

Accelerometer and Bluetooth based smart Wheelchair for Handicapped People

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ABSTRACT: The requirements of many persons with disabilities can be fulfilled with traditional manual or mechanical wheelchairs. A part of the disabled population finds it intricate or unworkable to utilize wheelchairs. There is wide-ranging explore on computer-controlled chairs where sensors and smart organize algorithms have been worn to decrease the level of human intrusion. This system describes a wheelchair for in the flesh disabled people. In this paper aim is to design and develop a system that allows the user to energetically interact with the wheelchair at different levels of the control and sensing. Dependent-user gratitude by hand movements and infrared sensor incorporated with wheelchair. Mechanical wheelchair fundamentally works on the principle of acceleration, one acceleration sensor, provides two axis, acceleration sensors whose output varies according to acceleration applied to it. Sensor gives x-axis & y-axis o/p independently which is fed to Comparator & then μC . On chair Obstacle sensors will be installed for detection of wall/obstacle in the backward direction. According to commands received from android the robot movement can be controlled and on wheelchair Light Dependent Resistor (LDR) is used to help them to move independently in the night. We have implemented accelerometer wheelchair which has various advantages. This Wheelchair will be cost-effective and it is reasonable to common people. In this paper smart wheelchair is proposed with a help of accelerometer whose demo model is design for physically handicapped people so that they can control their chair themselves. Designing of the hardware kit is done by using ARM7, DC motor, motor driver, LCD display, light sensor and accelerometer sensor. The work involves interfacing of the IR sensors for detecting the obstacles and monitoring the wheelchair to display the obstacles founded out on the LCD. Fitting the chair and connecting wheels for DC motors for the movement of the chair, So that they can control their chair themselves.

KEYWORDS: Android Smartphone, Bluetooth Module, Robot, ARM Board, accelerometer, LDR, LCD, IR sensor, motors, wheelchair.

I. INTRODUCTION

Approximately 6 million people in the world face the problem of disability due to paralysis of various degrees. Also there are lots of peoples who are handicapped whom need the help of others.

In today's time, an estimated 1% of the world's population needs a wheelchair. An increased percentage of elderly and disabled people who want to enhance their personal mobility, for them wheelchair is the best assistive device. A disabled or an invalid individual (usually the disability of the lower part of the body) can find it convenient to move around and manoeuvre using the help of a chair constructed on wheels which can either be pushed by another individual or propelled either by physical force or electronically. Such a chair is called as a Wheelchair.

Traditional wheelchairs have some limitations in context to flexibility, bulkiness and limited functions. Our approach allows the users to use human gestures of movement like hand and synchronize them with the movement of the wheelchair so that they can use it with comfort and ease on all kinds of terrains without the hurdle or cardiovascular problems or fatigue.

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Accelerometer smart wheelchair operated wheelchair will support them, the particular handicap will himself operate his own wheelchair and moves it in any direction. There is no need other person to be with him as a helper, here wheelchair is being directionally controlled through the hand movement activating a programmed accelerometer type switch. We are using accelerometer in our system, accelerometers are also used earlier to monitor patient's physical activities and their posture.

A. OBJECTIVE AND SCOPE

In today's time, an estimated 5-7% of the world's population needs a wheelchair. An increased percentage of elderly and disabled people who want to enhance their personal mobility, for them wheelchair is the best assistive device. A disabled or an invalid individual (usually the disability of the lower part of the body) can find it convenient to move around and maneuver using the help of a chair constructed on wheels which can either be pushed by another individual or propelled either by physical force or electronically.

Accelerometer smart wheelchair operated wheelchair will carry them, the particular handicap will himself operate his own wheelchair and moves it in any direction. There is no need other person to be with him as a helper. here wheelchair is being directionally controlled through the hand activating a programmed accelerometer type head switch. We are using accelerometer in our system accelerometers are also used earlier to monitor patient's physical activities and their posture.

The developed system is having a very much scope in providing the best facility for the physically challenged people in their day to day life. It reduces the efforts like pulling the wheelchair since it is battery operated well for the physically challenged people. Sensors work accurately so that the wheelchair can be moved in the desired direction with the gesture movement of the person.

