Explore the benefits of prototype testing for deriving meaningful insights for the design development of remote explosive detector.

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Background

Technologies for Criminal Investigations (TCI) is a Dutch-based research group with facilities in Enschede, Apeldoorn, and Deventer. The main focus of the research group is to lead in the field of "Crime Tech" by applying innovative technologies in criminal investigations. Their development is established by advanced tools and devices that make use of both research and applied methodologies with the mission for improving safety and security. TCI has built a close cooperation between the Police Academy and Saxion University of Applied Sciences and the major lines of research are focused on nanotechnology, forensic robotics, cold case research project, and silent witnesses. These lines prioritize specific areas of interest: murder, manslaughter, undermining, terrorism, and serial arson. The research group consists of 24 employees who have expertise in the fields of robotics, chemical science, data science, artificial intelligence, mechanical and software engineering. Currently, TCI has developed a working prototype of a narcotic detector ("Narco Neus") that was successful at identifying various types of drugs by sucking the surrounding air and analysing it with electrochemical sensors (Figure 1). The promising results of this project opened new possibilities for the research group namely in the development of an explosive detector ("Explo Sniffer"). The reason for this decision comes from the fact that narcotics and explosives can be detected with a very similar type of technology. Therefore, the Explo Sniffer will use the model of the Narco Neus as a starting point and will need the integration of additional functional components and design improvements that will ensure the desired explosive detection abilities. More specifically the main goal of the project is to create proof of concept that can remotely detect explosives by integrating the Explo Sniffer to an unmanned guided vehicle (UGV) (Figure 2).

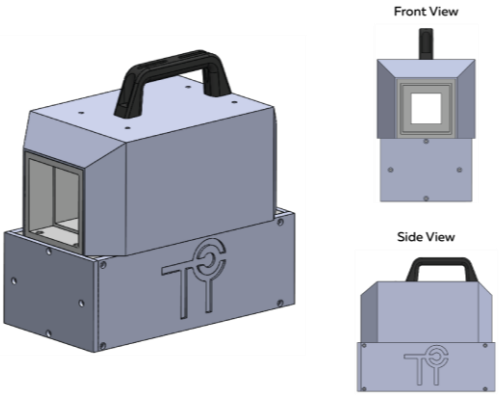

Figure 1. Narco Neus

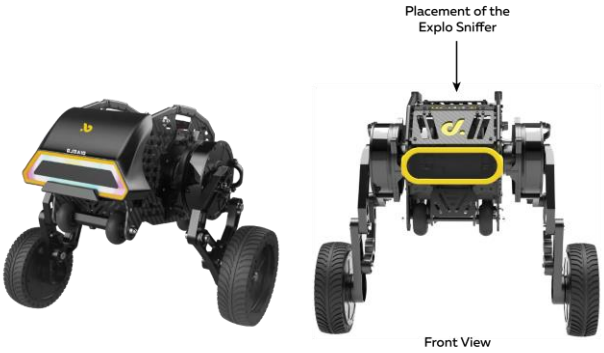

Figure 2. UGV

Objective

Because the project is in the early stages of development it is essential to get a better understanding of how to provide an accurate detecting technology with the objective of integrating both devices into one whole working system, therefore the aim of this thesis was to explore "How can prototype testing be used to derive meaningful insights for the design development of a remote explosive detector?"

Approach

Figure 3 represents the methodological framework that was used in order to answer the research question. This framework focused on conducting academic analysis from various fields which was later on used to build the final prototype of the Explo Sniffer.

