Remote Control Tractors

Team 2

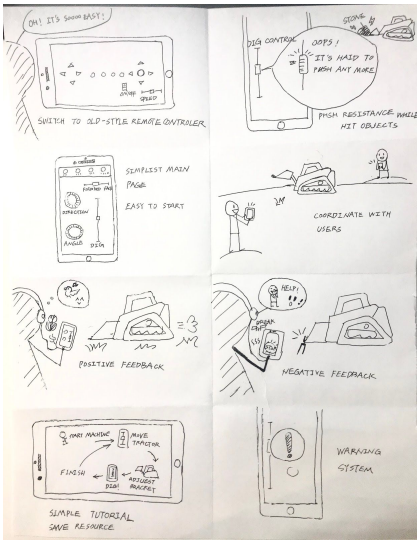
Stage 3 - Choose

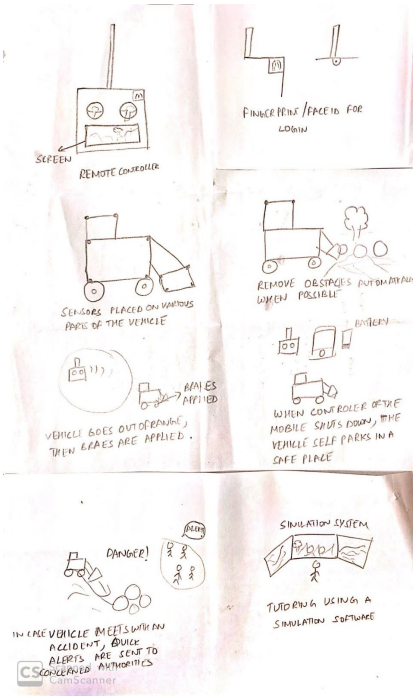
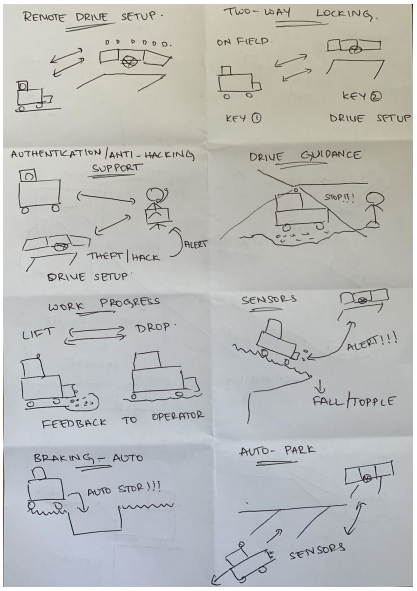
Name	Unity ID
Ge Gao	ggao5
Rithish Koneru	rkoneru
Srinivas Nethra Padala	spadala
Yudong Rao	yrao3
Shreya Tangri	stangri
Hongyi Fan	hfan4

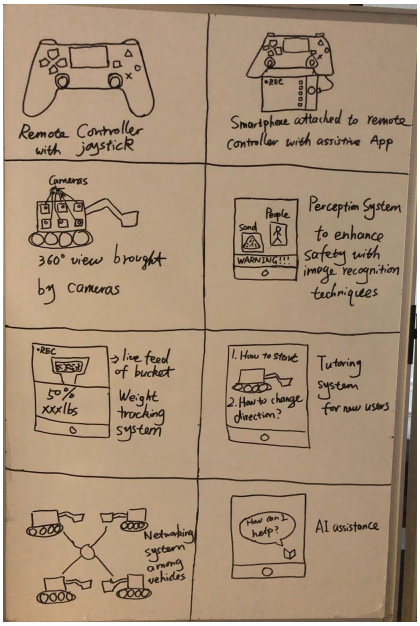
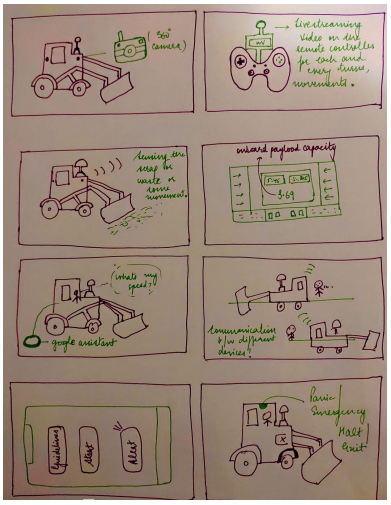
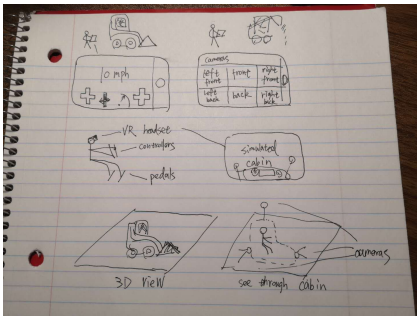
Client: David Hedley and Shelby Spivey, Caterpillar.

