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Handicapped Assistance Device for Controlling Electrical Appliances

Jamuna R[1], Abhinai S[2], Jhananadhan SP[3]

Assistant Professor, Department of ECE, SNS College of Engineering, Coimbatore, India [1]
UG scholar, Department of ECE, SNS College of Engineering, Coimbatore, India [2]
UG scholar, Department of ECE, SNS College of Engineering, Coimbatore, India [3]

***Abstract*—Hand gesture is a very natural form of human interaction and can be used effectively in human interaction with embedded systems. Interaction using gesture technology for effective communication empowering people suffering from Restless Legs Syndrome, Peripheral Artery Diseases, Rheumatoid Arthritis or Paraplegia to interact with electrical appliances and computing devices including 3-D graphic interactions and simulations. Thus, gesture-based interaction offers a smart way for the people who hope to express their views in most natural and convenient way in modern environment. This paper focuses on implementation of gesture recognition system built around a flex sensor that is used for gesture recognition and accordingly the control action assigned to the gesture takes place and the voice output is provided.**

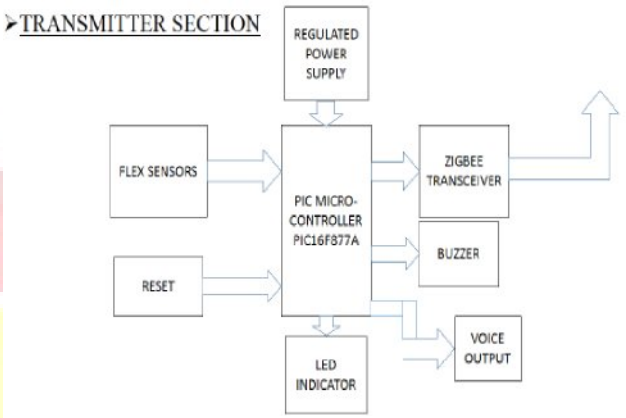
***Index Terms*— Flex sensors, Paraplegia, Gesture recognition.**

I. INTRODUCTION

In the recent advancement in the technology, like low power electronics and the wireless devices, ability to design both the analog front-end and the digital back-end are integrated in the embedded system has inspired a new range of wearable micro-devices.

We have implemented a glove with a motive to provide a low-cost solution to enable the handicapped people affected with leg syndrome to communicate with electrical appliances. To exploit gestures in the human machine interfacing, it is necessary to provide an intermediate embedded system. In this paper we described the functions of flex sensors. We also discuss about the implementation of gestures to voice outturn.

The main motive to develop such a device is manifold. It aims at venturing into the field of physiological computing and permitting convenient interaction with the surrounding appliances.



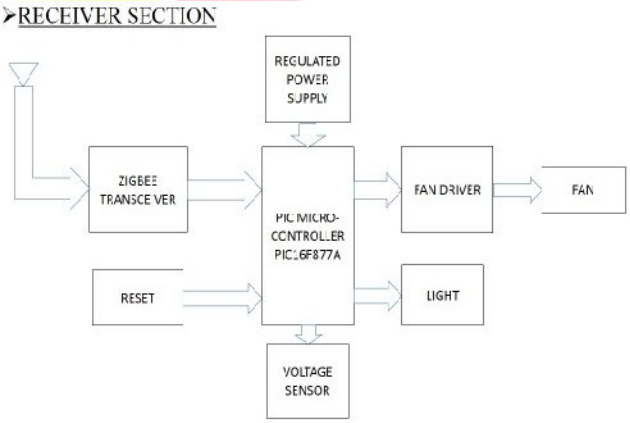


Fig 1: Block Diagram-Transmitter
Fig 2: Block Diagram-Receiver

II. SPECIFICATIONS

Structure	Specification
Gesture	Flex sensors-5
Communication	ZigBee Transceiver Module-2, Frequency range-2.4 Ghz
Processor	PIC 16F877A
Voice IC	APR33A3

Table 1: Specification

III. COMPONENT SELECTION

A. Power supply

The ac voltage, typically 220Vrms, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.

International Journal of Advanced Research in Biology, Ecology, Science and Technology (IJARBEST)
Vol. 1, Issue 1, April 2015

A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

i. Transformer

The potential transformer will step down the power supply voltage (0-230V) to (0-12Vand 12-0-12) level. If the secondary has less turns in the coil then the primary, the secondary coil's voltage will decrease and the current or AMPS will increase or decreased depend upon the wire gauge. This is called a STEP-DOWN transformer. Then the secondary of the potential transformer will be connected to the rectifier.

