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A Wearable Glove for Measuring Fingers Flexion to Identify Specific Hand Gestures Using Flex Sensors

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Abstract

This paper presents a special method of communication for the speech impaired people and other patients using their hand gestures. A microcontroller based system has been developed for measuring fingers flexion to identify specific hand gestures using flex sensors. The system is made wearable and has been deployed on a glove. To measure the fingers flexion for a specific hand gesture five flex sensors are tailored for each finger on the glove. These flex sensors produce signals corresponding to different hand gestures and finger movements. Flex sensors simply change their resistance values according to the degree of bend angle made. They convert the change in bend to electrical resistance-the more the bend, the more is the resistance value. The system has been built around a widely used eight bit microcontroller ATMega328P that has a built-in 10-bit multiplexed channel Analog-to-Digital Converter for the signal conditioning purpose. The important factors while designing a glove is the calibration, the finger size, height and thickness varies from patient to patient and these inaccurate measurements of parameter leads to overlapping of the sign.

Keywords: *Flex Sensors, Microcontroller, Hand Gestures, Gesture Recognition.*

INTRODUCTION

Gestures are significant body motions to impart some information and gesture recognition involves tracking of human limbs, interpretation of various orientations and movement of vital body positions. The Aim of the proposed work is to design and develop a microcontroller based hybrid system to identify and measure the vital body gestures including hand gestures using bend sensor array. These signals can be used to control the movements of some actuators, etc. The bend sensor arrays employ flex sensors. These sensors will be wearable in the form of gloves which will help produce signals corresponding to different hand gestures and finger movements. The system will read these signals and after signal conditioning processes these digitally converted signal values will be compared with the reference values predefined by the user to identify specific hand gestures. These flex sensors output data streams that vary with the degree of bend made by fingers and accelerometer gives the degree of palm orientation in two-axis. Flex sensors simply change their resistance values according to the degree of bend angle made. They convert the change in bend to electrical resistance-the more the bend, the more is the resistance value. The system will be built around a widely used eight bit microcontroller ATMega328P that has a built-in 10-bit multiplexed channel Analog-to-Digital Converter for the signal conditioning purpose.

PROPOSED WORK

To develop a wearable device based on the state-of-art technology to recognize the various hand gestures to assist the speech impaired people and also targeting patients suffering from paralysis in understanding sign language. These people can communicate digitally using this sign

language. The system should be made user friendly, wearable, light weight, configurable, highly responsive, capable of providing real-time outputs, rugged and viable. The purpose of this system is to be a wearable, wireless, multi-node data capture and gesture recognition system for the people suffering from speech disorders and patients lying disabled. So as per the demand, the system design purposes are primarily low power, high bandwidth communications, small size and lightweight realization, with the precept that the data captured be enough to distinguish gestures. High bandwidth communications is needed to assure that many nodes can transfer their data simultaneously, facilitating a real time system response. Small and lightweight system is required to make the device wearable so that it does not hinder the normal activity of the wearer. Low power is required to give the device a ample battery life with a small and therefore lightweight battery.

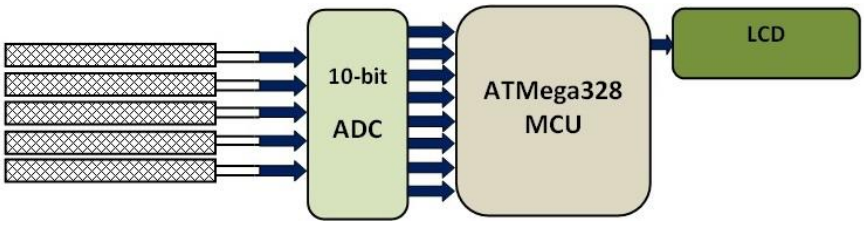


***Fig-1** Block Diagram of the Implemented System*

In order to meet the aforementioned goals, a compact wireless sensing unit was designed. This sensing unit consists of flex sensors, signal conditioning unit, high performance processor, wired/ wireless communication link, power source and wearable platform. Sensors used for this project is an array of flex sensors. The number of sensors supported on-card has been reduced to make the board smaller, although provisions are made for easy expansion.

