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Voice Controlled Wheelchair Using AVR

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Abstract— The paper describes Voice controlled wheel chair & devices control which would be a truly helping device for the old & disabled struck to wheel chair. The main objective is to convert vocal words into a unique fixed data as a command to master micro-controller, Atmega16. We are using a speech synthesis module which is capable of storing 64 words. Once trained the system will outputs a serial data assigned for each word when the word is spoken into the microphone of the module. Another objective is to turn on & off the devices remotely for which another micro-controller, Atmega328 as a slave device is being used. The main system on the wheel chair takes command from the speech synthesis module & if it is related to the device switching micro-controller identifies which device is to switched & related to that action. It sends a command through a Radio Frequency Communication Module (CC2500) module to slave micro-controller to perform the action. We are also using emergency alert system to provide more safety to concerned person. If the subject feels uneasy or unhealthy, he/she can press the emergency button that will contact the relatives for emergency help via Short Messaging Service (SMS) through a Global System of Mobiles Module (GSM Module).

Keywords- Wheelchair, AtMega328, AtMega16, CC2500, Speech synthesis module (HM2007), Motor Driver L293D.

I. INTRODUCTION

The number of people who need to move around with the help of some artificial means, whether because of an illness or an accident, is continually increasing. These means have to be increasingly sophisticated, taking advantage of technological evolution, in order to increase the ease of life for these people and facilitate their integration into the working world. The need of time is to empower the disabled to be able to defeat the discriminated capabilities to work. The main reasons for justification go as follows:

a) The current level of technology in the electronic and robotic systems, which is quite high, provides solutions to the locomotive problems of people. The solutions provided are quite appreciable to the phenomenon aimed at helping the locomotion disabled.
b) But unfortunately the number of people facing the problem is too high.[1]
c) The methods at present can be costly for higher levels of sophistications.

Aim in such system designs should be Reactive and Shared controlled systems that perform well under unknown contours and terrains. The purpose of the reactive and shared controller is to assist wheelchair users in providing an easier and safer navigation. Following a behavior-based architecture, it is designed as a fuzzy-controller. These behaviors are to be implemented: intelligent obstacle avoidance, collision detection and contour avoidance and user commands from voice or joystick. Therefore, the user and the vehicle share the control of the device. The reactive-shared control was tested on the Rob-chair powered wheelchair prototype, equipped with a set of ranging

sensors. Experimental results demonstrate the effectiveness of the micro-controller. The choice of fuzzy-logic control relies on its versatility which makes it suitable for mobile robotic applications. Real time execution is possible because no heavy processing is involved. Mathematical model is followed for formulating the navigation algorithms that are written through heuristic rules based on user's experience. Multiple Input or Multiple Output (MIMO) controllers can be easily designed. Finally, it is well suited for implementing the fusion of behaviors and therefore appropriate to implement a shared-control system. [2]

The paper focuses on ease of driving the wheelchair. This task can be crucial even for a normal person. In some cases like paralysis the patients are not able to manipulate the direction of the wheelchair using limbs. Hence the Robotic wheel Chair is developed to overcome these problems allowing the subject to perform safe movements. This is a dual input type operated wheel chair that is made to work based on voice and touch screen commands. Since the motorized wheelchair can move at a fair speed, it is important to control the speed of the wheel chair as per the end-user requirement. Thus the speed of the motors is controlled by using PWM method. The voice recognition is done by HM2007 voice recognition IC. The microphone is directly connected at the analog input of voice recognition IC HM2007 keeping the mode selection key in the record mode. The microcontroller ATMEGA8 along with motor driver L293D is used to drive and control the two DC motors. As it is a dual input type the system is designed such that based on the switch state the input is selected. In this system there are two input devices, speech recognition system and touch screen. In order to select a specific input device we are using a switch that is when the switch=1 voice recognition system is considered and when switch=0 touch screen is considered. The output of the touch screen is analog in nature, to digitize these signals we are using in-built six channel ADC of ATMEGA8 micro controller. On receiving the Signal the microcontroller directs the motors through the control circuit. In this, two DC brushless motors are used for controlling the the two wheels of the chair independently.

