Intelligent Wheelchair Design for Mobility Impaired People

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Abstract—People facing problems related to physical disability and mobility impairment need immediate attention as doing every day activities for them is a big challenge. In order to cater the needs of physically challenged people numerous AI based controller units have been developed in last decade. However the basic cost and their maintenance remains a big task. Hence in our country people with meagre income are comfortable with simplified low cost units which assist the disabled people in movement, setting alerts as when needed or maintaining electronic records. In in this work we propose a comprehensive design, experimentation and validation of a novel smart wheel chair. Smart Wheel Chair is device designed to provide self-mobility to the user through the commands given by him/her. This reduces the human efforts of the user and efforts to drive the wheelchair. In addition, it also provides a contingency for physically or visually disabled patient to shift from one location to another location. The wheelchair is also provided with detection of obstacle system which helps to reduce the chance of accident during period of travelling. The motive of this project is to make a wheel chair which has a kind of smartness and thus it helps the user for their self-mobility.

Keywords—Sensor Technology, wheel chair, intelligent, old age, self-mobility

I. INTRODUCTION

The smart wheelchair is aimed to support physically disabled people. It is especially very helpful for those people who have difficulty while walking. It will prove to be immense help for those who cannot able to walk. Most of the disabled people are commonly depends on other person in their day to day life; especially, the wheelchair users continuously need someone to help them in moving the wheelchair from one site to another. The lives of the disabled patients are made different due to lack of an impulsive control system which allows them to move their wheelchair independently. Due to the use of an electrically controlled wheelchair a huge amount of self-govern is provided for person who are not able to walk as well as not able to handle a mechanical wheelchair alone as it requires a lot of efforts and needs help from other person.

This is a model of smart wheelchair. The wheelchair is equipped with multiple functions. User can use this wheelchair for different purpose. The suggested technique have focus on designing of a gesture controlled and mobile app controlled automated wheelchair with the help of available technology that will reduce the huge complex data processing units need. We can control this wheelchair through mobile app or with gesture. Here the input is given by a wearable gloves containing accelerometer and then actions are initiated. Hence it gives self-mobility and reduce human efforts to push the wheelchair. While on the journey, to reduces the chance of collision the wheelchair is also equipped with obstacle detection system. For the detection of obstacles within range of meters this project also integrated with ultrasonic sensors which notifies the system and stop the wheelchair. It identifies the obstacles and indicates different led depends on the distance of wheelchair from that obstacle also displays the distance on LCD screen and gives sound indication via buzzer. The control using gesture and Bluetooth module android application is presented. All the components required for this project are available in the market, with cheaper rate and compact in size.

II. LITERATURE SURVEY

The traditional wheelchair is the mechanical device which is mostly used by disabled people and aged people for their movement. Wheel chairs have been used by terminally disabled people too.Normally the wheelchair user requires a support from other person or they need self-assistance by their hand for their movement.

According to the survey around 650 million people are suffering from some kind of physical disabilities which is nearly about 15% of the world population. The demand of automated wheelchair has been increasing rapidly because of physical disabilities of people are increasing with the growing number of population. Nowadays, the wheelchairs controlled using joystick are generally available throughout the world due to technological

development. These wheelchairs are not extremely available in developing and under developing countries as they are costlier. Furthermore, the control through joystick is difficult for handicapped people as they have issues with their hand movement. So joystick controlled wheelchairs are not suitable for those whose hand is paralysed. Moreover, patient who is unhealthy and whose wrist is weak due to ageing have face the same issue. Hence, to replace joystick in controlling the wheelchair several researches are still going on.Autonomous Wheelchair Arizona State University Utilize machine sight to recognize signs and centre wheelchair in hallway. Chinese University of Hong Kong make the use of neural network to control actions using map sensor readings to play back taught routes. Toyohashi University Omnidirectional wheelchair is used to avoid colliding with handicapped the wheelchair is utilizes with force-feedback joystick. The NEC Corporation developed an Automatic-Guided Wheelchair which moves through the tracks made up magnetic ferrite marker tape which makes the use of IR sensors to stop when handicap person detected in its route (3] M. Ghorbel), (Demiris 1. H.), (C. Huang Z. W.)The "travel to target" mode produced by University of Pennsylvania, that makes use of a three-point-turn, collision escape, door passage, deictic interface, and hallway way finding.

