MEMS Accelerometer Based Gesture Based System Security and Remote System Notification

O. M. Gaikwad
Student, MCT's Rajiv Gandhi Institute of Technology

S. K. Gabhane
Associate Professor, MCT's Rajiv Gandhi Institute of Technology

J. R. Mahajan
Assistant Professor, MCT's Rajiv Gandhi Institute of Technology

***Abstract*—**The project aims using MEMS accelerometer where in the gestures has been recognized using the accelerator. Here the use of Accelerometer is used for security purpose. The accelerator senses gestures used for system security. The project also aims in notifying the existing user of the system at remote places. The project also teams in the use of database for managing the use amount of templates to be stored. Does more number of users can be used for accessing the system and only the particular the authorized person will be allowed to use the system and to access the particular data. Also to notify the person there is use GSM module which will send SMS to the admin of the existing use of the system. Does the user will come to know what is happening with the system when is required and will also in the system if he wants to do.

***Keywords*—** *MEMS accelerometer; GSM module.*

*****

I. INTRODUCTION

System security is the need for data security. Data is to be secured in order to protect it from the outer world. Looking out to do this various Technologies and algorithms has been suggested to secure the data from the intruders. So for this there are various types for system security or data security. The times we include pin code security or gesture security. As you know that you are unique in nature. They depend upon people to people and only the particular person may know about it. It is hard to recognize the gestures by different people and utilize them. Every person may have different gestures. The type of justice may include hand gesture, iris gesture and so on. So here we are going to take the hand gestures as a system security input. Since we are using MEMS accelerometer as a sensor input device and gestures are being used in one dimensional, 2 dimension, or in three dimensions. Up till now the literature suggested in people regarding MEMS accelerometer are confined up to 1 dimensional and 2 dimensional approaches. But no literature has been provided for three dimensional approach. In order to increase the security of the data on the system 1D or 2D approaches fail. So in order to incorporate the security at the highest level we make use of three-dimensional approach using MEMS accelerometer. Thus this paper clearly represents the third dimension approach of the MEMS accelerometer that uses of all three axis. Further in order to increase the security of the system database is also included in order to keep the track of the people and countering the system and accessing the system. The database keeps the track for how much time the person is with the system amount of data used by the person and the access given to the system. The GSM module used is to inform the admin or the existing user to get notified in the absence of the system. The admin also gets informed about the system when is at the remote place as well. So even if he is not at the system he gets to know about the system 24 by 7 as and when required by him.So in this project we are going to implement gesture recognition for security purposes, wherein the gesture pattern combinations will allow access to the concerned person. The novel feature of this project is that it can keep the track of N number of templates which is stored in the Database. For templates to be identified we are going to use three models simultaneously where in earlier cases only one was used. Furthermore the intimation of the system accessed by other person will be informed to the existing user using GSM module [10][11].

II. METHODOLOGY

In this project we are going to use both hardware as well as software. This is project include sports hardware components as well as software's required for Gesture recognition as well as for database. The hardware's used you are GSM module, MEMS accelerometer, ARM processor and power supply unit. The software components include kiel software, matlab software and my SQL. The hardware's used here have GSM module which is used for sending the SMS to notify the admin of the system as in when required after particular intervals of time as well. he is to be notified about the proceedings that take place in his absence at the system. The same GSM module is used for receiving the SMS from the user so that he can interfere in the system and obstruct the allowance bestowed to the users if he requires to do so. This was about the GSM module. The next component is MEMS accelerometer. MEMS accelerometer is the key component of this project. The accelerator is basically to take the input from the user which is in gesture form which is nothing but the security aspect. The MEMS accelerometer is connected to the arm 7 processor which

then processes the gestures. This is about the hardware of this project. Moving to the software part which includes free softwares as discussed earlier the processor the microcontroller software intakes the gestures and then process is it using matlab software.The matlab software process the justice. That is template matching take place if the template is matched with the existing templates then the user is allowed to access this system else he is denied to access the system and the data in the system. The templates are stored in a database using my SQL software. The database is also responsible for storing the logs that will be generated time to time. The logs include time at which the person approached, the time for which he was with the system, the data access by the person, and so on[1][5][9].

III. HARDWARE IMPLEMENTATION

In this paper we suggested three hardware's i.e. MEMS Accelerometer, microcontroller board and GSM module.

A. MEMS Accelerometer

MEMS accelerometer is a three Axis device. It is a device used to take the input of gestures from the user. Suggest is generated can be in 1D 2D or 3D. The main advantage of MEMS accelerometer is that it is a very low power device. This device can work in milliamperes current. Also the main advantage of this device is that it has a long lasting ability that is it can be used continuously for the span of 10 years without any maintenance cost. There and new MEMS accelerometer developed which have Ultra low power utilisation. This ultra-low-power MEMS accelerometer works in nanoamperes current[12].

B. Microcontroller board

Microcontroller board that we are going to use is here is arm7 processor. Arm7 processor is capable of processing any amount of data. Hear the gestures are the input data to the system and which has to be processed very properly so for the same arm7 processor is used[13].

