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Shrewd Wheelchair for Elderly & Physically Disabled Persons

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ABSTRACT

Wheelchairs extend the capabilities of traditional powered devices by introducing control and navigational intelligence. These devices can ease the lives of many disabled people, particularly those with severe impairments by increasing their range of mobility. The wheelchair is integrated in such a way so that it can be used by the person with any type of disability. The proposed system uses the user voice recognition system accompanied with the ultrasonic sensor system that has been integrated in the wheelchair to give extra comfort to the user. The voice from the user is received using mobile phone and it is transmitted via Bluetooth module. The Bluetooth module is chosen as it has high reception to voice signal even in the presence of external noise. The LCD screen is used to display all the commands that are executed in the wheelchair. It has also the provision of joystick for the elderly persons so that the wheelchair can be easily operated. One of its main features is the GPS system that makes the security level of the user so high. The GPS is used for sending the location of the user in terms of latitude and longitude via SMS through the GSM module to the relative or to the guardian of the user.

Keywords: Wheelchair, Ultrasonic sensor, User voice recognition system, LCD, Bluetooth module, Joystick, GPS, GSM.

1. INTRODUCTION

Paralysis is the main reason for physical disabilities in human. According to a study conducted by Christopher & Dana Reeve Foundation, nearly every 1 person in 50 is suffering from paralysis due to damaging of nervous system. The figure 1 approximates to 6 million people worldwide and has increased by 33 percentages from previous estimation. The causes of Paralysis are mainly due to spinal cord injury stated in the figure. Here the voice recognition system in used to make it easy for the patients who are physically disabled to operate the wheelchair by simply giving commands. The additional provision of the joystick will help the elderly persons to operate the wheelchair by themselves without any need from others. For safety purpose GPS system is integrated in the wheelchair to locate the user in case of emergency situations. The ultrasonic sensor is used for the possibility of avoiding obstacles.

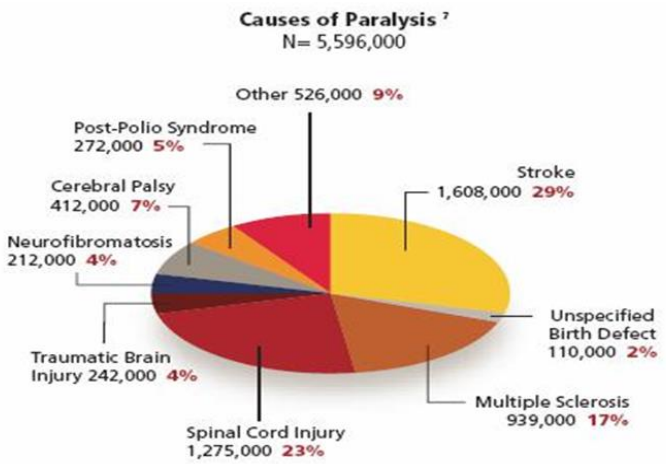

Figure 1: Pie chart showing the causes of paralysis

2. BLOCK DIAGRAM & DESCRIPTION

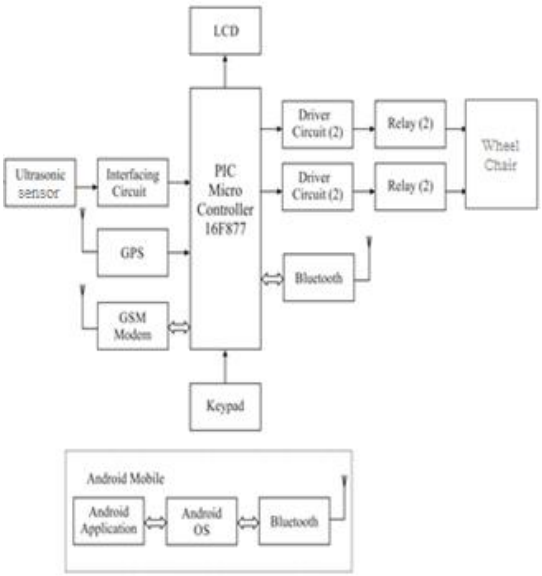

Figure 2: Block Diagram

2.1. Power Supply

Power supply of 12V and 9Amps is used in this wheelchair and this is the only source for all the entire setup of the wheelchair. It is a lead acid and rechargeable battery. Only 5V is required as the power supply for PIC microcontroller and Bluetooth module. To reduce the power, step down transformer is used. Direct 12V is used as power for relay, driver circuit and motor. It is responsible for all the sensors and the controller to supply the current to operate the respective components.

