A Gaze- vs. Joystick-Based Interaction Method for a Remote Reconnaissance Task

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Introduction

Increasing automation and artificial intelligence requires resolving complex human machine interactions. In the context of remote reconnaissance, an operator may be supported by software highlighting relevant objects and areas. With the aim to increase the speed and precision of the classification process, a gaze based interaction method was explored. In order to evaluate this interaction concept, a simulator experiment was designed, comparing it to a joystick input. Expert users will complete two equal scenarios using both interaction methods, whilst metrics such as task success are recorded and interviews are conducted for a balanced analysis of qualitative and quantitative, as well as subjective and objective data.

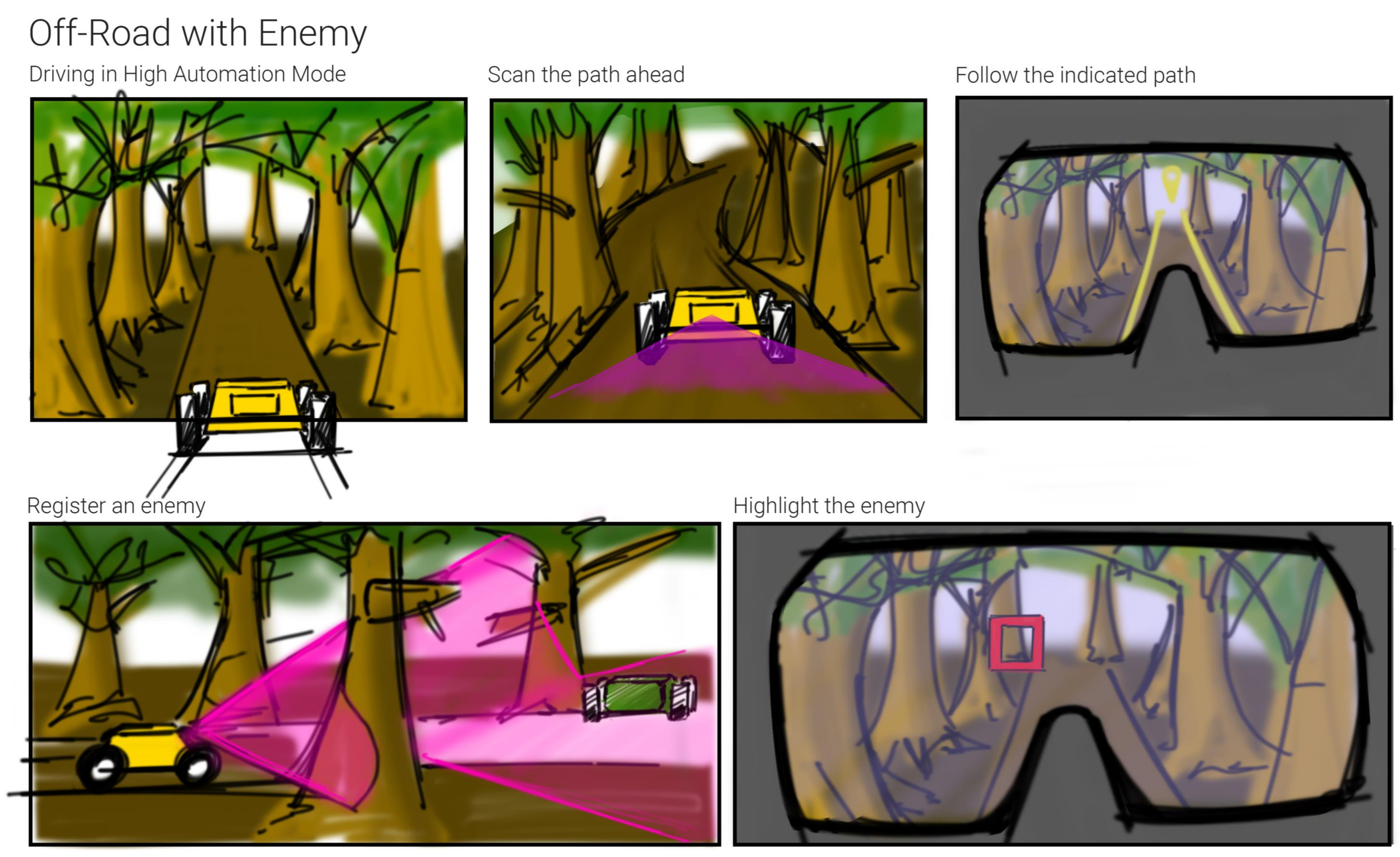

Figure 1: Storyboarding the interaction concept: a remote reconnaissance vehicle follows a set path, its sensors register an unknown object, which can then be classified by the operator.

Gaze Based Interaction

Developing novel human machine systems based on complex technical systems requires an approach, allowing the exploration of different solutions within a defined scope. The balanced Human Systems Integration (bHSI) approach; brainstorm, literature review, system modelling, exploration, implementation and test and evaluation [1,2] was therefore used to create the gaze based interaction concept. A storyboard (Fig.1) was used to visualize the initial concept for all stakeholders in order to review the initial interaction concept.

The concept is an extension of the "Magic" (Manual Acquisition with Gaze Initiated Cursor) method [3], which aims to avoid false inputs by combining eye tracking with a secondary hardware switch. The gaze point of the operator is tracked on a multi screen array, on which objects are highlighted by a software and displayed as a cursor. If the gaze point is moved to one of the highlights in the video feed from the reconnaissance platform, it is pre-selected for classification. A secondary input device is then used to either re-adjust the selection or classify the object. This device can also be used to control the speed of the reconnaissance unit, allowing the operator to conduct two tasks at the same time.

