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Smart Autonomous Wheelchair

Barath Niranjan S A[1],Gokulakrishnan K[2],Sathish Kumar[3]

[1-3] Final Year Student, Department of Computer Networking, PSG Polytechnic College, Coimbatore, India..

A B S T R A C T

Smart wheelchairs are an assistive wheeled mobility device. The world health organization reported 10 % of global population (650 million person) have disability and 10% among them need wheelchair. Wheelchair made it easier for many to pursue their life activities including education, work and social life. A smart autonomous wheelchair is developed in this paper to enhance the maneuvering tasks. The development of a smart autonomous wheelchair system with touch controlled using an embedded system. An android application is developed and installed on the android smart phone. The wheelchair will move according to the command given. For the touch mode, the user can select the specified direction displayed within the four quadrants on the screen of the android smart phone to control the wheelchair. An Arduino Uno is used to execute all commands. The MD30C motor driver and HC05 Bluetooth module are used in this system and ultrasonic sensor is also added for safty This system is designed to save time and energy of the user.

Keywords: Autonomous Wheelchair, Arduino Uno, Android Application

1. Introduction

A smart wheelchair is developed to help an elderly or physically disabled person (user) to move from one place to another independently. An android application is developed and installed in the android smart phone. The user can determine the wheelchair's movement by selecting the desired direction on the android smart phone screen. The command given by the user will be forwarded to the Arduino Uno via Bluetooth. The Bluetooth will convert the commands given by the user in a binary format and send them to the Arduino Uno. Arduino Uno will read and execute the command and lastly send the digital values to the motor driver device. The motor driver will direct the wheelchair according to the command given. When the user selects the "Go" arrow, the wheelchair will move in a forward direction, "Back" arrow prompts the wheelchair to move backward, and "Left" arrow causes the wheelchair to turn left, and "Right" arrow makes the wheelchair turn right. Ultrasonic Sensor HC-SR04 is a sensor that can measure distance. It emits an ultrasound at 40 000 Hz (40kHz) which travels through the air and if there is an object or obstacle on its path It will bounce back to the module. Considering the travel time and the speed of the sound you can calculate the distance.

2. Problem Definition

An elderly or physically challenged person can direct the direction and movement of the wheelchair with the help of the android smartphone in four different directions, left, right, forward, reverse and stop. The wheelchair will move according to the command given by the user. Presented an idea of an eye controlled system which enables the movement of wheelchair depends on the movements of eye-balls. A camera is mounted on the wheelchair; the wheelchair can move in a certain direction when the user looks at that direction by making eye movements. Based on the eye-detected location, the direction of the possible motion is found, the command is transmitted to the motor control device via Arduino. Pajkanovic and Dokic proposed a microcontroller system that enables an electric wheelchair to be controlled by the head motion. The system comprises electronic and mechanical component. The accelerometer is used to collect the head motion data. The output of the digital system is connected to a mechanical actuator and it is used to position the wheelchair's joystick based on the user's command. The sensor data is processed by a novel algorithm; it is implemented within the microcontroller. The user's head motion is translated into the wheelchair's joystick position.

Corresponding Author E mail: barathnir95@gmail.com

Nishimori et al. implemented a voice controlled wheelchair which uses the voice command as the interface. A grammar- based recognition parser named "Julian" is used in this system. This is open-source software which is developed by Kyoto University and Nara Institute of Science and Technology.

3. Methodologies

MIT App Inventor is an application to transform a complex language of text-based coding into a visual and drag-and-drop building block. A command is a block that specifies an action to be per formed on the phone. Some commands require one or more input values to completely specify their action. touch mode block diagram using Android application. The best part for using android is an open source electronics platform and it is able to read an input and convert it into an output. Arduino is cheaper compared to other micro controllers and it can run on windows, Macintosh OSX and Linux operating systemThe power supply is used to supply electrical energy to the Blue-tooth module, Arduino Uno, motor driver and motor. The user can control the movement of the wheelchair by giving command via the android smartphone. The user can select one of the modes to give command. For the voice recognition mode in, the user must turn on the Bluetooth on the android smartphone, and then select the correct paired device to connect. When the Bluetooth is connected, the user can start to give command. For the touch mode in the user need to connect to Bluetooth and start giving command by selecting the direction specified within the four quadrants on the screen.

4. Implementation

The implementation of this proposed model mainly involves two steps. The first step is the identification of which the Hall Effect sensor is activated and then sending the desired command to the wheelchair wirelessly. The touch controlled wheelchair when receives the commands, these commands are tested depending on the predefined conditions and then accordingly operate the wheelchairs you can see in the above circuit, It consists of 4 buttons, one side of all the buttons are connected with ground and the other ends are connected with the desired Arduino pins as defined in programming. The 433 MHz radio transmitter is connected with the Arduino. Its data pin is connected with the pin12 and the other pins are connected with 5v and GND to power up the transmitter. This circuit consists of 4 hall effect sensors, These sensor needs 5v to be powered up. All these sensors are connected with the Arduino Analog pins because it gives different values as per the magnetic field changed due to the presence of the permanent magnet. The VCC "5v" Pins of all the magnetic Hall Effect sensors are connected together and then connected with the Arduino's 5 volts. Similarly, the Ground pins of all the magnetic Hall Effect sensors are connected together and then connected with the Ground of the Arduino. While the signal wires of the magnetic hall effect sensors are connected with the desired analog pins of the Arduino or mega as defined in the programming This is the complete circuit diagram of the Receiver side. As the Tongue controlled wheelchair has two motors, that's why we need two h-bridges to control each motor. Each motor is controlled with the help of an H- bridge and each H-bridge consists of two relays. H- Bridges are used to control the direction of the dc motors. If you want to learn the designing of H- bridges then you can visit our YouTube channel "Electronic Clinic". The H-Bridge PCB looks like this and can be downloaded.

5. Result

Creating and designing an Android mobile app using mobile app inventor has been developed step by step and executed the coding in the arduino.

Fig 5. 1: Arduino joystick control application

Fig 5.2: Output of wheelchair's program

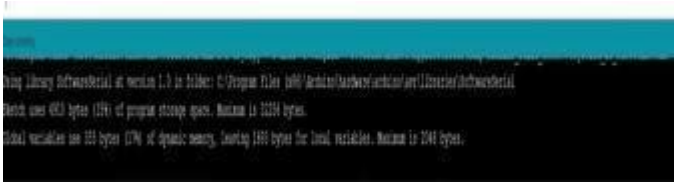

Fig5. 3: Output of ultrasonic sensor's program

Fig 5.4: Smart autonomous wheelchair

6. Conclusions

This wheelchair system is combination of mechanical, electrical and communications system. The main objectives were to design an android application that can direct the movement of a wheelchair, to develop the voice recognition mode and touch mode to help the elder lies and physically disabled people to move their wheelchairs independently and to provide the elder lies and physically disabled people with the ability to control the movement of the wheelchairs by using android smart phones. The system designed has undergone a few tests and successfully completed the basic performance. The objectives were achieved as the software and hardware implementation work well as expected. This system will helps the elder lies and physically disabled people to control wheelchairs with either a touch mode or voice recognition mode, therefore this success is to serve many people with disabilities.

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