Displays and Votes

Important things: 1) Since all classes and meetings are virtual, so to keep procedural fairness, one teammate presented all teammates' solutions with Crazy Eights, wrote down ideas represented by Crazy Eights, and then all teammates voted online. 2) Since, some ideas were duplicated among the teammates so, we are only writing down the duplicated ideas as one for voting.

Solutions (Presented as Crazy Eights)	Ideas	Votes
	1. Embed phone app with physical controler	Hongyi, Rithish, Srinivas, Yudong
	2. Sounds and smells immersive experience	
	3. Sensor to detect objects: give feedback to users easily	Ge, Srinivas, Shreya, Hongyi

	4. Universal controller	
	5. Secure login	Rithish
	6. Fail-Safe System	Ge
	7. Tutoring system for inexperienced users	Yudong, Hongyi
	8. 360 view cameras	
	9. Vehicle alignment scale	Srinivas

	10. Weight tracking system (for bucket)	Rithish
	11. Networking with other vehicles	
	12. Enhance user experience with AI	
	13. Intelligent battery of the remote controller	Ge
	14. Onboard payload sensor	Shreya
	15. Live streaming video	Shreya
	16. VR control station	

Notes

Ge
I voted for sensors to detect objects, fail-safe systems, and intelligent batteries. I liked the sensor idea and fail-safe system idea because it is always crucial for safety of tractors, no matter what is used to control them. It could be hard for remote controllers to focus on controlling while keeping caution on surroundings. It would be great if the system can monitor surroundings and provide safety feedback to users. I liked the intelligent batteries idea because it is novel for tractors controlling and practical.
For a single straw vote, I choose sensors to detect objects as I think safety is one of the most important things to be cared for tractors.

Rithish
I voted for embedding a phone app with the controller, secure login and weight tracking system for the bucket. I think using a phone app with the controller would give us the opportunity to easily add features when required. Also, using the secure login feature would be much easier if we embed a phone app with the controller. Once, the app is developed we can make use of the fingerprint scanner or face ID available on a mobile app to authenticate users. Finally, the weight tracking system for the bucket is crucial for ensuring the safety of both the vehicle and the user.
For a single straw vote, I choose to embed a phone app with the controller as I believe adding this feature would give us room to add and develop more features in the future.

Srinivas
I voted for the vehicle alignment scale, embed phone apps with physical controllers and sensors to detect objects (give feedback to the users easy). The idea of having real-time vertical and horizontal alignment of the skid-steer would allow us to avoid hazards like the toppling or any similar uncertainties. In addition to this, we can have sensors around the vehicle which notify when there are objects in the way of the vehicle that can cause accidents. I also liked the phone application idea since it makes it easier to make the controller available to any smart device and updating the software is easy.
For a single straw vote, I will choose the sensors to detect objects, this is a feature that makes a difference when you are controlling a skid-steer remotely when the possibility of accidents is high.

Yudong
I voted for embedding phone apps with physical controllers and a tutoring system for inexperienced users. I voted for them because I thought they are essential features that have proven successful before. Embedding apps with controllers work very well with drone operations(DJI Mavic Mini). It can effectively reduce the number of buttons on controllers, making controller design less complicated. And a tutoring system, if well designed, can resolve the safety issue efficiently.
For the single straw vote, I chose embedding phone apps with physical controllers because I thought it is the key feature of our project. We will have a lot of flexibility in the app and controller design and resolve a lot of issues with careful design. So I believe that this is the most important feature to implement.

