

Evaluation of Multi-Touch Gestures

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Abstract: Interaction possibilities are perceived as being diverse and self-evident, especially caused by rapid technology developments. The availability of interaction possibilities is not consciously experienced as something special but it rather appears as an unconscious perception. The process of interaction via touch gestures is nowadays a standard in many technologies. Additional technologies, such as head- and eye-tracking have become of great interest regarding agriculture adoption, and they were apparent shown at the Agritechnica 2013- the world's largest trade fair for agricultural machinery and equipment- in Hannover, Germany. The study "Evaluation of Multi-Touch Gestures" was conducted in co-operation between John Deere GmbH & Co. KG(Intelligent Solutions Group) and the DFKI GmbH (German Research Center for Artistic Intelligence GmbH). The research objective was to find out, if multi-touch gestures on machines - with a particular focus on tractors - will be applicable for users. In this study, users who used different gestures, while the machine was not moving and while they were driving on the field were interviewed afterwards. To receive their impressions/ and to analyze the results, users had to answer a questionnaire including 5 additional further questions to explicitely write down their individual feedback. . Users reacted positively towards the applications of gestures. The entire range of testing for this study, the results, a summary, as well as an outlook will be presented in this paper.

1 Introduction

With each passing day, people are becoming more acquainted with touch devices, such as mobile phones, tablets, laptops, ATMs, etc. The interaction via touch and voice entry in head- and eye-tracking devices are becoming in the focus of attention, while touch technologies are constantly being developed and improved. First, they were limited to single or dual touch systems and nowadays they are most likely multi-touch enabled. Various touch technologies include Resistive, Capacitive, Surface Acoustic Wave (SAW), IR, and vision-based technologies. In particular, Resistive, SAW and IR touch displays can support single or dual touch detection as well as limited gestures since they might be noise-sensitive. In contrary to resistive touch displays, capacitive ones, such as the Projected Capacitive, not only support natural gesturing, intuitive gesturing and multi-touch detection but also are highly durable as they can be protected by protection

surfaces without suffering any problems in functioning properly. Most new smart phones, tablets, and multi-touch laptops have them.

Research approaches on the topic "Mobile End Devices in Agriculture" have confirmed that there are just a few publications or analyses of applying gestures during the standstill and the ride on the field. For this reason, a survey was conducted in collaboration with John Deere GmbH & Co. KG and the DFKI GmbH (German Research Center for Artificial Intelligence GmbH) in order to find out if the touch gestures, during the standstill of the machine and during the ride through the field, are applicable. Afterwards, the twenty test persons had to fill out a multiple choice questionnaire and respond to five open questions which should evaluate their sensations during the ride. During the process, it became obvious that gesture applications during standstill of the machine are applicable without restrictions and that the test persons despite of different impacts while driving, had a positive attitude towards the applications. This article will take a closer look at their study and its results.

2 Material and Methodologies

In order to conduct the implementation of the study in a device-independent manner, the test persons were provided with the tablet Asus Eee Slate EP121 including a 12,1 inch display which is similar to today's displays in the tractor cabs. The test persons' familiarization with these technologies should be guaranteed and kept within a limit. Furthermore, the tablet was located in a position where the cab display is also found in modern standard tractors. After selecting the appropriate hardware for the experiment, the software¹ was implemented for the next step. The gestures in the study varied in the level of attention required to perform them and they were applied by scrolling up and down, rotating objects, zooming in or out, dragging or pulling objects from different directions on the display, drawing a check mark, and wiping the screen. Moreover, gestures that need high attention were also included, such as tracing a straight and a wavy line.

A total of fourteen different tasks have been tested which were carried out while driving and while the machine was at a stop. For practical reasons and due to the comprehensibility, a questionnaire was used within the framework of the study for the evaluation and analysis of the test persons' assessments. The questionnaire was divided into two separate parts and was available to be answered on a laptop on-site right after the test phase. The first part consists of a questionnaire with a total of ten closed questions. Each question is rated with a scale ranging from 1: "does not apply at all" to 5: „fully applies." Consequently, the test person had to answer five open questions in order to receive data about the expectations and the related user satisfaction. The experiment was conducted with twenty persons ages twenty-five to fifty-seven. These persons were classified within the framework of the study, according to their experiences

