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Research Article

Smart Navigation Of Wheel Chair Using Human Machine Interface

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Abstract: This manuscript deals with smart navigation of wheelchair using human machine interface. Physically challenged people are those who suffer from different physical disabilities. In day-to-day life, physically challenged people are facing many problems and one of them being to move around without external support, being independent and the freedom to move around independently is an integral part of one's life. This project is carefully designed by keeping in mind the problem's faced by physically challenged people. To implement the manuscript, Arduino UNO is used to control the motor coupled to the wheel of the wheelchair which is controlled by voice command from the android mobile phone through a Bluetooth module. Apart from moving the motor using voice command, the prototype also has an ultrasonic sensor which senses the obstacle on the way and controls the direction of the wheels accordingly. Apart from physically challenged people, aged people will also get benefited with this prototype.

Keywords: Android Mobile Phone, Arduino UNO, Bluetooth Module,Human-machine interface,Physically Challenged, Smart Navigation, Ultrasonic Sensor,Wheelchair.

1. Introduction

Physically handicapped and aged people feel uncomfortable to move around without the help of others. In order to help them to be independent, "**Smart Navigation of Wheelchair Using Human Machine INTERFACE"** prototype was developed. It uses Arduino UNO to control the movement of the wheelchair based on the voice command interfaced with the help of a Bluetooth module. Programming with Arduino is simple when compared to other related devices. Ultrasonic sensor is used to sense obstacles and direct the wheels according to the control command from the Arduino. Conventional wheelchairs use joy stick to navigate around, such manual operation can be avoided by using voice command.

In earlier research, Infrared sensor was used, but the limitation of IR sensor is that it cannot be used in the presence of sunlight because of ambient light interference etc. Ultrasonic sensor works on sound waves which detects obstacles without any hindrance. The range of ultrasonic sensor was found to be perfect and accurate.

A Prototype is implemented in this manuscript to overcome the difficulties faced in the earlier research.

This is a simple prototype of Smart Wheelchair that is multi functioned. One can use this wheelchair for various purposes and also can be used as a panic alarm. If the person using the needs instant help, he/she can press the panic alarm button so that someone can help him/her immediately. This wheelchair also has an LED light, making it convenient to move around in low light. Smart Navigation Wheelchairidentifies obstacles and chooses to go with the obstacle free path.

2. Literature survey

A study conducted by World Health Organization states that nearly every one person in fifty is suffering from paralysis due to damage of nervous system. The causes of paralysis are mainly due to spinal cord injury, strokes and cerebral palsy. The graph titled "PROPORTION OF DISABLED POPULATION BY RESIDENCE INDIA: 2001-11" describes percentage of disabled people in India has increased both in rural and in urban areas during the -last decade. The paralyzed person gets restricted to the wheelchair and becomes dependent on other people for their movement and daily needs. The existing wheelchair in the market like joystick wheelchair and hand control wheelchair have some or the other drawbacks such as environmental disturbances, mechanical problem or expensive.

According to the review paper published by Simpson in 2005 [1], there are many forms for designing a smart wheelchair. Early smart wheelchairs were mobile robots to which seats were added. Currently, most of developed smart wheelchairs are built on by modifying commercially available power wheelchairs. Few smart wheelchairs are designed as "add-on" units that can be attached to and removed from the underlying power wheelchair. All these designs are sharing the same objectives which are easing the way the chairs are used, avoiding collisions as much as possible, increasing travel distance and decreasing travel time.

A Survey of Disabled Persons by NSSO (2011) reported that Disability is an important public health concern in India. The wheelchair is the topmost used assistive device for enhancing the personal mobility of disabled people. Power wheelchairs are useful for those unable to propel a manual wheelchair. The disabled people with visual acuity, lack of motor skills and strength find it difficult to use a power wheelchair. To solve this problem, several researchers have used mobile robot technologies to create smart wheelchairs. A smart wheelchair typically contains a standard power wheelchair, a computer and a collection of sensors. The recent development in research areas such as computer science, robotics, Artificial Intelligence and sensor technology broaden the range of features in smart wheelchairs.

G Azam and M T Islam, an anticipated system that helps to the self-need of physically challenged and older people. It minimizes the manual attempt for acquiring and individuals to control the motion of a wheelchair.

The author suggested this devise could be enhanced by providing the wireless communication facility, using sensors to sense an obstacle in the wheel chair. By humanizing this system, we directly enhance the lifestyle of the disabled people in the community.

Neal Seemiller, presented a novel dynamic model using WMR planning, control, and estimation systems. Author applied 3-D kinematics method. Derivation Simulation tests proved that dynamic models to be more functional, stable, and efficient than common alternatives. Recent development promises a wide scope in developing smart wheelchair. This article presents a smart wheelchair which controls the movement of the wheelchair by voice command which helps disabled people to be independent so that they can move around at their free will.

