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Data Glove Technique based Gesture Recognition System

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Abstract*: Communication is one of the important bonds in relationships, but for deaf, dumb and paralyzed persons this is very difficult and thus they communicate by gestures. It is a mode of communication between persons and for each gesture there is a meaning. Here the gestures are converted to a meaningful sentence or word and it is given as an output through external speakers with the help of using a microcontroller. Simply a gesture recognition or identification system using a microcontroller named ATMEGA with the help of a data glove is being used. An auxiliary communication tool by the help of a data glove is aimed for speech and hearing impaired people so that there is an effective communication between them and the others. The data sent from flex sensor and 3-axis accelerometer (ADXL330) is an analog voltage, which is further converted to digital signal using a microcontroller Atmega16 (Port A). The results identified by the controller are displayed on Android phones using the working application (.apk) which can be downloaded from play store. Thus enhanced effective communication between differently abled and normal person under any circumstances can be established. This concept provides an ease of operation for controlling appliances in a household for immobile persons. This device can be proved as a boon for partially disabled people to raise the quality of their life and become self-sufficient in the society.

Index Terms: ATMEGA, Data Glove, Gesture, Flex Sensor, Immobile, Speech, Zig bee

I. INTRODUCTION

The development of devices and gadgets which attracted the priority in the field of innovations is the one which helped the differently-abled to lead a normal and suitable life. Recent advancements in modern technology which includes the technology of designing the analog front-end and digital processing back ends as integrated circuits, low-power electronic devices and wireless devices in a power electronic circuit has inspired a new collection of wearable micro-devices. It is an uncomplicated device for the speech impaired users to use as the device converts sign language to speech, and hence the speech impaired users can communicate with hand gestures.

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The speech and hearing impaired people uses sign language for communication which is a skill that uses gestures (instead of sound) to convey meaningful words. Moreover it combines hand shapes with facial expressions, orientations and movement of the hands, fingers, wrist arms and body to express what speaker wants to convey. There are certain signs which are used to communicate words and sentences to audience or normal people. Gesture recognition system using a data glove is basically based on flex sensor and gesture sensor accelerometer, which will provide the efficiency to recognize the gesture of the fingers and controlling the electrical appliances remotely. The specific shapes made out of the particular movements with the hands are a type of sign language called gesture. The aim of this work based on these technical events is to develop a gesture based application which can control electrical appliances remotely without any assistance. The transmitter section is wireless based communication unit incorporating flex sensor and 3 axis accelerometer which are used to detect the gestures of the finger movement. The processing unit is based upon microcontroller (ATMEGA 16), Bluetooth and Zigbee modules. This provides a helping hand for differently able people to interact more easily and efficiently towards normal ones.

II. LITERATURE REVIEW

A paper has been published which discusses a gesture recognition system which interprets gesture to voice and text messages accordingly [1]. This system is mainly composed of four parts: a data glove, a display kit, a processor for arm and an audio kit. The data glove has five one directional bend sensors (FLX-03) and a type of accelerometer called 3 axis accelerometer. The processor related to the arm collects the information that is transmitted from the data glove sensors through the input or output ports. It will also examine and estimate the data from the gestures at a distinct and then compares that obtained data with the models collected to see whether the gestures match properly. The recognition outputs are displayed on a screen, and the voice that is converted can be here through output speakers [1]. Another paper discusses the flex sensors where the resistance change depends on the amount of sensor [2]. A series of outputs can be gained using these flex sensors with different positions of bend. The PIC micro controller will receive the analog outcomes from sensor. By analog to digital signal conversion the signals are processed. A radio frequency system is utilized for encoding and transmitting the resultant digital signal. Radio frequency receivers accept the signal and feed the gesture recognition section through the decoder.

By speaker the Text to speech conversion can be played that takes place in the voice section [2]. Another paper shows the use of Velostat, a low cost packaging material for the preparing piezo-resistive sensors [3]. The data obtained by bending the fingers, which is detected by the flex sensors, is converted to a character set by introducing a Minimum Mean Square Error machine learning algorithm. The recognized characters were transmitted through Bluetooth technology to an Android phone, where a text to speech conversion is performed. The hand configurations are compared with the sign language charts using the designed Hand Talk, thereby generating an artificial speech which articulates the gestured words. This technology also has further applications as a 3D mouse, virtual keyboard, and control for precision control of robotic arms [3].

