More statistics in the intro
- Add bit about how the technology works
- Trying out different wording in script

Visuals
-

Sound
-

STARTED LOOKING FOR STOCK FOOTAGE

Script Draft 5-6

Script
- Intro removed excess wording
  - Intro almost final state
- Became too long, shortened the script by changing wording
- Removed “water level” mentioning from script
- Changed wording

Visuals
- Visuals started to become more concrete
- Due to input of what is on Envato
- Removed full animation because it doesn’t fit the style of the video

Sound
-

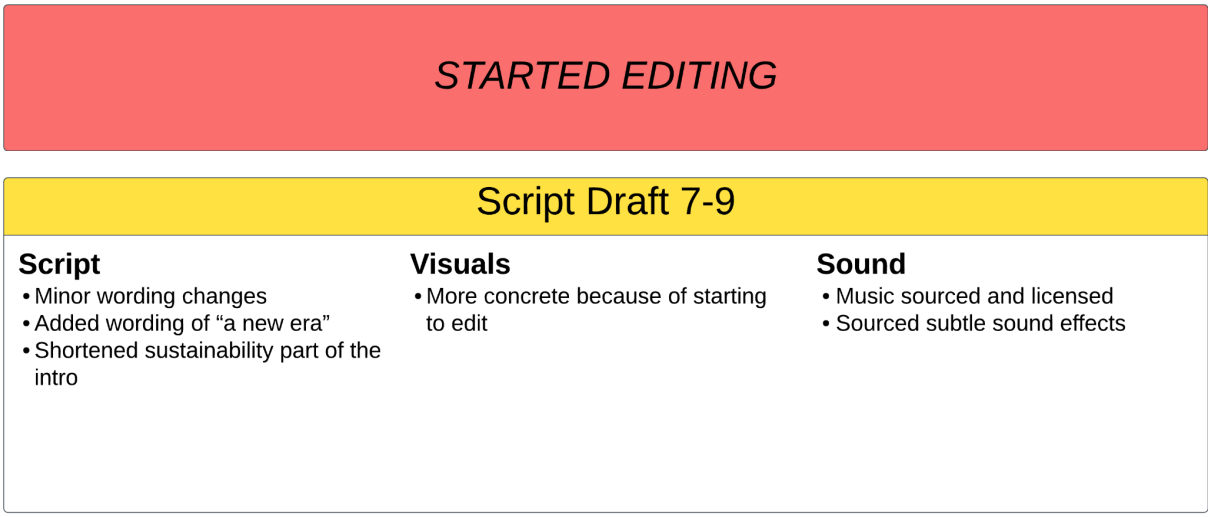

Fig. 2: Script drafts timeline

4.2 Video drafts

As a lot of effort already went in to making sure the script is as good as possible, only three versions of the video were necessary to achieve the desired outcome.

For draft one, an AI text-to-speech voice-over from Elevenlabs.io was tried out. However, as the intonation and pacing of the voice was not quite right, the author of this paper did the voice-over themselves as a placeholder for a better solution. When there would be a better solution, this would be implemented in the video instead of this one.

Draft two of the video had the voice-over part figured out. By using another AI function on Elevenlabs called speech-to-speech, the voice-over of the author could be modified to sound like a professional voice actor. This way, a professional voice can be heard while still maintaining the proper intonation and pacing.

Besides this, draft two also implemented a totally new shot. After feedback on version 1, it was decided that there needs to be a visualization of a neural network in the video to subtly show what it looks like. A new part of voice-over was created and the shot was edited and animated in.

Lastly, the second draft of the video corrected some voice-over imperfections as well as some subtitle errors. After these were all corrected the final version of the video was born.

Chapter 5 - Evaluation

The results of the evaluation survey are presented, the full questionnaire can be found in appendix D. The survey is conducted among 23 people. Of these respondents, 13 are students and 10 are employees at Periopsis.

5.1 Survey results

5.1.1 General effectivity questions

To what extent are you aware of the possibilities of artificial intelligence technologies, such as computer vision, on satellite imagery?

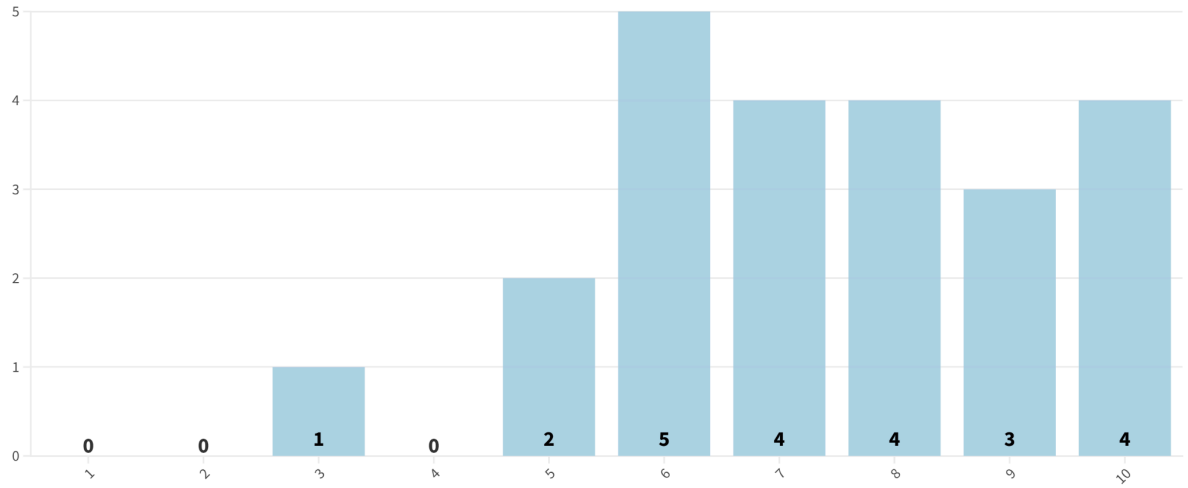

Fig. 3: To what extent are you aware of the possibilities of artificial intelligence technologies, such as computer vision, on satellite imagery?

Average: 7,4

This question was asked to gauge the respondents' level of knowledge on the technology. The figure shows, with some outliers, that the overall knowledge of the technology is already quite high. This is of course due to the fact that part of the respondents are from Periopsis itself.

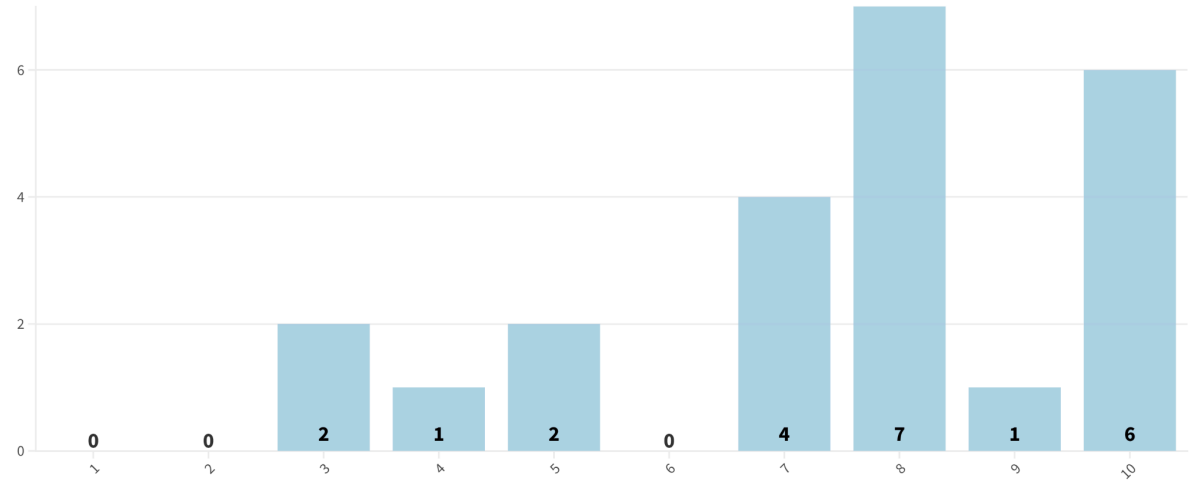

Fig. 4: How interested are you in AI technologies?

Average: 7,5

The second question to gauge respondents' knowledge on the topic was a more general one about AI technologies itself. As can be seen in the figure, similar to the previous question, the general interest in AI technologies is quite high, apart from some outliers. This is again the case because the higher grades of the Periopsis employees skew the graph to the right.

How urgent do you think our global sustainability issue is?

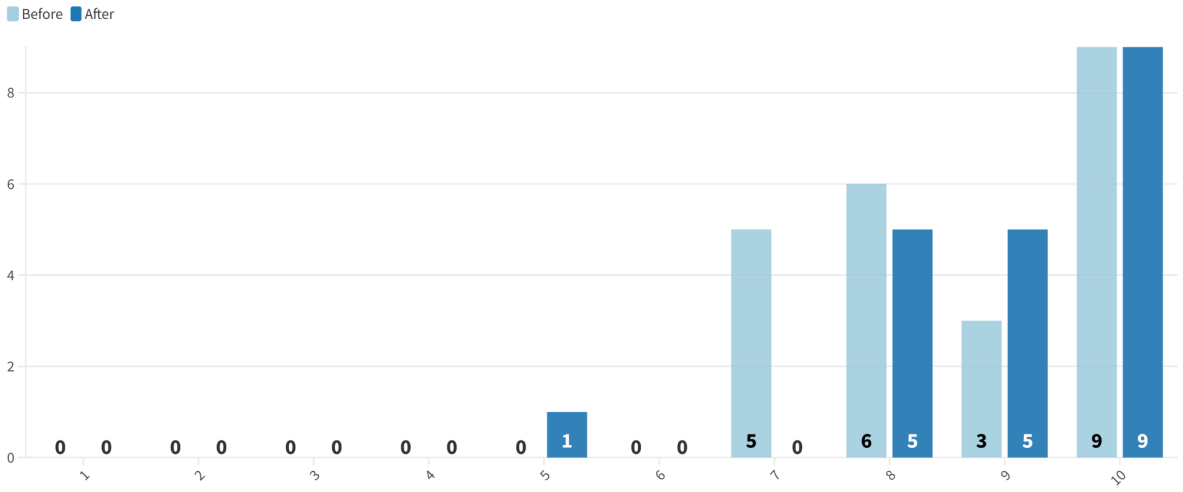

Fig. 5: How urgent do you think our global sustainability issue is?

Average before: 8,7 *Average after: 8,7*

The first video effectivity question is testing how good it is at creating more awareness about our global sustainability issue. As can be seen there is no difference in average grade between before watching the video and after watching the video. This is likely due to the average grade before watching the video already being relatively high.

To what extent do you think AI and satellite imagery can help make our planet more sustainable?

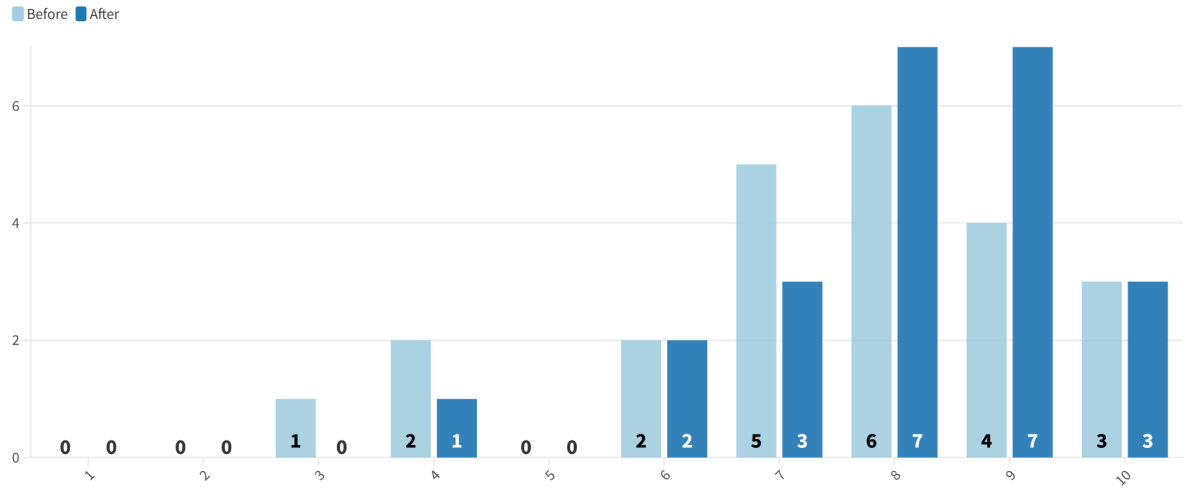

Fig. 6: To what extent do you think AI and satellite imagery can help make our planet more sustainable?

