EMBEDDED GESTURE RECOGNITION SYSTEM FOR AUDIO-VOCALLY IMPAIRED INDIVIDUALS USING SMART GLOVES

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***Abstract*—The work aims at recognizing the gestures and visually displaying them on an LCD screen, so as to aid effective communication for the audio-vocally impaired individuals. The system implemented has a glove that has flex sensors at each fingers that respond differently to the varied hand movements. The motion is sensed and communicated to arduino microcontroller which will identify the gesture appropriately. The data is transferred from the glove to the microcontroller. The model is designed to bring in most possible gestures known so far in various sign languages followed globally. The gestures are read and compared with the already available recognition engine embedded in the memory of the system.**

***Keywords*—Accelerometer, Flex sensors, LCD Display, Text to Speech (TTS) Module.**

I. INTRODUCTION

Gesture is defined as a motion of limbs or any other body part which are made to emphasize speech. It can also be defined as an act or a remark made as a sign of attitude. Gesture recognition is interpretation of human motion by a computing device. In general, people with inability to hear and speak have difficulty in communicating with others who do not understand sign language. Even those who do speak aloud typically have a “deaf voice” of which they are self-conscious and that can make them reticent. The Hand Talk glove is a normal, cloth driving glove fitted with flex sensors [4]. The sensors output a stream of data that varies with the degree of bend made by the fingers. Flex sensors are sensors that change in resistance depending on the amount of bend on the sensor. They convert the change in bend to electrical resistance - the more the bend, the more the resistance value. The output from the sensor is converted to digital and processed by using microcontroller and then it responds in the voice using speaker. This work focuses on developing a help for disabled people using this gesture recognition technique. In this system the gestures are converted into text messages for communication. A number of techniques are used to convert these gestures into required output, typically either image based or device based, although hybrids are beginning to come about. Although this technology is still in its emerging state, a number of applications have been implemented in real time. The basic concept involves the use of data gloves worn by disabled people [5]. These gloves are designed using Flex sensors. The flex sensors are normally attached to the glove. Flex sensors are analog resistors that function as analog voltage dividers.

II. RELATED WORK

The gesture recognition is done with the help of a sensor glove which consists of two flex sensors, a MEMS sensor, that are best positioned in the fingers[18]. The design of glove and the concept of decoding gesture is made possible by considering the axis orientation of the MEMS sensor with respect to gravity and generates some voltage values [15]. Based on the voltage values the corresponding words will be generated from the stored templates [1].

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The hardware module consists of a flex sensor and MEMS sensor which are arranged in a manner to correctly get positioned in fingers [6]. The concept of decoding of hand gesture movements is made possible by considering the axis orientation of the MEMS sensor with respect to gravity and it will generate some voltage values [19]. In the acceleration of a hand motion three perpendicular directions are detected by our MEMS sensor and get transmitted to the microcontroller [14]. Gesture is recognized by comparing the acceleration values with the stored template values and an automatic gesture recognition algorithm is developed to identify individual gestures in a sequential order [8]. According to the recognized gesture, respective command will be displayed in the mobile that get connected through Bluetooth using an app [3].

III. PROPOSED SYSTEM

In this work we have implemented, designed and developed hand gesture recognition system for speech impaired people [9]. Here we have used flex sensors and accelerometer in the glove. By moving the finger, based on the changes in resistance a reference value will be generated. By this reference value we have generated the database. With respect to the values we get from the gloves, corresponding information will be sent through wireless communication [10] and we can get the desired output as words, letters and numbers for the corresponding gestures in the LCD.

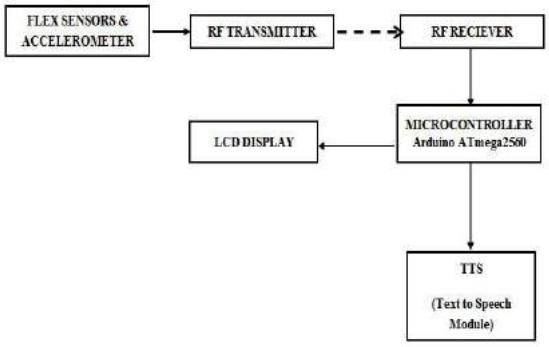

Fig.1. Proposed System Block Diagram

IV. FLEX SENSOR

A flex sensor or bend sensor is a sensor that measures the amount of deflection or bending. Usually the sensor is stuck to the surface and resistance of sensor element is varied by bending the surface. Since the resistance is directly proportional to amount of bend it is used as goniometer and often called flexible potentiometer.

The Flex Sensor patented technology is based on resistive carbon elements. As a variable printed resistor, the Flex Sensor achieves great form-factor on a thin flexible substrate. When the substrate is bent, the sensor produces a resistance output correlated to the bend radius—the smaller the radius, the higher the resistance value.

