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Wireless Sensing of Gestures using MEMS Accelerometer

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Abstract

Innovation assumes a noteworthy job in medicinal services for sensor gadgets as well as in correspondence, recording and show gadgets. The system tends to propose, interpretation of hand or head movement via complex algorithms. These algorithms are in the form of software, hardware or a combination of both. The main goal of gesture recognition system is to enable an individual or a group of individuals to communicate using specific sign languages or gestures. This paper proposes the use of a three axis accelerometer, wireless protocols of communication and a database system in a computer. The merits and the demerits of the above mentioned three attributes are presented in the paper.

Keywords: *MEMS accelerometer, Gesture Recognition, Hidden Markov Model, Bayesian network, ESP 8266*

INTRODUCTION

In the technologies evolving today from the invention of mouse and keyboards most are primarily based on tangible movements. These tangible movements or gestures of an individual or group of individuals are physical movements of hand or head which are expressive and meaningful motion to interact with the surrounding. Gesture recognition works with an aim at deciphering human gestures with the help of mathematical algorithms. Gestures can originate from the motion of any body or state.

One of the approaches that have been developed for gesture recognition is “Data-glove”. Data-glove integrates many senses together and needs a dedicated and customized server background system. The system mainly focuses on qualitative parameters rather than quantitative parameters. A technology that keeps in mind the significance of quantitative over qualitative parameters and avoids them in its working and performance in Micro Electro Mechanical System (MEMS).

Practical implementation of gesture recognition system based on varied possible movement can utilize variedsignal of movement based on acceleration measured using a MEMS accelerometer. The accelerometer behaves as a dumped mass on a spring, the sensor measures acceleration with thehelp of a layer of polysilicon suspended over a silicon wafer with the help of polysilicon rings. At the point when the accelerometer encounters quickening, the mass is uprooted to a certain degree where in the spring can quicken the mass. The removal caused is then estimated to give the increasing speed.

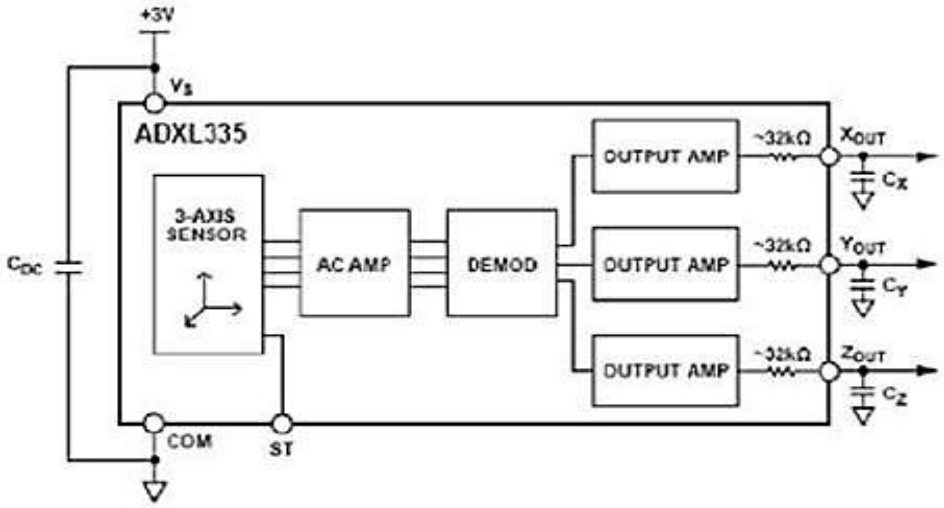

Figure 1: *Schematic Diagram of Mems Sensor.*

In [4] a hand gesture recognition system composed of six three axis accelerometer, controller, Bluetooth module and database system is developed. This system will only recognize the sampled data saved in the database while promoting maximum portability and mobility to the user via wireless Bluetooth technology. But the use of a Bluetooth module comes with its own disadvantages such as:

Pace of Data is Slow: All remote innovation has restrains on how quick they can transmit information. Quicker the association higher the vitality utilization. Since Bluetooth is planned to be very vitality effective it sends information generally gradually.

It allows only short range connections.
It can lose connections in certain conditions.
The above mentioned disadvantages can be avoided by adopting the below mentioned attributes, here an ESP 8266 Wi-Fi module is used instead of a Bluetooth. Its advantages are:

Better Durability: The ESP 8266 Wi-Fi module due to its wide operating temperature range between -40 and +125 degree Celsius makes it ideal for operation at varied conditions and environment.

