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AVR based Robotic Arm for Speech Impaired People

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ABSTRACT

Communication is the most important part of human life. Deaf and dump people face many problems while communicating with the normal people. They interact with help of sign language, but this sign language is not understood by the common people. Speech impaired people experiences many challenges while communicating. Solution to this problem is provided in this paper. we proposed a system which uses flex sensor and accelerometer to sense the hand gesture. Indian sign language is used for recognizing the words. The sensors are placed on the data gloves. The signals are processed using AVR controller, which are play backed in form of voice using play back voice module. Additionally a feature of wireless robotic ARM is also provided.

Keywords: Flex Sensor, Speech Impaired People, Robotic Arm, Indian Sign Language.

I. INTRODUCTION

Communication is most important part of human life. Communication language vary from place to place and country to country. Hand is one of the richest source for communication, as we talk normally our hand automatically moves in accordance with the speech. Deaf and dump people make use of sign languages to communication with each other. Loss of hearing and speech makes the impaired people lonely and isolated. Sign language is only the means of communication for them to communicate with people. Science and technology has been advanced with various technologies to overcome the problem of speech impaired people. sign language uses hand movement and manual communication to convey the message instead of voice or sound patterns. Sign language of speech impaired people vary from place to place and from country to country. Many challenges are faced by the speech impaired people while communicating with the normal people.

Some of the main challenges experienced by speech impaired people while communicating with normal people are social interaction, communication disparity, education, behavioral problems, mental health, and safety concerns. As a result of these obstacles, deaf and dumb people are discouraged to speak out about themselves or their situations in a public place or emergency cases or in a private conversation.

In this paper an embedded system is proposed which will translate Indian sign language and at the output we are having playback voice module, such that we can get output in form of sound. Flex sensors and accelerometer are used to sense the hand gesture. Additionally the feature of wireless robotic ARM is added. This provides virtual robotic ARM to move exactly same as that of the real hand. The device designed is portable and user friendly. It will be flexible to any common person.

The paper is arranged in the following manner section 2 contains of the methodology detailed working and implantation of the proposed system is discussed. In Section 3 design consideration and design equation are discussed, section 4 consist of experiments and results. Section 5 concludes the paper.

Previously hand gesture hand gesture system was developed by various ways, Watcharin Tangsuksant *et.al* in[6] they translated ASL from static postures. In this

they have designed the glove with six different colored markers and developed algorithm for alphabet classification. They have set the system by set by two cameras in order to extract 3D coordinate. There are three main important processes for algorithm consisting of marker detection by using Circle Hough Transform, computation of all feasible triangle area patches constructed from 3D coordinate triplet, and feature classification using feed forward back propagation Artificial Neural Network The image acquired from two camera are used for 3D extraction of maker coordinates using a DLT algorithm. Kotaro Tadano *et.al* in[8] proposed a grip Amplified glove using pneumatic artificial rubble muscles (PARMs). The PRAM is suitable with total 10 degrees of freedom and consist of four units. To achieve power assist motion ,a PI control, which is based on pressure value from a balloon sensor is performed . balloon sensor makes the the applied part free from the electricity. EMG patterns of muscles are measured to evaluate the power assist performance. The system becomes more complicated and bulky.S. Sidney Fels and Geoffrey E. Hinton [3] proposed a system which translates hand gestures to speech through an adaptive interface. They have segmented the gesture in vowel and consonant. Geetha M *et.al* in [11]proposed a method to recognize symbols from (A-Z)which have static gesture. In this they have used polygon approximation method with Douglas-Peucker algorithm. The algorithm was used to approximate the boundary of gesture image. The proposed system recognizes the open fingers and close fingers gesture. The system becomes more complex. Michiko Nishiyama *et.al* in [5] presented a wearable sensing glove with embedded hetero-core fiber-optic nerve, which uses hetero-core fiber-optic nerve as sensors that detect finger flexion to achieve unconstrained hand motion monitoring. To measure the transmission loss optical power meter and a laser diode were used. Beside of all these optical fiber losses can be observed in the system. Hussein Al-Osman et.al in [15] proposed a system for patient of post stroke with wrist disabilities. This system mainly aims on translating the wrist movement into gaming actions meant to provide entertainment and thus motivate the patient to spend more time for exercising. They have used 3D accelerometer for the wrist movements, for communication RS232 is used. However the systems which is implanted is more flexible, robust, also user friendly to common man. The most important thing is that the proposed system is real time operated system.