To evaluate depth information Machine vision and laser radius finder are used. To mark pre-set paths automatically inside the art gallery, University of Plymouth Used controller found on neural networks for 1 month. University of Portsmouth Demonstrated capability to navigate wheelchair through corridor found on information from sonar (H. Yuen), (5] F. Utaminingrum M. A.), (7] F. Utaminingrum).Kanazawa University Determines the location by calculating time-of-flight with the help of ultrasonic beacons. Information of locations are used to produce autonomous way finding. Prototype does not produce handicap avoidance. Intelligent Wheelchair University of Texas utilized a test bed for experimentation into spatial description and reasoning. Voice-Cum-Auto Steer Wheelchair CEERI Wheelchair can automatically travel to given location by reading the internal map or by following tracks of tape. To avoid accident and to observe tape tracks IR sensors are used. For computer sight of a Robotic wheelchair panoramic (360°) camera is used. Has two operating methods: person tracking and handicap avoidance (H. Yuen), (M. Ghorbel J. P.)Today in India, many people are suffering from many types of disabilities, there are many people whose lower part of the body is paralyzed and this paper reveals the benefit of the wheelchair by controlling it through hand gesture using accelerometer and mobile app control using Bluetooth to help them for their movement. This Wheelchair will provide the comfort to the user and make the life of person quite easier.

III. METHODOLOGY

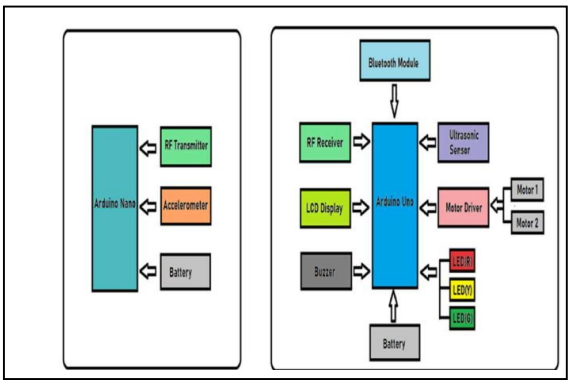

Figure 1:Block Diagram Smart Wheel Chair

Block diagram shown in Fig.1 indicates following blocks and their utility is explained subsequently.

1. Accelerometer is one of the main inputs for this project. The stable movements of gravity which is used in applications of tilt- sensing and the dynamic movements resulting from vibration, motion or shock can be measured using accelerometer. The accelerometer sensors are mounted on wearable glows and they transducer change in acceleration of hand movement to voltage signal which is sent to Arduino Nano.

2. RF Transmitter and Receiver:The 433 MHz is a small pair of RF transmitter and receiver module used to transmit and receive radio signals between any two devices. RF Transmitter is interface with Arduino Nano and RF Receiver is interface with Arduino Uno for the communication between two devices. RF Transmitter is interface with Arduino Nano and RF Receiver is interface with Arduino Uno. This module act as communicator between two controllers.

3. Arduino Nano:Arduino Nano is a type of microcontroller board, and it is designed by Arduino company. It can be built with a microcontroller like Atmega328 chip. It is the controller placed on wearable glows and process the signal from accelerometer

4. Battery:Battery provides supply voltage for both controllers. A rechargeable battery is an energy storage device to store the dc voltage and that can be charged again after being discharged by applying DC current to its terminals.

5. Arduino Uno:Arduino UNO is built with ATmega328P Microcontroller; it is based on an 8-bit AVR Architecture developed by ATMEL. It is the controller placed on wheelchair and process the signals coming from Bluetooth module and RF receiver. According to input signals it gives outputs.

6. Bluetooth Module(HC-05):The HC-05 Bluetooth module is used to add two-way i.e. full-duplex wireless feature. The Bluetooth module can be used in two operating modes, one is the Data mode and other is AT command mode. In data mode we can transmit and receive data from another Bluetooth devices and in the AT Command mode, we can change the settings of default device. By using the key pin, we can operate the HC-05 in one of these two modes. This Bluetooth module placed on the wheelchair. We can control wheelchair from mobile app through Bluetooth module.

7. Motor Driver(L298N):The Motor Driver (L298N) is a popular motor driver with high power used to drive DC as well as Stepper Motors. This motor driver module used to control directional and speed for 4 DC motors as well as 2 DC motors. Motor Driver amplifies the TTL output of the Arduino Uno such that it can drive the respective actuators. L298D IC is used for the switching the relay driver. It is dual H-Bridge IC.

8. Actuators:Actuators are the motors that drive Smart Chair. They actually change the electric signals of the microcontroller into the rotational motion and provide desired functionality. We used 12v, 200rpm DC motor for this wheelchair.

9. Ultrasonic Sensor(HC-SR04):Ultrasonic sensor is a detector used for measurement of distance and sensing objects in many applications. This module has a transmitter and Receiver in the front which forms two eyes like structure. This sensor works on the principle, Distance = Speed x Time. The ultrasonic Ranging Module we used to detect the obstacle. It is use to halt the wheel chair.

10. LCD:It is an electronic device that is used to display data and the message is known as LCD. The LCD has 16 Columns and 2 Rows hence the LCD is named as 16x2 LCD. Therefore, it has 32 characters in total i.e. (16x2) and each character displayed on LCD is made up of 5×8 Pixel Dots. LCD is the visual display unit of the project. It is used to display the range of obstacle from the wheelchair.

