Abstract
The persons with various disabilities like blindness, paraplegia (a spinal cord injury in which a person is half paralyzed) face many challenges in their daily work. The situation is exactly the same with the persons who unfortunately met with any kind of accident that resulted in the loss of movement of their legs, fingers or both. We are in the modern era that is gripped in the hands of electrically controlled appliances. Switches are used to operate these appliances and the disabled people find it difficult to operate them as their own. Considering the difficulty through which physically impaired persons have to underpass, we have developed a system which interprets the hand gesture of the person to control the appliances. An accelerometer which is basically a tilt sensor senses the movement which a gesture produced. The hand gesture helps the disabled person to a great extent to control the appliances and with a ZigBee module a person need not to set any angle for controlling purpose. Thus it is a possible solution not only for physically handicapped but also for the blind persons. The developed system has good accuracy, low power consumption and cost efficient characteristics.

I. INTRODUCTION
About 15% of the world’s population is facing the disability in one form or another form [1]. Around 20 to 40 percent of the people with disabilities lack the help they require to engage in everyday activities. According to 2001, 7.4% of the total population in India is facing this problem [3]. In our project we basically focus on physically disabled and visually impaired persons. Visually impaired data records approximately 285 million people in
which 39 million are blind and 246 million have low vision [3]. Incapability to move can either be a genetic or attained with age. Statistics shows 90 million elderly persons in 2011 with the number expected to grow to 173 million by 2026. This problem of being physical disable could also be the consequence of any disease or due to accidents.

The physical disabled persons face many problems in their day to day life. Even the aged persons also face such kind of difficulties to do day to day work. The rise in the aged people population from 1994 to 2004 is 9.3% and in numbers, it is 3.1 million people to 36.3 million people. Physical disability can be defined as loss of upper or lower limb. It also includes manual dexterity and disability in co-ordination with different organs of the body. In all these disabilities a person loses his mobility Mobility is essential to the maintenance of independent living as everyone is busy and there are very less people to assist the disable persons [11]. With the restriction in the mobility of a person, his daily activities may be affected. Likewise, visually impaired person also faces difficulty in living a hassle free, independent life as they are unable to locate and access equipment [18].

About 650 million people, have disabilities, of these, some 10% require a wheelchair and face problem in doing their basic work at home that include controlling electric appliance. In this era we are surrounded by electric appliance and we can’t imagine our life without these appliance. So for those who face difficulty in controlling these appliances due to their disability we have adopted a natural approach of using hand gesture to ease their life. Gesture is natural and frequently used way of communicating [15] with each other. Gesture can be made with any part of the body [19] like it can be hand gesture by simply waving your hand to say bye, or it can be head gesture by nodding your head to say yes or no, or it can also be an eye gesture by blinking your eyes. We are using hand gesture to operate appliances. Input systems for interacting with machines include switches. Those suffering from physical handicaps may be unable to use such form of inputs. Development in technology has enabled us to perform such activities using hand gesture which is a natural and intelligent approach [7].

II. RELATED WORK
Hand gesture is used in various arenas like at home, traffic lights, and wheelchair etc. Gestures are recognized by two approaches first one is image recognition approach and second one is action based approach by using camera and sensor respectively. Various studied work focus on gesture recognition using vision based approach like in the study of V. Solanki et.al [4] a wearable device is designed in which an infrared camera is used for image recognition but that require a laptop or PC for software application so this is the major drawback of his design. Naohiro Wakamura et.al [15] has created an intelligent room by using 3D camera this will remove the problem of restricted area of operation but using 3D camera, for recognizing gesture, compared to a sensor is very costly.

Hand Gesture can be recognized by considering two approaches one is vision based approach and second one is by using sensor. Since with vision based approach, our area of operation is restricted and it is also difficult for visually impaired person to operate in that particular area as the user must be in front of camera [17]. In our study we have used an
accelerometer which is a compact MEMS technology based sensor [11]. It senses the acceleration of the hand gesture.

III. PROPOSED WORK
In daily life information acquisition with the help of sensor has become familiar. In the form of accessories we can easily wear these sensors without any discomfort. And thus the acquisition of hand gestures is easy with this sensor build accessories like band or gloves. We can wear the sensor made system on a daily basis and thus our operating environment range is also extended with this feature. These wearable sensors can be applied to operate the electric appliances. Wearing wearable sensor accessories and producing some hand gestures, the interface can be functioned normally.

In this work, we research and develop a band to ease the user to operate the basic electrical appliances by using the hand gesture.