IMPLEMENTED SYSTEM

The system is implemented as a wearable hand glove that uses an array of flex sensors for each finger. The flex sensors are bend sensors and the resistance of these sensors vary with the bend angle. So bend resistance of these flex sensors can be calculated as per the finger movements and hand gestures. The mere parameters in designing the sensory glove are the glove instability and the misalignments of the sensors with respect to the related joints while using. The sensor chosen may bring out discrete data's or continuous data's. In the system implemented the flex sensors chosen gives out a continuous set of data's since sign language is encoded into different pattern that are classified. The consequences of a deciding number of sensors and location for them are resolved using flex sensor because a single flex sensor determines the position/angle of a particular finger. Hence the operation of the glove is enhanced. The main issues while designing a glove is the calibration, the finger size, height and thickness varies from patient to patient and these erroneous measurements of parameter leads to overlap of the sign.

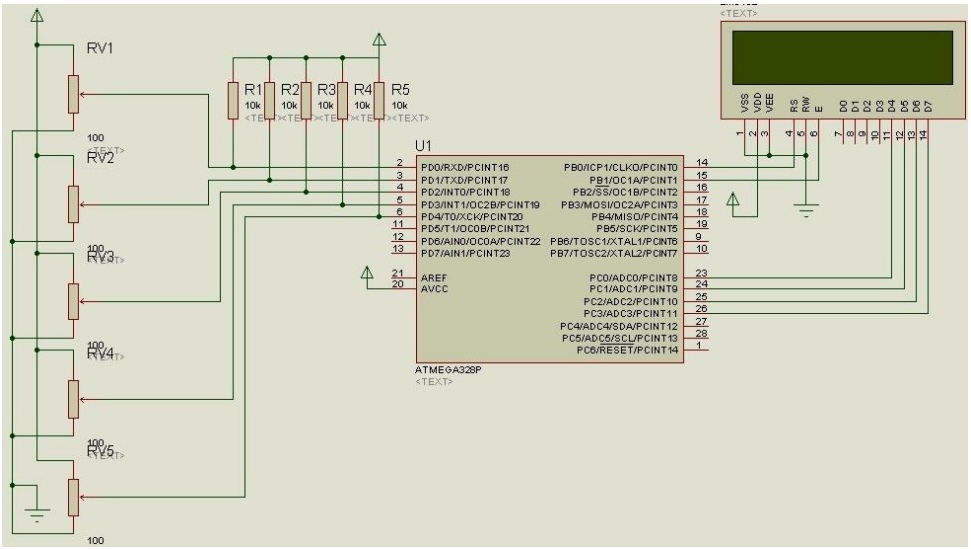
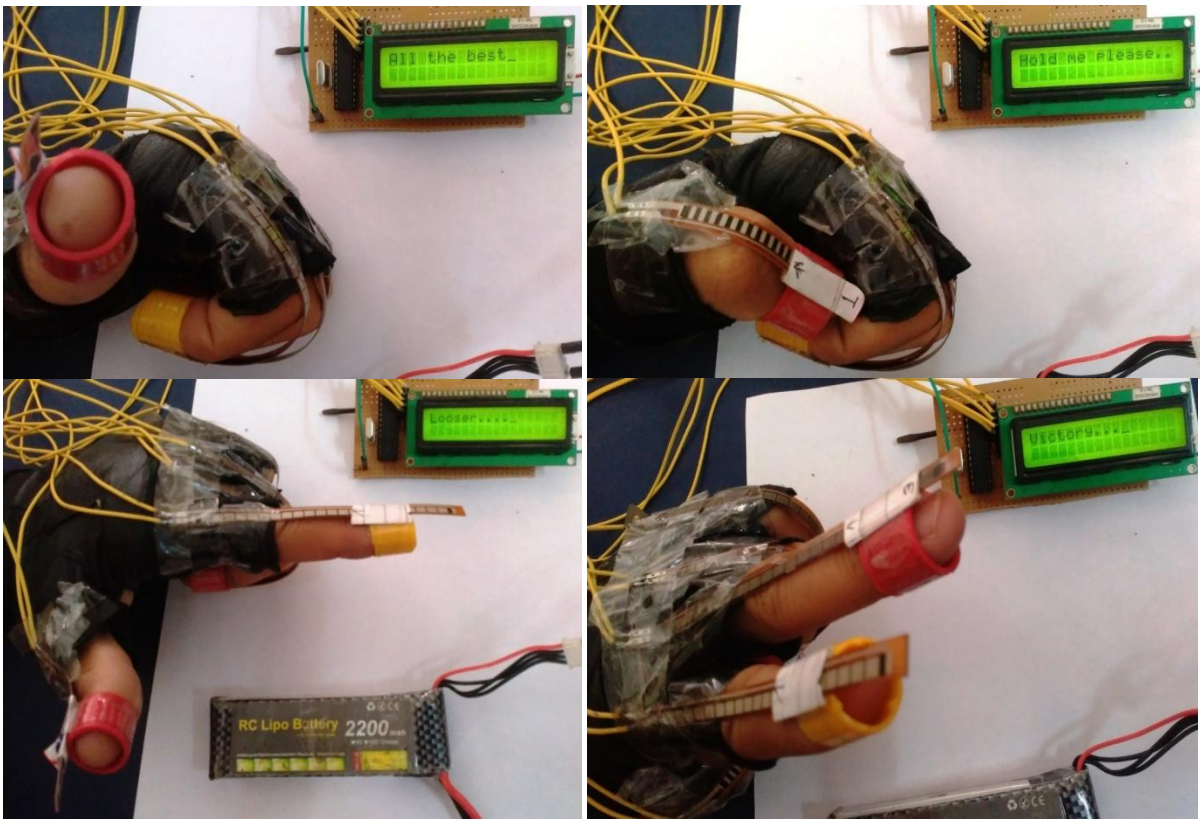