11. *Buzzer*:An audio signaling device like a beeper or buzzer may be electromechanical type. Buzzer is used as alarm when object is very close to the wheelchair.

12.*LED:*A light-emitting diode is a silicon based semiconductor component which emits light when current passes through it. Electrons in thesemiconductor reunite with electron holes and create a pair, releasing energy in the form of photons. Red, green and yellow led are used for indication of distance of obstacle from the wheelchair.

IV. FLOW CHART

The data flow diagram as seen in Fig 2 and circuit diagram Fig 3 given below is the work flow of the entire system of smart wheelchair –

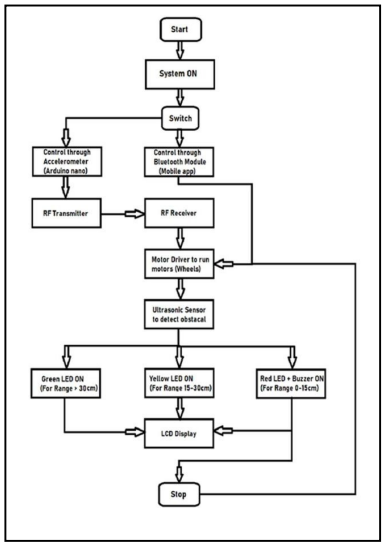

Figure 2: Flowchart

The project “Smart Wheelchair” is basically divided into two sections i.e. two controls, one control is to controlling the wheelchair through Bluetooth and mobile app and second control is through accelerometer which is placed on wearable glows i.e. gesture control wheelchair system. Along with this two controls some additional facilities are provided on this wheelchair, i.e. object detection system, led indication system, LCD display, sound indication, etc. According to which control we want, we can change the switch position.

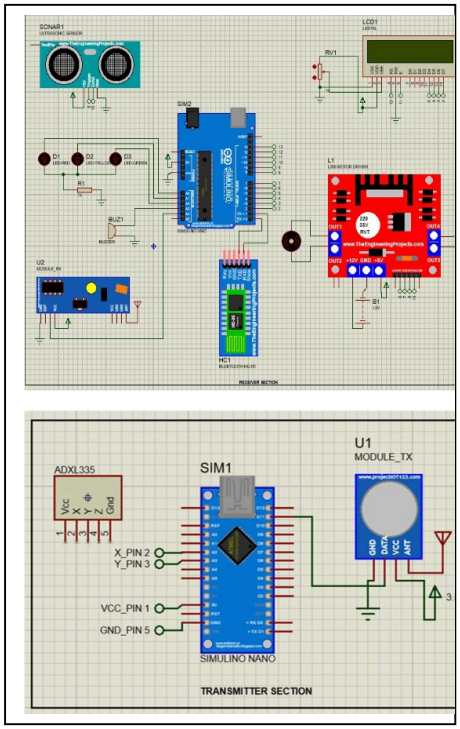

Figure 3: Circuit Diagram

So if it is gesture control, Arduino Nano sense signal from accelerometer ADXL335 & after processing that input signal, transmit it through 433MHz RF transmitter to RF receiver at Arduino Uno. If the control is through mobile app then Bluetooth HC-05 receive instruction from mobile app (we can use any car controlling app) and gives input to Arduino Uno. Arduino Uno process that signal and gives instructions to motor driver LM298D, then motor (connected wheels) movement is done according to that received signal.Ultrasonic sensor HC-SR04 used to detect obstacles in the path. According to distance of obstacle from wheelchair different LED’s indications are provided. For no obstacle detection green led turns ON means that there is no obstacle in path, if obstacle is in range 15-30cm then yellow led turns ON means that obstacle is near and for range 0-15cm means obstacle is very close to wheelchair then red led turns ON & buzzer stars beeping. These all range of distance from wheelchair to obstacle is continuously displayed on LCD display. At the condition when obstacle is very close to wheelchair i.e. when red led & buzzer turns ON, then wheelchair stop at the same position. Hence, clear indication of obstacle is provided to wheelchair user.Fig 3 shows the circuit diagram of wheelchair system:

V. CONCLUSION

As this paper aimed in developing an automated wheelchair for domestic use by middle class people. Gesture controlled was the main focus in its structure and mechanism. All the measures are taken to make wheelchair as cheaper as possible.Smart wheelchair has made advancement in the technology with sensors, indicators which has been operated by intelligent control to reduce the human involvement. This Smartly controlled wheelchair beneficial for user and helps the user to modify and to give commands to the system at different levels of speculationIt’s very easy for the user to control the wheelchair due to the hand gesture control, also the Bluetooth base mobile app control is provided which makes wheelchair more easy and comfortable to use. Wheelchair is embedded with some additional features like obstacle detection and obstacle indication with display and colour leds. We have successfully implemented the required applications with this gesture and Bluetooth controlled wheelchair.

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