¹ There are many operating systems, such as Android, Web OS, IOS, Win7, which offer the possibility to use gesture applications for the respective technologies. In this context, it is significant to note that depending on the operating system not all of the gestures can be used. However, it is possible that these gestures could be used in the future.

with tractors (beginner, advanced and expert) and their experiences dealing with multi-touch gestures (no experiences, beginner, advanced and expert). The evaluation took place via self-assessment of the participant. All test persons received a short introduction of the test procedure. During the explanation of the test procedure, the test persons became familiar with the test phases consisting of Phase I (stop of the vehicle) and Phase II (drive on the field). After conducting test phase I, the questionnaire with the closed and open questions was available for the test persons on a laptop on-site. Consequently, the test persons completed phase II and filled in the questionnaire again.

3 Results

To receive the feedback from the test persons, ten closed questions were formulated. In this part of the study different answers are compared with each other. The greatest frequency of the test persons' responses to the assessment is found in the middle area and was conducted from seventeen users who want to use such technologies on a regular basis. Only two of twenty persons who would not use such a system while driving the vehicle on the field did not have any difficulties using them while the machine was at a stop. One of the persons who would not use the gestures while driving was a fifty-year old male test person who does not have any experiences with gesturing. At first sight it was unusual for him using gestures during the drive; however, he had no difficulties using them when the machine was stopping. In his individual answers he wrote that he would be willing to use such systems after getting used to them. Based on this result, a general statement can be made, that test persons have not experienced any difficulties using the multi-touch systems during the stop of the vehicle. Since in this test not only more easier gestures are being used, such as Drag-Flick with the finger to the right or left but also rotating or zooming of images. Moreover, it was significant to find out if the test persons experienced the gestures that were selected for the test as unnecessarily complex.

Most of the test persons experienced the gestures both during the stop of the vehicle and while driving in the field as being too complex. In this context, the aspect of familiarity with the gestures in advance plays a major role. Test persons who knew the gestures but had less to not any experiences with tractors, experienced the gestures as being not that difficult. However, using them while driving the tractor was more difficult for them. Another remarkable aspect was that the concentration of the respective test person increased when it came to using the gestures and so they drove more slowly because of that. One direct comparison to it can be demonstrated with how long the test persons needed to use the gestures during a stop of the vehicle and while driving. This is shown in the next table which highlights the selected gestures for the test.

Based on this information, the question arose if another person is needed in order to complete the gestures. This person would initiate the gestures so that a secure application can be guaranteed. All test persons with one exception, however, were of the opinion that they could complete the gestures without external assistance. Another question was posed if there were any gestures missing and the double tap and the touch & hold gestures were mentioned in their responses.

Gesture	Still [sec]	Field [sec]	Gesture	Still [sec]	Field [sec]
Trace straight line	1.41	2.13	Drop	1.35	1.78
Trace wavy line	2.46	2.87	Drag-Flick left (One finger)	0.54	0.7
Rotate	2.73	2.42	Drag-Flick left (Two fingers)	0.6	1.03
Scroll down	1.32	1.44	Pull image out	1.07	1.12

Table 1: Time required for completing the gestures

To sum up, one can say that the test persons were very open-minded about using the gestures and have felt especially more safe and comfortable after repeatedly using the gestures. This was confirmed with the answers during the stop of the machine, such as "I felt more safe in using the gestures". And only two persons did not feel safe while driving and using the gestures. The most pleasant gestures were scrolling (down), dragging, pulling out, check mark, and zooming in and out. The most analogous statements were "I would continuously use such a system as long as the user surface is easy and the gestures in the applications are intuitive" and "I experienced the gestures as being very intuitive in their application. It was like using a smartphone." One test person noted the following in the open part of the questionnaire and this data should not be disregarded for subsequent studies: "Using the gestures while driving through road traffic can become very dangerous because one not only needs the concentration on the screen but also simultaneously pay attention to the road." Indeed, regarding the gesture applications especially with machines which have to follow the field lines on the field with GPS so that the user does not have to pay 100% attention to the field, should not cause any problems for the participants of this study.

4 Conclusions

Most of the test persons, irrespective of whether or not they were beginners or experts, were very open-minded about the multi-touch applications. Without losing sight of the aspect regarding safety, they would also use such systems while driving on the field. In this research field there is still a very great need for further research. Multi-touch applications for agricultural devices should be examined and evaluated with regards to acceptance, added-value and safety despite increasing acceptance within society.

References

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