B. PROBLEM FORMULATION

We have seen many handicapped peoples in our daily life that will not be able to move any part of their body without the help of others. We have seen them moving in their wheelchair with the help of others. But if there is no helping hand they cannot even move a bit even though there is wheelchair available with them. From these difficulties of persons we are motivated and came up with model entitled Gesture controlled smart wheelchair. Here we are implementing hand movement controlled wheelchair so that the handicapped people can give their hand gestures to move the wheelchair in required directions. Also we are using an IR sensor to find the obstacles in front of the wheelchair.

The main theme of our system is to make the wheelchair completely automated so that it helps such kind of peoples with all the facilities required for them. Even it saves manual power and time of the person who is in charge of helping those peoples.

II. RELATED WORK

The system consists of a demo chair fitted with four wheels for movement controlled with DC motor and driver having an embedded circuitry. The system works in following method Fig.1. The physically impaired person is provided with accelerometer sensor fitted in his hand which is having a wired connection with the microcontroller unit. The person simply needs to tilt his hand for movement of the chair. The signal got from the sensor is in the analog form and by using ADC the signal will be converted into digital format and processed by the microcontroller unit. A person can move the chair in four different directions like front, back, right, left and stop by tilting his hand in five different axis or dimensions. A wheelchair is fitted with a display system so that the person can get better direction for moving.

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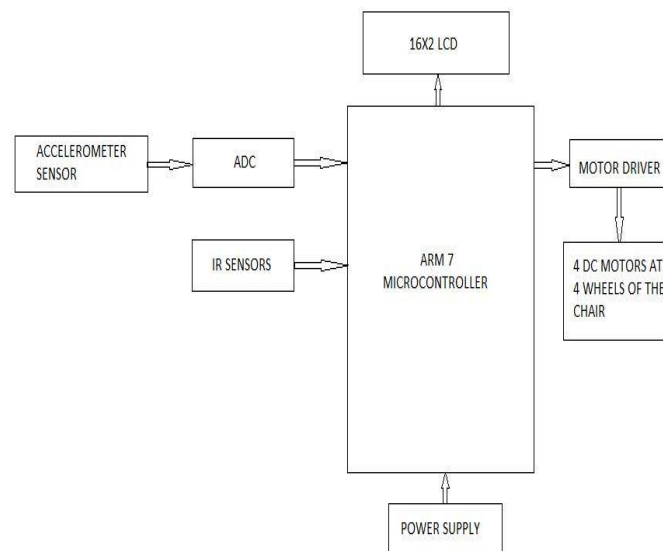


Fig. 1. Block diagram of Accelerometer operated wheelchair

Accelerometer is a device which is used for measuring the acceleration and the tilt angle of anybody over which it is mounted. The output of an Accelerometer IC is in terms of variable voltage linear to the acceleration or the tilt angle. So accelerometers can be used in a lot of applications as two wheel balancing system, vibration sensing machine, tilting remote etc. This concept can be used in robotics wherein one can control an RC car/robot's motion. In remote controlled robots, minimum of two axes are required; one for the forward-backward motion while the other is for left-right motion.

A. WORKING PRINCIPLE

When an accelerometer moves or tilts its position, it gives an analog signal to the microcontroller, which converts it into an appropriate digital level so as to move the motors of the wheelchair. Infrared sensors are used to detect obstacles. If any obstacle is detected, it gives a signal to the ARM7, and it will stop the motors. We measure the value of 2-axis accelerometer based on hand movement and convert it into digital with the help of ADC. ADC converts the data from the sensor and proceeds to the microcontroller for further conversion. The microcontroller gets the hex data from the accelerometer and converts it into ASCII code for LCD display. The LCD displays the X-Y-Z values and displays the values on the LCD. At the same time, the microcontroller gets the data and compares it with pre-defined variables. As we change the position of the hand, values are automatically changed, and the values are also shown on the LCD. Output from the ARM controller sends a command to the motor driver circuit. The direction of the chair's movement is dependent upon the received signals, depending upon the movement of the hand. The wheelchair moves in four directions like forward, backward, left, and right.

In this, we have used a microcontroller as CPU to control the overall functionality of the system. A DC gear motor is used to control the motion of the chair, LCD for displaying X-Y-Z co-ordinate values, IR sensor for obstacle detection, and the most important component is 3-axis accelerometer, which is the heart of the system.