Average before: 7,5 *Average after: 8,1*

This question was probably the most important question to assess the effectiveness of the video as this one directly relates to how well the video explained the technology and its benefits for sustainability. As can be seen, the average grade from before watching the video increased *10,8%* after watching the video.

How did the video make you feel?

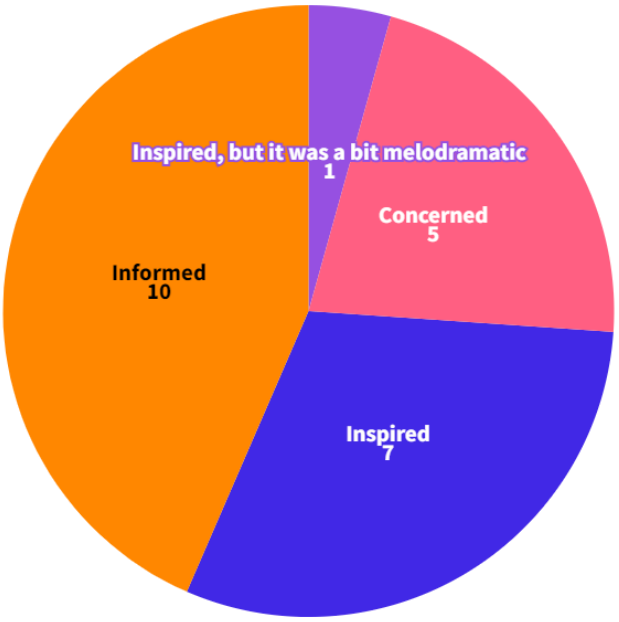

Fig. 7: How did the video make you feel?

This question was asked to assess how the video made viewers feel. The options were: informed, concerned, inspired, indifferent and a custom option. As can be seen in the figure, most people felt informed. After that, people felt inspired and concerned consecutively, with one person filling in the custom options stating that they felt “inspired, but it was a bit melodramatic”. Lastly, nobody felt indifferent after watching the video.

How convincing did you find the video to be?

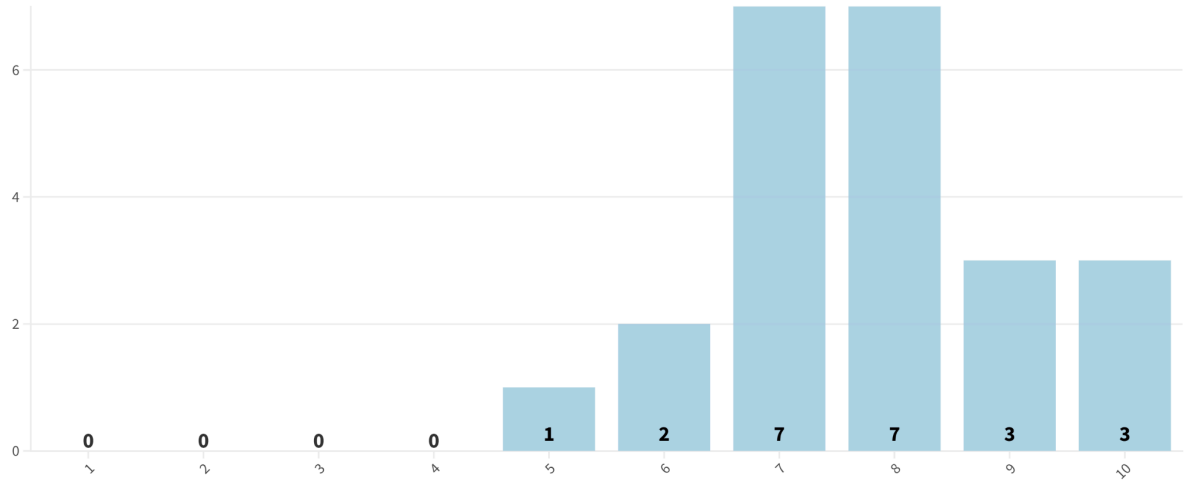

Fig. 8: How convincing did you find the video to be?

Average: 7,8

A final question about the general effectiveness of the video was also the most direct one. With a score of almost an 8 out of 10, it can be said the respondents found the video to be convincing.

5.1.2 Individual elements questions

To find out what elements of the video viewers liked more than other parts, some questions about the script, visuals and sound were asked.

What did you think of the individual parts of the video?

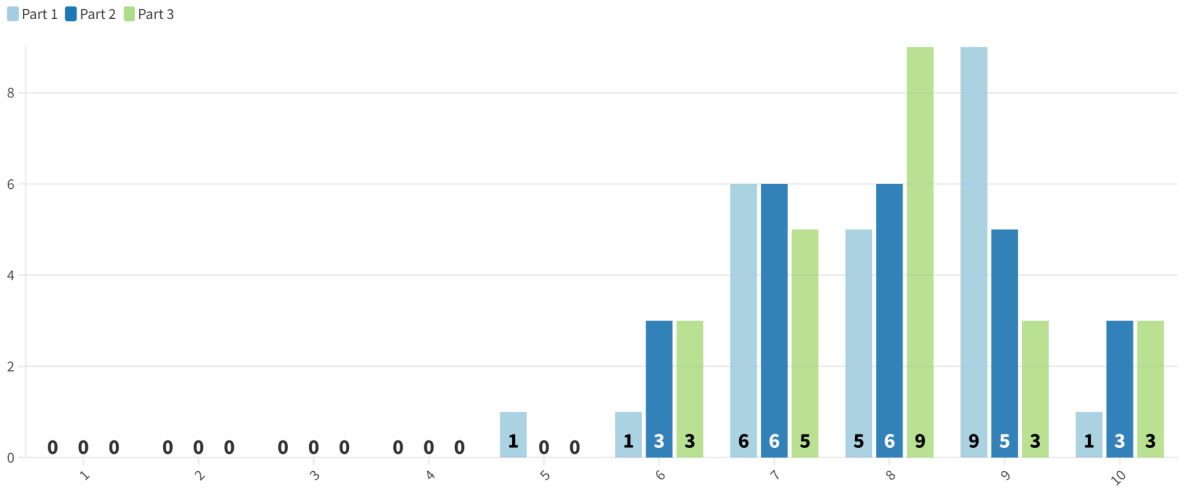

Fig. 9: What did you think of the individual parts of the video?

The problem statement part of the video received an 8 out of 10.

The solution part of the video also received an 8 out of 10.

The ending of the video scored a tiny bit lower than the other parts of the video with an 7,9 out of 10.

To what extent did the video footage match the video?

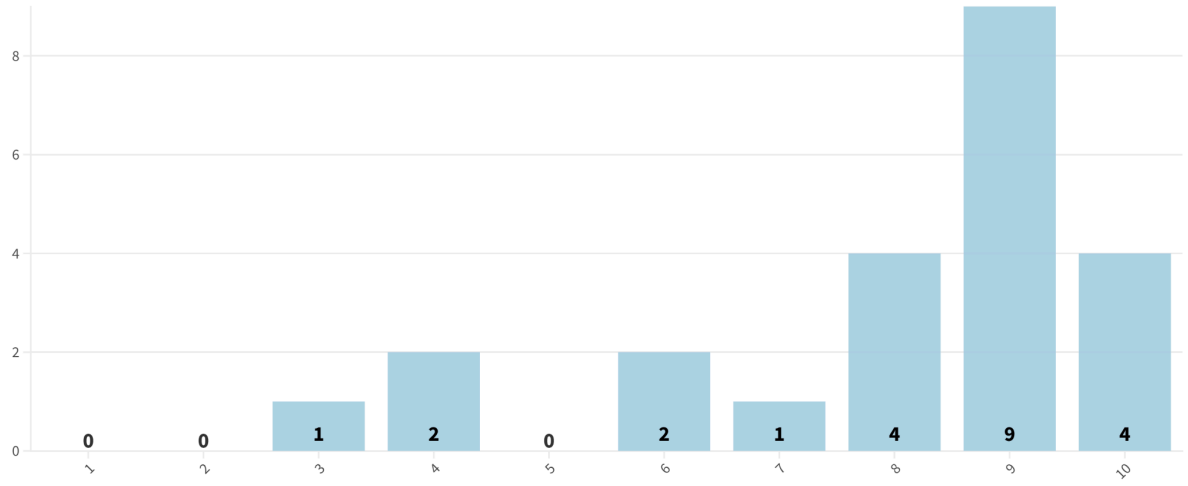

Fig. 10: To what extent did the video footage match the video?

Average: 8,0

The visuals matched the video script with an average score of 8 out of 10. Interesting to note is that there are some outliers on the lower side.

To what extent did the animations help the video?

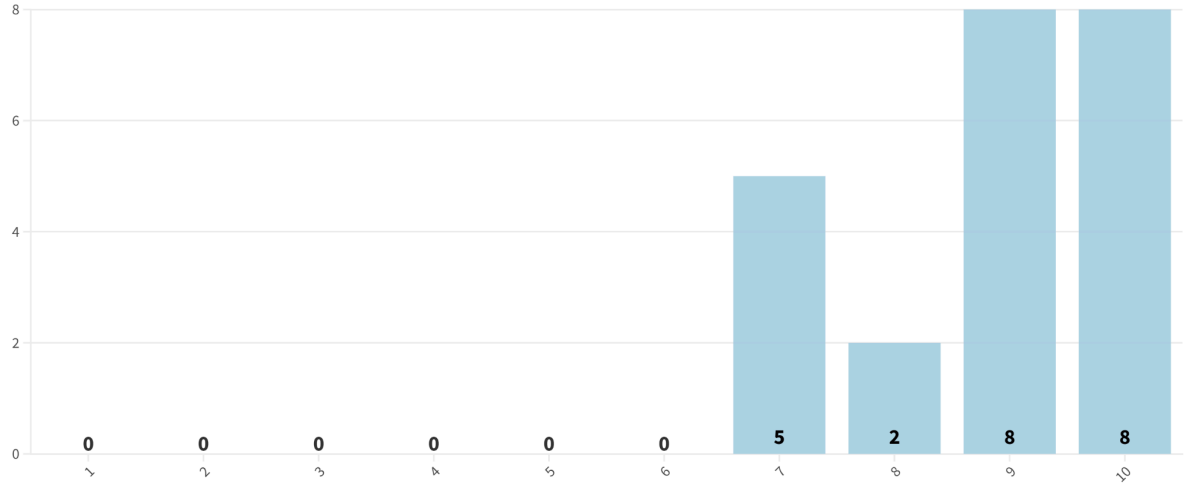

Fig. 11: To what extent did the animations help the video?

Average: 8,8

With an incredible average score of 8,8, it can be stated that the viewers like the animations in the video.

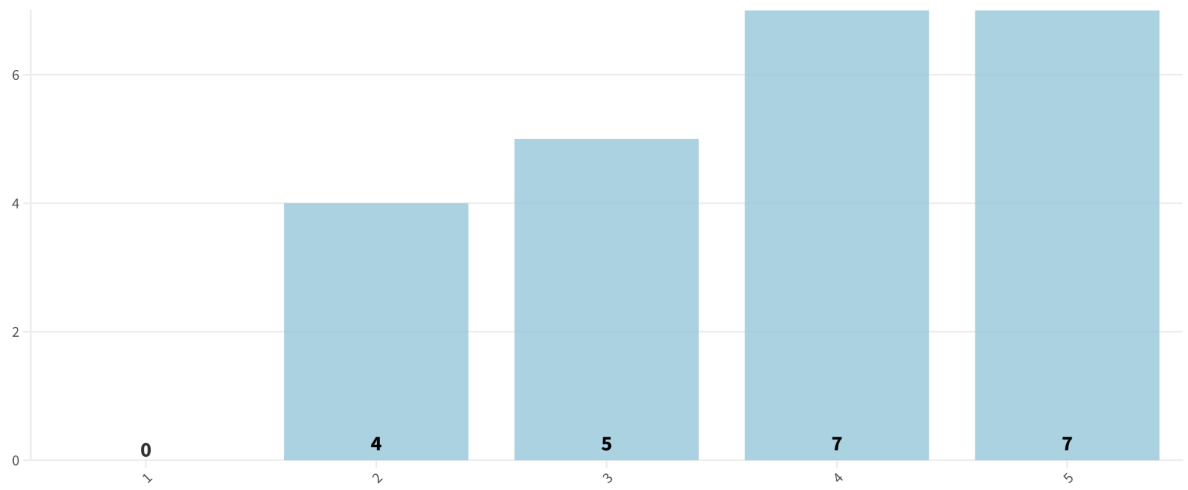

Fig. 12: To what extent did the voice-over match the video

Average: 3,8

This final question was asked to assess whether viewers liked the AI voice-over. With an average score of 3,8 out of 5, more people liked the voice-over than people disliked it. However, some remarks were left on the questionnaire specifically stating that they did not like the voice-over.