II. METHODS AND MATERIAL

The hand gesture recognition represented in this paper consists of the transmitter and receiver section. The transmitter section consist of Data glove, flex sensors ,Accelerometer, Amplifier (Op-amo), AVR Microcontroller, Zig-Bee and play back voice module. The receiver section consists of the same parts as that of transmitter section along with additional parts servo motors and robotic hand. The Fig.1.shows the block diagram of the ISL hand gesture recognition system.

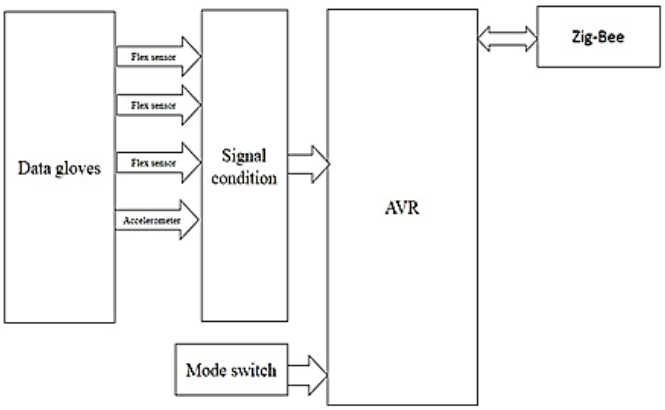

Figure 1. Block diagram of transmitter section

2.1 Data Gloves

Data gloves use in this system are simple woollen gloves which are used by common people. It is an associative device which provides tactile sensing and fine control motion. Flex sensors are arranged on middle index and thumb of the data gloves and accelerometer on the wrist of data gloves. It mainly used to direct way.

Sensory part consists of arrangement of the flex sensor and accelerometer. Flex sensors are used to sense the hand movement, and accelerometer is used to measure the wrist spins. In flex sensor resistance varies equivalent to bending of the sensor. This value is then converted into voltage by using voltage divider network. Accelerometer consist of three axes as X ,Y, Z and produces three different set of values corresponding each axis location based on movement of wrist and orientation made in hand movement.

2.2 Signal Condition

LM324N op-amp is used in non- inverting mode for signal conditioning. The flex sensor output obtained is in

mV, to amplify the signals and give it in proper voltage to controller, op-amp is used. Feedback control of the non-inverting op-amp is achieved by applying a small part of the output voltage signal back to the inverting (–) input terminal via a voltage divider network, it again produces a negative feedback. Good stability is produced with closed-loop configuration of non-inverting amplifier circuit.

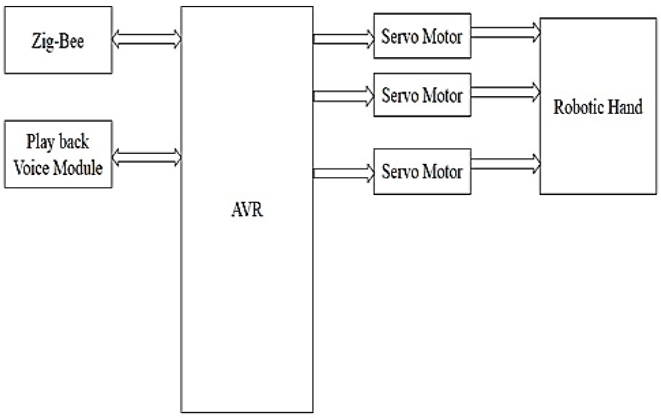

Figure 2. Block diagram of receiver section

2.3 AVR Microcontroller

Advance Virtual RISC processor is used for designing the system. It is High Performance, Low Power 8-Bit Microcontroller. This controller is chosen to obtain maximum range of voltage so that we can get more number of samples. The operating voltage range of AVR is between 0V-5V. The controller is used to govern the operations of the signal values which are being sensed by the sensor part. Thus the output of sensor and the accelerometer are given to the input pins for further processing.

