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GESTURE RECOGNITION BASED LOW COST SMART BRACELET FOR SEAMLESS COMPUTER INTERACTION

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ABSTRACT

Gestures have recently become attractive for spontaneous interaction with consumer electronics and mobile devices in the context of pervasive computing. So that nowadays most of electronic researches doing under the Gesture Recognition based wearable computing topic. To identify the gestures, different kind of controllers and techniques were used depend on the gesture patterns. Most of the time, devices such as electronic gloves, bands, caps or cloths. The introducing SMART Bracelet system is a low cost, real-time gesture recognition capable device which enable the user to interact with computer applications via personalized gestures. It has an inbuilt accelerometer and gyroscope sensors which gather the motion data for gesture recognition. In the system these data manipulated by using filtering, positioning and quantization algorithms to achieve an efficient system. In this research, the SMART Bracelet was used as a presentation controller to implement its use as an application. While testing the device accuracy with the help of several users, majority of them adopt to the system immediate and gain the ability to repeat same gesture without any trouble.

Keywords: Dynamic Time Wrapping, Gesture Recognition, SMART Bracelet

1. INTRODUCTION

Gesture Recognition is one of the most interested topics in consumer electronics and wearable computing. It has been researched vastly due to its potential to produce enormous interaction capability to day-to-day life. Despite of the many different kind of gesture recognition techniques, e.g. Dynamic Time Wrapping (DTW) [1,2] and Hidden Markov Model (HMM) [3,1], still the field lacks a simple, efficient and real-time recognition method for wearable devices. Also, even the same gesture implementation can differ from person to person, thus, it is necessary for users to have the ability to create and to recognize their own personalized gestures[4].

In this research work, a bracelet based real-time gesture recognition method has presented which will be helpful for a broad applications scope. This work is mainly focused on developing and fabricating a device prototype which is low cost and has a real-time gesture recognition capability. It can support number of personalized gesture and can adapt to users from beginners to experts with higher flexibility.

2. EXPERIMENTAL

Firstly a unique gesture recognition model was developed for achieving efficient gesture recognition capability for minimum hardware support. One of main aspect for designing this model was to implement it in low cost consumer electronic appliances, like a bracelets or an arm band. The model requires only one gesture sample to work, as in uWave[4]. Unlike computer vision based methods[5], or three axis accelerometer methods[6], this model is able to work using data from one axis. Therefore it require less computational power in real-time processing. as the main reflection surface. Four LEDs were mounted in the central area of the reflector with equal distance. Two mirror like surface, side reflectors were added to reflector so that it will

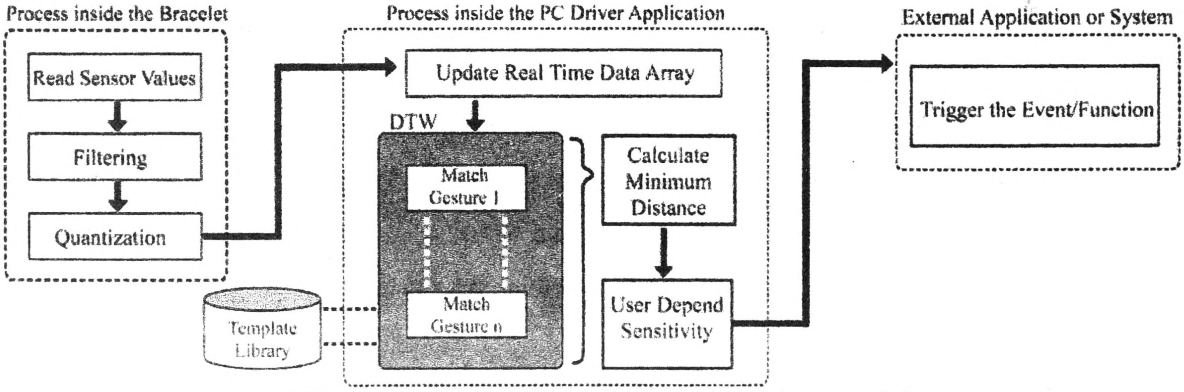

Figure 1: Real-time gesture recognition model

The developed bracelet is consisted of a MPU6050 module (Accelerometer sensor + Gyroscope sensor), a Bluetooth module, Vibration based feedback system, an Atmega328p based control unit and protection circuits. It gathers data from user using MPU6050. Then filter (Complementary Filter) them to gain higher accuracy using data from both accelerometer sensor and gyroscope sensor. Before transmit the real time data via Bluetooth, it quantizes the data set to reduce the length of the input time series. This further helps to minimize the required computational power. When a gesture is identified, a vibrate motor has used to acknowledge the user.

