CISC 325 ASSIGNMENT 2

Group 9

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Appendix

Idea

Our idea is to create a remote control glove, which can implement a function of a touch screen with just itself. Our group realized that nowadays when people are presenting on the stage, it's hard for them to do complex operations on their computers like drawing something, zoom in and out, etc. They have to get back to their computer, using a mouse or keyboard, which is inefficient. Our project would solve this problem. Based on different gestures the user does, the glove will send different instructions to the computer in order to make the computer does different corresponding operations. In order to achieve that, we would first buy the hardware accessories that we need for the project. The hardware would include gyro sensors, accelerometer, speed sensors, a Raspberry Pi, and some other sensors to track the finger action. Then, we will combine the sensors to the Pi and put all of them on the glove. Next, we will start developing our software so that the computer can receive and compute what gesture the user did. At last, we will keep testing it to ensure that our finished product would not have any errors.

References

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Design Decisions

We design the glove that can prevent the actions that are made by mistakes.

For example, functionalities of the gloves are not always active. They need to be activated by a special gesture. So every time if the user wants to do something, he or she needs to do the specific gesture first, so that the computer can react to the following movements the user does.

Another design would be to set a higher trigger value of the sensor, which can prevent small movements would not be triggered. For example, the user needs to fully stretch their index finger over 170 degrees to finish the click operation.

We want to design our glove to be user-friendly, so we will design our gestures that can be easily performed and learned by users. Users can learn how to use it in less than 5 minutes.

Task Analysis

The user uses the glove

1. Click

   1.1 Single Click

      Stretch index finger and restore

   1.2 Drag

      Stretch index finger and move the hand

2. Move Cursor

      Move the hand to the relative position to the screen

3. Slide

      Open hand and move towards a direction

4. Prepare to use

      Make a specific gesture in 2 seconds

5. Zoom

   5.1 Zoom in

      Open index finger and thumb, and then move them close to each other

   5.2 Zoom out

      Close index finger and thumb, and then open them

6. Use a virtual pen to write

      Move the hand to the right place and close thumb, index and middle finger like holding a pen, keep this gesture and start writing by moving the hand

Goals: User wants to use the glove as a touch screen.

Tasks: User wants to click, drag, move the cursor, slide, zoom in & out, and use a virtual pen to write.

Plans: 1. Click: user makes a specific gesture, then stretches index finger, then restore

2. Drag: user makes a specific gesture, then stretches index finger, then move

3. Move cursor: user makes a specific gesture, then moves the glove to the position

4. Hold and slide: user makes a specific gesture, then opens hand and moves to a direction

5. Zoom in: user makes a special gesture, then keep index finger and thumb open, and then close them

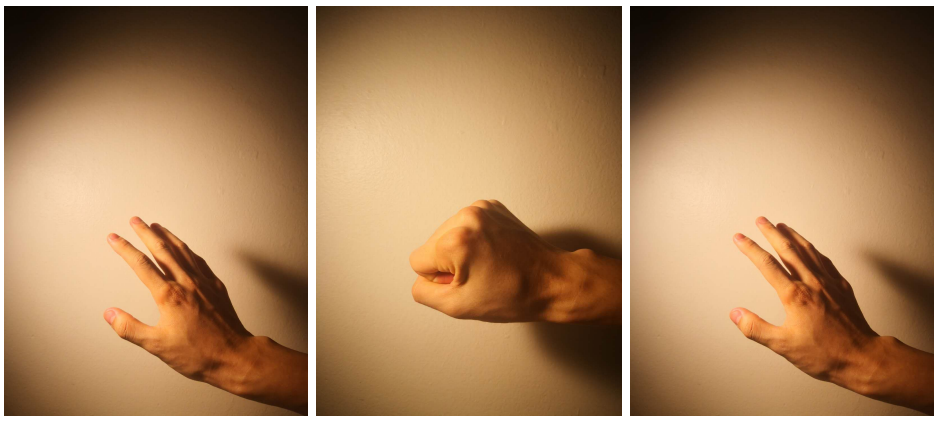
6. Zoom out: user makes a special gesture, then close index finger and thumb, then open them

