Human Computer Interaction Using Accelerometer in Smartphone

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Abstract : As days go by mobile phones have become minicomputers equipped with many sensors due to advancement in microelectronics, which increases the processing power of these devices and has made possible new forms of input interfaces like gesture based user interfaces. Due to the increase in power a new type of interaction has been introduced in which the user interacts with the computer using movements or gestures made while holding a device or while interfacing with the device. We have developed a system which makes use of the data gathered from accelerometer and gyroscope. In the system, we have fixed gestures which are used to execute certain operations in the user's computer. With the development of this system our main aim is to reduce the user's dependency on traditional input devices like mouse and keyboard.

Keywords : Gesture, Smartphone, Inertial sensors, HCI

I. Introduction

Human Computer interaction using conventional input systems like Mouse-Keyboard have been around for past 4 decades now. There has been massive development in HCI, like remote input devices, Touch Screen devices, Gesture control systems. After touch screen devices, the most popular way of input is gesture input. Since the development of Gesture based input systems, there were many different versions for Gesture based input system. Most of the systems that used gesture based system used 3rd Party hardware like Wii Mote, input pointing devices, etc. While these systems could be used successfully they created a dependency on third party devices. The main motive behind development of current system is to rule out the need of a 3rd party hardware for Gestural input used for interacting with a computer system. Considering the number of Android devices available in current market and the Inertial Sensors that come with those devices we can use these devices for gesture based input for computer interaction.

Our main goals are:

- Utilize mobile phones inertial sensor.
- To control the computer system explicitly
- To rule out the need of Camera and infrared based devices for gesture recognition
- To recognize hand gestures using mobile phones sensors
- To use natural hand gestures for Human-Computer Interaction

II. Applications

- Cursor movement:

With the data obtained from the inertial sensors we can formulate a way in which the data can be used for cursor movement. This covers the basic usability of the app. This also covers the basic use of a mouse, a third-party hardware device whose use we aim to reduce. With the use of the app the user won't even have to use the mouse or the touchpad.

- Gesture Recognition:

Along with cursor movement we can implement a gesture recognition system from the gathered data. With the use of gestures the user gets an additional way to interact with the system. The user can record a gesture and then perform the same gesture to execute certain operations.

III. Methodologies

The starting phase of our system begins with the gathering of data from the mobile device. This data is fetched from the accelerometer. The data includes the values for the X, Y and Z axis. This data is used in the next part of the system. We have to make sure that the data that has been gathered has no discrepancies and can be used for further operations.

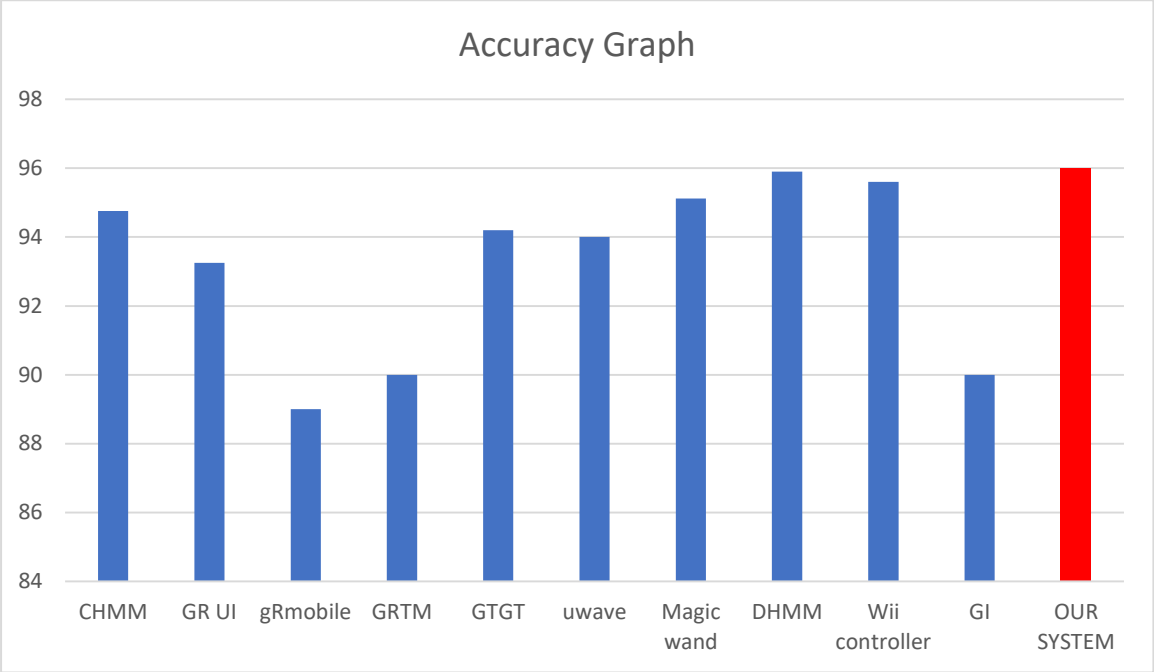
After the data is recorded we have implemented a gesture recognition pipeline. For this we have used the gesture recognition pipeline ideology provided by Nick Gillian in his gesture recognition toolkit. This gesture recognition pipeline allows us to introduce the sensor data into the pipeline. The sensor data can then be used to recognize the gesture and retrieve the predicted label from the last phase of the pipeline. After recording the training data we have used this to train the classification or regression algorithm at the core of the pipeline. The pipeline can be trained using the training data.

