Remote Control Tractors

Team 2

Stage 5 - Evaluate

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Client: David Hedley and Shelby Spivey, Caterpillar.

Participants/Customers

- **Total Number of Participants:** 6
- **Actual characteristics:**
  - Interviewee 1
    - **Age:** 28-30
    - **Gender:** Male
    - **Designation:** Student at North Carolina State University
    - **Years of driving experience:** More than 5 years
    - **Familiarity with tractors(out of 5):** 3
    - **Prior exposure to remote control vehicles:** Yes
  - Interviewee 2
    - **Age:** 20-23
    - **Gender:** Female
    - **Designation:** Student at North Carolina State University
    - **Years of driving experience:** 1-3 years
    - **Familiarity with tractors(out of 5):** 3
    - **Prior exposure to remote control vehicles:** No
  - Interviewee 3
    - **Age:** 24-27
    - **Gender:** Female
    - **Designation:** Student at North Carolina State University
    - **Years of driving experience:** 1-3 years
    - **Familiarity with tractors(out of 5):** 1
    - **Prior exposure to remote control vehicles:** No
  - Interviewee 4
    - **Age:** 28-30
    - **Gender:** Female
    - **Designation:** Student at North Carolina State University
    - **Years of driving experience:** Under 1 year
    - **Familiarity with tractors(out of 5):** 1
    - **Prior exposure to remote control vehicles:** No
  - Interviewee 5
    - **Age:** 24-27
    - **Gender:** Male
    - **Designation:** Working at a company
    - **Years of driving experience:** Under 1 year
    - **Familiarity with tractors(out of 5):** 1
    - **Prior exposure to remote control vehicles:** No
  - Interviewee 6
    - **Age:** 28-30
    - **Gender:** Male
    - **Designation:** Other
    - **Years of driving experience:** More than 5 years

        - **Familiarity with tractors(out of 5):** 1
        - **Prior exposure to remote control vehicles:** No
- **List of Characteristics**
    - **Wanted characteristics:**
        - Different age groups
        - Different levels of driving experience
        - Some familiarity with the tractors and its operating facility
    - **Unwanted characteristics:**
        - Unbalanced gender ratio
        - Participants who have not driven any remote-controlled vehicles
- **How we recruited them**
  We designed a screening survey and sent them to our friends, engineers as well as students who are not in our class and have not heard about this project before. We assigned random anonymous ids to them without collecting their name, email, or any information that might identify them. Then we selected six people who matched the characteristics we wanted from all the responses.
  Link to the screening survey is listed below:
  https://docs.google.com/forms/d/e/1FAIpQLSdGWNar_NIZI22GAE30nFBx2pMynM90Ma3NcQYDiSqWupRt9Q/viewform?usp=sf_link

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Lab

- **Lab setup**
  We conducted the meetings remotely using the online chat rooms. In order to not make the participants feel nervous, we followed the professor's advice and limited the number of teammates in the chat room to three because we cannot set up a different room for monitoring the 'in-person' interviews. This means that two observers and one interviewer were in the same chat room with each interviewee.
  We hosted the prototype online so that the interviewees could easily go through the prototype and the team members could observe interviewees. They took notes while the interviewees shared their screens.
  After all the interviews we met up online, shared our findings, discussed patterns, and 'follow up' suggestions.
- **Tools Used**
    - Justinmind: for the prototype
    - Google Form: for survey
    - Google Meet: for online interviews
    - Google Doc: for documentation

Interviews

- **Script**
  "Hello! My name is _____. Thank you for taking out your crucial time for us from your busy schedule to participate in our Usability Testing Study. We will be walking you through this session today. We will explain what you have to do in this study. You will be given time for any questions, doubts that you have during as well as after the interview.

  A little background about this project is that we have to give nice ideas about designing a user interface of the remote controller of the Caterpillar company which is in Raleigh. We have visited that company and we really loved that trip to the CAT. We got an opportunity to drive a tractor using a remote controller. We have developed a simple prototype using 'JustInmind'. It does not contain any actual functionality because that's what our role was in this project. We are looking forward to having a nice user interface for this remote controller. The view is simply a graphical creation having the interconnecting links known as the wireframes. The navigation is represented by clicking on the arrows/links which will navigate you to different wireframes.

  Your duty is to evaluate the ease-of-use of the prototype as well as the overall feel of the prototype. Let us tell you that we will be evaluating our prototype, not you. If you find the prototype difficult to use or anything that you didn't like, then that information will be really useful for us because, at this time, you are our customer. According to your views, we will try to improve our prototype.
  Before we begin, we would like to ask you some questions.

  (Begin the interview process which is explained in details in next section)

  (After the interview) Thank You So much! Stay Safe!"

- **Interview Process**
  - Before we let the interviewees test the prototype, we asked them the following questions:
    - Could you think of some challenges you would face driving a tractor?
    - Would you prefer driving in the tractor or driving remotely? Why?
  - Then we let the interviewees play with the prototype. We let them play freely for one minute. After that, we pointed out the key features of our prototype and let them walk through the features one by one.
  - After the interviewees went through the prototype, we asked them the following questions:
    - On the scale of 1-5, rate the prototype created by us!
    - On the scale of 1-5, rate the below features of the prototype:
      - Combination of mobile app and remote controller
      - Tutoring system for inexperienced users
      - Physical warning button system functionality

        - Power on-off indicator light system on the remote control
        - Object detection and warning system
    - Which features did you like? Why?
    - Which features you didn't like? Why?
    - Please give us suggestions on how to improve/modify our prototype.