7. Virtual Pen: user moves hand to the right place and closes the thumb, index finger and middle finger together

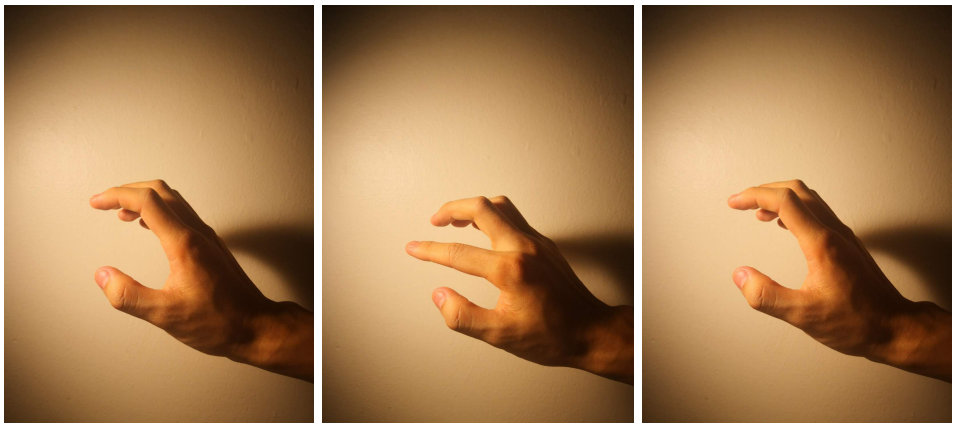
Why decide to stop at a certain level of details: We found that these gestures can cover almost everything that can be performed on a touch screen, it is not needed to include functions that are not important such like 3D touch.

Storyboard

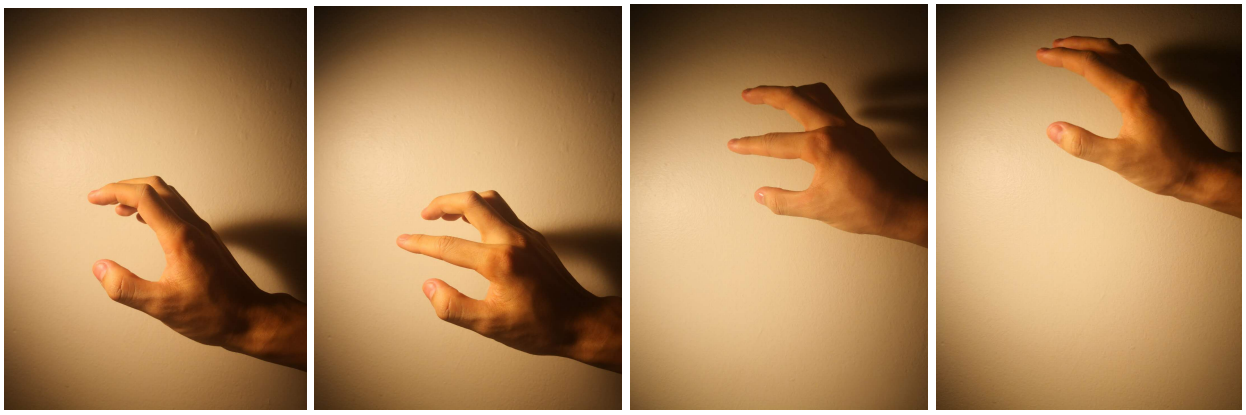
Before doing any gesture, the user needs to do a specific gesture to activate the glove, then the glove will catch the following gesture as instructions. The user can settle it by himself/herself. The user needs to complete this gesture in 2 seconds in order to avoid misoperation. For example, the initial set is: open hand, fist, open.