The code is written in arduino such that the speed of the motors is controlled by using PWM output pins of arduino. The motors are controlled with four different speed levels that is with 100% duty cycle, 75% duty cycle, 50%duty cycle, 25% duty cycle.[3]

This paper explain "World report on disability" (2011) jointly presented by World Health Organization (WHO) and World Bank says that there are 70 million people are handicapped over the world. This number of handicapped people is going on increasing unfortunately, due to road accidents as well as disorders like paralysis. Of all the disabilities ratio of physically handicapped people is most. Even the smallest of chores and life essential works become a dependency for disabled. Hence, a voice operated wheelchair is to be developed which will operate on the commands from the user for locomotion. Mobile device is in the form of a Android mobile. PIC16F877A micro-controller receives signals from a Bluetooth module. A simple Infrared led-photodiode pair is used for obstacle detection. DC motors along with driver (L298) are used to turn wheels.[4]

1.1 Indian Statistics On Disability

The truth is that the world population is increasing at the rate of explosion. India being the country on top of the population density chart has almost 120 million disabled people with about 40% locomotive handicapped at the end of year 2003. One more concern is the increasing number of accidents that are responsible for increase in the number. Also, disorders like paralysis are raising their heads to a greater extent acting like a catalyst to the situation.

Below chart describes the distribution of disabilities over the country for year 2003. 40% of all the disabled is the mobility handicapped people.

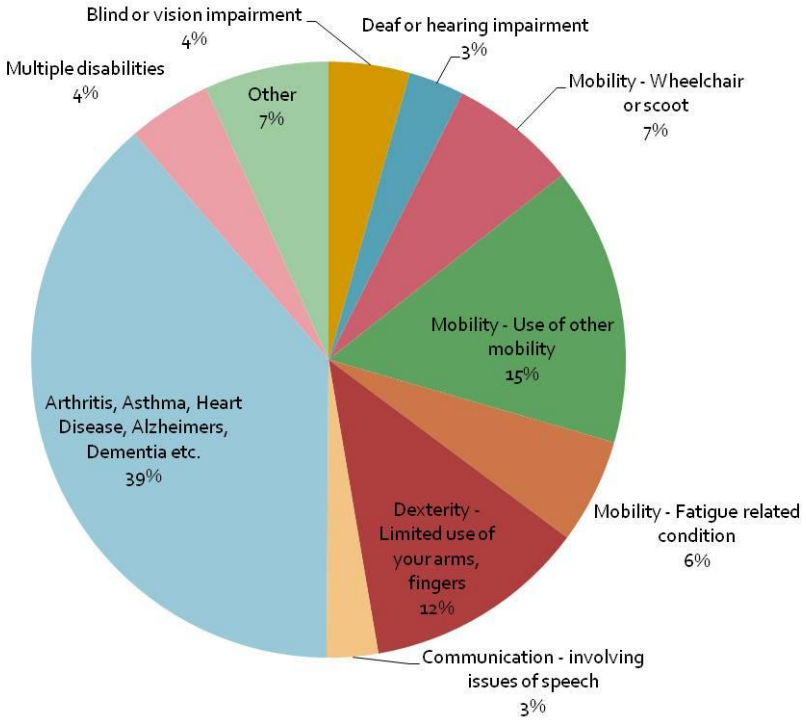

Figure1. Statistics of Disability in India(year 2003)

1.2 Recommendations By World Health Organization (WHO) in THE WISDOM PROJECT[5]

1) Enable access to all mainstream policies, systems and services.
2) Invest in specific programs and services for people with disabilities.
3) Adopt a national disability strategy and plan of action.
4) Involve people with disabilities
5) Improve human resource capacity.
6) Provide adequate funding and improve affordability.
7) Increase public awareness and understanding of disability.
8) Improve disability data collection. Strengthen and support research on disability.

II. HARDWARE REQUIREMENT AND WORKING PRINCIPLE

2.1 Block Diagram

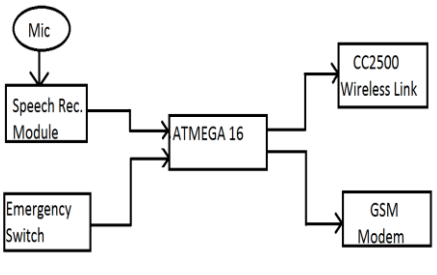

Figure 2. Block diagram of Transmitter

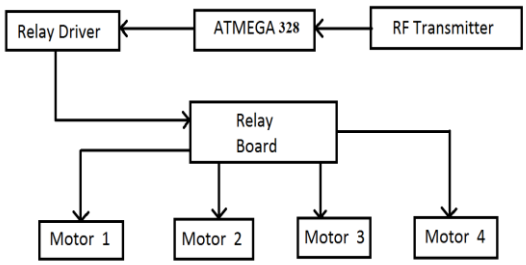

Figure 3. Block diagram of Receiver

2.2 Working

The main objective of the project resides in recognition of speech data and converting it to suitable signals to the motor driver in order to enable movement. The basic solution discovered is to use a speech recognition module that can save a certain amount of spoken words and that will give out signals serially to the controller regarding action to be taken.

