Evaluation of train remote control via tablet in a railway model layout

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Fig. 1. Remote Operator workplace (upper left) seperate from the railway model layout (right). Lower left: Test locomotive (Re460 series with integrated video camera) in the staging yard.

Introduction

In the Project ARTE (Automated Regional Trains in Lower Saxony [1]) we investigate driverless operation in Grade of Automation (GoA) 3 and 4 on regional lines. An important component is the development and investigation of remote train operation (RTO) as fallback solution [2] in the event of automatic train failure or other incidents. One aim is to implement a simplified remote control system that can be operated by either train personnel or a remote train operator [3].

Method

A user test with 13 participants (train drivers and rail traffic controllers) was carried out in a model railway layout built by the Priorter Modulgesellschaft e.V. (PMG). Aim was to check whether remote control using a tablet computer and the Z21 model railway app (Modelleisenbahn GmbH) is practicable. The user interface with implemented limited function volume is shown in Fig. 2.
The provisional workplace of the remote operator was situated in a room separate from the model railway layout (see Fig. 1).

After an introduction to the tablet and the app, participants remotely drove a model train in timetable mode. After that, participants completed the SUS [4] and a questionnaire regarding tablet control with the app. The test took in total between 1 and 2.5h dependent on route knowledge and Wi-Fi quality.

Results

Overall, the user test showed that remote control is feasible using a tablet and the Z21 app.

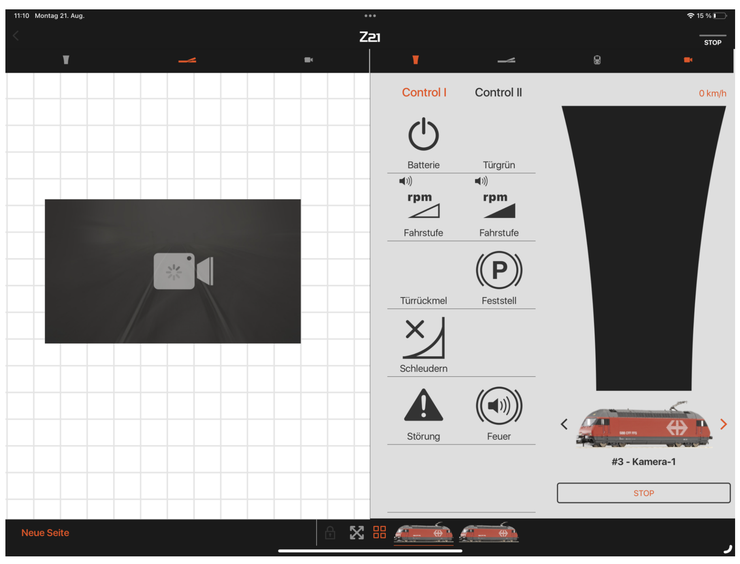

Fig. 2: User Interface of the Z21 app (adapted from Modelleisenbahn GmbH).

The key findings were that route knowledge is also required for remote control and that the video image must be of sufficient size and quality. Also, it must be possible to see when the connection (Wi-Fi) is interrupted and the video image is a still image. Most participants see the field of application of tablet remote control mainly in shunting and on secondary lines.
For the Z21 app with the limited implemented function volume, a SUS-score of 70.8 (optimum = 100) was reached. The majority of test participants found the Z21 app easy to use, not unnecessarily complex and quick to learn. The majority of test participants found the functions in the app to be quite well integrated and indicated a medium level of perceived safety in operation. Around half of the participants felt that they needed further support (e.g. manual) to be able to use the app.
Further optimization requirements for using this tablet solution for the remote control of a real train were identified (for details see [5]). For example, more specific functions and additional information should be integrated.

References

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Outlook

In a next step, the tablet remote control is going to be tested in a field test with a real train. In future projects it should be investigated which functions considered important by the participants should still be implemented and how haptic control elements could be a useful addition to tablet control.