2.4 Play Back Voice Module

QPR33A3 IC is used as Voice play back module. The hand gestures which are performed by the speech impaired people are sensed, processed and then send to the voice play back module. These signals are given at the output in form of sound through speaker.

2.5 Servo Motor

Servo motors are used for the movement of robotic Arm. The flex sensors are mapped into 0° to 180°. Fully stretched is equivalent to 0° and full bend is equivalent to 180°.

These motors can individually handle the load up to 9gram.

2.6 Zig-Bee

Zig-Bee is used for transferring the wireless information from transmitter to receiver having2.4GHz frequency .

Figure 3. Indian sign language gesture

III. DESIGN OF SYSTEM

A. Flex Sensor:

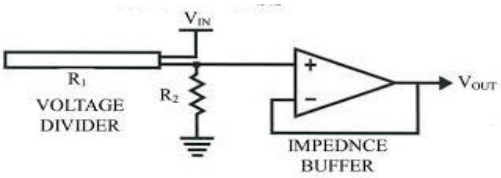

Figure 4. Basic Flex Sensor circuit [21]

$$\text{Vout} = \text{Vin}\left(\frac{\text{R1}}{\text{R1+R2}}\right) \text{(1)}$$

Where,
Vout = output voltage
Vin= Input voltage
R1= fixed resistance
R2=variable resistance

From the above equation (1), the output voltage (Vout) is calculated. Input voltage Vin is 5V, fixed resistance is taken as 35k and the variable resistance value R2 is measured from flex sensor. The resistance comes around 70kΩ to 75kΩ for fully bend and 30kΩto 35kΩ for fully stretched. Vout is calculated and it comes as 3.40V for fully bend and 2.5 V for fully straight.

B. Amplifier(op-amp)

Operational amplifier used is non-inverting op-amp. Fig 4 is the circuit diagram of op-amp, Vin is 5V. Deflection between fully stretched and fully bend flex is near about 0.7V to 0.8V. so the voltage at the positive or non-inverting terminal is taken as 0.7V.

At the non-inverting terminal potential divider network is used. In that we assumed the value of R3 as 200kΩ.From equation (2) the value of R4 is 33KΩ.

$$V1= \left(\frac{R4}{R3+R4}\right)Vin \quad (2)$$

$$Av=\left(1+\frac{Rf}{R1}\right) \quad (3)$$

$$\text{Also , } Av=\frac{Vout}{Vin} \quad (4)$$

Where,
Av=Gain
Rf=flex sensor resistance
R1= fixed resistor

From the equation (3)value of R1 is calculated. Initially theoretically we get the gain as 7.14 from equation(4).so for calculation it is taken as 6. From equation (3) the value of R1 comes as 18k. from equation (4) output voltage is calculated. For flex resistance value Rf=35kΩ when it is fully stretched output voltage is 2.1V and gain is 3 for fully bend Rf=75kΩ and output voltage is 3.6V.

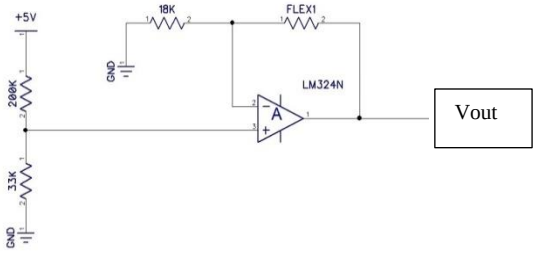

Figure 5. op-amp circuit

Fig 6 represents the flow chart of the transmitter section, firstly the serial port is initialize and baud rate is set to 9600 bps. The flex sensor senses the gesture movement of the fingers. After that two modes are provided for gesture and robotic arm. If mode=0 then Robotic Arm mode is selected and if mode=1 Gesture mode is selected.