The secondary objectives are to operate devices remotely and sending out SOS signals whenever and wherever necessary. For the former, a Radio Frequency Communication module CC2500 is found to be ideal. This module being a simplex communication module communicates with other of the kind for remote access. For sending a SOS signal however will require a more sophisticated and wide range system. For this, a GSM module is to be employed in order to be able to send out SMS whenever required. GSM module, SIM900 is being used.

The master and slave micro-controllers are being played by a ATMega16 and ATMega328 respectively. Being constructed on the AVR architecture, both of these controllers are up to the mark stable and reliable. Being easy to program is the cream of the cake.

Coming to the part of locomotion of the wheelchair, a motor driver L293D is being used. Being able to drive two motors at a time, the device is sufficient in case of this model. This driver converts TTL output signals from the controller to 12V DC supply current to motors. It also enhances the currents provided for well operation of the motors.

For speech recognition, HM2007 speech module is to be selected. It is able to store up to 64 words of different languages and slangs.

Digital infrared proximity sensor is used for sensing presence of obstacles. The sensor gives high logic level output when the obstacle is detected. Operating on 38 kHz modulated infrared light, it is immune to disturbances.

The flow and details of the operation of project go as follows.

1) Words are spoken into the microphone of HM2007.
2) HM2007 sends processing data to the master controller.
3) After manipulation the master passes signals to the slave controller through two CC2500s.
4) Slave processes commands and uses L293D to rotate wheels in particular direction to move the wheelchair in desired direction.
    a) Forward: Both motors in forward direction.
    b) Backward: Both motors in backward direction.
    c) Right: Right side wheel in backward and the left one in forward direction.
    d) Left: Left side wheel in backward and the right one in forward direction.
5) In case of emergency button is pressed, master controller sends out an SOS call through SMS through a GSM module attached.
6) For remote switching of devices, master controller will send signals through CC2500 to slave responsible for device switching operations.

III. RESULT

The design of all the systems has been carried out taking the different environments in which the wheelchair has to move into account and special attention has been paid to reliability, cost, power consumption, the possibility of making future additions, size and the possibility of adaptation to the chassis of commercial wheelchairs. The results obtained show a prototype which responds to a large degree to the requirements of people who need a wheelchair in order to be able to move around. It only requires the help of a person to configure the system initially. Here we have done only simulation process using Proteus software.

When we apply 0 state to switch one and keeping the switch two in reset position every time then, relays indicate off state of wheels. Similarly in each state motor will rotate according to the state assign by the switch as describe bellow.

STATE = 1, relays indicate forward moving state of wheels.
STATE = 2, relays indicate backward moving state of wheels.
STATE = 3, relays indicate left moving state of wheels.
STATE = 4, relays indicate right moving state of wheels.
STATE = 6 to STATE = 9, remote device toggling signals on UART.