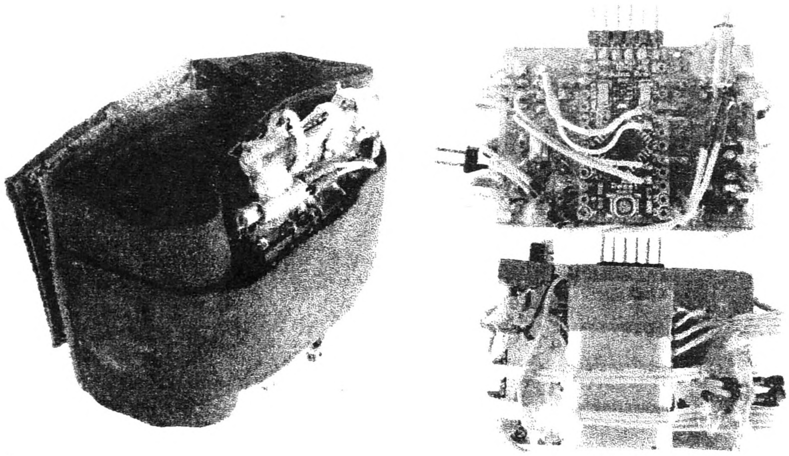

Figure 2: Developed SMART bracelet prototype

The controlling and recognition processes are done using a PC driver application, which is also used as the diagnostic application for the bracelet. It also responsible to maintain a data array to collect real time data receiving from the bracelet. DTW based template matching is the core recognition technique used in this model. Each time a new data is arrived, the app counts the minimum distance between the templates. If this difference is lesser than the user defined sensitivity threshold (Minimum distance between two time series) value, the ongoing gesture is identified as a valid one. Accordingly, the app will trigger a predefined event. This sensitivity threshold value can be adjusted to a higher value for a beginner and can be reduce for an experienced user. The lower the value, higher the accuracy.

3. RESULTS AND DISCUSSION

Each sensor raw data analyzed before use them for gesture recognition process. When analyzing the data it was found that raw data from accelerometer sensor made lot of noise and gyroscope data drift over time. As a solution for this issue, complementary filter was applied and results were shown in figure 3.

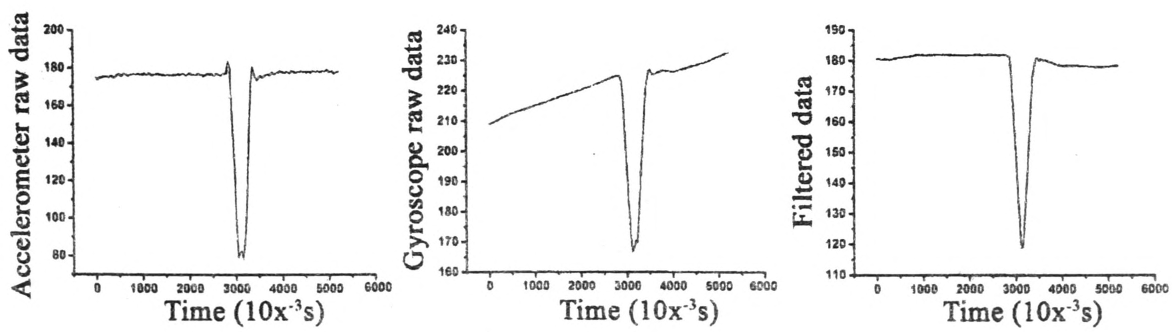

Figure 3: Example gesture unfiltered and filtered data

To calculate the gesture accuracy in real time, an experiment was conduct using 10 participants in age between 18 and 35. The participants were asked to wear the SMART Bracelet and perform two simple gestures.

Participants were performed gestures repetitive and observed the positive gesture accuracy. Experiment is formed by putting together all the repetitions. It is done on each user separately and the average accuracy among all users is computed. Then system's performance on the number of repetitions per gesture was plotted as shown in below figure 4.

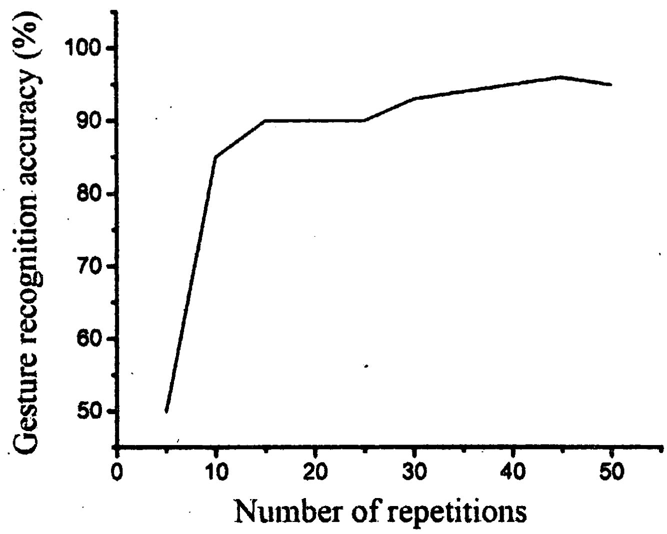

Figure 4: Average Accuracy against the Number of Repetitions

The graph shows that with as minimum as three repetitions, the recognizer is capable of achieving an accuracy of 85%.

The complete prototype (Bracelet and the Driver Application) has been fabricated and verified for its operation. The bracelet was fabricated using Surface Mount Devices (SMD) technology to make it more compact and noiseless. Built-in rechargeable battery, charger and protection circuits assure safe and flexible everyday use.

The driver application successfully identified two different gestures with and accuracy 85% for a beginner. After few minutes of training, the system was able to identify the same gestures with an accuracy of 90%. With these two different gestures, driver application was able to control a PowerPoint presentation precisely.

4. CONCLUSION

The proposed model and prototype can be used for numerous gesture based consumer electronic applications. Such as Presentation Controllers, TV/Radio Remote Controllers, RC

Plane/Quadcopter controller and Simulated Gaming and Training Environments. It is low cost, easily expandable, energy efficient and usable in the real-time operations with maximum yield of the gesture recognition.

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