B. ZigBee Module

CC2500 RF Module is a transceiver module which provides easy to use RF communication at 2.4 GHz. It can be used to transmit and receive data at 9600 baud rates from any standard CMOS/TTL source. This module is a direct line in replacement for your serial communication it requires no extra hardware and no extra coding to it to works in Half Duplex mode i.e. it provides communication in both directions, but only one direction at same time. No complex wireless connection software or intimate knowledge of RF is required to connect our serial devices. Designed to be as easy to use as cables. No external antenna is required, the module has in-built antenna to both transmit and receive. There are two types of interfaces are in this module i.e. RS232 and TTL interface.

Features	Specification
Coverage range indoor	30m
Outdoor line of sight	90m
Baud rate	9600
Operating frequency	2.4GHz

Table 2: Specification

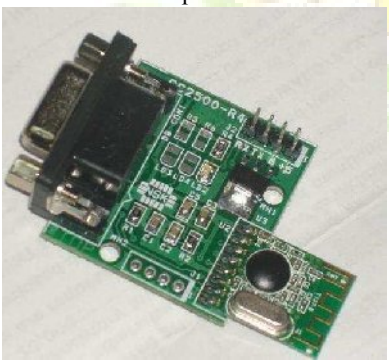


Fig 3: ZigBee Module

C. Processor

Microcontroller is a general purpose device, which integrates a number of the components of a microprocessor system on to single chip. It has inbuilt CPU, memory and peripherals to make it as a mini computer. A microcontroller combines on to the same microchip .A timer module to allow the microcontroller to perform tasks for certain time periods. A serial I/O port to allow data to flow between the controller and other devices such as a PIC or another microcontroller. An ADC to allow the microcontroller to accept analogue input data for processing. Micro controller is a standalone unit, which can perform functions on its own without any requirement for additional hardware like I/O ports and external memory. The heart of the microcontroller is the CPU core. In the past, this has traditionally been based on an 8-bit microprocessor unit. For example Motorola uses a basic 6800 microprocessor core in their 6805/6808 microcontroller devices. In the recent years, microcontrollers have been developed around specifically designed CPU cores, for example the microchip PIC range of microcontrollers.

PIC 16F877A

The microcontroller that has been used for this project is from PIC series. PIC microcontroller is the first RISC based microcontroller fabricated in CMOS (complementary metal oxide semiconductor) that uses separate bus for instruction and data allowing simultaneous access of program and data memory. The main advantage of CMOS and RISC combination is low power consumption resulting in a very small chip size with a small pin count. The main advantage of CMOS is that it has immunity to noise than other fabrication techniques. Various microcontrollers offer different kinds of memories. EEPROM, EPROM, FLASH etc. are some of the memories of which FLASH is the most recently developed. Technology that is used in pic16F877A is flash technology, so that data is retained even when the power is switched off. Easy Programming and Erasing are other features of PIC 16F877A. The PIC start plus development system from microchip technology provides the product development engineer with a highly flexible low cost microcontroller design tool set for all microchip PIC micro devices. The pic start plus development system includes PIC start plus development programmer and mplab ide. The PIC start plus programmer gives the product developer ability to program user software in to any of the supported microcontrollers. The PIC start plus software running under mplab provides for full interactive control over the programmer.

D. Flex Sensors

Flex sensors are sensors that change in resistance depending on the amount of bend on the sensors. They convert the change in bend to electrical resistance – more the bend more the resistance value. They are usually in the form of thin strip from 1inch to 5inch. They can be made uni-directional or bi-directional.

Flex sensors works as a variable analog voltage dividers. Inside the flex sensors are carbon resistive elements within a thin flexible substrate. Flex sensor with more carbon means the resistance will be less. When the substrate is bent the sensor produces a resistance output relative to the bend

International Journal of Advanced Research in Biology, Ecology, Science and Technology (IJARBEST)
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radius.

Spectra Symbol has used this technology in supplying Flex Sensors for the Nintendo Power Glove, the P5 gaming glove and also for several other applications.

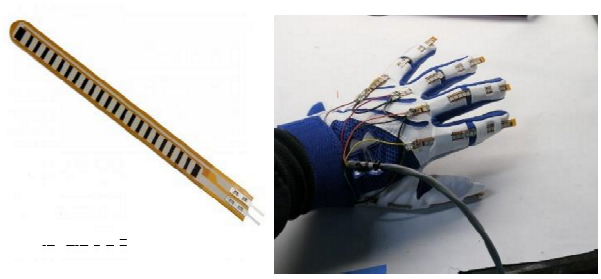

Fig 4: Flex Sensor & Glove

IV. COMMUNICATION

A. Transmitter Section

For transmission and reception in RF band there are lot of devices available. Here, the often used method of ZigBee module (CC2500) is employed with reduced noise and high bandwidth. This allows peer to peer communication. which are used to control the movement on the receiver side is connected with the input pin DI of ZigBee module to asynchronous, serial communication module, hence data are buffered and transmitted one by one to DI pins and is transmitted through ZigBee device. By the ZigBee, the amplified signal will be modulated and send from the transmitter end.