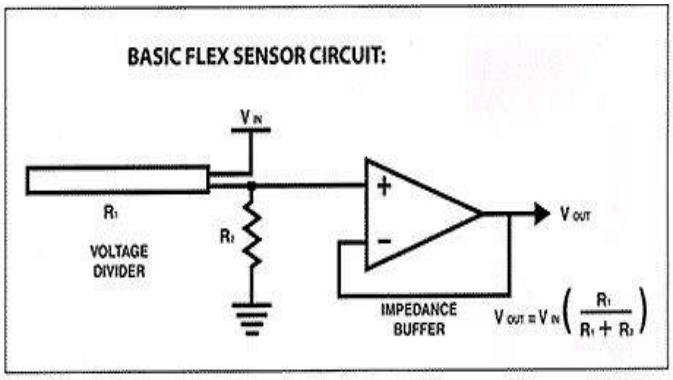

Fig.2. Working of Flex Sensor

Gesture recognition research intends to design and implement the system using gesture as input. The gesture recognition in this paper is done using a flexible, resistive sensor known as Flex Sensor. The main principle of a Flex sensor is that the change in resistance gives respective amount of change in voltage. A flex sensor is designed such that as sensor is bent, the resistance of sensor alters. Resistance of 45 degree bend is different from that of a 90 degree bend of a sensor.

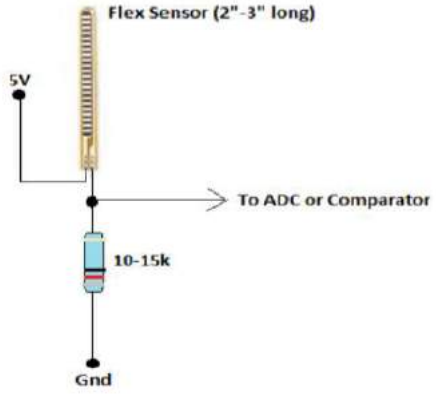

Fig.3. Flex Sensor

V. ACCELEROMETER

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tilt sensing applications, as well as dynamic acceleration resulting from motion, shock or vibration. The user selects the bandwidth of the accelerometer using the C_X, C_Y, and C_Z capacitors at the X_{OUT}, Y_{OUT}, and Z_{OUT} pins. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis. The ADXL335 is available in a small, low profile, 4 mm × 4 mm × 1.45 mm, 16-lead, plastic lead frame chip scale package.

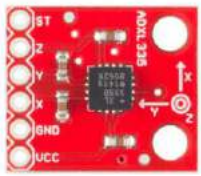

Fig.4. Accelerometer ADXL335

VI. LCD DISPLAY

LCD (Liquid Crystal Display) screen is an electronic display module that finds wide range of applications. A 16x2 LCD display is a very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

VII. RESULTS AND CONCLUSION

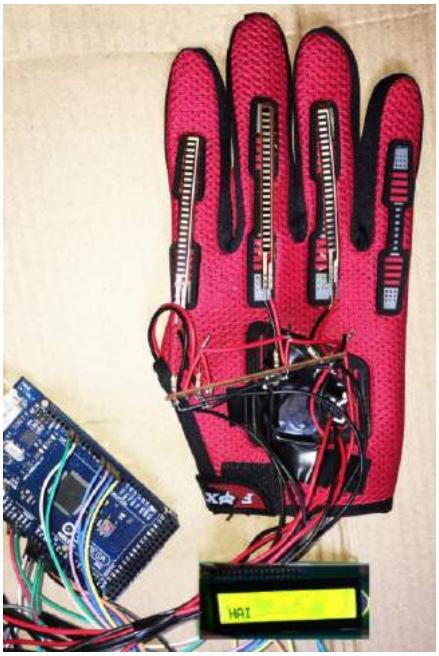

Fig.5. Hardware Output

In this work, we have presented gesture recognition through the use of flex sensors and accelerometer [16]. This work uses 3 axes acceleration values whereas the existing system uses only 2 axes [17]. The incoming values for each gesture will be compared with values in the stored memory. Since the standard gesture pattern are generated by motion analysis and are simple features represented by only acceleration values, big database and complex recognition systems were not required and now needs to collect as many gesture made by different people as possible to improve the recognition accuracy. The advantage of this approach is the potential of mobility. The main aim of the work is to help speech impaired people to communicate with others without the use of complex form of inputs [11]. In this work we have used gloves for hand gesture recognition which is very easy to wear and it doesn't need any special training, so it is user friendly and can be used by all. This work covers various issues like what are gesture, their classification, their role in implementing a gesture recognition system, system architecture concepts for implementing a gesture recognition system, major issues involved in implementing a simplified gesture recognition system, exploitation of gestures in experimental systems, importance of gesture recognition system, real time applications and future scope of gesture recognition system [13]. We have a method to recognize the unknown input gestures by using hand tracking and extraction method [12]. We apply this system to recognize the single gesture. In the experiments, we assume stationary gestures so that our system will have smaller search region for identifying the gestures.