Further another paper discusses a recognition system which deals as a topic in computer science and the technology where it is used as a language converter done by mathematical algorithms [4]. Now more focuses are given in the field to include emotion recognition from the gestures of hand and face. Sign language conversion can be done through various means like cameras and computer vision algorithms. In gesture recognition techniques, the main considerations include the understanding and recognition of gesture and posture of human behavior. A case study on the various hand gesture recognition systems and devices with data glove and vocalizes system is done. The differently abled people will be beneficial with these systems as their hands will be speaking on their behalf after having worn the gesture vocalize data glove [4].

A real-time Human-Computer Interaction called K-NN for the recognition of gesture was proposed with hand data glove and a classifier [5]. Data glove was used for the recognition of the hand gestures to capture timely position of the arm and the angular degree between the ankles with least error and more accuracy. These features are used to classifying the gestures and its recognition by using K-NN classifier. This method of using gestures was classified into different categories such as rotating, pointing, clicking, and dragging a standard position. By recognizing all these varieties of gestures, relevant actions for particular gestures are taken for example air writing and 3D sketching which is done by tracking the path, helpful in virtual augmented reality (VAR). The outcome reveals the idea about how glove can be used for interaction. Usage of mouse will be more accurate than normal static keyboard for interaction process [5].

The hand gesture recognition provides a natural, intelligent and convenient way of interaction named as human–computer interaction (HCI) [6]. The gesture-based control and Sign language recognition (SLR) are the two major executive files for hand gesture recognition technologies. Sign language recognition is used because it can automatically interrupt sign languages by a computer thus it aids a deaf person to communicate with the society. The sign language is a highly symbolic gesture set of a human and is a large structured language whose recognition helps for the improvement of a general gesture-based HCI. This will provides with the idea to create a communication between living and nonliving object such as a human and a computer to operate in a PC by using a mouse cursor [7].

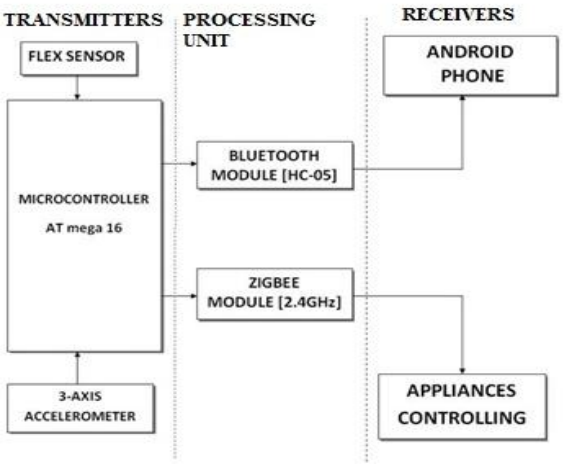

Fig.1. Block diagram for gesture recognition

III. BLOCK DIAGRAM

Block diagrams is a technique for representing the link between different signals in a particular system [8]. They are normally used for higher level description with minimal explanation to clarify the overall concepts. In electrical engineering, schematic and layout diagrams are used to show the performance details of all the electrical components and physical structure of the circuits. The Basic Block Diagram as shown in fig. 1 is classified into the following three parts:

A. Transmitter Section

This section mainly constitutes of Flex sensor and Accelerometer whose output is sent to the microcontroller for further data transmission. Gestures from the hand glove are sensed using the above mentioned input units. The bending action of the fingers causes, resistance variation in the flex sensor. The flex sensor circuit enables voltage generation for the corresponding resistance change from the sensor. Similarly the hand motion along the three dimensional axis is sensed with the help of an accelerometer [9]. The combinations of analog values (or voltage signal) from the sensors are converted to digital values with the help of microcontroller. The ATMEGA 16 microcontroller has an in-built ADC (analog to digital converter) at Port-A. This digital signal is fed as an input to the Bluetooth and Zigbee module for further serial data transmission.