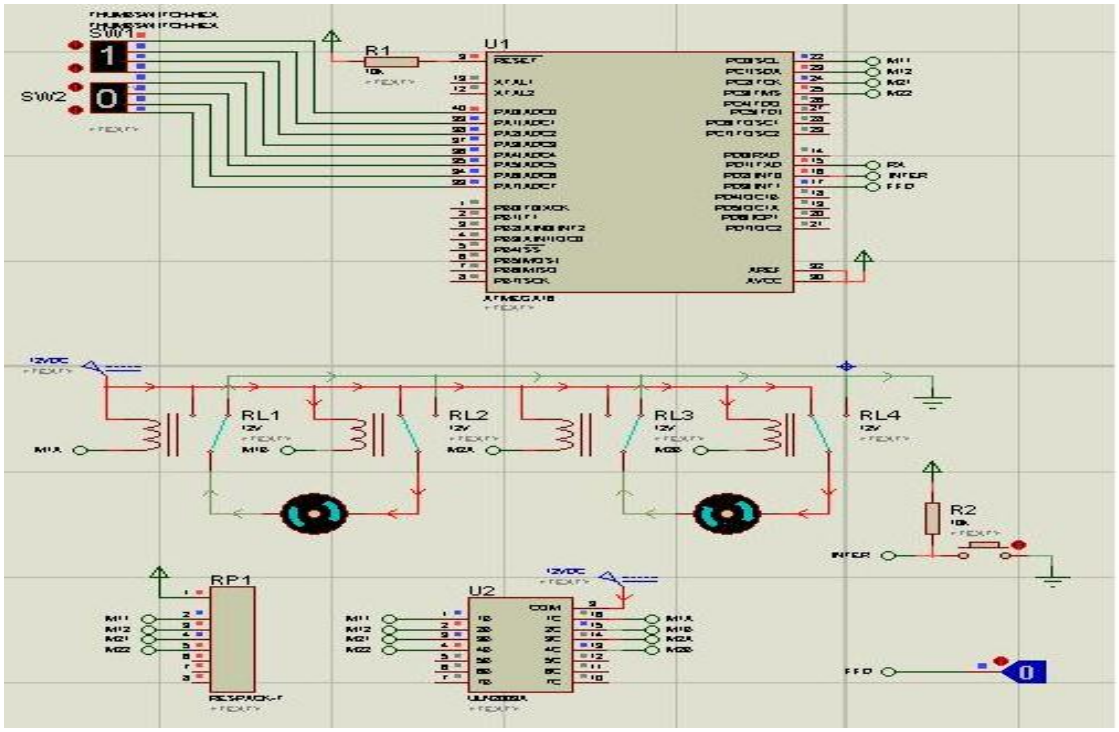

Figure 4.Simulation Screen for STATE = 1.

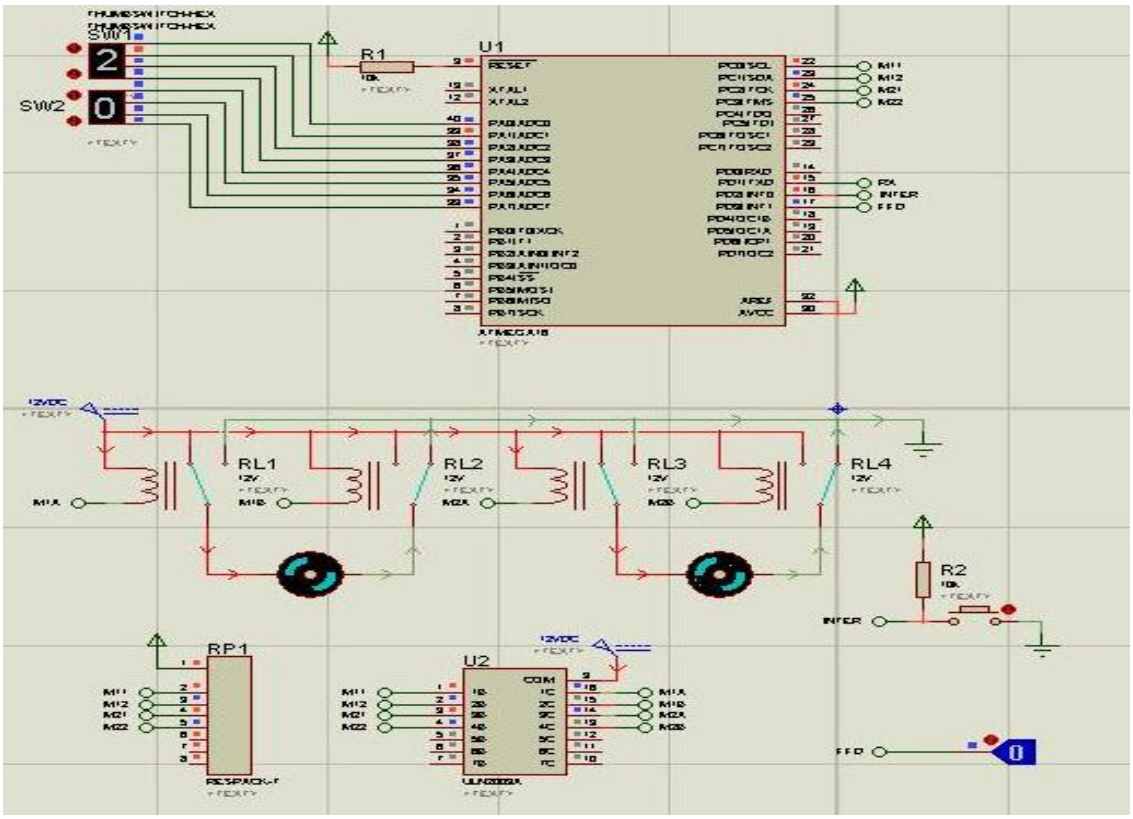

Figure 5. Simulation Screen for STATE = 2.

IV. CONCLUSION

The system being developed is real time and fully feasible. There are no bugs causing problem to the operation so can be actually mountable on wheelchair. The reliability of the system is high and real time. It is based on stable microcontroller design. Installation is easy. System provides effortless wheelchair driving option for old and disabled. The system can be installed at the time of assembly by the manufacturer. Brain machine interface can be option for voice commands. Emergency button can be provided to convey relatives and care takers that help is needed.

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