III. IMPLEMENTATION

The flow chart of IR and Accelerometer sensors is shown in Fig.2. The accelerometer gives the analog values, based on the given ADC values, which are taken in ranges like if the ADC value is 550, then the wheelchair motor will move in the forward direction,

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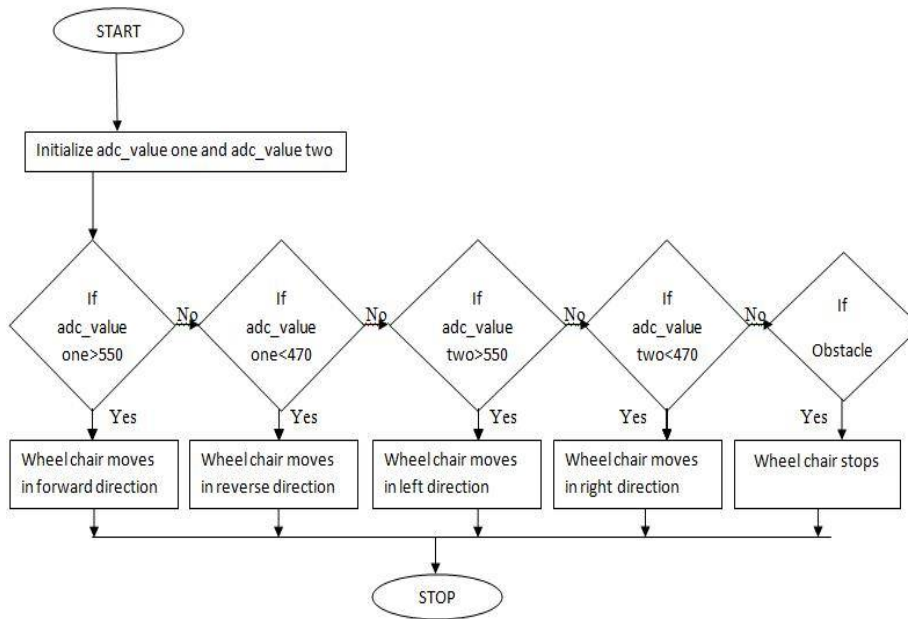


Fig. 2. Flow chart for IR and sensor



if ADC value one is less than 470 then wheelchair motor will move reverse direction, if ADC value two is grated then 550 then wheelchair motor will move left direction and if ADC value two is grated then 550 then wheelchair motor will move right direction. And message will display on LCD. If wheelchair meets with Obstacle and it display stop message on LCD and it stops the wheelchair.

Command Words	Operation
f	Moves forward
i	Moves backward
r	Moves left
b	Moves right
s	Stops moving

Table 1. Command words and its operations

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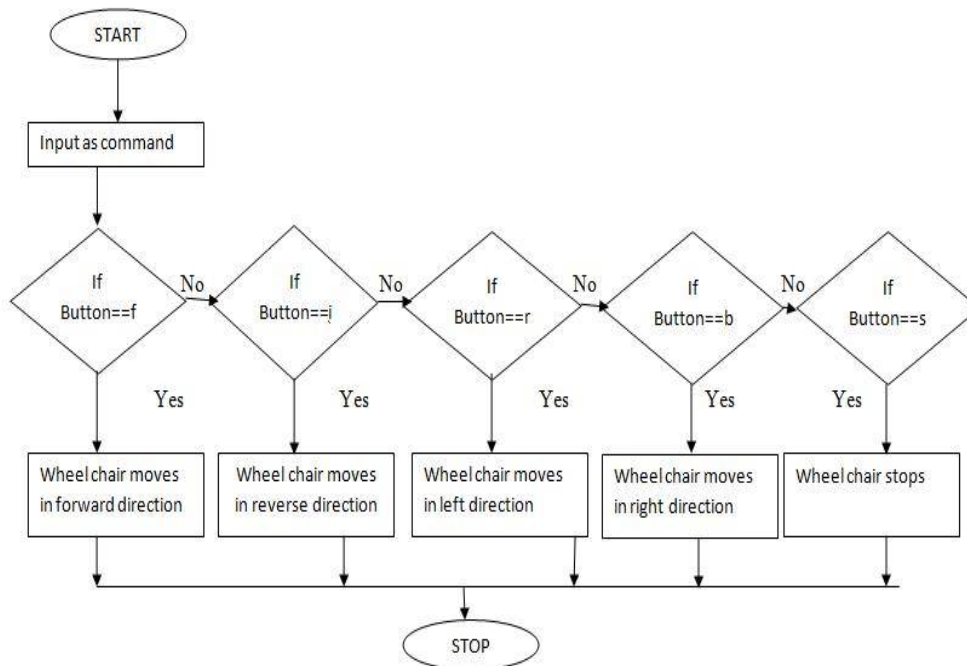