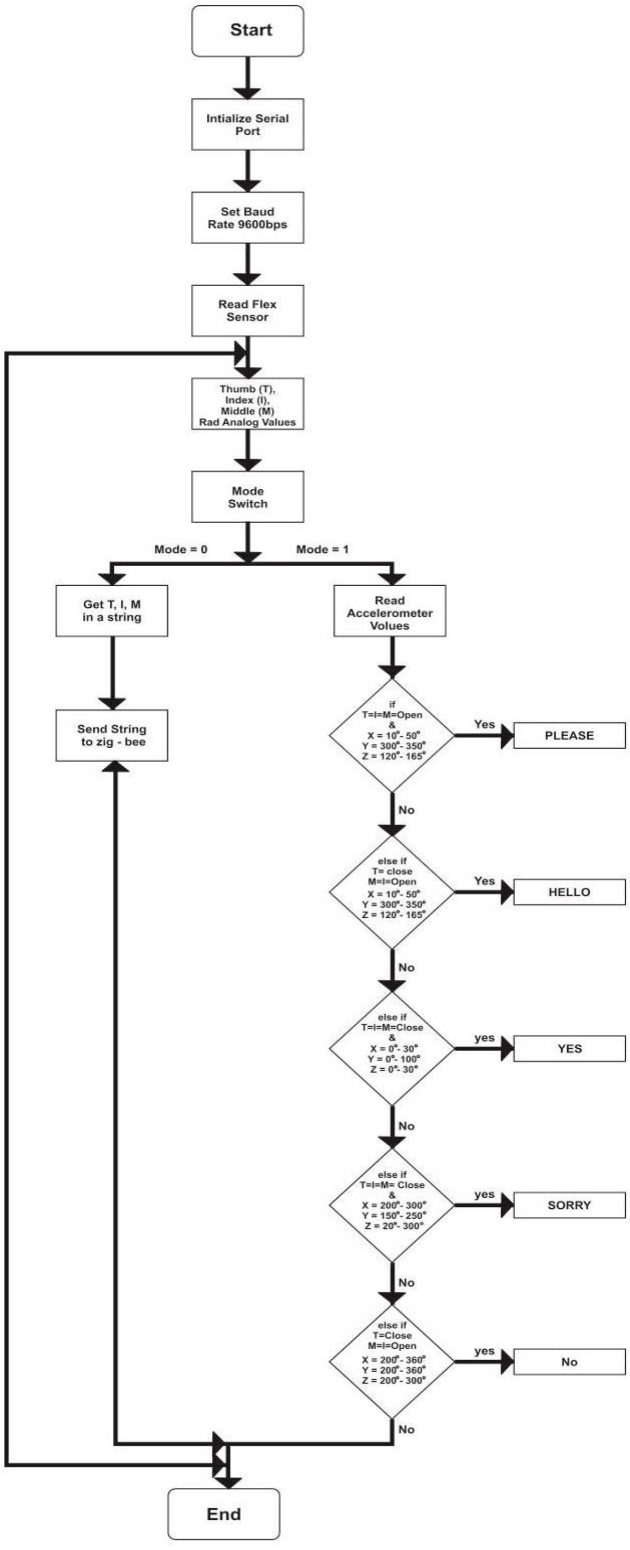

Figure 6: flow chart of transmitter section

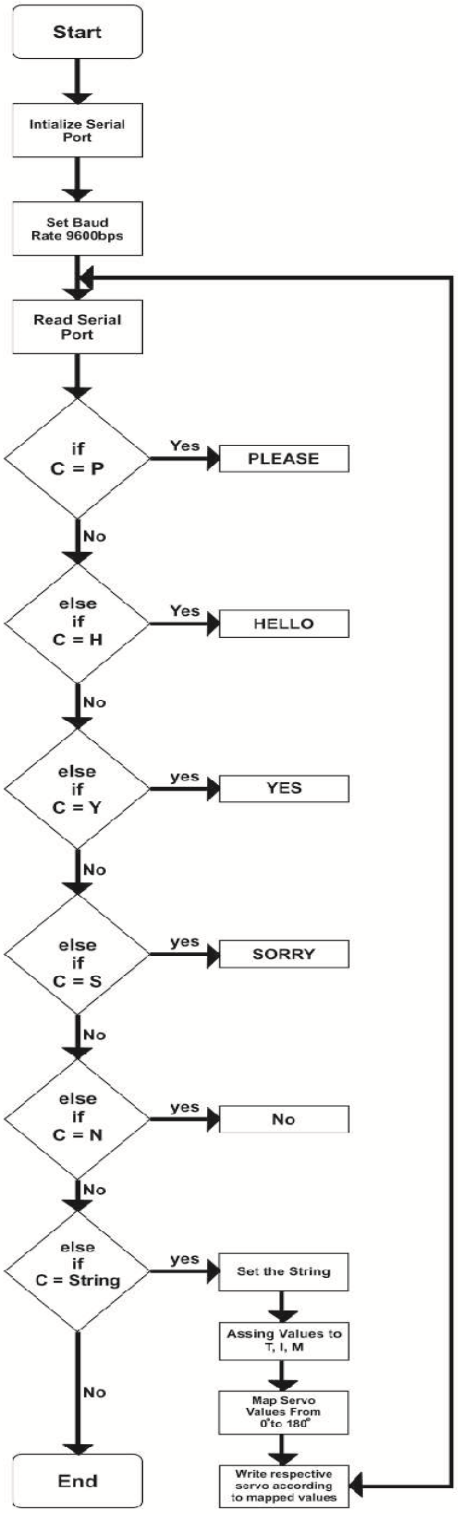

Figure 7. Flow chart of receiver section

If mode=1 then accelerometer will sense the position of the hand. All the three fingers value are read. Four words namely HELLO, YES, NO,SORRY and PLEASE are taken. Respective values are set for each word. The controller will read the input values and compare with the set value. If the input value matches any one of the four words, suddenly the condition will become true and that specific word will be given at the output. If mode=0 then the values of T,I and M are taken in string. After that the string is send to Zig-Bee. The conditions are arranged in else if loop, if any of conditions is not satisfied then again the input values are read and the loop continues. In this manner number of iterations takes place and once the condition satisfies the loop is ended.

Fig 7 represents the flow chart of the receiver section, firstly the serial port is initialize and baud rate is set to 9600 bps. The serial port is read according to input which is receiver from the receiver section. A variable "c" is set. This variable checks the current value. Like if c=P then it gives PLEASE at the output. Accordingly t All the four words are HELLO, PLEASE, YES ,NO and SORRY are checked. If the c=string then that is separated and values are assign to T, I , M respectively. The values are mapped into servo motor values from 0° to 180° accordingly. The respective servo is write according to the mapped values. This operation goes on in a closed loop manner. If the c≠ string then the loop ends.

IV. RESULTS AND DISCUSSION

Figure 8. Transmission Section

The fig.6 shown above is transmission section of the system. Flex sensors are arranged on the data gloves. Microcontroller is used for processing of the signals and Zig-Bee of frequency 2.4GHz is used to transmit the data.