B. Processing Units

For the transparent wireless serial connection setup, an effortless serial port protocol was designed called Bluetooth module (HC-05). While the unit is working, the LED will flicker. The flicker style mode is different for each time interval, so the flickering will indicate the particular mode. When the serial is paired with Bluetooth, the LED will be switch on. It means the connection is built successfully. The ZigBee module (2.4 GHz) is controlled with a separate ATMEGA 16 microcontroller. This module is used for long range transmission of serial signals under radio frequency (RF) range. For a specific gesture from the hand glove ZigBee sends serial data which turns on the 12V relay.

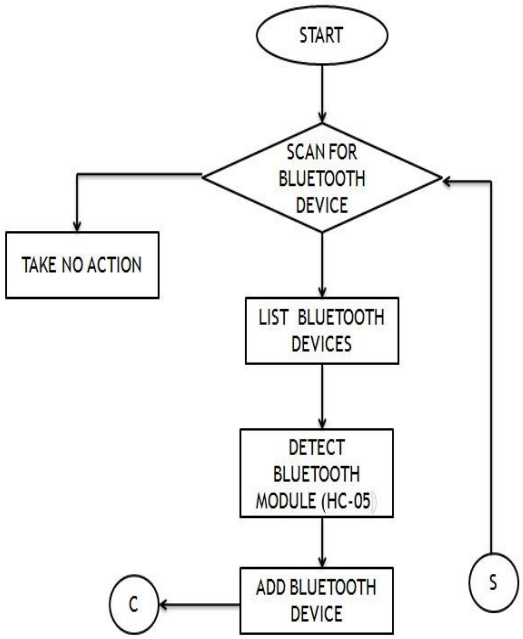

Fig.2. Flow chart for gesture recognition

The output of the relay is further connected with plug points or lamp holders, for appliances controlling.

C. Receiver Section

Under this receiver unit or output section, the fundamental aim of the project is accomplished. Using a smart phone working under the Android platform, conversion of the gestures to voice (as well as text) output is carried out. The application (.apk file) required to run the setup can be made access from the play store directly. Thus by turning on the Bluetooth of the phone communication between persons is enhanced successfully. The appliances controlling is performed with the help of 12V single channel relay. [10] The relay is responsible for turning on or off of the electrical system. The appliances used here is an electrical lamp and a fan.

IV. FLOW CHART

The flow chart will provide a graphical or pictorial representation of how the program or application software works.

In the flowchart given in figure 2 first searching for Bluetooth device and select the proper device. The data got is processed and the result is provided through a screen or a speaker, this is shown in flowchart shown in figure 3. The flowchart is a cyclic process, the loop will rotate and rotate thus the application will work properly.

V. RESULT AND DISCUSSION

In this work a technique for the recognition of gesture done by a person is converted into valid information and expressed it by using a mobile phone or external speakers. For this work, firstly the literature survey of the work was done and thus the results of the design for the data glove are made.

The block diagram for this setup consists of transmission section, processing section and receiver section, which are considered as the main parts for this technique.