Fig. 3. Flow chart for Bluetooth operation

The Flow chart for Bluetooth operation is shown in Fig.3 and Table 1. the Bluetooth is connected to the mobile application through application when command is passed like if button is equal to 'f' then wheelchair motor will move forward direction, if button is equal to 'i' then wheelchair motor will move forward direction, if button is equal to 'r' then wheelchair motor will move forward direction, And if button is equal to 'b' then wheelchair motor will move forward direction, and message will display on LCD.

ADVANTAGES

- Provide Fastest, easiest, most efficient way to move from one place to another using this smart wheelchair.
- More Efficient way of working compared to manually operated wheelchairs.
- Automatic monitoring stress free operation.
- Wheelchair can be monitored easily by handicapped people by their hand movement.
- Simply by tilting the hand, the wheelchair direction can be controlled.
- Low cost and easy to handle.
- Rechargeable battery to make the wheelchair electrically driven to avoid the human force.
- No need of extra man to move the physically challenged people.
- User friendly.

APPLICATIONS

It can be implemented in Airports and Hospitals for providing better facility to the patients and passengers.

This concept can be implemented in the schools and colleges for inside movements from one place to another. Can be used in hospital by replacing the traditional wheelchairs driven by extra human force Can be used in orphanages and or old age homes.

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IV. EXPERIMENTAL RESULTS

As shown in the above Fig.4, Fig.5, Fig.6 and Table.2, the accelerometer sensor is connected to the ARM7 as the signal got from the accelerometer sensor will be in analog form so the inbuilt ADC in the ARM7 will convert it into digital form.

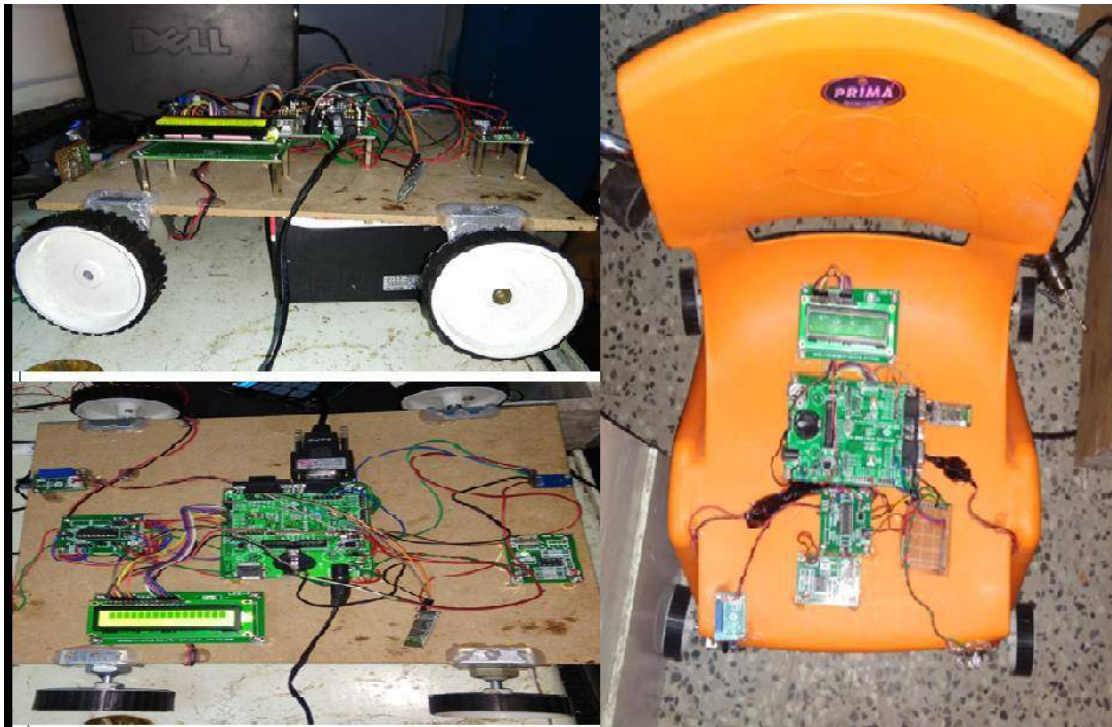


Fig. 4. Interfacing with ARM

The LCD is connected to ARM7 which is used to display the direction given by the accelerometer sensor.