- **Grid produced**

	1	2	3	4	5	6
Combination of mobile app and remote controller	**Positive:** Looks like a fancy idea **Negative:** Different mobile phone sizes may cause problems	**Positive:** Can make an update of remote control system easy with mobile app	**Positive:** Liked this feature the most, having a view of an onboard camera will help the person have better steering control due to the awareness of orientation of the tractor	**Positive:** Liked the idea of having a remote control like this **Negative:** Mobile phone battery may not have enough power	**Positive:** Can separate the display and control parts, the mobile app brings the huge potential of extension	**Positive:** Cool idea
Tutoring system for inexperienced users	**Negative:** Didn't understand what it will teach users about clearly	**Positive:** A good place to get started **Negative:** Seems too simple	**Positive:** Many tractor drivers don't use remote control now. Transitioning them to remote control is important	**Positive:** Visuals look pretty helpful **Negative:** Not enough details	**Positive:** A tutoring system helps drivers drive safe **Negative:** No interactions in the tutoring system at all	**Positive:** Very helpful for a new driver
Physical warning button system functionality	**Positive:** Straightforward and easy to use **Negative:** It's possible to miss-click	**Positive**: Looks like an important feature for safety	**Positive:** Good for preventing accidents	**Positive:** Not a bad idea **Negative:** What if users miss a click	**Positive:** This function looks quite essential and easy to use	**Positive:** May save people's lives **Negative:** Maybe useless in places where there's no signal
Power on-off indicator light system on the remote control	**Negative:** Doesn't look like an important feature	**Positive:** Good idea to make the power status obvious	**Negative:** Seems to be redundant and is not necessarily an important element.	**Positive:** Can remind users when they forget to turn off **Negative:** Doesn't look like		**Positive:** Could be an environment al-friendly feature by reminding

				an important feature. All remote controllers nowadays seem to have this function		users to turn off
Object detection and warning system	**Positive:** The object detection and warning system will be very useful to drive the tractor remotely as it will enable the driver to be aware of any obstacles in the ground	**Positive:** Provides more safety to the user of the tractor	**Positive:** 1.Smart feature! Because it should be able to handle the end of the road or some obstruction in the path else it can lead to accident damage to the vehicle 2. Provides more safety to the user of the tractor **Negative:** 1. What if the object being detected and locking of the tractor is the one that actually needs to be moved around? 2. Detecting any object may not be feasible in real-life settings. If it's not sensitive enough, it may be hard for people. But if it's too sensitive, it may stop even if any stone falls down from the wheels.	**Positive:** Best way to avoid any unfortunate accidents	**Positive:** Since we are controlling it remotely, it's difficult to identify how big an object is. This feature can be helpful under such circumstance	**Positive:** The biggest problem while driving a tractor is that it is hard to catch all the surrounding information. So, having such a feature will help us a lot

Results

- **List of patterns we found**
    - General
        - Participants thought of our prototype positively as a whole. The average rate of our prototype is 4 out of 5

        - Most participants found driving tractors challenging due to their dimensions and power, and hence preferred remote controller for driving the tractors
    - Combination of mobile app and remote controller
        - Participants liked this feature with an average rating of 4.5
        - Some participants believed that the mobile app can bring huge potential
        - There are some concerns about mobile phone size. Some say that larger phones may not fit well with a remote controller.
    - Tutoring system for inexperienced users
        - In general, participants believed that the tutoring system is helpful
        - Tutoring system is not interactive enough and lacks details too
    - Physical warning button system functionality
        - This feature is highly popular with the rating of 4.7/5
        - Participants believed that this system was easy to use and could be very helpful for the driver's safety
        - There are concerns about misclicking of the button
    - Power on-off indicator light system on the remote control
        - This feature received the lowest rating of 3.7/5
        - Some participants believed this feature can be useful
        - Most participants found this element redundant
    - Object detection and warning system
        - Opinions about this feature seem to be mixed
        - Generally participants believed that this function is important for safety
        - Concerns about the feasibility were voiced by some of the participants

- **Follow up we recommend:**
    - Overall the prototype is a success. We recommend few minor changes as:
        - For remote controllers, two separate controls for raising and lowering the bucket are likely to cause confusion. So, we recommend using joysticks for steering.
    - For combination of mobile app and remote controller
        - Try to support different mobile phone sizes and the power capacities
    - For tutoring system for inexperienced users
        - Add more details into the tutorials session
        - Make the tutorial more interactive so that the users can have a better learning experience
    - For physical warning button system functionality
        - Add some safety mechanism to prevent misclicking
    - For power on-off indicator light system on the remote control
        - Remove the feature as it's not much useful
    - For object detection and warning system
        - As the system should be reliable enough to distinguish real hazards from the ordinary objects at a job site, we recommend putting into more effort into this feature to make successful