Power Saving Architecture

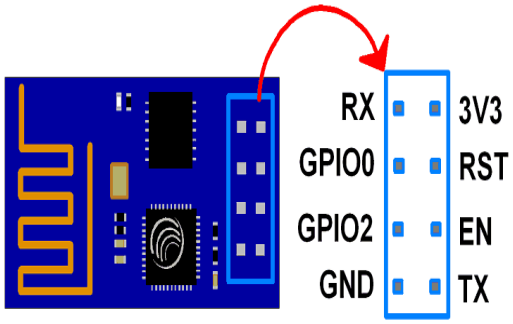

Figure 2: *The ESP 8266 Module Pin Description.*

3V3: 3.3 volt power pin
GND: ground pin
RST: active low reset pin
EN: active high enable pin
TX: serial transmit pin of UART
RX: serial receive pin of UART
GPIO0 and GPIO2: general purpose input output pins

The accelerometer used for gesture recognition can be either two axes or three axes. The three axis accelerometer gives an added feature of 3D positioning; The ADXL 335 used in figure 1 is a three axis accelerometer. In [4], each three axis accelerometer used has three sensing elements which are the x, y and z signal directions. The z sensing elements is oriented along the gravity vector that is perpendicular to the earth surface. The x

and y sensing elements lay perpendicular to the z axis.

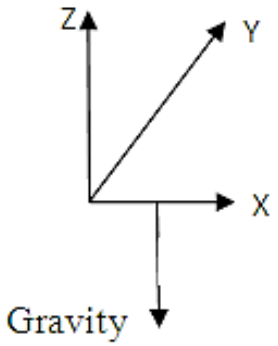

Figure 3: *Three Axis.*

From [1], the problems associated with hand gestures are:

The Physical and Structural Variance: In the case of gestures both inter and intra person variation exists, which makes the recognition of particular gestures difficult at certain conditions. This occurs because gestures such as hand and head movements are never standardized and is subject to vary from person to person.

More than one Attributes: Gesture recognition process has to simultaneously consider more than one attributes like hand postures region of function and change of orientation.

Feature Vectors: One way to define gestures is by using feature vectors which in other words are well defined primitives. This is application dependent and the designer has to spend a lot of time studying the various possible feature vectors.

HIDDEN MARKOV MODEL

Out of the many gesture recognition methods such as template matching, statistical approach, neural network etc the HMM stands out with is capability of being able to generate a language from a series of strings. [2] A first order HMM works on the following two assumptions

- A new state is entered based only on the current state.
- The output probability distribution function depends only on the state at the particular time regardless of how and when the state is entered.The key idea behind HMM based gesture recognition is the use of multi-dimensional HMM representing defined gestures. They are ,

1. To impart utilizing motions important motions should initially be determined.
2. To portray each signal as far as a HMM. A motion is spoken to as a lot of N unmistakable concealed states and R dimensional M particular noticeable images.
3. Collect training data. Train the HMM through training data.
4. Train the HMM through training data.
5. Evaluation of signals with prepared model.

One of the main disadvantages of the above mention Hidden Markov Model are:

- Only a little division of dispersions over the space of potential successions can be spoken to by a sensibly compelled Markov Model.
- Inability to speak to conditions between concealed states.
- Presence of an enormous number of unstructured parameters.
- Limitation because of first request Markov property.

CONCLUSION

This paper mainly aims to recognize the merits and demerits of the various modules and approaches used in wireless gesture recognition with an application of the three axis accelerometer using MEMS. The Bluetooth technology used is effective but again has a disadvantage of short range connection and loss of connection at certain environment, which is certainly improved with the introduction of the ESP 8266 Wi-Fi module. Then comes the Hidden Markov Model which has formed

the base for effective wireless gesture and speech recognition techniques even after the introduction of the Bayesian network which takes into consideration the flaws in the HMM model.

For our future work, the designing of some additional gestures can be learnt and recognized in order the make the gesture recognition and tedious and error free and more efficient in terms of performance. The glove used in most of the gesture recognition for patients can be made even more user friendly, compact and portable.

REFERENCES

1. "Low cost Hand Gesture Learning and Recognition System Based on Hidden Markov Model". JinjunRao, TongyueGao, Zhenbang gong and Zhen Jiang.
2. Jie Yang NadYangshenXu, "Hidden Markov Model for Gesture Recognition, "Robotics institute, Camegie Mellon University, May, 1994.
3. "Smart wearable health monitoring system for diagnosing disease in patients", S.S.Abarna, D.Renija, S.Saffana Parveen, S.SaradhaPreetha.
4. "Wireless Gesture recognition System using MEMS accelerometer", Othman Sidek, Munajat Abdul Hadi.
5. Stack.stackexchange.com.
6. "An introduction to Hidden Markov Models and Bayesian Networks", ZoubinGhahramani Unit, Gatsby Computational Neuroscience unit.
7. "MEMS and vision based Gesture Driven System for patients", Suchrita M, Sowmya M, Anirudh M, Chidvilas B.
8. En.wikipedia.org/wiki/Hidden_Markov_model#History.
9. En.wikipedia.org/wiki/Bayesian_network#History.
10. Link.springer.com /article/10.1023/A:1008101200733.
11. learn.sparkfun.com/tutorials/accelerometer-basics/all.
12. www.dimensionengineering.com/info/accelerometers.
13. www.electronicwings.com/sensors-modules/esp8266-wifi-module.
14. www.espressif.com/en/products/hardware/esp8266ex/overview.
15. www.polytechnichub.com/advantages-disadvantages-bluetooth/.

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