C. GSM Module

When the gestures are compared and then the decision is made whether the permission is to be granted or not. Thus its notification is given to the existing user using GSM module and from the user the message codes can be received so as to manage the system from the remote place also.

IV. SOFTWARE IMPLEMENTATION

A. Keil

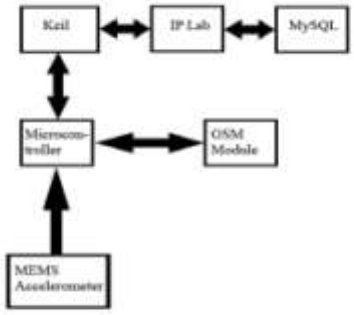
It is a microcontroller software used for receiving the gesture patterns from the user. These gestures are not the processed ones and are to be fed to the Matlab software.

B. Matlab

Matlab is a signal processing software. We use this one for processing the gestures signals in the proper format. Here feature extraction is done and the generated template gesture is compared with the existing templates stored in the database. The matlab software could not store many gestures thus we use here Database using MySQL.

C. MySQL.

MySQL is a database software. It is used for storing templates and generating logs in the database. The logs are basically time of user approach, duration of user with system, amount of information or type of information utilized.



(1) Block Diagram

V. GESTURE MODELS USED

A. MODEL 1: SEQUENCE GENERATION AND HOPFIELD ALGORITHM BASED GESTURE RECOGNITION

The 1D motion of hand gesturesare left, right, up, down, these gesture having the axis of x and z only [12]. The MEMS sensor output is analog that is sign sequence, to determine the sign sequence. The x axis have the 4 codes, and z axis have the 4 codes so we choose the total sequence of gesture code is 8 number representation. In this sign sequence to encode the sequence as 1, -1 only [13]. Before recognition, first gesture code is encoded so that Hopfield network should restore. Since the Hopfield network is only

knows a “1” and “-1”, so we can encoded the sign sequence as positive sign, negative sign, zero signs are represented inthe format below,

• “1 1” is positive sign;

• “-1 -1” is negative sign;

• “ 1 -1” is zero sign.

Hopfield Network

The Hopfield algorithm consists of a set of very large interconnected neurons. All neurons are both input and output neurons. Hence, by using the bidirectional associative memory (BAM) notations, the input layer Sx is the same with the output layer Sy. The involvement of Hopfield algorithm as a recovery mechanism makes the recognition algorithm more
fault tolerant. When part of the input is lost or wrong, the network can still retrieve the most likely pattern which has been stored previously. First to use Hopfield algorithm to construct the weight [14].

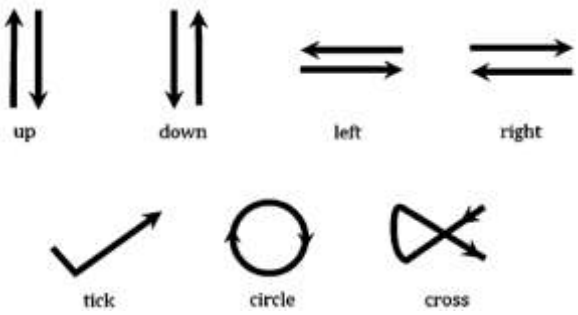
B. MODEL 2: AREA SEQUENCE GENERATION BASED GESTURE RECOGNITION

This approach istoneardifferent feature which is the velocity increment or the area bounded by the acceleration curve and x-axis, to implement classification [15]. According to the sign the acceleration is partitioned first. The area should decreases or increases at depend on the sign sequence. Before to store the data the area sequence is normalized to normalization is implemented using the formulae.

$$A_{norm} = \frac{A_{original}}{A_{max}}$$

C. MODEL 3: SEQUENCE GENERATION AND MATCHING FOUND BASED GESTURE RECOGNITION

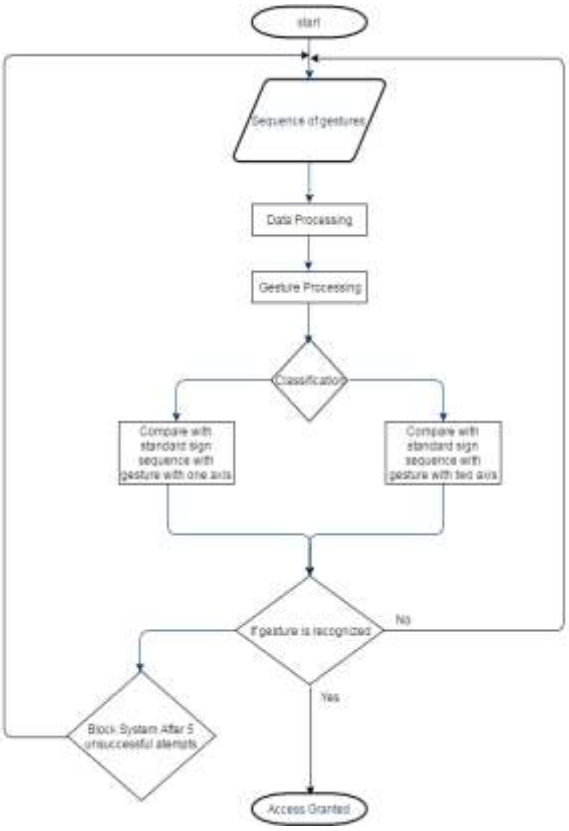
The recognition algorithm of this model is very similar to that of model 1,there is no usage of Hopfield network. Hence encoding sign sequence into different combinations of 1’s and -1’s is not necessary. All the sign sequences are represented by 1,-1 and 0.