Figure 7. Receiver Section

Fig.7 Shows receiver section. Zig-Bee of frequency 2.4GHz is used to receive the data from transmission side at the output there is playback voice module through which the gesture is recommended and is given out in the form of voice. also the Robotic Arm moves in same way as the real hand moves.

TABLE I. SENSOR READINGS

fingers name	**fully bend (close)**	**fully stretch (open)**
Thumb	664	395
Index	639	479
Middle	600	597

The above table I represents the experimental readings of the flex sensor. Three fingers namely Thumb, Index and Middle are taken to perform the movement. The results were noted individually for each finger when it is fully bend and fully stretched.

TABLE II. HAND GESTURE READINGS

Sr. No	Thumb	Index	Middle	X^0	Y^0	Z^0
HELLO	300	345	425	10-50	300-350	120-165
YES	675	500	653	0-50	0-50	0-50
SORRY	725	565	625	0-100	0-100	0-100
PLEASE	315	342	501	10-50	300-350	120-165
NO	425	475	456	300-360	0-50	300-360

Table II represents the hand gesture readings. The 1st column represents the letter which are produced using hand gesture. We have tested it for four words namely HELLO, YES, NO,SORRY & PLEASE. The thumb index and middle fingers column defines the position value of the respective finger. X,Y,Z column represents the position of the accelerometer in degrees**.**

V. CONCLUSION

The proposed system is designed and implemented. The gesture made by the speech impaired people to express their words are interpreted accurately. The gesture is sensed properly by the flex sensor. The performance of system is verified experimentally. The flex sensor values are accurately mapped to servo motor values. The Robotic Arm moves correctly same as the real hand. The designed system is more reliable and user friendly.

