Electronic Voice Controlled Wheelchair

Drasti Kanakia, Aditi Shah, Rushabh Shah, Ami Jariwala

Abstract—This paper discusses a prototype of an electronic voice command controlled wheelchair. It is developed to make an amputee as independent as possible considering safety . It has two main parts – one is the electronic control given with the help of switch which are linked to the wheels in order to make the wheelchair move. Second is the voice control by which the patient can direct the wheelchair by giving command. These commands are read by the micro-controller to move the wheels in the desired direction. The commands are FORWARD, BACK, LEFT, RIGHT and STOP. It is a battery driven wheel chair, making it an independent system. The battery used is rechargeable. Moreover, speed control mechanism can be incorporated in order to vary the speed, as per the patient's requirement. We have tried to make it as user friendly as possibly.Safety mechanisms like horn, hand brake, Infrared obstacle detector and an emergency stop button is also provided. It is an attempt keeping in mind the various categories of people using it. It is designed to be used as a partner rather than a tool.

Index Terms— Electronic Wheelchair, Voice controlled wheelchair, speed control, Voice recognition module rev2, Infrared obstacle detectors, Motor driver, hand brake.

1 INTRODUCTION

WHEELCHAIRS were developed back in the sixth century. Human being riding on wheels is probably the only fascinating thing about those wheelchairs. Unfortunately, with very little modifications, those wheelchairs are still in use in most parts of the world, especially in the developing countries. Keeping such a scenario in mind, we have designed prototype of a wheelchair which can help the patient to be as independent as possible. It can be used as a partner rather than as a tool. According to the survey from National Health Interview Survey (NHIS), two distinct trends have contributed to the increasing overall prevalence of disability: a gradual rise, due largely to demographic shifts associated with an aging population, as well as a rapid increase that is due to health impairments and accidents. Many individuals have problems to use a conventional wheelchair. A recent clinical survey indicated that 9%-10% of patients who received power wheelchair training found it extremely difficult or impossible to use it for their activities of daily living, and 40% of patients found the steering and maneuvering tasks difficult or impossible. These people, suffering from motor deficits, disorientation, amnesia, or cognitive deficits, are dependent upon others to push them, so often feel powerless and out of control [1]. This electronic and voice operated wheelchair not only gives the ease of moving with simple commands, but also electronic controls with the help of switches. Safety is taken care of by the Infrared Sensors and emergency Hand Break mechanism.

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2 BLOCK DIAGRAM

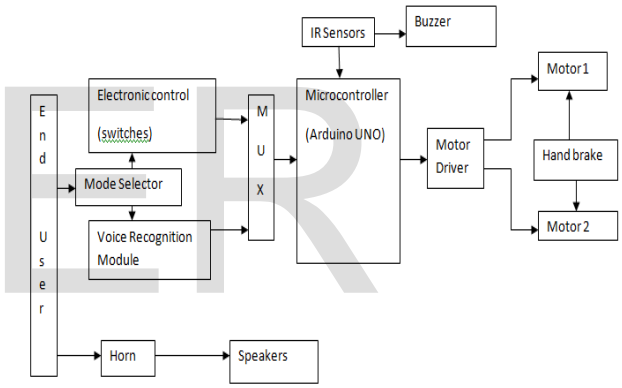

Fig. 1. Block diagram of electronic voice controlled wheelchair.

The above block diagram portrays the functionality of the wheelchair. Two basic mechanisms- voice recognition module and electronic switches are used to control the wheelchair. A mode selector switch allows the end user to choose either of them. The commands from any one of the input controls (as determined by the mode selector) is fed to the microcontroller to be decoded. Motor driver circuit is connected to two motors which require four inputs in all. These inputs are provided to the motors through the motor driver. On the front panel of the wheelchair lies an array of infrared sensors and detectors. They sense the presence of any obstacle and give a feedback to the microcontroller. A buzzer is provided indicating the patient about the obstacle and also halts the motors. The microcontroller is in wait state till next instruction is delivered. Safety horn is directly connected to the speaker and can be used after the wheelchair is ON. Hand brakes are connected to the rim of the wheels and can be used in cases of emergency.

3 SYSTEM WORKING

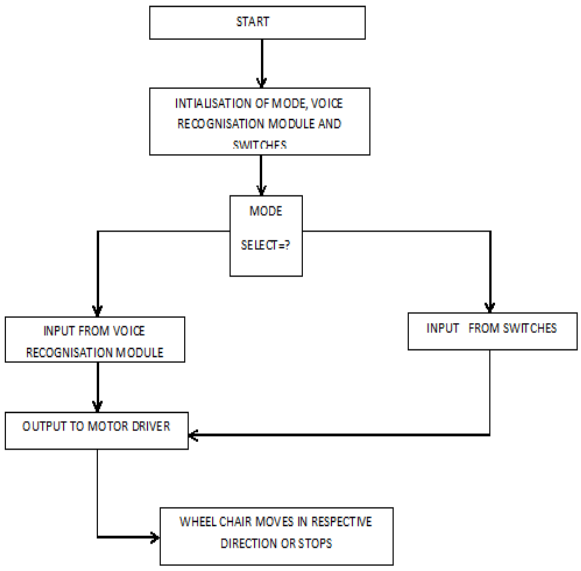

Fig. 2. Flow Chart of System working of voice controlled wheelchair.