Fig-2: *Circuit Diagram of Implemented System*

EXPERIMENTAL RESULTS

Fig-3: *Implemented Hand Gestures Recognized by the System*



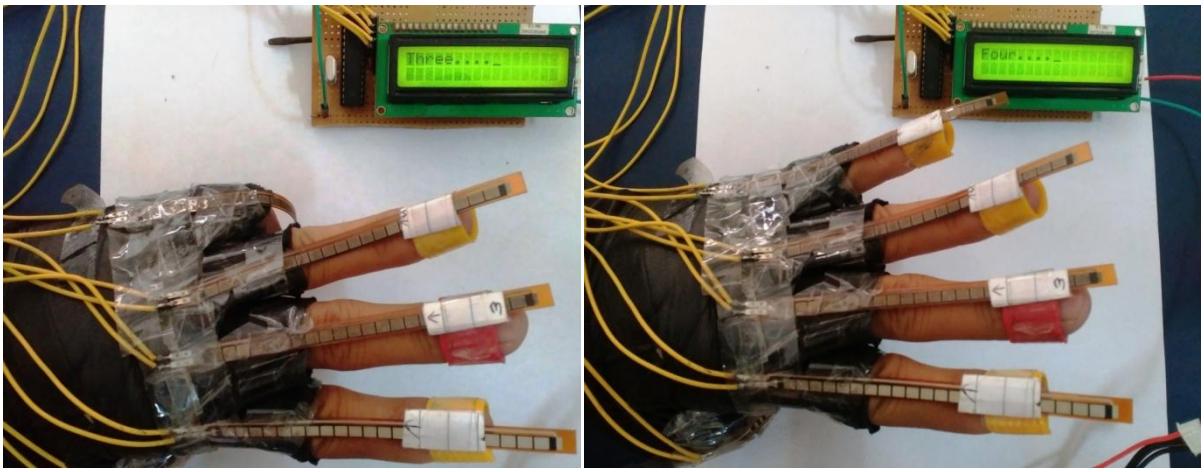


Fig-4: *Different Hand Gestures Recognized by the System*

CONCLUSION

In this system a hand gesture recognition system is explained by using flex sensors. The system mainly consist of sensor data collection, segmentation and recognition. When bend angle and acceleration data from the sensing device is received, a segmentation algorithm is applied to find out the start and end points of gesture by self. The gestures codes are taken as classifying features. Then the gestures codes are compared with the stored standard gestures pattern so that it can find the most likely gesture. Since motion analysis generates the standard gesture pattern, the recognition system does not need a big database. However to increase the operating capability of the system we need to improve segmentation algorithm to raise its accuracy in finding the terminal points of the gestures. Moreover, we will study more recognition methods in our future work.

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