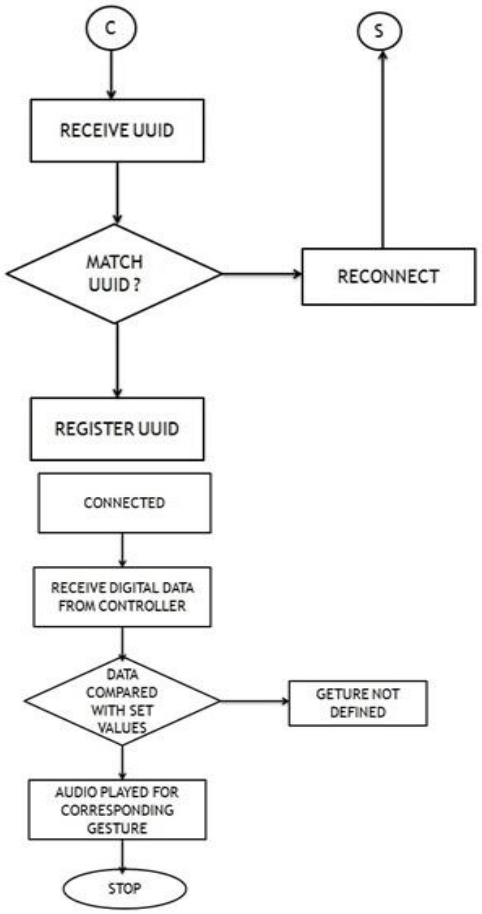

Fig.3. Flow chart for gesture recognition

The heart of this project is the software algorithm for the proper working of the system which is represented through the flowchart.

VI. CONCLUSION

Gesture recognition using data glove techniques for differently abled persons is discussed in this work. Various survey reports have given the ideas and technologies which is used for this technique. A particular model for data recognition is developed as shown in block diagram with three different units. The transmitter section will take the gestures and modified at the processing unit. The processed results are taken by the receiver and the outcomes can be observed through a screen or by using speakers. The flow chart for the working of data recognition provides the details of how the application works. In short, the system as a whole utilizes two modes of operation for the differently- abled people.

REFERENCES

1. J. Wang Jingqiu, "ARM-Based Embedded Gesture Recognition System Using a Data Glove", *26th Chinese Control and Decision Conference (CCDC)*, 2014, pp.1580-1584.
2. Shoaib Ahmed .V, "Magic Gloves (Hand Gesture Recognition and Voice Conversion System for Differentially Able Dumb People)", *Tech Expo-The Global Summit*, London.
3. Kumar P, Rautaray S S, Agrawal A, "Hand data glove: A new generation real-time mouse for Human-Computer Interaction", *Recent Advances in Information 1583 Technology (RAIT)*, 2012.

4. Meenaakumari.M, "MEMS Accelerometer Based Hand Gesture Recognition", *IJARCET*, 2013, Vol. 2, No. 5.
5. Leigh Hochberg, "People with paralysis control robotic arms using brain", *Computer Interface*, 2012.
6. Xu Zhang, Xiang Chen, Associate Member, IEEE,"A Framework for Hand Gesture Recognition Based on Accelerometer and EMG Sensors", *IEEE Transactions On Systems, Man, And Cybernetics—Part A: Systems And Humans*, 2011,Vol. 41, No. 6.
7. J. Yang, "Analysis and compensation of errors in the input device based on inertial sensors", *International Conference on Information Technology: Coding and Computing, 2004. Proceedings. ITCC*, April 2004.
8. L. Wang, "Feature selection with kernel class reparability", *IEEE Trans. Pattern Anal. Mach. Intell*., 2008, vol. 30, no. 9, pp. 1534–1546.
9. Piyush Kumar, "Hand Data Glove: A Wearable Real-Time Device for Human-Computer Interaction", *International Journal of Advanced Science and Technology*, 2012, Vol. 43.
10. J. Ruiz-del-Solar, "Dynamic gesture recognition for human robot interaction", *Proceedings of 6th Latin American Robotics Symposium (LARS)*, 2009, pp. 1
11. W. Stewart, "Gestures, 3D, Mobile Changing Gaming Market", *International CES Daily, Gaming*, 2011, Vol. 104, pp. 6-8.
12. A.A. Mathew and S. Vivekanandan, "A Review On Ayurvedic Approach In Sphygmology: Characteristics, Traditional Parameters And Existing Sensors In Sphygmology", *International Journal Of Scientific & Technology Research*, 2020, Vol. 9, pp. 7188-7203.
13. http://en.wikipedia.org/wiki/Atmel.
14. J. K. Oh, et al. (2004), "Inertial sensor based recognition of 3-D character gestures with an ensemble of classifiers," *9th Int. Workshop on Frontiers in Handwriting Recognition.*
15. Didier Coquin, "Gestures Recognition Based on the Fusion of Hand Positioning and Arm Gestures", *Journal of Robotics and Mechatronics*, 2006, Vol.18 No.6.

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