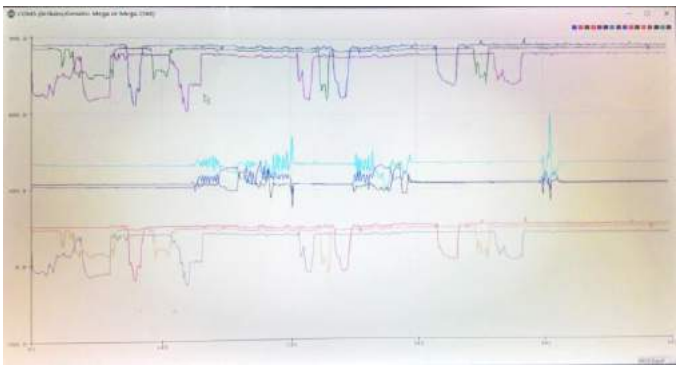

Fig.6. Simulation Output

VIII. REFERENCES

[1] Rohitha U M, "Microcontroller based Hand Gesture Recognition System using Flex Sensor for Disabled People", National Conference on Electronics and Communication (NCEC), 2015.

[2] Mrs. Ambikapathy **"**Hand-talk Gloves with Flex Sensor: A Review**"**, International Journal of Engineering Science Invention (IJESI), Volume 2, Issue 4, pp. 43-46, 2013.

[3] Ms. R.Vinitha, Ms. A. Theerthana Ms. B. Yasmin, "System for Speech Impaired People" International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE), Volume 5, Issue 4, April 2016.

[4] Preetham, C.; Ramakrishnan, G.; Kumar, S.; Tamse, A.; Krishnapura, N., "Hand Talk-Implementation of a Gesture Recognizing Glove," India Educators' Conference (TIIEC), 2013 Texas Instruments , vol., no., pp.328,331, 4-6 April 2013.

[5] Chouhan, T.; Panse, A.; Voona, A.K.; Sameer, S.M., "Smart glove with gesture recognition ability for the hearing and speech impaired," in Global Humanitarian Technology Conference - South Asia Satellite (GHTC-SAS), 2014 IEEE , vol., no., pp.105-110, 26-27 Sept. 2014.

[6] Bui, T.D.; Nguyen, L.T., "Recognizing Postures in Vietnamese Sign Language with MEMS Accelerometers," Sensors Journal, IEEE, vol.7, no.5, pp.707, 712, May 2007.

[7] Rishikanth, C.; Sekar, H.; Rajagopal, G.; Rajesh, R.; Vijayaraghavan, V., "Low-cost intelligent gesture recognition engine for audio-vocally impaired individuals," Global Humanitarian Technology Conference (GHTC), 2014 IEEE , vol., no., pp.628,634, 10-13 Oct. 2014.

[8] Arefin Shamsil and Thilakshan McMaster University"Motion Tracking Glove for Human- Machine Interaction:Grasp & Release", 4-23-2010.

[9] J.Davis, M.Shah. Recognizing hand gestures. In Proceedings of European Conference on Computer Vision, ECCV: 331-340, 1994.

[10] D.J.Turman, D. Zeltzer. Survey of glove-based input. IEEE Computer Graphics and Application 14:30-39, 1994.

[11] Prateem Chakraborty, Prashant Sarawgi, Ankit Mehrotra, Gaurav Agarwal, Ratika Pradhan ―Hand Gesture Recognition: A Comparative Study‖ Proc. The International Multi Conference of Engineers and Computer Scientist 2008 Vol. 1

[12] Ginu Thomas ―A review of Various Hand Gesture Recognition Techniques‖ Proc. VSRD-IJEECE, Vol. 1(7) 2011.

[13] 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 motion sensors," in Proc. IEEE Int. Conf. Nano/Micro Engineered and Molecular Systems, Jan. 2009, pp. 935–940.

[14] Y. Luo, C. C. Tsang, G. Zhang, Z. Dong, G. Shi, S. Y. Kwok, W. J. Li, P. H. W. Leong, and M. Y. Wong, "An attitude compensation technique for a MEMS motion sensor based digital writing instrument," in Proc. IEEE Int. Conf. Nano/Micro Eng. Mol. Syst., 2006, pp. 909–914.

[15] 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.

[16] S. J. Preece, J. Y. Goulermas, L. P. J. Kenney, and D. Howard, "A comparison of feature extraction methods for the classification of dynamic activities from accelerometer data," IEEE Trans. Biomed. Eng., vol. 56,no. 3, pp. 871–879, Mar. 2009.

[17] Y. P. Chen, J. Y. Yang, S. N. Liou, G. Y. Lee, and J. S. Wang, "Online classifier construction algorithm for human activity detection using a triaxial accelerometer," Appl. Math. Comput., pp. 849–860, Nov. 2008.

[18] Z. Dong, U. C. Wejinya, and W. J. Li, "An optical-tracking calibration method for MEMS-based digital writing instrument," IEEE Sens. J.,vol. 10, no. 10, pp. 1543–1551, Oct. 2010.

[19] 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.