5.2 Conclusions

After testing 23 respondents on how effective the video is at creating awareness about our global sustainability issue and what AI and satellite imagery can do to help, the following conclusions can be made.

Partly because of an already good awareness of our sustainability issue, the video was not particularly effective at increasing it. However, with an increase of *10,8%* the video was effective at creating awareness around what the technology can do to help. By making the viewers feel informed, inspired and concerned, the video is deemed to be convincing with an average grade of 7,8.

After assessing the general effectiveness of the video, the individual elements of the video were surveyed. All three parts of the structure of the video received around an 8 out of 10 score. Besides this, the visuals also matched the script with an 8 and the animations scored the highest with an 8,8 out of 10. This means that although all elements of the video were received well, especially the choice of overlaying animations on the video was a good idea. Finally, the AI voice-over was a controversial topic. However, still more people liked it than there were people that disliked it with an average score of 3,8 out of 5.

Chapter 6 - Conclusion

Over the past few years a lot of development has happened in two fields of technology. The amount of active satellites we have in orbit has dramatically increased and so does the quality of the technology aboard. At the same time, artificial intelligence technologies such as deep learning and machine that are used for computer vision use cases have seen a steep increase in capabilities. By combining these two technologies, Periopsis is a company that is taking advantage of their growth. By using the power of AI to quickly and cheaply analyze vast amounts of satellite imagery, a multitude of services can be offered to Periopsis' clients.

The goal of this project was to help Periopsis communicate to the world what the possibilities of this technology are in creating a more sustainable planet. To do this, an engaging animated story was created that illustrates what the technology can be used for and why this is important. In order to make the video effective in doing so, a scientific literature review was done that systematically explored the state of the art of this research field. Additionally, similar purposed videos have been examined on what makes them effective. This way, all ingredients were there to craft a compelling animated story that resonates with stakeholders of the technology.

Sub research question 1 aimed to provide the video with proper scientific backup of what the possibilities of the technology are. The goal of the literature review was therefore to explore what possibilities are mentioned in the literature, how much potential they have for aiding sustainability and how each of them could contribute to the video in a valuable manner. Based on these criteria, the following 7 uses cases were proposed to be used in the video: precision farming, forest mapping and monitoring, renewable energies, detecting modern-day slavery, natural disasters, marine habitats and the measuring progress toward sustainability goals.

Sub research question 2 aimed to provide the video with information on how to effectively craft an awareness creating video. By analyzing 8 similar purposed videos on their content, visuals, sound, time and their goal, and by interviewing the client, a list of video requirements could be made.

After 9 script drafts and 2 video drafts, most of the video requirements were matched. However, in order to achieve the desired video length, the use cases yield prediction, landslide susceptibility, slavery detection and renewable energies had to be removed from the script. Additionally, the pacing on the explainer part of the video (part 2) was increased. Although this was not planned, it was still allowed according to the analysis of similar videos. Here, awareness videos were slower paced, but explainer videos were faster pace; hence the decision to make the explainer part faster paced.

Another way the final video differs from the original plan was by removal of the fully animated shots. When starting to source footage and when starting with the montage, it was quickly realised that fully animated shots would not fit the style of the video. Finally, after experimenting with a text-to-speech AI voice-over, a speech-to-speech model was used instead. This was done to ensure the right pacing and intonation of the voice-over.

When the video was finished, it was time to test its effectiveness. This was done with an online survey with 23 respondents, of which 10 were Periopsis employees and 13 were students. By asking the respondents to grade their knowledge on the topic and their awareness of our global sustainability issue before and after watching the video, the effectiveness of the video was tested.

As could be expected with 10 of the respondents being employees of Periopsis, the general knowledge on the topic and the awareness about the sustainability issue already scored high before watching the video. This likely had a significant influence on that the average awareness grade did not increase after watching the video. However, respondents' awareness did see an almost 11% increase in average grade. Moreover, when directly asked how convincing the respondents think the video is, an average score of 7,8 was achieved. From these scores it can be stated that by doing a scientific literature review about the state of the art of the technology, and by analyzing similar videos, an animated story can be crafted that is effective at informing and creating awareness of the possibilities of combining satellite imagery with artificial intelligence technology.

This thesis contributes to the field by demonstrating the power of animated storytelling in simplifying and disseminating complex technologies, thus fostering a broader understanding and appreciation of the role of remote sensing and computer vision in achieving a more sustainable way of living.

Chapter 7 - Discussion

7.1 Limitations

A limitation of the research is the subjectivity in selecting and motivating which use cases are “best” for the video. Substantial effort has been put into making sure this process happens as objectively as possible. This is done by providing a definition and a framework of what sustainability is, as well as by objectively looking at the contribution each use case makes to the video. However, personal preference inevitably played a role in the selection process.

Nevertheless, this subjectivity does not take away from the effectiveness of the current selection. The current selection might, theoretically seen, not be the absolute best selection possible. However, by implementing the discussed methods of making the selection process as objectively underpinned as possible, the current selection should still be effective in informing the audience of the significant potential of this technology in supporting sustainable development worldwide, which is what it is all about.

The same can be said about the analysis of similar videos. For the scope of this project, analyzing 8 similar videos was sufficient. However, if more videos were analyzed, probably more elements would be found that could increase the effectivity of the video.

Another critical limitation of the research is that the evaluation of the video was done among students and Periopsis employees. Of course, as the video creates awareness around a problem that concerns all living beings, everybody can be seen as a stakeholder of this technology. However, the video should also be tested among more direct stakeholders. These are the stakeholders that are possible clients of Periopsis. By testing how well the video engages these type of stakeholders, a valuable conclusion can be made about how the video contributes to the main goal of Periopsis. Which is to acquire clients that together want to make the world more sustainable. Additionally, it is possible the video scores better among these stakeholders as they do not have as much knowledge of the technology and its possibilities before watching the video.

7.2 Recommendations

Based on the experience from the project and based on the discussed limitations, the following recommendations can be made to Periopsis to continue with the project.

Firstly, as discussed, the video should be evaluated among more direct stakeholders of the technology. This will more concretely determine the effectivity of the video.

Secondly, armed with this new knowledge, a new video should be made that is more targeted toward converting interested stakeholders into clients for Periopsis. The first video will warm the stakeholders up to the possibilities of the technology, and the second video will be more explanatory and informative about what exactly Periopsis can do for them. This way, potential clients will go from not knowing about the technology, to knowing enough to start working with Periopsis on their sustainability goals. This way the video, and therefore this project, serve as a step on the path to a more sustainable planet.

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Appendix

Appendix A: Use Case Table

	Research paper	1	2	3	4	5	6	7	8	9	10	11	12		
Environmental															**87**
	Agriculture														**30**
	Crop classification	■	■	■		■	■	■	■					7	
	Vegetation health measuring	■		■		■	■	■	■					6	
	Crop yield prediction	■		■		■	■		■					5	
	Soil moisture levels measuring	■	■		■		■	■						5	
	Mapping of invasive plant infestation areas		■				■				■			3	
	Crop breeding (phenotyping)						■							1	
	Precision farming						■							1	
	Crop water content						■							1	
	Leaf nitrogen content detection						■							1	
	Natural Disasters														**22**
	Landslide susceptibility prediction		■	■		■		■		■				5	
	Disaster response coordination	■		■	■					■				4	
	Assessing building damage after disaster	■		■	■					■				4	
	Wildfire prevention and burned area mapping		■			■				■			■	4	

	Flood risk analysis			■	■					■				3	
	Storm surge prediction									■				1	
	Seismic building load-bearing capacity				■									1	
	Environmental mapping														**18**
	Land use classes	■	■	■	■	■	■	■	■			■	■	10	
	Forest mapping and monitoring	■	■	■	■	■			■		■	■		8	
	Marine habitat														**9**
	Water quality monitoring	■	■			■								3	
	Corals and seagrass classification	■	■											2	
	Detection and mapping of marine litter	■									■			2	
	Sandbar detection		■											1	
	Water source recognition		■											1	
	Renewable energies														**4**
	Wind power output forecasting	■	■											2	
	Solar irradiation prediction	■	■											2	
	Fishing														**4**
	Global footprint of fishing			■							■			2	
	Illegal fishing detection			■							■			2	
				■							■				
Economical															**17**

	Infrastructure															**10**
	Urban mapping and planning														8	
	Road quality monitoring														2	
	Nationwide economics															**7**
	Predicting economic growth														3	
	Predicting poverty														2	
	Estimating GDP distribution														1	
	Energy consumption monitoring														1	
Social																**5**
	Population															**5**
	Informal settlements (slums) detection														2	
	Population mapping														2	
	Detecting modern-day slavery														1	

Appendix B: Analysis of Similar Videos

Part 1

	Criteria	H2OforALL	Soil Solutions to…	Network Earth
Content				
	What is the story structure like?	Talk about water (Introduce theme) Talk about water cleaning problems Talk about goal of the project How will they conduct the project Who is involved in the project	Talk about amazingness soil (introduce theme with interesting statistics) Talk about soil problem and consequences How the problem can be fixed and its benefits What country is already tackling this problem well (showing a good example)	Start with globe Explain importance and abundance of networks Examples of networks Problem with networks collapsing Researchers have developed new tool to predict networks Examples of solution applications and further possibilities in different networks
	What is the conflict?	Interest in what is the project	Soil problem stated at the beginning and explanation follows	Collapsing of networks and how to prevent it
	Involvement viewer		Shows you why soil is important	
	How they mention numbers	Only mention number of contributors with fitting infographic	Show them on screen in creative ways or just with simple but clear text on screen	
	How they call for action	No call for action	Talk about problem, then current solution but then tell this is the best solution (All we need is a lot more photosynthesis instead of complex solutions)	Hint to their research paper
	Do they reference sources in the video?			
	Do they use subtitles?			
Visuals				

	Use of color	Blue colors because of water theme	Green and brown colors because of topic, soft cinematic colors Animations are lightly transparent grey	Blue, green red
	Animation type	All animation flow into each other	On top of stock footage	Simple yet effective
	Text usage	To place emphasis Hard to understand terms	Text on screen per topic (most important words)	Lot of text (also because of data graphics)
	Data graphics usage			Show a lot of data graphics that are animated to show linkage between plants and ants Data graphis morph into each other in animated way
	How engaging is the video?	Fast pace keeps it going	Dramatic/inspiring start, engaging storytelling	Can be a bit boring, lots of graphics though
Sound				
	Use of music	Consistent Rhythmic Lo-fi beats	Dramatic/cinematic start	Intense, dramatic music, hopeful Piano
	Voice over	Female voice	Male, easygoing	Female, dramatic
	Other speakers			
	Other sounds		Little sound effects for the animations on top of stock footage	
Time				
	Duration	3:00	4:09	4:49
	Pace	Starts off slower, picks up pace	Slow pace, varying with the story and important timecodes	Slow pace, deliberate and thoughtful
Goal				

	What is the goal of the video?	Increase awareness around water cleaning systems Explain what H20ForAll is going to do Explain why this project is important	Raise awareness around the importance of soil health Explain what can be done to improve soil health and what the benefits of doing this are Call for action	Explain possibilities of new research in predicting all sorts of network collapse Create urgency
	Where is it shown/published?	Social Media Events	Youtube (centerforfoodsafety)	Youtube (nature video)
	Who is it targeting?	Stakeholders of the project, Researchers	Policy makers / stakeholders	Researchers, stakeholders
	Is it trying to evoke an emotion?		Yes with music and storytelling the emotion of sadness and then excitement/hopeful First this is wat the problem is, but we can solve it like this!	Sadness of disappearing ecosystems

Part 2

	Intro…	BIC: Two…	UN Sust…	Social Medi…	Cybersecur…
Content					
	There is free energy from the sun up for grabs Starting with solar panels is frustrating Engineer got an idea to make a map Explanation of project and progress so far and future Mention benefit to society	Sustainable development is buzzword, but what is it about? History of the word Aspects of sustainability and challenges Why being sustainable is good Sustainable development affects everything More and more companies are committed and it helps them	Start with interesting statistic Explain what the goals are Will result in wellbeing of people and environment How to reach the goals Take action	Starts with logo animation Introduction to the problem How to tackle the problem as a social media user Enjoy social media responsibly	Start with tension music and title card We're more and more digital Make scared about digital safety Give examples of how they do it Everyone is vulnerable, everyone needs protection End with subtle call to action
		Sustainable development is everywhere	We need sustainability	You might not realize how much of your data is being tracked on social media	You're not aware of the cybersecurity dangers you might be in
			Asks you to take action and tell your friends to do so as well	Explains how to use social media responsibly	Mention that you're in danger as well
	By making it look like your using the tool that shows you numbers		Numbers ons screen with engaging animations		
	Place website link to project on screen	Showing that sustainability can be profitable as well	Take the lead and share with your friends Very clear call to action	"Enjoy social media responsibly" Go to their website for more information	"See you soon" to imply you're now scared enough that you're coming to us
					Yes all the way at the bottom in large sentences