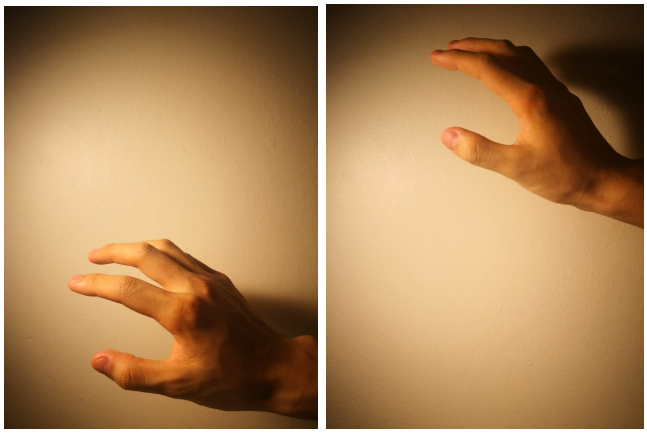
If the user wants to click something, stretchs the index finger, and restores.



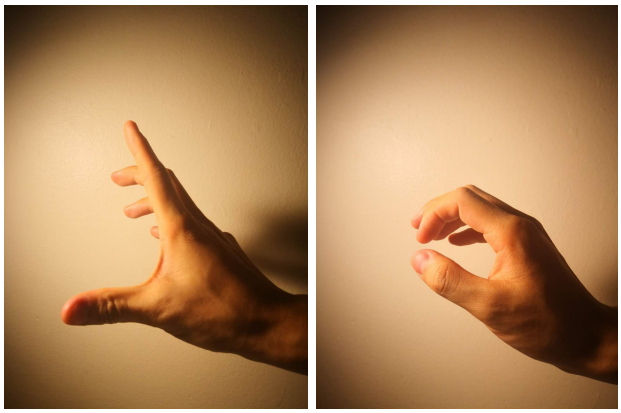
If the user wants to drag something, then stretching the index finger, keeping the gesture and moving the hand.



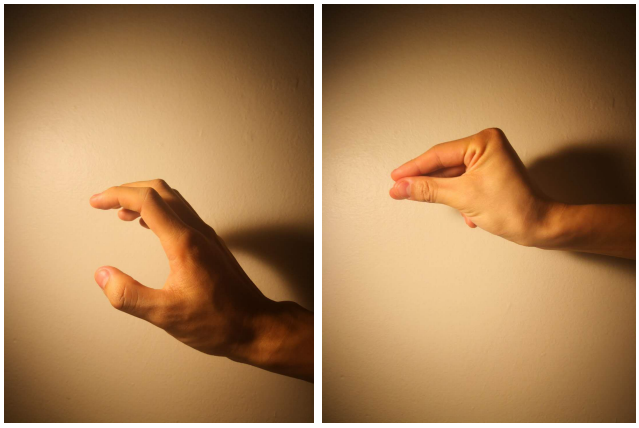
If the user only wants to move the cursor, just move the hand.



If the user wants to zoom in, then opening index finger and thumb, and then move them close to each other. Vise versa for zoom out.



There is a specific operation which does not need the pre-gesture to activate. If the user wants to use a virtual pen to write down some notes, the user only needs to move the hand to the right place, close thumb, index and middle finger like holding a pen, keep this gesture and start writing by moving hand.



Implementation

Hardware:

1. Create the general frame of the glove to place all the models that will be created in further work.
2. Create the hand movement action collect model based on Raspberry Pi with the accelerometer, speed sensor, and Gyro sensor.
3. Create the finger status collect model by using some mechanical structures and sensors connected to the glove.
4. Make the finger model adjustable to fit different users that have different hand sizes or shapes.
5. put all the models together to make the actual glove product.

Software:

1. Create a software entity for data collection to build the connection bridge between the user and the Raspberry Pi.
2. modify and add rules to the software in order to make it able to recognize the gesture that the user is performing.
3. Add constraints to the software to avoid user activating the glove accidentally
4. create Bluetooth connection entity to enable the connection between the glove and computer.

5. Create a computer-based software to process the information computer received from the glove and make the correct response.
6. Modify the computer-based software so that it can be customized by the user to bind one hand gesture to a response action on the computer.

