Remote Control Tractors

Team 2

Stage 1 - Research

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Client

David Hedley and Shelby Spivey of Caterpillar.

Long Term Goals

Caterpillar is the world's leading manufacturer of construction and mining equipment, diesel and natural gas engines, industrial gas turbines and diesel-electric locomotives. They own a complex portfolio of brands whose roles and relationships support the growth to achieve their own enterprise goals. We have got the opportunity to work on an interesting project. Our main focus is to improve the user interface of the remote controller which is very important in controlling the machine real-time activities.

Challenges

Safety

Since the product we are going to work on is a remote controller, and target users including both experienced operators and novice operators, safety could be a main challenge. If users

misunderstand the User Interface and press the wrong button unconsciously, the machines could be risky for people standing around. Or if the connection between sent command and machines is prolonged or stuck, the machine might dig in the wrong place and cause damage to its surroundings.

Cost

To maximize the usability of the remote controller to avoid risks at the technical level, carriers for remote control and base stations to transport signals are necessary. In the future, traditional carriers such as joysticks might don't fulfill the increased needs. To keep on the same page with possible customers, techniques for remote control will be updated. Thus, the cost of a great remote control would be a problem. For designers, if the blueprint is Utopian, the cost for accomplishing the blueprint would also be unforeseeable.

Visibility

After discussion with two clients from Caterpillar, we realized that lacking visibility was a big issue for both inside-machine operators and remote control operators. Caterpillar already designed two cameras, one in front and the other in back, to help operators get to know the surroundings. However, there is still a dead zone for operators. Also, we learnt it would be too expensive for Caterpillar to install more cameras. When future operators interact with our remote User Interface, missing visibility might still be a challenge, since interface design cannot solve everything.