In the purposed work a hand gesture based band is developed to control the appliances. Two appliances are controlled by applying four gestures. Gestures are defined as top, bottom, left, right relative to the motion of hand, and accordingly light is on, off and to demonstrate the controlling of fan we have use bulb and its intensity is controlled as shown in the figures. Purposed work has some hardware and software part. Hardware part consists of:

**Band system:** Band system consists of an accelerometer and a microcontroller and other electric components.

a) **Accelerometer:** Acceleration that is produced by making the gesture is measured by an accelerometer. It is a compact MEMS technology based sensor use to sense the acceleration of hand gesture. It is an electromechanical device that is used to sense either static or dynamic force of acceleration. Number of gestures can be made by the movement of hand or any body part. It basically measures motion or acceleration in three axis, but we are just considering the two axis.

b) **Microcontroller:** At the transmitter part the sensed acceleration value of accelerometer is given to micro-controller. The microcontroller that we are using has inbuilt A/D converter which will convert the analog accelerometer sensed output value into digital form.

**ZIGBEE:** It is a wireless technology used to transmit data wirelessly over a range of 100m. The digitized output from the microcontroller is then transmitted through ZIGBEE transmitter and is received at the receiver section by another ZigBee module

**ES with USB:** This unit consists of a microcontroller and a relay circuit and a Triac is also used for controlling the speed of a fan.

a) **Microcontroller:** At the receiver section the ZigBee module output is given to a microcontroller which is then used to operate appliances.

b) **Relay:** It is an electromechanical switch that is used to control the appliances.

**Definition of Problems:** To design the system need to deal with these following challenges

- Classify the Gesture: No. of Gestures can be performed by hand, so we have to use gestures which are recognizable and easy to remember.
How to Recognize: Appliances need to be controlled without delay and there should not be any recognition. So four Gestures are defined that are not complex and these gestures can be easily differentiated from each other.

Figure 1: Hand movement showing top, right, left and bottom gesture in a clockwise direction

Software part of the system consists of developing algorithm for different gestures. Gestures are recognized as left, right, top and bottom by calibrating the degree of change we observe in the sensor value. Accelerometer coordinates are measured and accordingly gestures are named. And further these gestures perform the task of controlling the appliance. At the receiver section we check for zero cross and then decode the predefined gestures. Need to set PWM width of decoded code to control the appliance. Gesture recognition and Application algorithm is shown in figure 3 and figure 4 respectively.

Figure 2: Wearable Band Hardware

Figure 3: Transmitting Unit
IV. RESULT

Gesture are first tested at the transmitter(band) section by displaying the particular gesture command on the LCD screens these commands are then used to control the appliances at the receiver section. Application of the particular command is explained in the table. They are used to control light and bulb but we have demonstrated the controlling of fan by using light only. Increase in the intensity of light demonstrates the increase in speed of the fan and decrease in the intensity of light demonstrates the decrease in speed of the fan.

A. Recognition of waving hand at the transmitter section

Images of the gesture recognized at the transmitter section and the gesture associated with the hand movement are displayed on the LCD screen as top, left, bottom and right movement.

Figure 5: Display shows the left gesture performed by hand
B. Recognition of waving hand at the receiver section
We tested the waving or tilting hand position and examine the controlling of the appliances. The home appliances in this study are a fan and a light, their controlling was tested for 20 times and based on the control action, and recognition rate of the waving hand at different position was concluded as summarized in the given table.

<table>
<thead>
<tr>
<th>Distance</th>
<th>1m</th>
<th>3m</th>
<th>5m</th>
<th>7m</th>
<th>10m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognition rate</td>
<td>98%</td>
<td>98%</td>
<td>97%</td>
<td>97%</td>
<td>96%</td>
</tr>
</tbody>
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Testing of the final device is done in the lab and speed of the fan is demonstrated by increasing and decreasing the intensity of the light as shown in the below figures:

Figure 6: Intensity Of light decreases by tilting the hand in downward direction (Bottom Gesture)

Figure 7: Intensity Of light increases by tilting the hand in upward direction (Top Gesture)

<table>
<thead>
<tr>
<th>GESTURE</th>
<th>SIGN</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>L</td>
<td>Light Off</td>
</tr>
<tr>
<td>Right</td>
<td>R</td>
<td>Light On</td>
</tr>
<tr>
<td>Top</td>
<td>T</td>
<td>Speed increase</td>
</tr>
<tr>
<td>Bottom</td>
<td>B</td>
<td>Speed decrease</td>
</tr>
</tbody>
</table>
V. CONCLUSION
A wearable band has been developed that will be used as a remote by the physically disabled and blind persons to control basic home appliances. This system is based on the hand gesture hence the life of disabled persons will be eased to some extent. Hand gestures are recognized with the help of a tilt sensor (Accelerometer) that converts the gesture, movement into corresponding analog values which are further interpreted by the controller and other units to control the appliances. The system is simple yet robust and easy to use, only the user has to remember some predefined gesture to operate particular appliances. However, the gesture can be used to control further more appliances as approx. 256 appliances can be controlled with this system if able to define more no. of gestures.

VI. FUTURE SCOPE
i.) It can be more advanced by integrating our system with voice recognition system
ii.) It can be further implemented for the quadriplegia patient (do not have movement of both lower and upper limbs) by using head gesture.

VII. REFERENCES


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