Visuals					
	Greyish with elements of bright colors	Lots of bright colors	Bright colors	Bright colors, lots of blue	Somber colors according to theme
	Cartoonish, flowing from one element to another	Lot of animations flowing into one another	Animations according to the looks of SDGs Fun animations that look nice and flow	Flowing animations	Simple and spooky
	Cartoonish handwritten font	Text used with creative animations	Text on screen for impact of themes	Lots of text	Lots of text on screen
	Show what the tool would look like	Animated to tell a story	Not literal, use graph of SDGs to structure video		Used to create oversight
	Very much, very active very engaging elements and pace	A lot of active animations	Lots of engaging animations	Lots of engaging animations ,changes quickly	Scary video makes it engaging, interesting topic
Sound					
	Funky and happy	Uplifting, corporate music	Uplifting corporate flute	Active "rock" music	More spooky / tension building music
	Enthusiastic woman	Older man, english accent; enthusiastic	Female	Younger male, sounds like he has a cold	Middle age male, serious
	Lots of animation sound effects	Uplifting SFX for animations			
Time					
	1:30	3:49	2:12	2:10	1:57
	Fast paced	Fast paced	Fast, immediately starts with "did you know"	Medium-fast	Medium pace
Goal					

	Explain new Google project and possibilities	Provide a definition of sustainable development in 2 mins Showing their company cares about sustainbility Create urgency	Provide an overview of the SDGs Create urgency	Create awareness and inform around social media data privacy Explain how to use social media responsibly	Make you scared / aware of your cybersecurity Get new business customers for the company
	Youtube (Google)	Youtube (BIC group)	Youtube (UNICEF Georgia)	Youtube (Illinois organisation)	Youtube (Cybersecurity company page)
	People interested in solar panels and/or google projects	Their customer group	Everyone interested (society)	Society	New customers
			Wants you to take action	Not making you scared, just wants to inform and makes sure you're responsible	Fear

Appendix C: Script Drafts

Script Draft 1

Start with problem statement	Over 3 billion people don't have regular access to healthy food	*Hunger stock footage shot*
	2400 trees are lost every single minute	*Deforestation shots*
	6.6 million hectares of forest has been lost in wildfires in 2022 alone	*Forest fire shots with text in screen*
	3 billion animals were killed or displaced in the Australian wildfires of 2019 and 2020	*Forest fire animal shots with text in screen*
	Tens of thousands of people die from natural disasters each year	*Quick edits of natural disasters with accompanying SFX*
	But these are just a fraction of the sustainability problems our planet faces	*Full screen collage of previous shots*
	silent moment, music ending But what can we do? *hopeful music starting*	
Talk about technology opportunity	~~Luckily, the incredible development of artificial intelligence offers a lifeline~~	*Cool futuristic AI shot appearing from the dark*
	~~Especially when combining AI technologies with satellite imagery~~	*Transitional shot of planet earth appearing*
	~~In 2018, 2000 active satellites orbited the earth~~	*Cartoon planet earth animation with 2018 inside the earth* *Satellites orbiting the earth*
	~~As of 2023, this number has increased to over 8500~~	*2018 increasing to 2023* *Number of satellites increasing that orbit the earth*
	~~But not only the number of active satellites has improved, the quality of the technology aboard is increasingly better as well~~	*Zoom in on one of the satellites where additional elements are added*

		OR *Technology icons (gear icon perhaps) appearing above satellite icons*
What can this technology do to help?	~~The combination of satellite imagery and AI offers a wide range of earth observation possibilities for sustainability~~	*Leafs appearing around the globe* 
	The rapid development of artificial intelligence opens up a world of possibilities	
	Including the increased usefulness of earth observation from satellites	
Use Cases (Solution to the problem)	By applying AI technologies such as machine learning on satellite imagery, we can help farmers produce enough food for everybody	*Farmer with tablet in hand in field* *Drone shot of wheat field with animation of data analytics (heat map) tracked over top*
	This technology can help prevent failed harvests by early detection of contagious plant diseases and insect pests for example	
	Or, farmers can use the data to make predictions about what their crop yield will be for the season	*Smart farming system shot* *OR* *Farmer harvesting*
	This way they will be better equipped to optimize their productivity to achieve zero hunger worldwide	*Farmer harvesting and exporting his product* *OR* *Products on the market / in third world countries with food*

	Forests provide habitats to over four-fifths of all species living on land. Which is why we have to preserve our forests as much as possible	*Drone shot forest (maybe make animation where some of them appear "selected" / "appearing blue as if they're selected")* *Stock footage of animals in the woods*
	By using special sensors, satellites can measure how dry certain vegetation is to predict how susceptible they are to fires.	*Drone shots forest with the heat map again*
	This way a lot of wildfires can be predicted and prevented, saving countless ecosystems from being destroyed	*Happy animals in the forest*
	But wildfires aren't the only natural disaster that can be predicted	
	By using ai to analyze the susceptibility of landslides caused by earthquakes, measures can be taken to prevent such catastrophes from happening.	
	Even more lives can be saved by using the technology to detect brick kilns in India, which are known indicators for modern-day slavery	
	But the possibilities aren't just limited to observing land.	*Marine litter shot with box around it classifying it as "plastic"* *Split screen appears where fishers boat is seen fishing in the dark, box around it appears stating "illegal fishery"*
	The technology can also be used to protect our oceanic ecosystems by detecting marine litter illegal fishery	
	to measure water quality, or to map ocean seabeds up to 38 meters deep	*Animation:* *Side view of ocean, seeing satellite radar beam going through the water. Arrows indicating the depth of the water appear that state 38 meters*

	And with some creative thinking, even more possibilities open up.	*Sea drone shots with rough sea* *Classification box appearing around the waves that state the wind speed* *Placement of wind turbine shots*
	For example, Chinese researchers analyzed the roughness of the sea to optimize the placement of wind turbines.	*Animation*
	Similarly, heat maps can be made to optimize placement of solar panels	*Heat map of drone shot of the sun on an area* *OR* *Solar panels being placed*
	Lastly, because the technology is non-destructive, cost-effective and applicable on a global scale. It is the perfect way to measure progress toward our sustainability goals.	*Returning to planet animation* *Leaf around the planet growing to indicate more sustainability*
	Because there is only one thing more important than setting sustainability goals, and that is knowing how far we are in reaching them.	
	These examples are just a fraction of the ways this technology can help us achieve global sustainability.	*Transitional shot of animation turning into beautiful stock footage shot*
	As Socrates said: *“Man must rise above the earth to the top of the atmosphere and beyond for only thus will he fully understand the world in which he lives”*	*Beautiful and quiet shot of satellite looking over the earth* *Socrates quote appearing next to the satellite*
	If only socrates could have seen what we can do with a little help of artificial intelligence…	*Beautiful and quiet shot of satellite looking over the earth* *satellite beeping at the end (sonar like sound)*
~~Who can benefit and~~		

~~how~~		
Periopsis logo animation		*Previous shot fading out and periopsis logo animation appearing*
Call to action to Periopsis website		*"www.periopsis.com for more information"* appearing below the logo

Script Draft 2

Intro (1 minute)	It is no secret that humanity is rapidly burning through earth's natural resources	*Beautiful shot of the earth from space*
	It is estimated that almost 10 billion people will live on earth by 2050	*Beautiful shot of the earth from space*
	With our current way of living, with that amount of people, we will need almost 3 planets to sustain ourselves	*Beautiful shot of the earth from space*
	But given that we only have *one*, what can we do?	*Beautiful shot of the earth from space*
	As Socrates said: *"Man must rise above the earth to the top of the atmosphere and beyond for only thus will he fully understand the world in which he lives"*	*Statue of Socrates appearing on screen* *Quote appears on screen*
	At Periopsis we harness Socrates' advice, but we give it a little twist	
	By using the power of *artificial intelligence* to analyze satellite imagery, we can observe the earth in ways that were previously impossible.	**Shot that highlights AI in the voice over**
	Using this technology we get crucial insight into our impact on the planet and how to minimize it	
Use cases (2,5 mins)	Farmers for example, can hardly keep up with the rapid population growth, which is why it is essential to promote sustainable farming	
	By regularly analyzing aerial photographs of crop land, AI models can automatically detect crop diseases or insect pest invasions	
	This way early measures can be taken to minimize crop loss	
	Humans are also destroying oceanic ecosystems with plastic pollution and by overfishing	
	By mapping plastic waste and illegal fishing vessels, this technology offers a cost-effective way to inform us what is happening to earth's oceans	
	Forests provide habitats to over four-fifths of all species living on land.	

	By using the technology to map deforestation on a global scale, we get a broad picture of the health of our forests.	
	This way policy making on deforestation can be done more effectively, saving millions of trees in the process	
	But besides human deforestation, human-caused global warming dramatically increases the amount of devastating wildfires	
	However, by using special satellite sensors, the wildfire susceptibility of certain vegetation can be mapped	
	This way we can predict and prevent wildfires from occurring	
	These are just a few ways this technology can help, but the possibilities are endless	
Periopsis (15 sec)	At Periopsis, our most popular service is illegal waste dumping detection	
	By using high-resolution satellite imagery combined with our own state-of-the-art AI models	
	we help governments and environmental organizations keep our planet clean	
Outro (15 seconds)	Socrates agrees that, only by looking at our planet from the atmosphere and beyond, we can fully understand how to protect it	
	If only Socrates could see what we can do with AI…	
Periopsis logo animation		*Previous shot fading out and periopsis logo animation appearing*
Call to action to Periopsis website		*"www.periopsis.com for more information"* appearing below the logo

Script Draft 3

Intro (1 minute)	Human population is growing fast 50 years ago there were 4 billion of us Today, that number has doubled to 8 billion	*Crowd stock footage*
	At the same time, the natural resources of the earth are finite and limited, while soil in many areas is being degraded and water is polluted.	*Pollution footage*
	However, earth's natural resources are limited	
	With our current way of living, we need almost 3 planets to sustain ourselves	
2-4 examples are convincing	All the while human impact on climate change is making matters worse	
	2400 trees are lost every single minute.	*Deforestation footage*
	More natural disasters are happening with increasing intensity, causing tens of thousands human casualties and severe biodiversity loss each year	
	Over 3 billion people don't have regular access to healthy food today.	
	if we wish to ensure the sustainability of the planet and the well-being of our species, we must take action right now	
	silent moment, music ending But what can we do? *hopeful music starting*	
	emerging technologies allow us to observe the earth in unprecedented scale, being able to understand where problems occur,	

	better utilizing our resources to solve those problems, shaping fairer, effective and environmental-friendy policies. Artificial intelligence opens up a world of possibilities, where computer vision allows machines to analyze what they observe from satellite photos.E By using the power of *artificial intelligence* to analyze satellite imagery, we can observe the earth in ways that were previously impossible.	
	Using this technology we get crucial insight into our impact on the planet and how to minimize it	
Use cases (2,5 mins)	By combining satellite imagery and AI, we can help farmers produce enough food for everybody	*Farmer with tablet in hand in field*
6-8 examples are convincing	We can prevent failed harvests, detect early contagious plant diseases and insect pests,	
	and we can make predictions on crop yields and optimize production	*Smart farming system shot* *OR* *Farmer harvesting*
	Forests provide habitats to over four-fifths of all species living on land.	*Stock footage of animals in the woods*
	By using the technology to map deforestation on a global scale, we get a broad picture of the health of our forests.	
	This way policy making on deforestation can be done more effectively, saving millions of trees in the process	