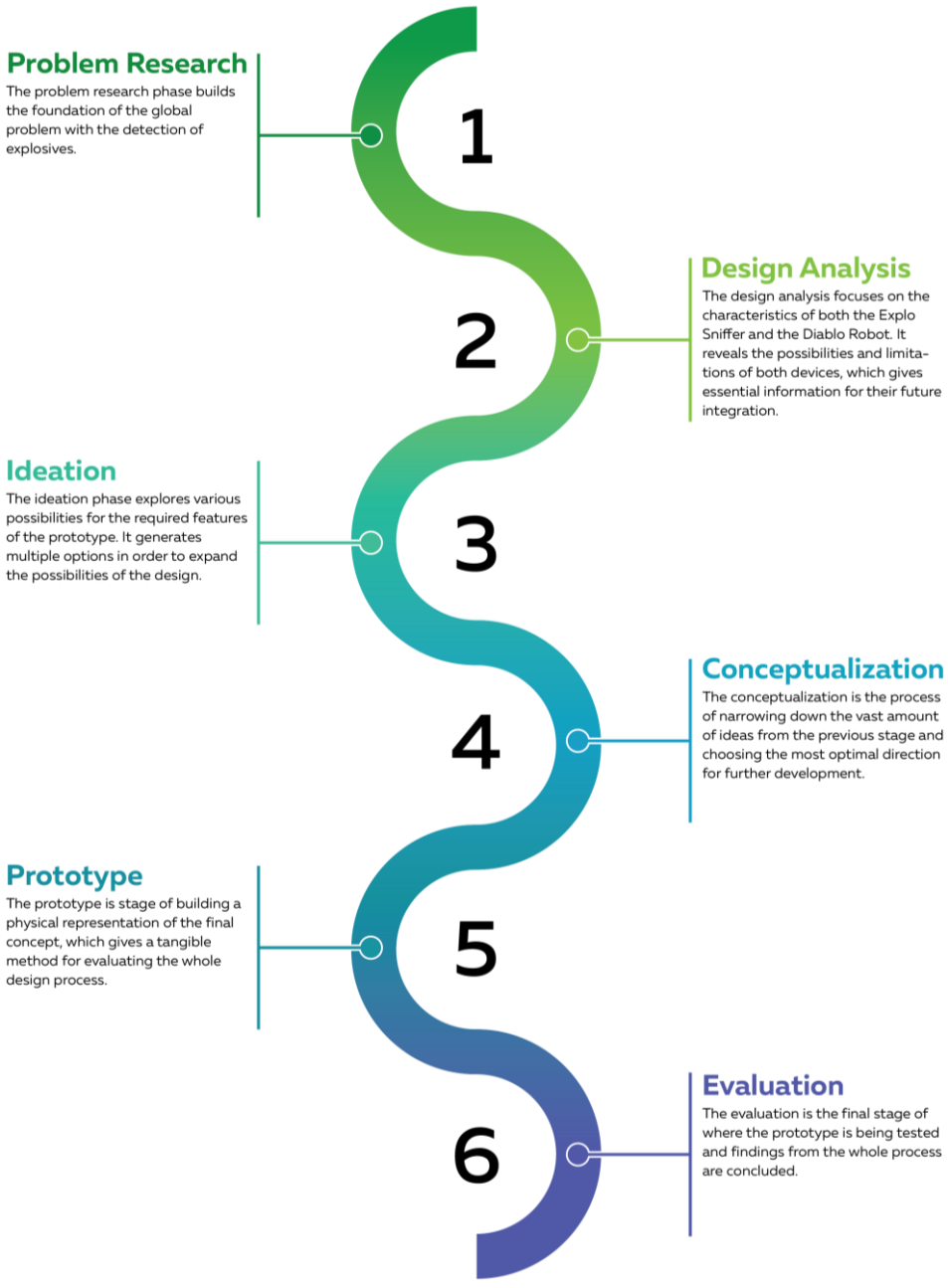

Figure 3. Methodology for the thesis

Results

Figure 4. Final prototype of the Explo Sniffer

Figure 5. Integration of the Explo Sniffer and the UGV

As a result, the objectives for the Explo Sniffer assigned by TCI were delivered. The analytical research provided a base for understanding the recent problems revolving around the detection of explosives. Analysing the design functionalities for both the explosive detector and the unmanned guided vehicle revealed essential aspects about the limitations and possibilities of both devices so that they can be integrated together as a one operating system. All this research was channelled for processing ideas about the required functional elements of the explosive detector. The exploration

of possible options provided a wide scope for determining the most optimal choices that would satisfy the objectives proposed from the research group. The end product of all the conceptual work represents a semi-functional prototype of an explosive detector that can be attached to a UGV with the goal of remote operations. Although the final prototype did not fully meet all expectations, the results obtained from it provided essential insights that can be applied in the next stages of the Explo Sniffer's development. Thus, this is where the answer to the initial research question “How can prototype testing be used to derive meaningful insights for the design development of a remote explosive detector?” comes into place. The findings, coming from the prototype testing, were beneficial for refining the design, improving its functionality, and ultimately creating a more effective remote explosive detection system. Prototype testing provided a tangible way of identify design flaws, operational challenges, and areas for improvement that wouldn’t have been apparent in the theoretical models. It allowed for real-world assessment of the device's performance under various conditions, which helped to connect the conceptual design with the practical application of its intended functions. Lastly, it can potentially provide concrete evidence to stakeholders about the project's progress, which can be crucial in securing the further support and resources for continuing with the project. All of these points justify the advantages that prototype testing brings to the development process of the remote explosive detector.