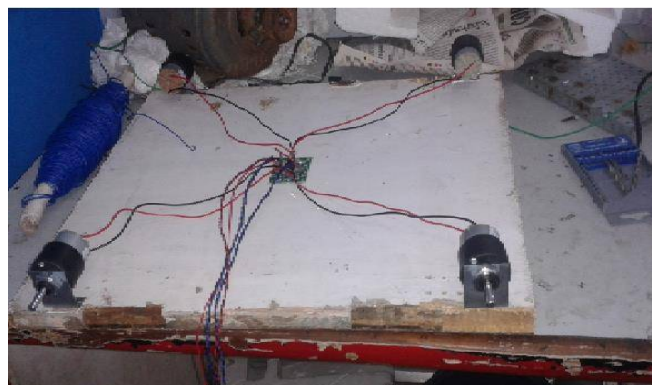


Fig. 5. DC Motors Connected to Motor Driver

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Command	Condition	Left/Right Motor
f	Moves Forward	On/On Forward
i	Moves Backward	On/On Backward
r	Moves Left	Off/On Forward
b	Moves Right	On/Off Forward
s	Stops	Off/Off

Table 2. Command and its motor operations

In Fig 6.2 the DC motors are connected to a motor drive because DC motors can be driven simultaneously, both in reverse and forward direction. Basically the system consists of a demo chair fitted with four wheels for movement controlled with DC motor and driver having an embedded circuitry.

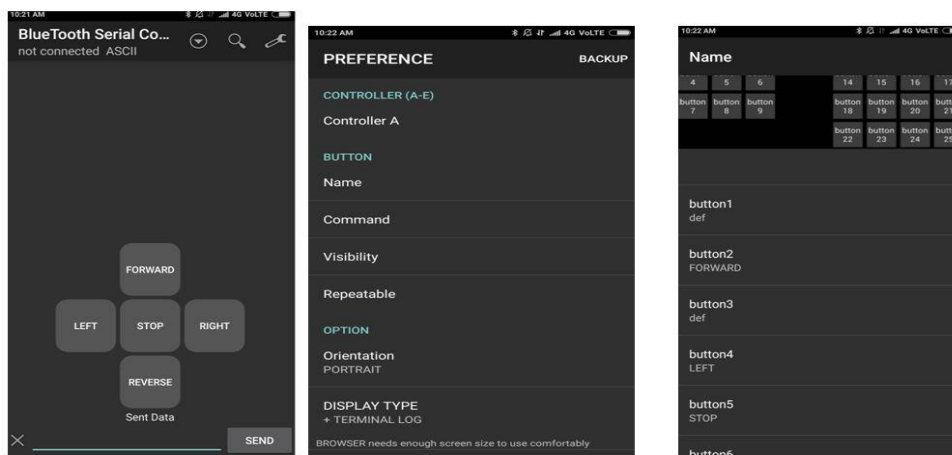


Fig. 6. Mobile app for Bluetooth operation

Fig.6 shows the mobile application where the smart wheelchair is directly operated using mobile by passing command to ARM7 through Bluetooth, based on passed command smart wheelchair will take its direction.

V. CONCLUSION

We have proposed implemented accelerometer wheelchair which has various advantages. This Wheelchair will be cost-effective and it is reasonable to common people. In this system wheelchair is proposed with a help of accelerometer, model is aim for physically handicapped people so that they can manage their chair themselves. Designing of the hardware kit is done by using ARM7, DC motor, motor driver, LCD display and accelerometer sensor. Work is to be done is interfacing of the IR sensors for detecting the obstacles and monitoring the wheelchair to display the obstacles founded out on the LCD. Fitting the chair and connecting wheels for DC motors for the movement of the chair. So that they can control their chair themselves and this system elaborates the design and construction of Smart Electronic Wheelchair with the help of Bluetooth Module. The circuit works properly to move as the command given by the user. After designing the circuit that enables physically disabled to control their wheel using an android application in their Smartphone's and it has also been tested and validated. The detection of any obstacle is successfully controlled by the microcontroller. As the person switches on the circuit and starts moving, any obstacle which is expected to lie within a range of 4 metres will be detected by the Ultrasonic sensor. This proposed system contributes to the self-dependency of differently able and older people.

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