Figure 2: A three-screen simulator setup with the eye tracking, the joystick and the first iteration of the secondary input device.

Experiment Design & Procedure

In a simulator study with expert users, e.g. drone pilots, two different input methods will be compared in a reconnaissance task. After familiarizing themselves with the setup (Fig.2) consisting of three monitors, eye tracking, a joystick and a stand-alone numeric keyboard as secondary input device, one of two 25-30mins long routes will followed. The platform will navigate automatically through open grass fields, lightly forested areas and a dense forest, with only the speed controlled by the operator. The aim is to spot and classify the objects, distributed in an equal number of along both paths. Using a singular environment with two paths, aims to increase the comparability between the two different interactions designs:

- Using the gaze to select highlights and classifying them using the secondary input device
- Using a joystick to control an on-screen cursor to select highlights and classifying them using the secondary input device.

As precision and speed are key, they will be evaluated by recording the time for the entire task, the distance to the object when classified, and the error rate. The speed of the platform will also be recorded as a graph, highlighting different "driving" styles as a relevant factor in comparison to the error rate.

Outlook

A future step is to include the challenge of mode transitions by allowing the operators to change between highly automated and manual modes as well as including real systems and camera feeds into the evaluation.

1 **Flemisch, F., Semling, C., Heesen, M., Meier, S., Baltzer, M., and Krasni, A. (2013). To-wards a balanced Human Systems Integration beyond time and space: Exploroscopes for a structured exploration of human-machine design spaces. NATO STO meetings proceedings of the STO Human Factors and Medicine Panel Symposium: Beyond Time and Space**

2 **Kelsch, J., Heesen, M., Löper, C., and Flemisch, F. (2009, October). Balancierte Gestaltung kooperativer multimodaler Bedienkonzepte für Fahrerassistenz und Automation: H-Mode beim Annähern, Notbremsen, Ausweichen. 8. Berliner Werkstatt MMS: 7.-9.**

3 **Zhai (2003) What's in the eyes for attentive input Communications of the ACM Volume 46 Issue 3 March 2003 pp 34–39 https://doi.org/10.1145/636772.636795**