3. Methodology

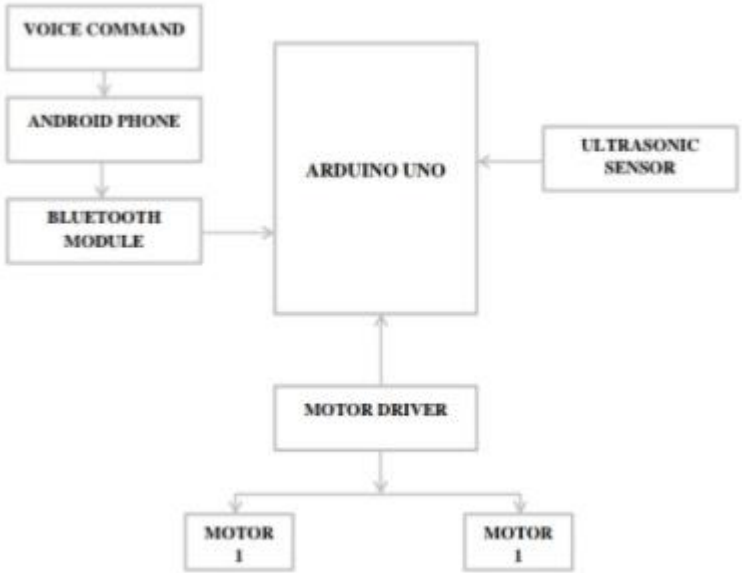

Fig.1 Block Diagram

This is a system which include personal security features and can be used by misfortunate people so that they can navigate easily without external aid. This system can take the person of interest to different rooms in the

house by just speaking a word which is predefined. With the help of the command the wheelchair will navigate itself to the required destination by avoiding the obstacles in its way. This system can help the physically challenged to live life like normal people.

The android mobile and Bluetooth module was interfaced by an application. On getting the voice command, Bluetooth device will send the command to the Arduino. Based on the program controller, the controller will send the signal to the driver IC and it will direct the motor based on the voice command and the control specified in the Arduino program. Supply for DC motor was supplied from battery. Apart from voice control, ultrasonic sensor is used to detect the obstacle on its way.

4. Components required

1. Android Mobile and Bluetooth Module

By using an application called voice control BOT, voice command was recognized by an android phone. Bluetooth device was used to interface voice command recognized by the mobile phone with the Arduino to provide information regarding the direction of the motor.

2. Ultrasonic Sensor (HC-SR04)

Ultrasonic sensor is used to detect the obstacle on the path of the wheelchair. A short ultrasonic pulse is transmitted at the time 0, reflected by an object. The sensor receives this signal and converts it to an electric signal. The next pulse can be transmitted when the echo is faded away. This time period is called cycle period. The recommend cycle period should be no less than 50ms. If a 10μs width trigger pulse is sent to the signal pin, the Ultrasonic module will give an output of eight 40kHz ultrasonic signal and detect the echo back. If no obstacle is detected, the output pin will give a 38ms high level signal.

Based upon the response from the sensor, Arduino will control the wheel direction.

3. DC Motor

12 V, 150 rpm, high torque DC gear motor providing 20000gm-cm torque is used to drive the wheelchair. The motor generates a low RPM which is very ideal for making gripper to pick and place heavy objects with greater accuracy.

4. Motor Driver IC (L298N)

L298N is a dual H-Bridge Motor driver IC. It is an integrated monolithic circuit in a 15- lead Multiwatt. It is a high voltage, high current dual full-bridge driver designed to accept standard TTL logic levels and drive inductive loads such as relays, solenoids, DC and stepping motors.

Based upon voice command, corresponding enable pin will get enabled which in turn will make the motor operate in direction programmed in the Arduino according to the voice command.

5. Arduino Uno

Arduino Uno is commonly used nowadays where a simple, low powered, low-cost Arduino are needed. Because of the above reason Arduino Uno was used. It was programmed to control the motor operation based on the voice command signal from the Bluetooth module. Output of the Bluetooth device will be in the form of binary numbers. Based upon the input values from the Bluetooth device, Arduino was programmed accordingly so that wheelchair will navigate with the help of Motor driver IC L298N.

5. Conclusion

This project elaborates on the design and construction of Smart 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 smartphones and it has also been tested and validated. The detection of any obstacle is successfully controlled by the Arduino UNO. As the person switches on the circuit and starts moving, any obstacle which is expected to lie within a range of 4m will be detected by the Ultrasonic sensor.

6. Result

A hardware prototype “Smart wheelchair using human machine interface” has been developed with the idea of helping the disabled and the aged to move around in ease without the help of others.

The aim was to build a smart wheelchair with voice command activation which was achieved using an

Android phone and Bluetooth module. This proposed system contributes to the self-dependency of differently abled and older people.

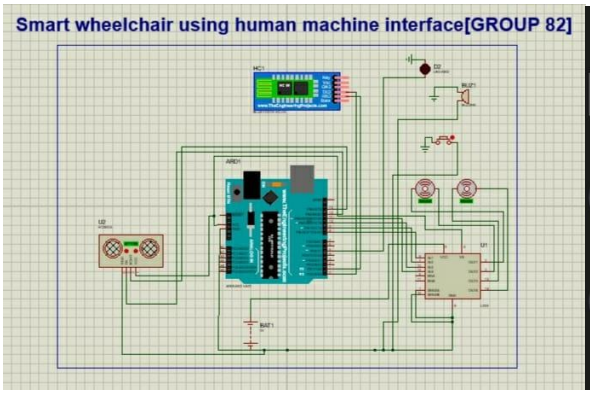

Fig.2 Simulation Design

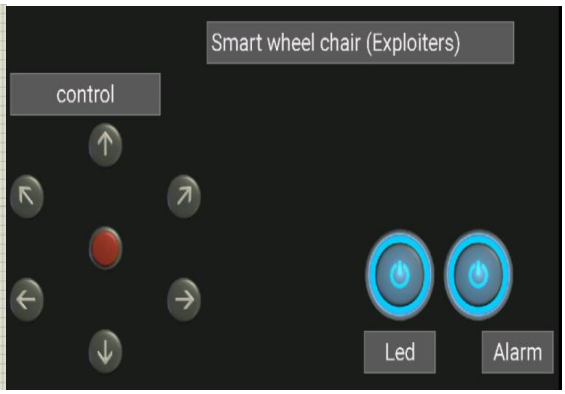

Fig.3 Bluetooth Module

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