(1) 1-D and 2-D Gestures [4][7]

	Up	Down	Left	Right	Tick	Circle	Cross	Mean
Model I	95.0	86.0	91.0	84.0	64.0	75.0	61.0	79.0
Model II	87.0	19.0	63.0	94.0	25.0	0.0	88.0	54.0
Model III	94.8	91.1	96.7.0	100	94.4	97.7	94.4	95.6

(2) COMPARSION OF HAND GESTURE RECOGNITION ACCURACY (%) [4]



(3) Flow Chart

VI. CONCLUSION

This paper describes the security of a system using MEMS accelerometer to the user at remote places also. This paper also suggests the use of database for creating the logs of all the sessions taking place at the system and informing about it to the user remotely. The user can also operate the system from the remote place using same GSM module without moving towards the system.

REFERENCES

[1] O. Mirabella, M. Brischetto, G. Mastroeni, "MEMS based gesture recognition", Human System Interactions (HSI), May 2010.

[2] Ruize Xu, Shengli Zhou, Wen J. Li, "MEMS Accelerometer Based Nonspecific-User Hand Gesture Recognition", presented at IEEE Sensors Journal, Volume: 12, Issue: 5, May 2012.

[3] Othman Sidek, Munajat Abdul Hadi, "Wireless gesture recognition system using MEMS accelerometer", presented at Technology Management and Emerging Technologies (ISTMET), May 2014.

[4] D. Jayaraman, K. Vanitha, "Nonspecific-User Hand Gesture Recognition By Using MEMS Accelerometer", presented at Information Communication and Embedded Systems (ICICES), Feb 2014.

[5] S. Zhou, Q. Shan, F. Fei, W. J. Li, C. P. Kwong, and C. K. Wu *et al.*,"Gesture recognition for interactive controllers using MEMS motionsensors," in *Proc. IEEE Int. Conf. Nano/Micro Engineered and MolecularSystems*, Jan. 2009, pp. 935–940.

[6] G. Zhang, G. Shi, Y. Luo, H. Wong, W. J. Li, P. H. W. Leong, and M. Y. Wong, "Towards an ubiquitous wireless digital writing instrument using MEMS motion sensing technology," presented at the IEEE/ASME Int. Conf. Advanced Intelligent Mechatronics (AIM), Monterey, CA, Jul. 2005.

[7] Z. Dong, G. Zhang, Y. Luo, C. C. Tsang, G. Shi, S. Y. Kwok, W. J. Li,P. H. W. Leong, and M. Y. Wong, "A calibration method for MEMS inertial sensors based on optical tracking," in *Proc. IEEE Int. Conf.Nano/Micro Eng. Mol. Syst.*, 2007, pp. 542–547.

[8] Shengli Zhou, Zhuxin Dong, Wen J. Li, and Chung Ping Kwong, "Hand-Written Character Recognition Using MEMS Motion Sensing Technology", *IEEE/ASME International Conference on AdvancedIntelligent Mechatronic*, pp. 1418-1423, August 19th , 2008.

[9] S. Mitra and T. Acharya, "Gesture Recognition: A Survey", IEEE Transactions on Systems, Man and Cybernetics," vol. 37, no. 3, May 2007, pp. 311-324.

[10] Matthias Rehm, Nikolaus Bee, Elisabeth André, "Wave Like an Egyptian – Accelerometer Based Gesture Recognition for Culture Specific Interactions", British Computer Society, 2007

[11] Shiqi Zhang, Chun Yuan, and Van Zhang, "Handwritten Character Recognition Using Orientation Quantization Based on 3D Accelerometer", *the 5th Annual International Conference on UbiquitousSystems*, July 25th , 2008.

[12] S. Zhou, Z. Dong, W. J. Li, and C. P.Kwong, "Hand-written character recognition using MEMS motion sensing technology", in Proc.IEEE/ASME Int. Conf. Advanced Intelligent Mechatronics, 2008, pp. 1418–1423.

[13] RuizeXu, Shengli Zhou and Wen J.Li, Fellow, "MEMS Accelerometer Based Nonspecific-user Hand Gesture Recognition", IEEE Sensors journal May 2012.

[14] J. S. Lipscomb, "A trainable gesture recognizer",Pattern. Recognit.,vol. 24, no. 9, pp. 895–907, 1991.

[15] N. Popoviciu and M. Boncut, "On the Hopfield algorithm. Foundationsandexamples",Gen. Math., vol. 13, no. 2, pp. 35–50, 2005.