Possible difficulties:

1. It might be hard to build the finger status collect model and make it adjustable.
2. Process the finger status information and translate it into the hand gesture may take a long time to build the database and algorithm.
3. Make the computer-based software customizable will take a huge effort.

Checklist:

Hardware	Software
Create the general frame	Create the data collection entity
Create the hand movement action collect model	Modify software to make it able to recognize the gesture
Create the finger status collect model	Add constraints to the software to avoid accidentally activate
Make the finger model adjustable	Create Bluetooth connection
Put all the models together	Create the computer-based software
	Make the computer-based software customizable

Integration

When the users move their hand, the sensors on the glove will continuously send signals to the computer, and the software inside the computer will receive the position change of each finger. Then the software will calculate and identify the gestures and perform corresponding operations on the computer. This system combines the glove, the signal receiver, and the software as a complete entity.

Tests

There are two phases of testing. The first phase of tests is performed after adding sensors to one of the fingers on the glove. This prototype limits the number of sensors tested and makes it easier to identify the problems. The second phase of testing is performed after completing all other sensors. Tests are mainly based on the signal transferring between the sensors and the software. There are five sets of tests:

1. Movement in x-axis
2. Movement in y-axis
3. Movement in z-axis
4. Movement in the combination of three axises
5. Movement caused by gestures

Hardware:

In five sets of tests, the signals are successfully sent by the sensors on the gloves in the correct axis.

Software:

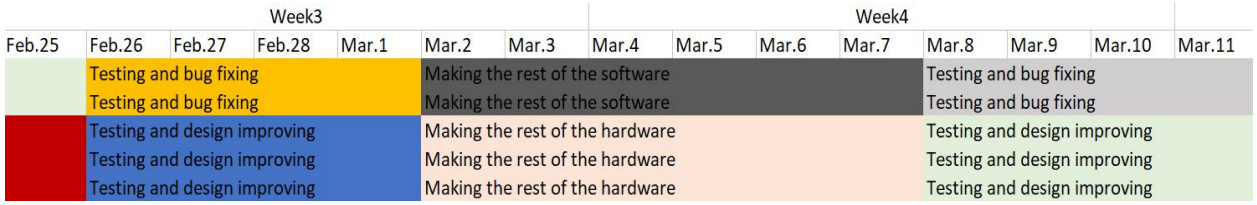
In the tests, the software should receive the signals from sensors and record the position change in three axises correctly. It also needs to successfully recognize certain special position change caused by gestures. At the same time, the software ought to perform operations such as cursor movements or drag on the computer or on other software (Powerpoint, Word, etc.) according to different position changes in sets 1, 2 and 3. In 4 and 5, it should perform designed operations based on gestures such as zoom in and zoom out.

Stretch Goals

The basic functions of our glove is to implement a touch screen. However, if we have enough time and resources, we may combine our glove with VR technology, especially in the field of video games. Nowadays, there are plenty types of VR equipment created and used by players. However, there are no controllers like our glove. Due to our research, the products depend on the complexity of software, limitations of application scenario and the final cost of producing. Our plan in the future is to design a piece of Somatosensory equipment with a shape of a glove which can precisely catch any movement on the user's hand. We will also build a VR game with a Medieval duel theme. In this game, the user will use different weapons such as swords or bows. The user could fight with other players in the game. Because the user needs to hold

different weapons and does various postures, the glove must be sensitive to catch movement, which will be a tough job. Furthermore, our group would also build not only gloves, but equipment that can be worn on foot, arms and so on. The quantity of work is huge, but it will be pretty interesting and commercially valuable, since our project provides strong hardware support for those crazy ideas which are not added to the game yet due to the limitations of the hardware.

Timelines



Contribution

Student ID	Name	Accomplished Tasks	Upcoming Tasks
20001744	Zili Luo	outline report	Design Architecture
10211404	Yingjie Jin	outline report	Install software
20013187	Mengfan Liu	outline report	Design Architecture
20031764	Hanzhe Zhang	outline report	Buy equipment
20018814	Chuyan Zheng	outline report	Buy equipment