VI. REFERENCES

[1] Y. Park, J. Lee, and J. Bae,"Development of Wearable Sensing Glove for Measuring the Motion of Fingers Usin Linear Potentiometers and Flexible Wires"IEEE Transactions On Industrial Informatics, Vol. 11, No. 1, February 2015,pp.198-206.

[2] Mrs.N.Harish, Dr.S.Poonguzhali "Design and development of hand gesture recognition system for speech impaired people"IEEE International Conference on Industrial Instrumentation and Control, May- 2015

[3] W. Tangsuksant, "American Sign Language Recognition by Using 3D Geometric Invariant Feature and ANN Classification", IEEE International Conference on Biomedical Engineering, 2014

[4] K. Tadano, M. Akai,"Development of Grip Amplified Glove using Bi-articular Mechanism with Pneumatic Artificial Rubber Muscle"IEEE International Conference on Robotics and Automation, 2010

[5] M.Nishiyama and K.Watanabe,"Wearable Sensing Glove With Embedded Hetero-Core Fiber-Optic Nerves for Unconstrained Hand Motion Capture"IEEE Transactions On Instrumentation and Measurement, Vol. 58, No.12,pp. 3995-4000,December 2009

[6] Y. Li, "A Sign-Component-Based Framework for Chinese Sign Language Recognition Using Accelerometer and sEMG Data"IEEE Transactions On Biomedical Engineering, Vol. 59, No. 10,pp.2695-2704,Octoboer 2012.

[7] P. Subha Rajam, Dr. G. Balakrishnan,"Real Time Indian Sign Language Recognition System to aid

Deaf-dumb People", IEEE International conference, 2011
[8] S. Sidney Fels and G.E.Hinton,"Glove TalkIIA Neural-Network Interface which Map Gestures to Parallel Formant Speech Synthesizer Controls"IEEE Transactions On Neural Network, Vol. 8, No. 15,,pp.977, September1997
[9] C.S. Fahn and H. Sun,"Development of a Data Glove With Reducing Sensors Based on Magnetic Induction"IEEE Transactions On Industrial Electronics, Vol.No.52,pp.585-594, April 2005
[10] S. Ueki,"Development of a Hand-Assist Robot With Multi-Degrees of-Freedom for Rehabilitation Therapy"IEEE Transactions On Mechatronics, Vol 17 No.1,pp.136-146, Februrary 2012.
[11] Geetha M, R. Menon,"Gesture Recognition for American Sign Language with Polygon Approximation"IEEE International Conference on Technology for Education,2011
[12] C. S. Weerasekera, M. H. Jaward, and N. Kamrani "Robust ASL Fingerspelling Recognition Using Local Binary Patterns And Geometric Features"IEEE International Conference,2013
[13] Y. Park, J. Lee, and J. Bae,"Development of a Finger Motion Measurement System using Linear Potentiometers"IEEE International Conference on Advanced Intelligent Mechatronics, 2014
[14] K. Li, I-M.chen, S. H. Yeo,"Design and Validitaion of a Multi-Finger Sensing Device on Optical Linear Encoder"IEEE International Conference on Robotics and Automation,May 2010,pp.3629-3634.
[15] H. Al-Osman,"E-Glove: An electronic glove with vibro –Tactile feedback for wrist rehabilition of post –stroke patients"IEEE International conference 2011.
[16] C. Preetham, G. Ramakrishnan."Hand Talk-Implmentation of a Gesture Recognition Glove",IEEE Conference on Txas Instruments 2013
[17] P.S. Rajam, Dr.G.Balakrishnan,"Real Time Sign Language Recognition system to aid Deaf dump People",IEEE International Conference,2011.
[18] Y. Khambaty, S. Nehal,"Cost Effective Portable System for Sign Language Gesture Recognition"IEEE conference 2008.
[19] www.alldatasheet.com/view.jsp?Searchword=Atmega328p
[20] www.futurlec.com/Linear/LM324N.shtml
[21] https://www.sparkfun.com/datasheets/Sensors/Flex/flex22.pdf
[22] www.micropik.com/PDF/SG90Servo.pdf
[23] https://www.sparkfun.com/datasheets/Components/SMD/adxl335.pdf