2.2. Programmable Interface Controller

The PIC microcontroller used here is the main basic component among all the other components as it is the controller that controls all the inputs given and produces the appropriate outputs. It accepts the input from the Ultrasonic sensor, Keypad, Bluetooth module and GPS. It sends power to the motor to operate in the particular direction and displays every command via the LCD screen. At emergency situations, it sends alert message to the guardian through the GSM.

2.3. Ultrasonic Sensor

Ultrasonic sensor is used to detect the nearby objects and makes the user to be safe enough from colliding into objects. This detects and sends the data to the controller. If there is any obstacles in front of the wheelchair while operating, it will sense and stops the wheelchair. This gives extra comfort to the user as it can stop itself and help them from bumping into objects.

2.4. Liquid Crystal Display

The Liquid Crystal Display screen used here displays the command received to ensure whether the command given by the user is correct. And it is also helpful in displaying the error messages along with the detail about what he had

to do next. In emergency situation, the message will be displayed on the LCD screen along with the latitude and longitude measurements.

2.5. Global Positioning System

The Global Positioning System is used for keeping an eye on the users especially elders who are in need of extra special care. When the person is out of the safe region in their house, the corresponding person who is incharge of the person, can know the exact location of the person by the help of this Global Positioning System. The GPS detects the lattitude and longitude of the user's location and send it to the gaurdian's number which can be given as an input through the keypad interfaced with the controller.

2.6. Global System for Mobile communication

A GSM modem is a specialized type of modem which accepts a SIM card and operates over a subscription to a mobile operator just like a mobile phone. The Global System for Mobile communication is used to send the message to the number stored in the controller. It can be changed according to the user's convenience with the help of keypad in the system. GSM module is a chip or circuit that will be used to establish communication between a mobile device and a computing machine.

2.7. Bluetooth module

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent, wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. It is used for transferring the commands spelled by the user from the smartphone to the controller. This is done by connecting the bluetooth module HC-05 with the bluetooth in the user's mobile phone. Then the commands given through the mobile application is sent through the bluetooth in the user's phone to the controller via the bluetooth module.

2.8. Relay

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch but other operating principles are also used such as solid-state relays. The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. Relay is used as a switch to initialize the motor.

2.9. Driver Circuit

The driver circuit is an electrical circuit or an electronic component used to control another circuit or other component, such as a high-power transistor. The following circuit will allow you to drive a 12V relay using logic voltage (an input of 4V or greater will trip the relay). The circuit has its own 12V power supply making itself contained but the power supply portion can be left out if an external supply will be used.

2.10. DC Motor circuit

Two DC motors are used here to move the wheel chair in the respective direction. One motor on the either side controls and moves the wheelchair in all direction according to the user's convenience. A voltage of 12V is necessary for the motor to operate. This is directly given from the rechargeable battery in the system. The relay and driver circuit are used to drive the motors.

2.11. Keypad

This is the alternative form of controlling the chair for the person who are physically abled but deaf and dumb. For those special people, this keypad will help them in controlling the wheelchair with their hand itself. It is a five button keypad. The top left and right button are used to move the wheelchair in forward and reverse direction respectively. The bottom buttons are used to move the wheelchair in left and right directions. By simultaneously pressing the bottom buttons the wheelchair can be stopped. It has an additional feature of entering the gaurdian's number which can be dumped into the controller.