	But besides human deforestation, human-caused global warming dramatically increases the amount of devastating wildfires	
	However, by using special satellite sensors, the wildfire susceptibility of certain vegetation can be mapped	
	This way we can predict and prevent wildfires from occurring	
	Prevent and whenever needed respond to natural disasters	*PERIOPSIS can provide images here*
	Refer to detection of illegal dumping?	*PERIOPSIS can provide images here*
	Mention urban planning? Measure the area of buildings or detect swimming pools, or count cars in city centers?	*PERIOPSIS can provide images here*
	But the possibilities aren't just limited to observing land.	*Marine litter shot with box around it classifying it as "plastic"* *Split screen appears where fishers boat is seen fishing in the dark, box around it appears stating "illegal fishery"*
1-2 examples	The technology can also be used to protect our oceanic ecosystems by detecting marine litter. illegal fishery	
	to measure water quality, or to map ocean seabeds up to 38 meters deep	*Animation:* *Side view of ocean, seeing satellite radar beam going through the water. Arrows indicating the depth of the water appear that state 38 meters*
	Lastly, because the technology is non-destructive, cost-effective and	*Returning to planet animation*

	applicable on a global scale. It is the perfect way to measure progress toward our sustainability goals.	*Leaf around the planet growing to indicate more sustainability*
	Because there is only one thing more important than setting sustainability goals, and that is knowing how far we are in reaching them.	
Outro (30 seconds)	These examples are just a fraction of the ways these emerging technologies can help us achieve global sustainability.	*Transitional shot of animation turning into beautiful stock footage shot*
	Socrates said it best: “Man must rise above the earth to the top of the atmosphere and beyond for only thus will he fully understand the world in which he lives”	*Beautiful and quiet shot of satellite looking over the earth* *Socrates quote appearing next to the satellite*
	If only socrates could have seen what we can do with a little help of artificial intelligence…	*Beautiful and quiet shot of satellite looking over the earth* *satellite beeping at the end (sonar like sound)*
Periopsis logo animation		*Previous shot fading out and periopsis logo animation appearing*
Call to action to Periopsis website		“*www.periopsis.com for more information*” appearing below the logo

Script Draft 4

Intro (1 minute)	Human population is rapidly increasing 50 years ago there were 4 billion of us Today, that number has doubled to over 8 billion	*Crowd stock footage* *Numbers on street with lots of people walking there*
	However, earth's natural resources are limited At the same time, earth's natural resources are limited	*Earth animation with resource "meter / gauge" decreasing*
	With our current way of living, by 2050, we will need approximately 3 planets to sustain ourselves	*Two more planets appear in the animation*
	And although this is common knowledge, humans are still the biggest contributor to climate change Unfortunately humans are the biggest contributors to climate change	
	We cut down 2400 trees *every single minute*	*Deforestation footage*
	We release around 10 billion metric tons of co2 into the atmosphere every year	*Quick car shots*
	Because of this, more extreme natural disasters are happening, causing severe biodiversity loss and thousands of human casualties Natural disasters are becoming more frequent and more intense	*Natural disaster footage* / *News footage*
	If we wish to ensure the sustainability of the planet and the well-being of our species, *If we wish to ensure the sustainability and the well-being of our species* we must take action right now	*Work to climax with increased intensity* *"right now" ends buildup*
	silent moment, music ending	*Black screen with text appearing:*

	But what can we do? *hopeful music starting*	*'But what can we do?"*
	Satellites allow us to observe the earth in unprecedented scale. (or remote sensing)	
	By using the power of *artificial intelligence* to analyze satellite imagery, we can observe the Earth in ways that were previously impossible. in other words: Artificial intelligence opens up a world of possibilities, where computer vision allows machines to analyze what they observe from satellite photos.	*Fade in of satellite shot overlooking the earth*
	Being able to understand where problems occur, we can better utilize our resources to solve those problems	*Corporate room with people discussing* *People discussing in nature*
	Therefore shaping fair, effective and environmental-friendly policy making	*People shaking hands*
	By combining satellite imagery and AI, we can provide insights to various stakeholders or beneficiaries.	
Use cases (2,5 mins)	Farmers may produce enough food for everybody	*Farmer with tablet in hand in field* *Farmer producing food*
	This is because this technology can detect plant diseases in crops, before it's too late	*Animation overlay of detection of infected crops on aerial shot of wheat field*
	Besides this, we can make use of the technology to predict crop yield, allowing farmers to optimize their harvest and maximize productivity	*Animation overlay of total yield of wheat field* *Farmer harvesting*
	Forests provide habitats to over four-fifths of all species living on land, which is why it is	*Aerial view of forest*

	essential to manage them sustainably	*Stock footage of animals in the woods* *People planting trees*
	By using the technology to map deforestation on a global scale, we get a broad picture of the health of our forests.	*Trees being "detected" and "classified" on aerial shot with animation overlay*
	This way, policymaking on deforestation can be done more effectively, saving millions of trees in the process other words: better policymaking can save millions of trees	*Stock footage of animals in the woods* *Biodiversity flourishing*
	Besides human deforestation, countless trees are lost from the increasing amount of wildfires	*Wildfire footage*
	Luckily, by using satellite images, we can predict and prevent wildfires from ever happening	*Another forest aerial shot* *Classifying animation overlay of wildfire susceptibility*
	And the possibilities aren't just limited to observing land	*Drone shot forest to sea*
	These insights can also be used to protect our oceanic ecosystems by detecting marine litter and illegal fishery	*Marine litter shot with box around it classifying it as "plastic"* *Split screen appears where fishers boat is seen fishing in the dark, box around it appears stating "illegal fishery"*
note: 3 mentions of the "technology" thing one after the other. this becomes a bit tiring? perhaps "approach"?	These examples are just a fraction of the ways this emerging technology can help us achieve global sustainability.	*Return to satellite in space overlooking earth*

	And because it is a non-destructive, cost-effective and applicable on a global scale It is an efficient way to measure progress toward our sustainability goals.	*Returning to planet animation* *Leaf around the planet growing to indicate more sustainability*
	Because there is only one thing more important than setting sustainability goals, and that is knowing how far we are in reaching them.	
Outro (30 seconds)	Socrates said it best: “Man must rise above the earth to the top of the atmosphere and beyond for only thus will he fully understand the world in which he lives”	*Socrates quote appearing next to planet animation*
	If only Socrates could have seen what we can do with a little help of artificial intelligence…	*Shot fading out*
Periopsis logo animation		*Periopsis logo animation appearing*
Call to action to Periopsis website		“*www.periopsis.com for more information*” appearing below the logo

Script Draft 5

Intro	Human population is rapidly increasing Just 50 years ago there were 4 billion of us Today, that number has doubled to over 8 billion	*Crowd stock footage* *Numbers on street with lots of people walking there*
	As our numbers grow, so does our demand on Earth's limited resources	*Earth animation with resource "meter / gauge" decreasing*
	and the consequence is clear, if we don't change our way of living before 2050, we will need 3 planets to sustain ourselves	*Two more planets appear in the animation*
	And although this is common knowledge, humans are still the biggest contributors to climate change	*Industrial shots*
	We cut down 2400 trees *every single minute*	*Deforestation footage*
	Since the 90s, we have almost doubled the amount of CO2 in the atmosphere	*Quick car shots*
	Because of this, natural disasters are becoming more frequent and more intense, causing even more damage to our planet	*Natural disaster footage* */* *News footage*
	To secure the well-being of us and the Earth we live on, we must take action now	*Work to climax with increased intensity* *"right now" ends buildup*
	silent moment, music ending But what can we do? *hopeful music starting*	*Black screen with text appearing:* *'But what can we do?"*

	While satellites have allowed us to observe the Earth for decades, a new era has emerged	*Fade in of satellite shot overlooking the earth*
	Now, we can use *artificial intelligence* to analyze satellite imagery; allowing us to create analytics that were previously either very hard, or even impossible to get	*AI Stock footage* *Analytics animation overlay*
	This powerful tool enables us to craft environmentally-friendly policies, guiding us toward a sustainable future where one planet is enough for us all	*Sustainability shots stock footage*
Use cases	Farmers can use this technology to detect crop diseases early, saving their crop and increasing their productivity	*Farmer with tablet in hand in field* *Farmer producing food* *Animation overlay of detection of infected crops on aerial shot of wheat field*
	Forests decrease climate change by absorbing billions of metric tonnes of CO2 every year, which is why it is essential to limit deforestation	*Aerial view of forest* *Deforestation shots*
	By using the technology to map deforestation on a global scale, we get a broad picture of the health of our forests.	*Trees being “detected” and “classified” on aerial shot with animation overlay*
	This way, policymaking on deforestation can be done more effectively, saving *millions* of trees in the process	*People planting trees* *Animals in forest happy*
	Besides human deforestation, countless trees are lost from the increasing amount of wildfires	*Wildfire footage*
	By measuring water levels in vegetation, we can predict and prevent wildfires from ever happening	*Another forest aerial shot* *Classifying animation overlay of wildfire susceptibility*
	And the possibilities aren’t just limited to	*Drone shot forest to sea*

	observing land	
	These insights can also be used to protect our oceanic ecosystems by mapping plastic garbage patches	*Marine litter shot with box around it classifying it as "plastic"*
	These examples are just a fraction of the ways this emerging technology can help us achieve global sustainability.	*Returning to planet animation*
	This tool's cost-effectiveness and global reach make it an efficient way to measure progress toward our sustainability goals	*Leaf around the planet growing to indicate more sustainability*
	Because there is only one thing more important than setting sustainability goals, and that is knowing how far we are in reaching them.	*Wide shot of Earth*
Outro	As Socrates once said: "Man must rise above the earth to the top of the atmosphere and beyond for only thus will he fully understand the world in which he lives"	*Socrates quote appearing next to planet*
	If only Socrates could have seen what we can do with a little help of artificial intelligence…	*Shot fading out*
Periopsis logo animation		*Periopsis logo animation appearing*
Call to action to Periopsis website		"*www.periopsis.com for more information*" appearing below the logo

Script Draft 6

Intro	Human population is rapidly increasing Just 50 years ago there were 4 billion of us Today, that number has doubled to over 8 billion	*Crowd stock footage* *Numbers on street with lots of people walking there*
	As our numbers grow, so does our demand on Earth's limited resources	*Earth animation with resource "meter / gauge" decreasing*
remove "and"	and the consequence is clear, if we don't change our way of living before 2050, we will need 3 planets to sustain ourselves	*Two more planets appear in the animation*
remove "and"	And although this is common knowledge, humans are still the biggest contributors to climate change	*Industrial shots*
switch this one with the next one	We cut down 2400 trees *every single minute*	*Deforestation footage*
[put this above, before the trees]	Since the 90s, we have almost doubled the amount of CO_2 in the atmosphere	*Quick car shots*
remove "Because of this,"	Because of this, natural disasters are becoming more frequent and more intense, causing even more damage to our planet	*Natural disaster footage* / *News footage*
	To secure the well-being of our species and the sustainability of Earth and its biodiversity, we must take action now	*Work to climax with increased intensity* *"right now" ends buildup*
	silent moment, music ending But what can we do? *hopeful music starting*	*Black screen with text appearing:* *'But what can we do?"*
	a new era has emerged when satellites allowed us to observe the Earth	*Fade in of satellite shot overlooking the earth*

remove “either” and “even”	*Artificial intelligence* allows to analyze satellite imagery with high precision; creating analytics that were previously either very hard, or even impossible to get	*AI Stock footage* *Analytics animation overlay*
	This combination of technologies enables us to craft environmentally-friendly policies, guiding us toward a sustainable future where one planet is enough for us all	*Sustainability shots stock footage*
Use cases removed “use this technology to”	Via these technologies, farmers can detect crop diseases early, saving their crop and increasing their productivity	*Farmer with tablet in hand in field* *Farmer producing food* *Animation overlay of detection of infected crops on aerial shot of wheat field*
	Forests decrease climate change by absorbing billions of metric tonnes of CO2 every year, which is why it is essential to limit deforestation	*Aerial view of forest* *Deforestation shots*
	By using these technologies to map deforestation on a global scale, we can get a broad picture of the health of our forests.	*Trees being “detected” and “classified” on aerial shot with animation overlay*
	This way, policymaking on deforestation can be done more effectively, saving *millions* of trees in the process	*People planting trees* *Animals in forest happy*
	Besides human deforestation, countless trees are lost from the increasing amount of wildfires	*Wildfire footage*
removed “ever”	By observing the earth, soil and climate, we can predict and even prevent wildfires from happening	*Another forest aerial shot* *Classifying animation overlay of wildfire susceptibility*
removed “And”	The possibilities aren’t just limited to observing the land	*Drone shot forest to sea*
removed “patches”	These insights can also be used to protect our oceanic ecosystems by detecting pollution and mapping garbage and debris at the sea	*Marine litter shot with box around it classifying it as “plastic”*