Shreya:
I voted for Onboard Payload Sensor, Live Streaming Video, Sensing the Obstacles. I voted for them because I thought they can be well-integrated within a single solution and can offer varieties of features to the user but then I realized that there is something better that can be done based on the several new ideas introduced by my teammates. After going through all the ideas and also having a discussion with the professor and caterpillar clients, I changed my mind.
For the single straw vote, I would like to choose "sensor to detect objects" which is a very useful feature as it will give timely feedback to the users. With the help of a camera, it will sense any kind of obstacle and will raise an alarm. I feel this is one of the most important features in the tractor and therefore, should be implemented.

Hongyi
I voted for embedding a phone app with a physical controller, sensor to detect objects and tutoring system for inexperienced users because they seem to be some of the most essential features for remote tractors and they can solve some current problems.
For the single straw vote I chose embedding a phone app with a physical controller because I think it helps drivers operate remote tractors the best.

Critique

Since we hold our meetings remotely, following the instructions on sprint on our course website, one team member (facilitator) introduced each solution (3 min per solution) and stressed the ideas (1, 3, 7) with many votes. For each idea, the originator of the idea remains silent by muting himself or herself and later revealing themselves in the end. To make sure that the opinions from each person are well-recorded and respected, we recorded our meeting with consent from everyone in the meeting, and one team member (scribe) jotted down the opinions at the same time.

Critique from Each Member:

Ge
I didn't vote for 360 view cameras though it looked nice. To accomplish 360 view, cameras' quality or quantity are highly required for each tractor. To illustrate, we can choose to either increase the number of cameras on tractors, or highly improve the techniques of cameras. This could increase the cost for each tractor, thus raising concerns from buyers whether it is worth to buy the tractors so that they might seek a substitution from other companies.

Rithish
I didn't vote for adding sound and smell feedback for immersive experience because sensors around the vehicle do the same job of providing sound feedback and though the idea of implementing smell feedback is good, I think it would have little impact when the vehicle is mostly operated at terrains where smell Is usually the same. Apart from this, I really liked the idea of 360 viewing as I thought it would integrate well with the mobile application developed.

Srinivas:
I didn't vote for embedding apps with controllers because they deliver nothing in terms of haptic feedback, absence of hard-wired buttons makes it tough for a person whose controlling the vehicle to understand if he has given input, this could raise an ambiguity. I didn't vote for the VR control system because it is expensive to build such a system and scale it across different customers, moreover, it is not very flexible in the sites of work and construction.

Yudong:
I didn't vote for sensors to detect objects because I didn't think it's very essential given that we have cameras to do the same job. It's more than enough to solve the problem with visual feedback displayed in our mobile app. I didn't vote for the idea of tutoring system at last because I thought it's not as significant as the idea of embedding apps with controllers. While I'd be happy to implement all the features, priority must be taken into consideration.

Shreya:
I did not vote for "Tutoring system for inexperienced users" because I thought users will surely have a guidance before operating a tractor or a remote controller. He/she would be given training for this thing and hence may not need an app or some computer lessons for operating devices. I don't think anyone would like that! I did not vote for secure login because I thought the company already has particular members and there is a security check before entering the field. Why would any stranger or any person drive the tractor without any purpose. I believe all the ideas are really good and can be chosen but when it comes to the priority, I would choose a sensor to detect objects or anything in the device.

Hongyi:
I did not vote for secure login because I didn't think it focuses specifically on remote controlled tractors. I did not vote for VR control station because I think embedding phone app with physical controller is a better option to solve the same problem. I did not vote for tutoring system in the last vote despite thinking it is a great idea because I think embedding phone app with physical controller is more significant.

Summary

After discussion, we summarized what each team member stressed about 'likes or dislikes' and the reasons:

1. The idea 'Tutoring system for inexperienced users' is a controversial one. It has the most dislike votes. Three members said that they disliked this idea because: 1) It's not significant among all functions, 2) It looks redundant while guidance will be provided to users. Two of the team members voted for this idea.
2. The idea 'VR control station' got two dislikes for reasons: 1) It's not compatible compared to the embedding phone app with physical controller, 2) It's quite expensive.
3. The idea 'Sensor to detect objects: give feedback to users easily' got only one vote for dislike, while four people voted in favour for this idea. The reason for dislike is that cameras can substitute the sensor.
4. The ideas '360 view cameras', 'Sounds and smells immersive experience', and 'Secure login' got one vote for dislike with concerns about cost and suspicion of unnecessary functionality.