3.1 Voice Recognition Module with Arduino

The voice commands delivered by the user are converted to respective electrical signals by the Voice Recognition Module rev2. These electrical signals are then decoded by the Arduino UNO in order to perform respective tasks. This module is trained first for it to record the pitch and accent of a particular word. It is user specific. Hence if it is trained in patient's voice, it shall not accept any other person's commands. Commands like FORWARD, BACK, LEFT, RIGHT and STOP are stored in respective hexadecimal locations. These locations are accessed in the program as 0x11, 0x12, 0x13, 0x14 and 0x15 respectively. The arduino sets the pins related to the motors as high or low required by the command. For example, to make the wheelchair move forward, 0x11 is selected in a conditional statement. Then the pins defining motors are made high. This setting is delivered to the motor driver circuit and hence the wheelchair moves forward.

3.2 Electronic Switches with Arduino

It is extremely important to give a backup service to people using our device. This will not only make the device technologically more active, but also be useful for various categories of patients making use of it. Hence an alternative switch mec hanism is incorporated in our system. Four switches are provided to the end user for FORWARD, BACK, LEFT and RIGHT. Technically, they are SPST (single pole single throw) push switches which will remain active till pushed and auto stop the wheelchair when released. This is essential for the safety of the user.

3.3 Mode Select

Inorder to switch from Voice controlled mode to switch mechanism mode, a selector is required. For this purpose, we have chosen to use an SPST (single pole single throw) push-and-lock switch. When it is pressed, voice recognition module is selected and the motors are controlled by voice commands. When the switch is pressed again, contact is lost and the mode switches to using switching mechanism.

3.4 Speed Control

DC motor works on simple principle of higher the voltage, greater will be its rpm. We have used 100 rpm motors. Hence the greatest speed that can be achieved is 0.36 m/s at maximum voltage of 12 V dc supply (for prototype having wheels of diameter 7cm). Inorder to regulate its speed, we have used a potentiometer. As the resistance of the potentiometer decreases, voltage across the circuit decreases. Hence speed of the motor decreases. By doing so, circuit complexity also decreases in comparison with... Speed control mechanism can be obtained by a potential divider circuit as well as by using pulse width modulation.

4 MOTOR DRIVER

Motor driver is an important part in the wheelchair as it provides a regulated current to the motor enabling the wheelchair to move. It prevents the back current from flowing into the microcontroller which otherwise could damage the arduino as well as the voice recognition module.

5 SAFETY MECHANISM

5.1 Emergency Switch

An Emergency switch is provided on the switch panel of the wheelchair. This acts as the circuit breaker in case of an emergency. In case of emergency when the voice command fails to function properly and the user needs to stop the wheelchair immediately then this emergency switch can be pressed which cuts off the power supply from the main circuit and hence the wheelchair comes to a standstill.

5.2 Infrared Obstacle Detector

The infrared obstacle detector is one of the latest development of the wheelchair. An array of infrared sensors are place on the front side of the wheelchair. These infrared (IR) sensors act as obstacle detector. When the wheelchair is in motion and

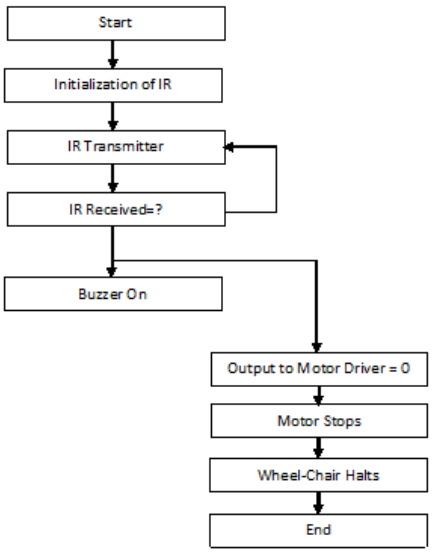

Fig. 4. Flow Chart Of Infrared obstacle detectors.

there is an obstacle lying ahead, then these infrared sensors detect the obstacle and a buzzer connected to the sensors will start ringing indicating the user about the presence of an obstacle. The IR sensors have a transmitter and a receiver. The transmitter sends continuous Infrared waves. If there is an obstacle lying ahead of the wheelchair then the IR waves are reflected back from the obstacle and are picked up by the receiver. Hence it gives a high voltage as output due to which the buzzer starts ringing and hence the user is cautioned.

5.3 Safety Horn

The safety horn is included as a distress signal feature. In case the user is in any kind of difficulty or a situation where he/she might need help of another person then he/she can honk the horn. A simple switch mechanism is used for this feature where in if the user presses the switch then the horn is activated and upon the release of the switch, the horn is deactivated

5.4 Braking mechanism

In this electronic voice controlled wheelchair, apart from the voice controlled braking mechanism as mentioned earlier, another braking mechanism is introduced as a fail safe. If the voice controlled braking mechanism fails to stop the wheelchair in time then this mechanism can be used. In this case, the brakes are mechanical and are directly applied on the rim of the wheels. The brakes are mechanical in nature i.e., no electronic components are used.

CONCLUSION

This electronic voice controlled wheelchair is developed keeping in mind patient's independence and safety. Also we have tried to incorporate mechanisms that are user friendly, reliable and making use of technologically advanced. The main aim of our project was to deshn a wheelchair which could be electronically and voice controlled at a cost affordable by a common man. We hope to replicate this prototype model into a complete product useful for the society at large.

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