	These examples are just a fraction of the ways these emerging technologies can help us achieve global sustainability.	*Returning to planet animation*
i was not excited about this paragraph	Satellite imagery and AI offer cost-effectiveness and wide reach, making these technologies efficient to measure progress toward our global sustainability goals	*Leaf around the planet growing to indicate more sustainability*
[should be some small silence here before this sentence]	Because there is only one thing more important than setting sustainability goals, and that is knowing how far we are in reaching them.	*Wide shot of Earth*
Outro	As Socrates once said: “Man must rise above the earth to the top of the atmosphere and beyond for only thus will he fully understand the world in which he lives”	*Socrates quote appearing next to planet*
	If only Socrates could have seen what we can do with a little help of artificial intelligence…	*Shot fading out*
Periopsis logo animation		*Periopsis logo animation appearing*
Call to action to Periopsis website		*“www.periopsis.com for more information”* appearing below the logo

Script Draft 7

Intro	Human population is rapidly increasing Just 50 years ago there were 4 billion of us Today, that number has doubled to over 8 billion	*Crowd stock footage* *Numbers on street with lots of people walking there*
	As our numbers grow, so does our demand on Earth's limited resources	*Earth animation with resource "meter / gauge" decreasing*
	The consequence is clear, if we don't change our way of living before 2050, we will need 3 planets to sustain ourselves	*Two more planets appear in the animation*
	Although this is common knowledge, humans are still the biggest contributors to climate change	*Industrial shots*
	Since the 90s, we have almost doubled the amount of CO2 in the atmosphere	*Industrial pollution shots*
	We cut down 2400 trees *every single minute*	*Deforestation footage*
	Natural disasters are becoming more frequent and more intense, causing even more damage to our planet	*Natural disaster footage* */* *News footage*
	To secure the well-being of our species and the sustainability of Earth and its biodiversity, we must take action now	*Work to climax with increased intensity* *"right now" ends buildup*
	silent moment, music ending But what can we do? *hopeful music starting*	*Black screen with text appearing:* *'But what can we do?"*
	While satellites have allowed us to observe the Earth for decades, a new era has emerged	*Fade in of satellite shot overlooking the earth*
	Now, we can use *artificial intelligence* to	*AI Stock footage*

	analyze satellite imagery with high precision hereby making it possible to create analytics that were previously very hard, or impossible to get	*Analytics animation overlay*
	This combination of technologies enables us to craft environmentally friendly policies, guiding us toward a sustainable future where one planet is enough for us all	*Sustainability shots stock footage*
Use cases	With these technologies, farmers can detect crop diseases early, saving their crop and increasing their productivity	*Farmer with tablet in hand in field* *Farmer producing food* *Animation overlay of detection of infected crops on aerial shot of wheat field*
	Forests decrease climate change by absorbing billions of metric tonnes of CO2 every year, which is why it is essential to limit deforestation	*Aerial view of forest* *Deforestation shots*
	By using the technologies to map deforestation on a global scale, we can get a broad picture of the health of our forests.	*Trees being "detected" and "classified" on aerial shot with animation overlay*
	This way, policymaking on deforestation can be done more effectively, saving *millions* of trees in the process	*People planting trees* *Animals in forest happy*
	Besides human deforestation, countless trees are lost from the increasing amount of wildfires	*Wildfire footage*
	By observing the earth, soil and climate, we can predict and even prevent wildfires from happening	*Another forest aerial shot* *Classifying animation overlay of wildfire susceptibility*
	The possibilities aren't just limited to observing the land	*Drone shot forest to sea*
	These insights can also be used to protect our oceanic ecosystems by detecting and mapping plastic pollution	*Marine litter shot with box around it classifying it as "plastic"*

	These examples are just a fraction of the ways these emerging technologies can help us achieve global sustainability.	*Returning to planet animation*
	Satellite imagery and AI provide a cost-effective and broadly reaching method for measuring progress toward our global sustainability goals	*Leaf around the planet growing to indicate more sustainability*
	Because there is only one thing more important than setting sustainability goals, [*pause]* and that is knowing how far we are in reaching them.	*Wide shot of Earth*
Outro	As Socrates once said: “Man must rise above the earth to the top of the atmosphere and beyond for only thus will he fully understand the world in which he lives”	*Socrates quote appearing next to planet*
	If only Socrates could have seen what we can do with a little help of artificial intelligence…	*Shot fading out*
Periopsis logo animation		*Periopsis logo animation appearing*
Call to action to Periopsis website		“*www.periopsis.com for more information*” appearing below the logo

Script Draft 8

Intro	Human population is rapidly increasing Just 50 years ago there were 4 billion of us Today, that number has doubled to over 8 billion	*Crowd stock footage* *Numbers on street with lots of people walking there*
	As our numbers grow, so does our demand on Earth's limited resources	*Earth animation with resource "meter / gauge" decreasing*
	The problem is that if we don't change our way of living before 2050, we will need 3 planets to sustain ourselves	*Two more planets appear in the animation*
	And although this is common knowledge, humans are still the biggest contributors to climate change	*Industrial shots*
	Since the 90s, we have almost doubled the amount of CO2 in the atmosphere	*Industrial pollution shots*
	We cut down 2400 trees *every single minute*	*Deforestation footage*
	Natural disasters are becoming more frequent and more intense, causing even more damage to our planet	*Natural disaster footage* / *News footage*
	To secure the well-being of our species and the sustainability of Earth and its biodiversity, we must take action now	*Work to climax with increased intensity* *"right now" ends buildup*
	silent moment, music ending But what can we do? *hopeful music starting*	*Black screen with text appearing:* *'But what can we do?"*
	While satellites have allowed us to observe the Earth for decades, a new era has emerged	*Fade in of satellite shot overlooking the earth*
	Now, we can use *artificial intelligence* to	*AI Stock footage*

	analyze satellite imagery in novel ways This makes it possible to create analytics that were previously very hard, or even impossible to get	*Analytics animation overlay*
Use cases	Farmers for example can use this combination of technologies to detect crop diseases early, thereby saving their crop and increasing their productivity	*Farmer with tablet in hand in field* *Farmer producing food* *Animation overlay of detection of infected crops on aerial shot of wheat field*
	Forests decrease climate change by absorbing billions of metric tonnes of CO2 every year, which is why it is essential to limit deforestation	*Aerial view of forest* *Deforestation shots*
	By using the technologies to map deforestation on a global scale, we can get a broad picture of the health of our forests.	*Trees being "detected" and "classified" on aerial shot with animation overlay*
	This way, policymaking on deforestation can be done more effectively, saving *millions* of trees in the process	*People planting trees* *Animals in forest happy*
	Besides human deforestation, countless trees are lost from the increasing amount of wildfires	*Wildfire footage*
	By measuring the water levels in vegetation, we can predict and even prevent wildfires from happening	*Another forest aerial shot* *Classifying animation overlay of wildfire susceptibility*
	And the possibilities aren't just limited to observing land	*Drone shot forest to sea*
	By mapping plastic in our oceans on a large scale, we get a better understanding of how to protect our oceanic ecosystems	*Marine litter shot with box around it classifying it as "plastic"*
	These examples are just a fraction of the ways these emerging technologies can help us achieve global sustainability.	*Returning to planet animation*

	Perhaps most importantly, they provide us with a cost-effective method for measuring progress toward our sustainability goals on a global scale	*Leaf around the planet growing to indicate more sustainability*
	Because there is only one thing more important than setting sustainability goals, [*pause]* and that is knowing how far we are in reaching them.	*Wide shot of Earth*
Outro	As Socrates once beautifully said: “Man must rise above the earth to the top of the atmosphere and beyond for only thus will he fully understand the world in which he lives”	*Socrates quote appearing next to planet*
	If only Socrates could have seen what we can do with a little help of artificial intelligence…	*Shot fading out*
Periopsis logo animation		*Periopsis logo animation appearing*
Call to action to Periopsis website		“*www.periopsis.com for more information*” appearing below the logo

Script Draft 9 [FINAL]

Intro	Human population is rapidly increasing Just 50 years ago there were 4 billion of us Today, that number has doubled to over 8 billion	*Crowd stock footage* *Numbers on street with lots of people walking there*
	As our numbers grow, so does our demand on Earth's limited resources	*Using resources stock footage*
	The problem is that if we don't change our way of living before 2050, we will need 3 planets to sustain ourselves	*Two more planets appear in the animation*
	And although this is common knowledge, humans are still the biggest contributors to climate change	*Industrial shots*
	Since the 90s, we have almost doubled the amount of CO2 in the atmosphere	*CO2 bubbles going into atmosphere*
	We cut down 2400 trees *every single minute*	*Deforestation footage*
	Natural disasters are becoming more frequent and more intense, causing even more damage to our planet	*Natural disaster footage* / *News footage*
	To secure the well-being of our species and the sustainability of Earth and its biodiversity, we must take action now	*Work to climax with increased intensity* *"right now" ends buildup*
	silent moment, music ending But what can we do? *hopeful music starting*	*Black screen with text appearing:* *'But what can we do?"*
	Satellites have allowed us to observe the Earth for decades, but a new era has emerged	*Fade in of satellite shot overlooking the earth*
	Now, we can use *artificial intelligence* to analyze satellite imagery in novel ways	*AI Stock footage* *Analytics animation overlay*

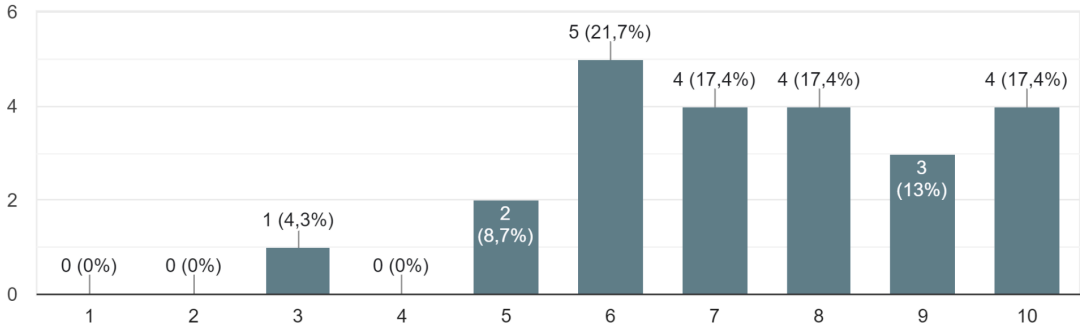
	This makes it possible to create analytics that were previously very hard, or even impossible to get	
Use cases	Farmers for example can use this combination of technologies to detect crop diseases early, thereby saving their crop and increasing their productivity	*Farmer with tablet in hand in field* *Farmer producing food* *Animation overlay of detection of infected crops on aerial shot of wheat field*
	Forests decrease climate change by absorbing billions of metric tons of CO2 every year, which is why it is essential to limit deforestation	*Forest with CO2 bubbles going in it*
	By using these technologies to map deforestation on a global scale, we can get a broad picture of the health of our forests.	*Trees being "detected" and "classified" on aerial shot with animation overlay*
	This way, policymaking on deforestation can be done more effectively, saving *millions* of trees in the process	*People planting trees* *Animals in forest happy*
	Besides human deforestation, countless trees are lost from the increasing amount of wildfires	*Wildfire footage*
	By measuring the water levels in vegetation, we can predict and even prevent wildfires from happening	*Another forest aerial shot* *Classifying animation overlay of wildfire susceptibility*
	And the possibilities aren't just limited to observing land	*Drone shot forest to sea*
	By mapping plastic in our oceans on a large scale, we get a better understanding of how to protect our oceanic ecosystems	*Marine litter shot with box around it classifying it as "plastic"*
	These examples are just a fraction of the ways these emerging technologies can help us achieve global sustainability.	*Returning to planet animation*
	Perhaps most importantly, they provide us with a cost-effective method for measuring progress toward our sustainability goals worldwide	*Leaf around the planet growing to indicate more sustainability*

	Because we should not forget that measuring progress toward our goals is just as important as setting them	*Wide shot of Earth*
Outro	As Socrates once beautifully said: “Man must rise above the earth to the top of the atmosphere and beyond for only thus will he fully understand the world in which he lives”	*Socrates quote appearing next to planet*
	If only Socrates could have seen what we can do with a little help of artificial intelligence…	*Shot fading out*
Periopsis logo animation		*Periopsis logo animation appearing*
Call to action to Periopsis website		*“www.periopsis.com for more information*” appearing below the logo

Appendix D: Survey Results

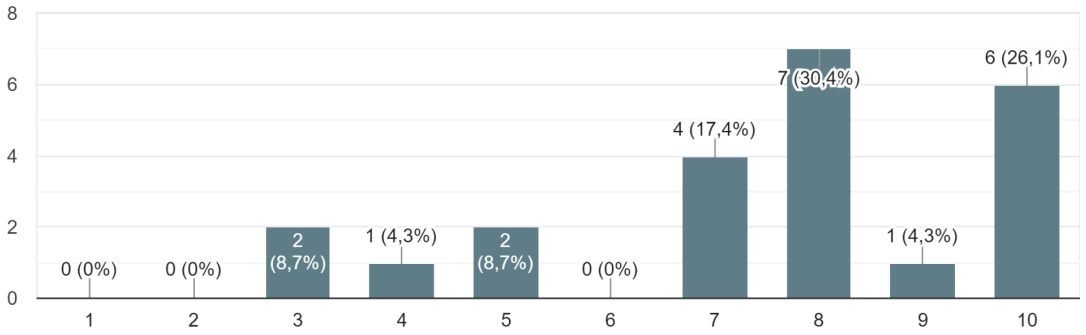
To what extent are you aware of the possibilities of artificial intelligence technologies, such as computer vision, on satellite imagery?