B. Receiver Section

At the receiver end it consist of another ZigBee transceiver module. This ZigBee module act as the receiver and the transmitted signal will demodulated and it will processed by microcontroller and the corresponding signal will be sent to the driver circuit for controlling electrical appliances.

V. SYSTEM ARCHITECTURE

Here the system architecture consists of 2 sections i.e. hardware and software. Software section consists of electronic interfaces, processors. This is the collection of controller processes that the set of controlling task that the system is nominally able to perform. Here the motor driver circuit and the electrical appliances works with the control signal set by the pic microcontroller depending on the received signal sent by the transmitter and pre-programmed conditions in the controller using software. Hardware architecture is the technological target into which the above mentioned software will be uploaded. This section includes the five sensor operated remote control. ZigBee transceiver module, fan motor driver control circuit, fan relay and voltage sensors. System architecture should be designed in such a way that it has to ensure guarantee in system performance, economical and easy accessing.

VI. METHODOLOGY

In the hardware section, the flex sensor is used for gesture recognition. The block diagram gives a representation of transmitter and receiver section. As told previously the flex sensor unit acts as the recognizer. Whenever the sensor is pressed the resistance of the flex sensor varies and the signal corresponding to it is send to the microcontroller along with the transmitter, which transmits signal to the receiver microcontroller through transmitter and receiver (ZigBee modules). In our project, the short circuit indication in the receiver is also given to the transmitter section. LCD displays which electrical appliances is turned on and off on both sections. Only six command set in the flex sensor is taken and each has different resistance variation. So that when a digit of particular flex sensor is pressed, the control code is matched with that resistance value. As far as this project is concerned only a less number of functions for controlling electrical appliances are used. Hence, we state that flex sensor offers a powerful and flexible tool for sensing. It can be used in a various applications with almost high level of recognition. It can be incorporated into a standard technology to increase interaction between human and machine.

VII. CONTROL CIRCUITRY

In order to provide the appropriate control by the appliances according to the signal given by the sensor and to avoid the short circuit, a circuit must be provided to control the functioning of electrical appliances.

This task is implemented by the control circuitry which consist of 5 flex sensors, fan driver circuit, controller, voice IC (APR33A3), voltage sensor, transformer and transceiver.

ZigBee transceiver module is capable of transmitting and receiving simultaneously in both direction.

The electrical output for the corresponding movement from flex sensor are as follows.

Flex Sensor	Switching	Result
1	Once	Light ON
1	Twice	Light OFF
2	Once	Fan ON
2	Twice	Fan OFF
3	Once	Speed Variation
4	Once	Speed Variation

Table 3: Command Set

VIII. CONCLUSION

The final research platform has five flex sensors with two for ON and OFF of light and fan, and the other flex sensor for

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Vol. 1, Issue 1, April 2015

speed variation of fan. This system is designed to operate on gesture controls from the transmitter side remote model. It can also be controlled by tethering or by infrared communication.

IX. FUTURE WORK

This paper can be further extended in future by giving more control circuitry for sensors for controlling more appliances within the domestic environment so that the physically disabled people can access the home appliances which is more advantageous.

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Mrs. R. JAMUNA. Assistant Professor(SR) in the Department of ECE at SNS College of Engineering, Coimbatore, obtained her Bachelor's degree in Electronics& Communication Engineering from Bharathiar University in the year 1997. She obtained her Master's degree in VLSI Design from Anna University Coimbatore. She has 17 years of teaching experience. Date of birth is 17th December 1974. Her registration for Ph.D. in 2010.

Mr. S.ABHINAI, Under graduate scholar, Department of ECE , SNS College Of Engineering, Coimbatore is from Erode, born on 26th December 1993.He has published the paper in National Conference on"Trends in Automotive Parts Systems and Applications" (TAPSA'15)

Mr. SP. JHANANADHAN, Under graduate scholar, Department of ECE, SNS College Of Engineering, Coimbatore is from Namakkal, born on 12th January 1994. He has published the paper in National Conference on"Trends in Automotive Parts Systems and Applications" (TAPSA'15)