3. HARDWARE DESCRIPTION

The power supply of 12V is turned ON. A small voltage of 5V is enough to run the PIC microcontroller. Thus the voltage from the battery is reduced to the required level with the help of step down transformer. The controller controls the Ultrasonic sensor, Bluetooth module, LCD and the motor. Then the input mode is selected by the user. The user can give the input by three ways according to the kind of disability they have. The users who suffer from physical disability can control the wheelchair by giving voice commands using the mobile application in the smartphone. They just need to spell the command like Forward, Reverse, Right, Left and Stop. This is enough to move the wheelchair. When user spells the command, it is been checked with the spell stored in the mobile application. When both spell matches, then the command is sent from the Bluetooth of the mobile to the Bluetooth module interfaced with the PIC microcontroller. The PIC runs the coding dumped in it and matches the command given with the work to be done. For example, when a "forward" command is given by the user, then the spell will be checked in the smartphone itself and then checks with the controller. Then the controller moves the wheelchair in forward direction and it is displayed on the LCD screen. When the command received is incorrect, the error message will be displayed on the LCD screen. This is done in order to make sure to give the correct command to move the wheelchair in a more efficient way by the user. The same command will be executed until the next command is given by the user.

The next way of operation is by using the keypad interfaced with the controller. The keypad is placed on the controller board and it is the most efficient way to control and move wheelchair. The command given by the keypad is much faster and more efficient when compared to the other way of giving commands. The execution speed is more. This type of operation of the wheelchair is best suited for the persons with deafness and lameness. Almost the same procedure takes place in this method too. The keys are pressed according to the need of the user and the wheelchair moves in the respective direction according to the code dumped in the controller. It is a five button

keypad. The top left and right button are used to move the wheelchair in forward and reverse direction respectively. The bottom buttons are used to move the wheelchair in left and right directions. Accordingly, the wheelchair moves in the respective direction.

The another way of controlling the wheelchair is by the use of virtual joystick created as a mobile application. Here, the user just need to open the mobile application and move the mobile in the respective direction to move the wheelchair. This almost works like the accelerometer. When the user tilts the mobile in forward direction, the wheelcahir moves in the forward direction. So, the wheelchair will move in accordance with the tilt of the phone. This is the coolest way of giving command to the wheelchair to operate. This can be used by the persons with deafness and lameness. In all the three mode of input, the common thing is that, whenever a command is received it is been checked with the previously coded command and moves the wheelchair in the respective direction. Other than these features, whenever there is any obstacle found on the way of the wheelchair it will automatically detect and stop from bumping into objects. This is done with the help of the Utrasonic sensor. All the commands can be erased with the reset button in the controller. Each and every error message will be displayed on the LCD screen.

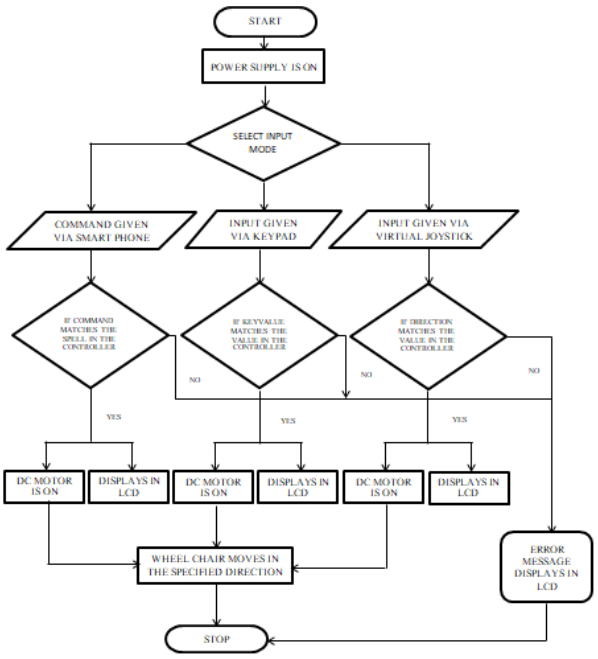

Figure 3: Flowchart showing the entire process happening in the wheelchair

4. RESULT & CONCLUSION

In such a way, the shrewd wheelchair for physically disabled and elderly persons is designed to provide the ease for them and give motivation that they are equal to others. The combination of voice recognition system and ultrasonic sensor, the wheelchair will be able to move in the desired direction with full safety. The GPS system supports the security by alerting the guardian in case of any emergency related to the user.

Figure 3a: Overview of the shrewd wheelchair

Figure 3b: Top view of components used in the shrewd wheelchair

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