23 antwoorden



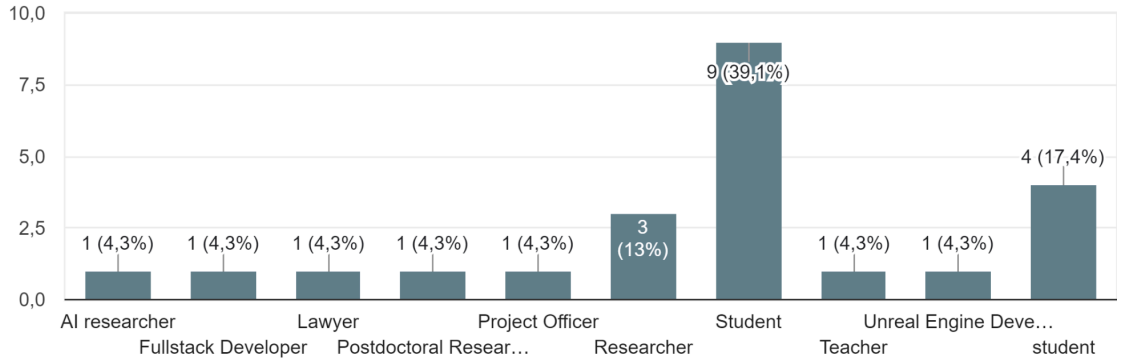
How interested are you in AI technologies?

23 antwoorden



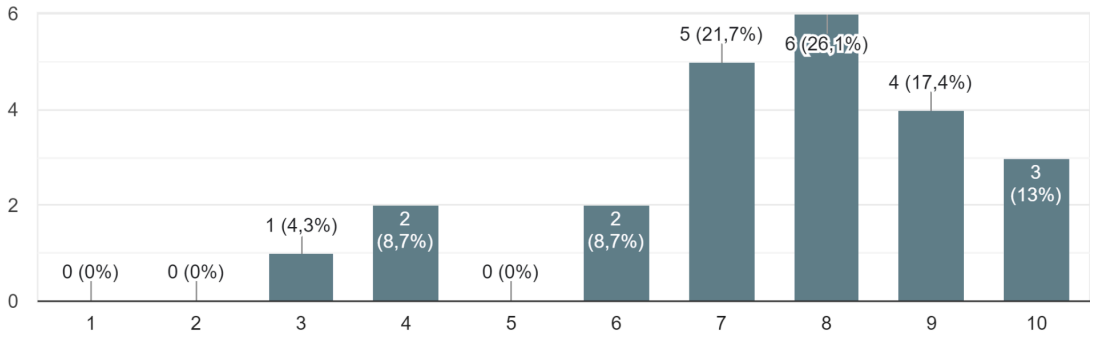
What is your current profession? (for students: fill in "student")

23 antwoorden



To what extent do you think AI and satellite imagery can help make our planet more sustainable?

23 antwoorden



How do you think AI and satellite imagery can help improve our planet's sustainability?

17 antwoorden

From deforestation to droughts, AI and satellite imagery are our early warning system, helping us manage resources, prepare for disasters, and build a greener planet.

Efficiency of renewable sources, help put things in perspective for the general public and identify problems and put them in certain priority.

Monitoring landscapes, make informed policy-making

Earth observation and monitoring at scale, shaping environmental policies, detecting contamination and disasters early enough

By providing insights that will allow us to take more informed decisions towards sustainable development and the protection of the environment.

I don't really know what it can do at all

Automatically finding the problematic areas in terms of greenhouse gasses

By measuring greenhouse gasses and tracking trashspread

Recognize possible hazards, pollution and contamination on the planet imagery.

AI models can be trained to analyze satellite images to determine the current state and see if efforts to improve areas are working as intended

By predicting degradation of local ecosystem envirenments with a lot of different climate data

Better crop planning and urban development

Policy making

By imaging where issues occur and targeting solutions more effectively

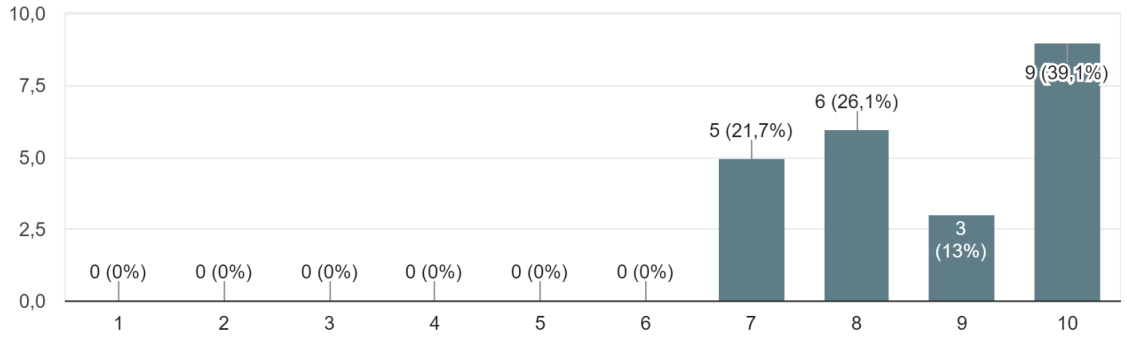
By identifying a broad picture of the problem, with the power to go into almost infinite detail. For instance in agriculture the farmers can provide only the necessary of nitrogen for a plant to grow in that particular place, instead of putting in the amount of cow dung their grandpa thaught them.

Large scale monitoring

By monitoring areas to see if changes have a positive or negative effect on the sustainability. Or by seeing possibilities for sustainability by scanning areas using satellite imagery.

How urgent do you think our global sustainability issue is?

23 antwoorden



What did you learn from this video?

18 antwoorden

AI and satellite imagery offer powerful tools to address sustainability challenges by enabling early detection of crop diseases, monitoring deforestation, predicting wildfires, and mapping plastic in oceans. This technology provides cost-effective ways to measure and achieve global sustainability goals.

Ways to improve the sustainability of our earths ecosystem.

We have to act now

Environmental challenges we're curretly facing and the potentials of artificial intelligence combined with satellite imagery in agriculture, wildfire prevention, and in general environmental monitoring and protection.

I didn't know the exact numbers, but this sounds as bad as I thought. And I've never heard of this kind of technology before, so that's new

It's possible to detect crop diseases, map plastic in the ocean etc. using satellite imagery and AI to help offset the harm to the planet.

I learned about the concrete actions that are currently being taken using AI models to analyze satellite

That ai could help spot problems we should take (preventive)care of

AI can help prevent forest fires and save crops

Importance to stop global warming, effects humans have on the planet, using satellite imagery for preventing global warming

AI can be used in several ways in respect to sustainability

Ai can be applied to the identification of r
Global sustainability risks

Some nice facts at the beginning of the video and of course how AI/Satellite imaging can be tool for solving lots of problem by understanding it well. Finally quote of Socrates!!!

Examples of what ai can do

Satellite imagery can provide us with a holistic view of the planet, helping us to identify problems,setting

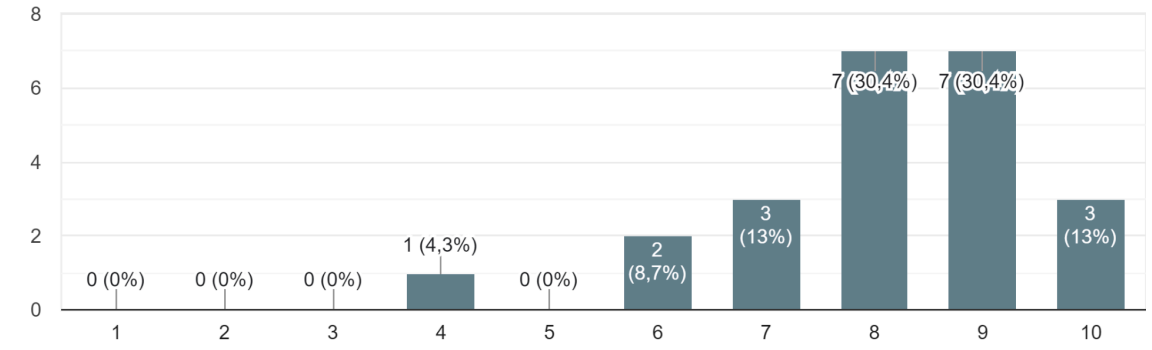
The possibilities af AI to analyse satellite images

Human population is a major cause of climate change. Human activities have contributed towards biodiversity loss and climate change. To solve it, we can use AI e.g. large scale mapping for afforestation, farm monitoring, wildfires monitoring, plastic mapping, oceanic monitoring. These are cost effective methods using AI and satellite imagery

Besides stressing again how important it is that we do something to increase sustainability, I learned many ways AI in combination with satellite imagery can help to make our planet more sustainable Like: checking for crops diseases, looking for deforestation, checking water levels to prevent wildfire and monitoring the amount of plastic in the ocean.

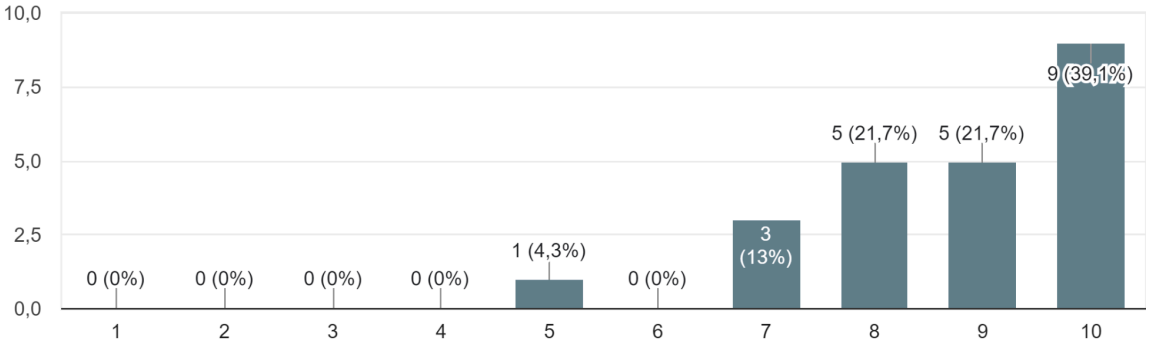
To what extent do you think AI and satellite imagery can help make our planet more sustainable?

23 antwoorden



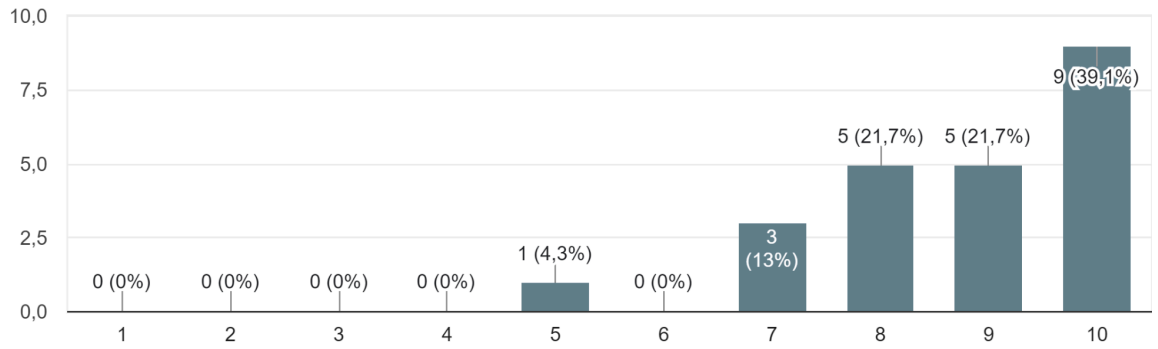
How urgent do you think our global sustainability issue is?