To implement the classification pipeline, we have used a powerful classifier call Dynamic Time Warping. It can be used to recognize temporal gestures. Temporal gestures are a

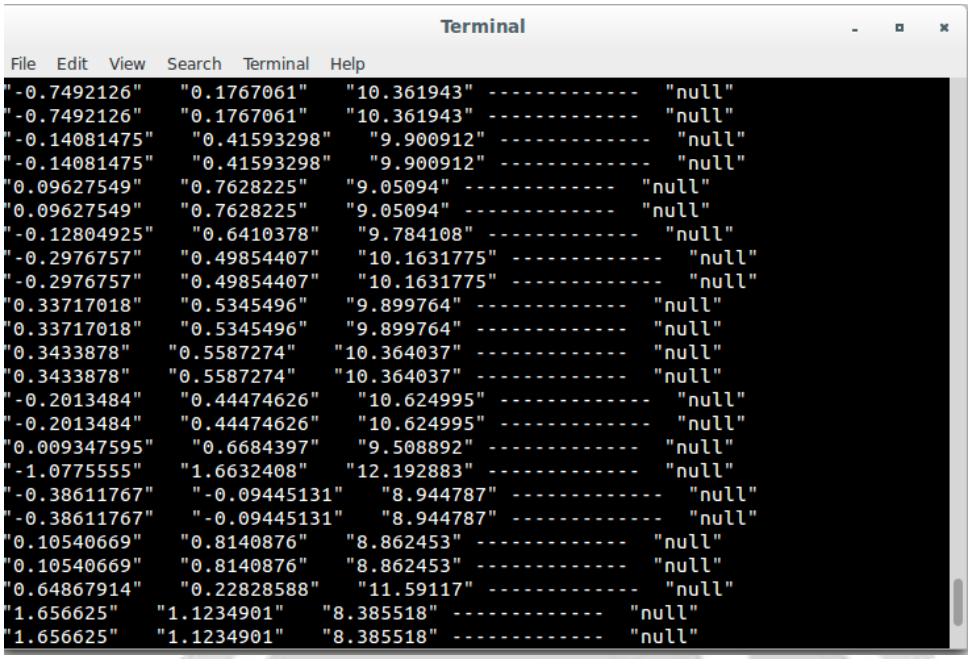
number or movements which take place over a given time period. DTW can be used to recognize the similarity between two gestures or data streams even if the whole data set does not match. This makes it very helpful for us to implement it in a gesture recognition pipeline.

IV. Results

According to the classifiers that we have surveyed we have found out the accuracy. Comparing this to our system we have implemented a system for cursor control along with gesture recognition which has never been provided before in the same system. While considering the gesture recognition pipeline we have achieved an accuracy or 96%. We have compared our system with systems implementing classifiers like continuous HMM and discrete HMM.



Along with the implementation if gesture recognition we have also successfully implemented the use of accelerometer data to control the cursor movement.



Cursor movement data

V. Conclusion

We have been able to implement the system successfully and accurately. What we have offered is a system which provides the functionality to have a cursor control and gesture recognition in a single app. We feel that due to this the user would find the application very helpful. From what we have tested the users are able to use the system fairly easily. Thus, we feel that we can achieve our goal to implement a system that can reduce the dependability on traditional devices. The future aspect of the system would be to improve the accuracy and increase the usability of the system.

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