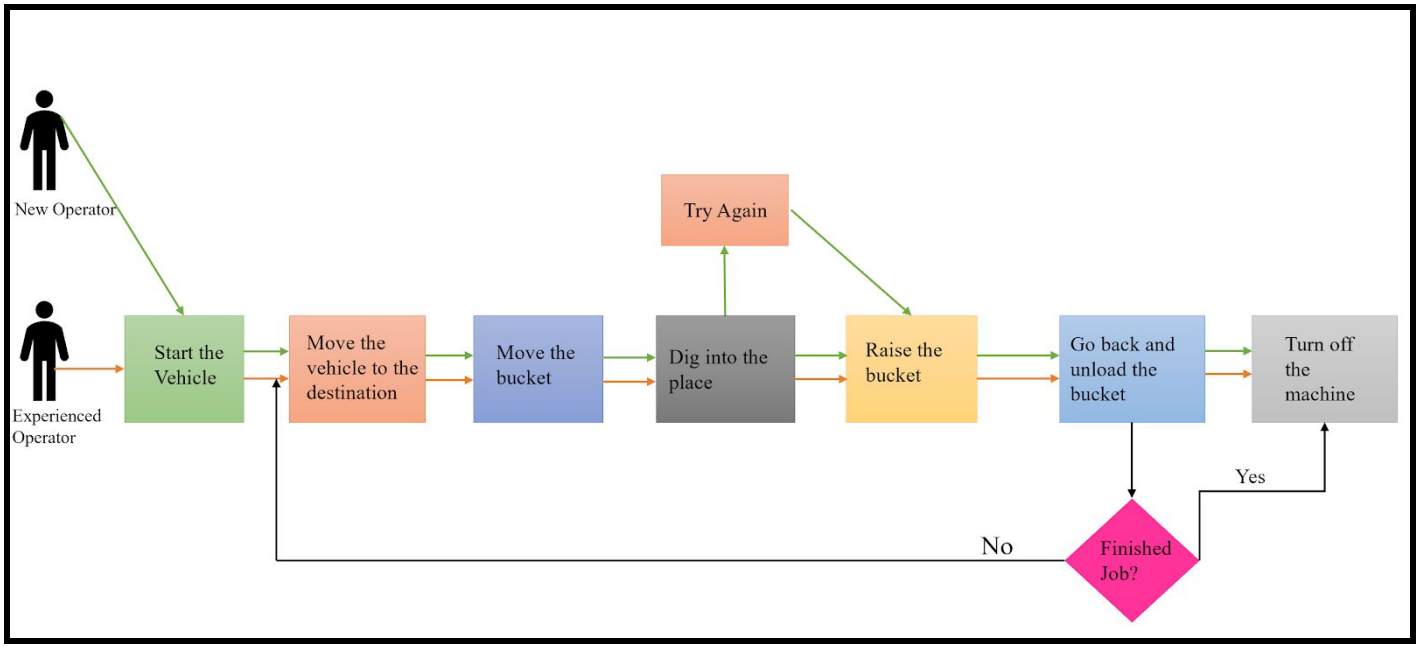
Communication with new operators

New operators will be one of our target users. Compared to experienced operators, new operators have no prior knowledge in interacting with the remote controllers. Therefore, we should have efficient and straightaway communication with the new operators before they start. No matter which type of controller we provide, such as a cell phone APP, the communication with new operators can be a challenge based on the 47 functions required. It can be difficult for new operators to remember where and when to use a specific function.

Test

Based on what we control is a huge machine, e.g. the operating weight of Compact Track Loaders 299D3 is 11464lb, we should be very cautious when we are testing with the remote controllers. Due to limitations of usable sites and various operators, unexpected cases can happen during the test. However, it's unavoidable because of the necessity for a large amount of tests before a new controller is devoted to the market.

Experience map



Expert notes

Mr. David Hedley and Ms. Shelby Spivey from Caterpillar gave us a presentation about the current scenario and issues they are facing right now. After a detailed discussion with them and Dr. Watson, major points are documented as follows:

Background knowledge about Caterpillar products:

- Caterpillar has 8 BCP (Building Construction Products) families with more than 70 models.
- Caterpillar has sales of 5 billion dollars and sites all over the world.

Terminology:

- Cab: Enclosure to the operator, sometimes environmentally controlled.
- Operator station: UI for the operator; Seat, HVAC, controls, displays, entertainment, etc.
- CTL and SSL: Compact Track Loaders and Skid Steer Loaders

Current scenario:

Remote control is used in Caterpillar's Skid-steer Loaders for the following purposes:

- Use emerging technology to solve existing construction problems
- Take operators out of unsafe environment
- Improve site productivity
- Make it possible for disabled operators to work

Right now the remote control UI has 47 functions, each corresponds to a function of skid-steer loader dashboard. Functions includes:

- Ignition methods
- LED warning indicators
- Work tool indicators
- Left/right hand joystick
- Emergency stop
- Speed control
- Creeper control
- Auxiliary control
- Parking brake switch
- DPF regeneration warning
- Machine angle warning

Current issues:

- Operators might not be onsite but the machines are there, so there may still be safety issues when animals or other machines approach the machine
- Inexperienced operators may have difficulty using remote control
- Visibility issues as we don't have view inside the bucket

Possible improvements in the future

- Use cell phones for the real-time remote control

Problems/opportunities

Ensuring Robustness:

The vehicle in discussion is meant to be operated on construction sites where the terrain is usually uneven, ruggy and rough. So, the operators need to be mindful of the area they are working in and any obstacles they may encounter. Any damage to any of the safety devices placed on the vehicle might not only raise safety concerns but could also cause permanent damage to the devices. How might we make modifications to the design such that more protection is provided to all the delicate and fragile parts on the outer side of the vehicle?

Scalability:

The software on the remote controller must be scalable. We must be able to add features, update existing features and provide bug solutions just by updating the software. Both the controller and vehicle must be relying more on the software aspect when compared to hardware as the cost to up-scale software is way cheaper, how might we find an opportunity to build such software?

Authorized login:

Safety is a major concern when operating the vehicle in harsh environments so the operator needs proper training before operating in such environments. It is important that no one else gets

access to working with the vehicle. How might we add a feature to the software which only allows users to operate the control only if they are authorized?

Target

Customer type: A remote control operator.

Event: Controlling a skid-steer loader.

Problem: Our team will try to improve upon the current user experience of the tractor's remote control, allowing the driver to operate the tractor with ease outside its cab, when he/she can visually access the tractor or when off the job site.