23 antwoorden



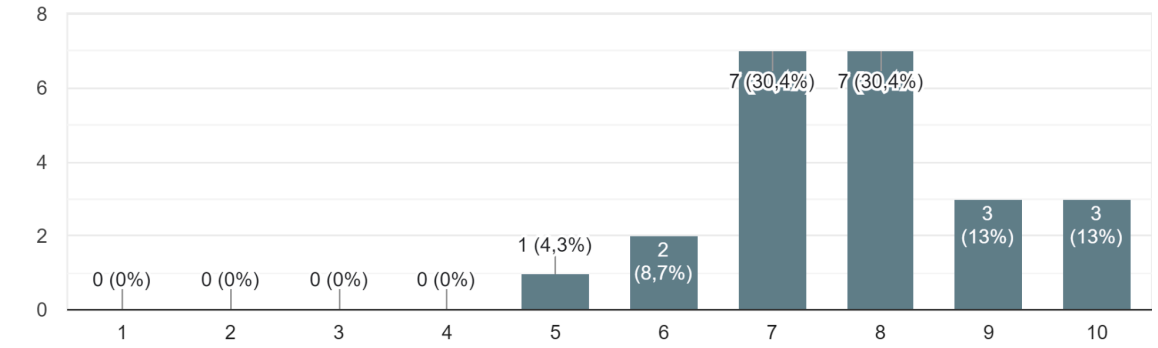
How urgent do you think our global sustainability issue is?

23 antwoorden



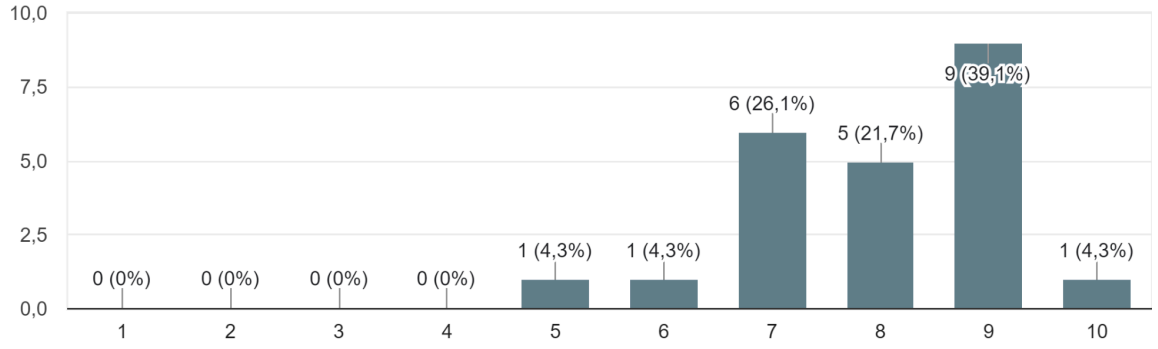
How convincing did you find the video to be?

23 antwoorden



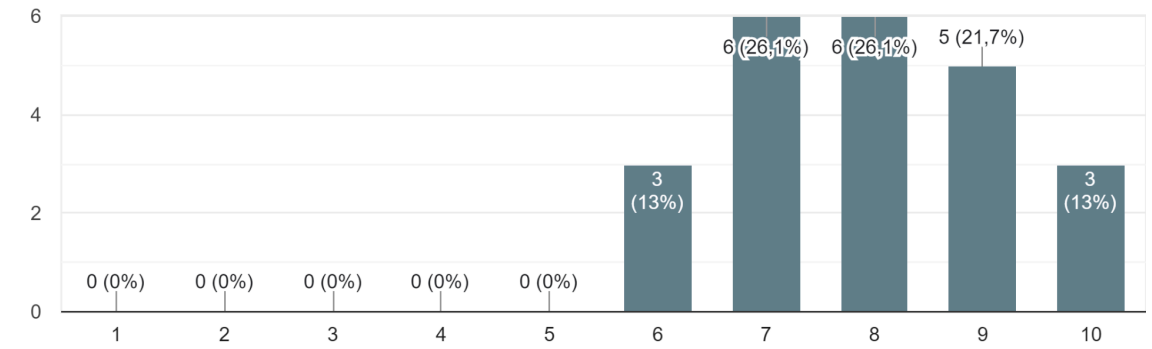
How well was the sustainability problem explained? (first part)

23 antwoorden



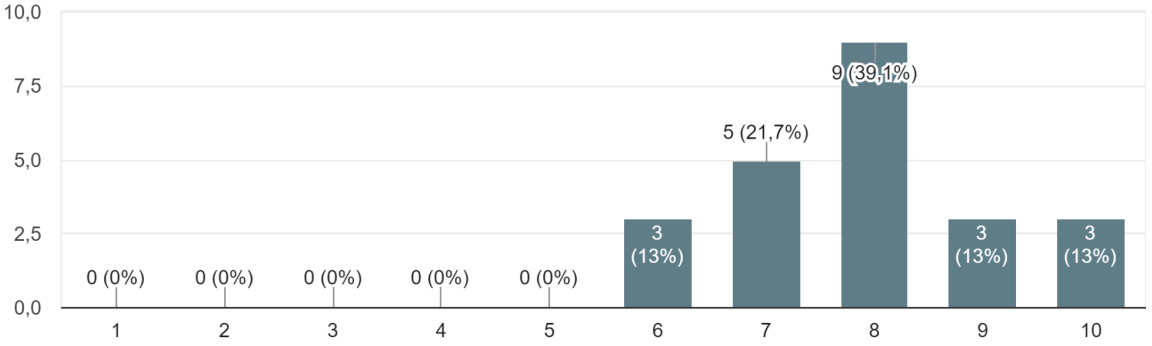
How well was the solution presented? (explanation of the technology + examples)

23 antwoorden



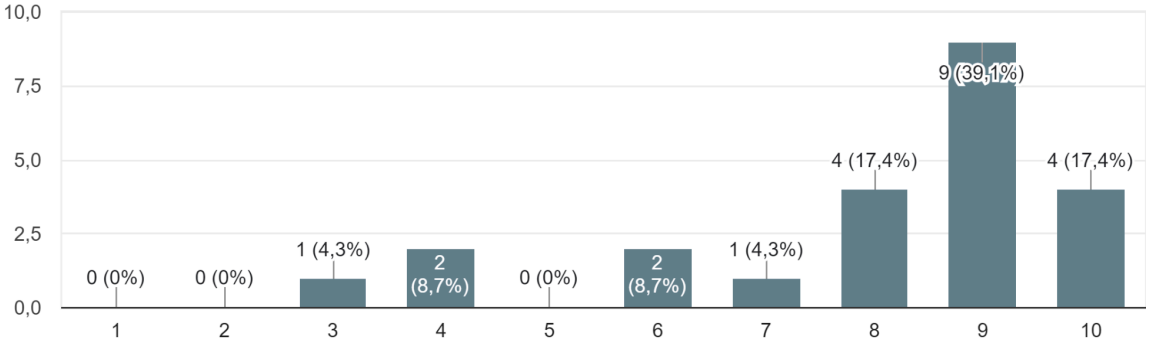
How good was the ending?

23 antwoorden



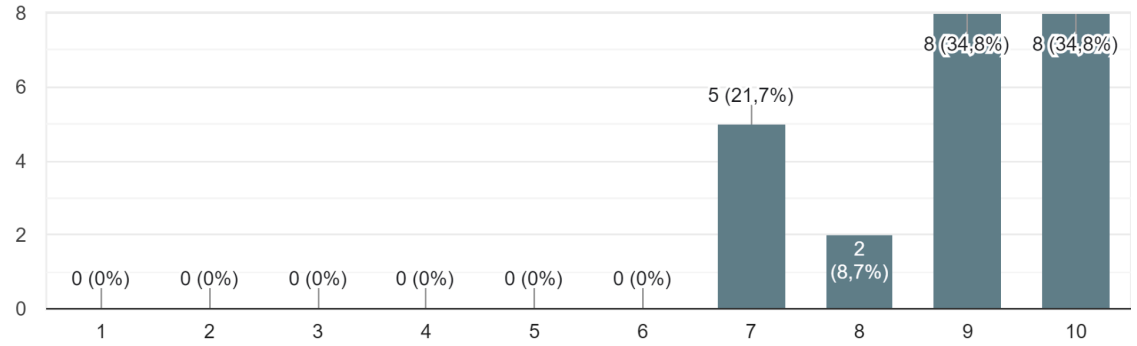
To what extent did the video footage match the video?

23 antwoorden



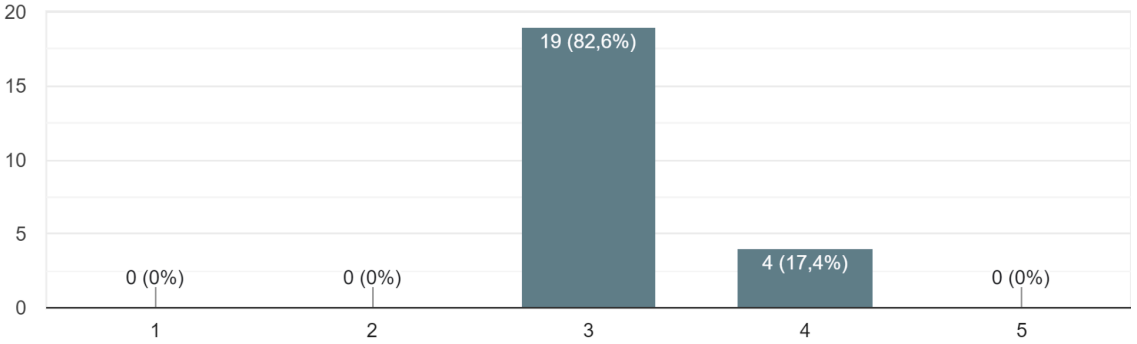
To what extent did the animations help the video?

23 antwoorden



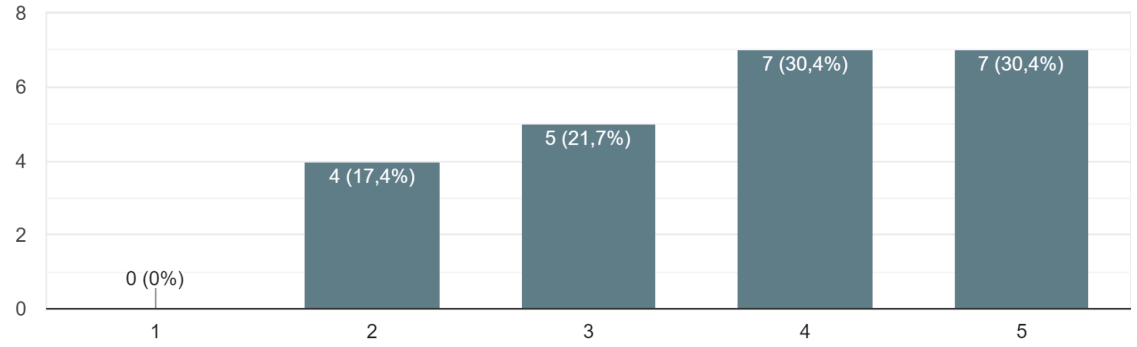
Was the video too short or too long?

23 antwoorden



To what extent did the voice-over match the video

23 antwoorden



Thank you for filling in the survey! Anything else you want to say about the video?

13 antwoorden

1. The background music is dominant compared to the actual voice.
2. I sense that the voice is produced using TTS (text-to-speech) technology, leading to some undesirable sounds. An authentic human voice might be more suitable for conveying information in an introductory video.

The video is really well made. Two slight, nitpicky, changes I would make.

1) Maybe the volume of the music to be turned down just a tiny bit.
2) At 0:35, the white text that is shown on the ground could be a different colour instead of white to highlight the point this information is making (could be red for example). Just to add a bit of variety as well.

The footage, the script and the animations are excellently placed. Well done!

Great job!

It took longer than 6 minutes

Nicely done

Why "metric tons" instead of just "tons"?

I loved the subtle animations, they brought the video to the next level and helped visualize what was being said

Found the voiceover's voice a bit too deep

Nice work!

In the first part of the video the music volume should be lower than the voice. Currently, the music volume is high, making it challenging to listen to and understand what the presenter is saying in certain parts of the video. On the flip side, the music is excellent, but its beat is too fast when compared to the presenter's explanation speed (for the first part of the video).
In the second part, the volume was acceptable but could be lower, and the beat matched well with the flow of the explanation.

Nice video! I think this would be a very nice video for someone new to "how Satellite imagery could help humanity?"

please don't use such a large bassdrop for zooming in on the planet, my speakers almost jumped of their sockets :D

Great work!!