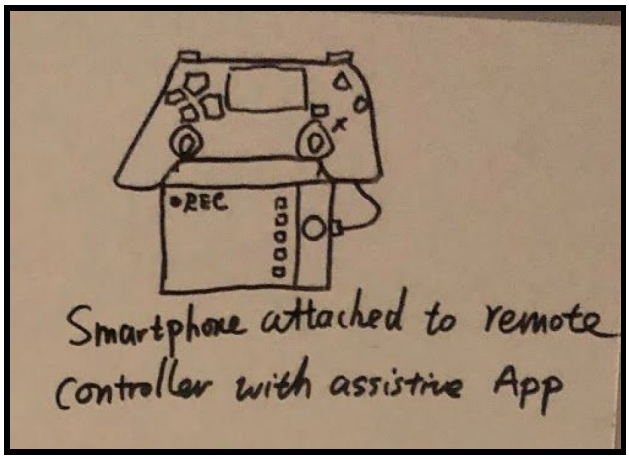
5. The idea ‘Embed phone app with physical controller’ got one vote for dislike while four voted in its favour. The reason for dislike is that it cannot provide haptic feedback to users, thus making it difficult for users to control tractors without hard-wired buttons.

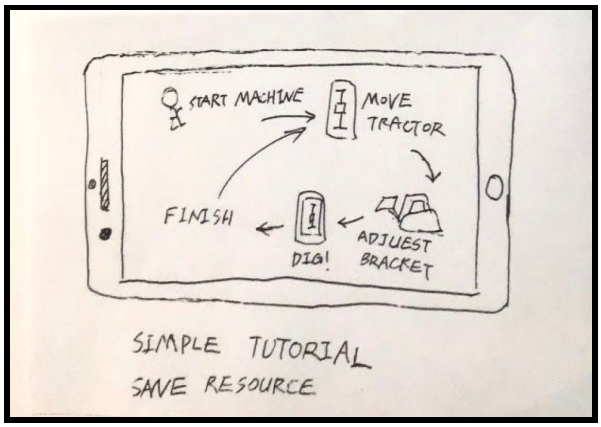
Straw and Decider Votes

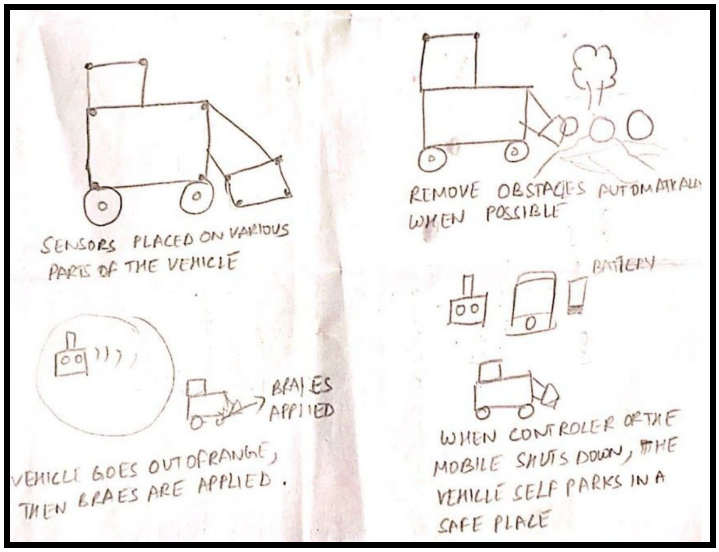
We invited David from Caterpillar as the decider to join our meeting. And we captured the three winners:

1. Embed phone app with physical controler
2. Tutoring system for inexperienced users
3. Sensor to detect objects: give feedback to users easily

The original sketch of the three ideas are shown in the following:







Merge or Not

We have decided to merge because the three features which we have chosen, can be well integrated with each other seamlessly. The sensors can be used to give feedback to the controller and help inexperienced users to operate the machine. The tutoring system can be a part of the mobile app that a user can select if he/she feels guidance is needed. The app with a physical controller can not only be used to control the tractor, but can also display information provided by the sensors.

Storyboard