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AUTONOMOUS AND VOICE ENABLED EMBEDDED WHEEL CHAIR

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ABSTRACT

As the technology increases we can solve many problems of the people. There are lots of persons who cannot walk very easily due to blindness. For them travelling with safety is a major problem. An intelligent electric vehicle is thus required to solve their problem. The vehicle is made with a lot of technologies such as Digital image processing for obstacle detection, edge detection and road detection, Sonar based obstacle avoidance, GSM based emergency servicing and semi-automatic control system for vehicle. We propose a design of completely intelligent electric vehicle for blind which can be implemented successfully. The vehicle is designed in such a way that it can climb footpaths. The vehicle is designed to obey all traffic signals so that the design is apt for real world.

Keywords: blind, wheel chair, ultrasonic sensor, GSM module.

1. INTRODUCTION

Independent mobility is a key component in maintaining the physical and psychosocial health of an individual. Further, for people who are partially sighted, independent mobility increases vocational and educational opportunities, reduces dependence on caregivers and family members, and promotes feelings of self-reliance. Psychologically ,a decrease in mobility can lead to feelings of emotional loss, anxiety, depression, reduced self-esteem, social isolation, stress, and fear of abandonment. Even though the benefits of powered mobility are well documented, the safety issues associated with operation of powered vehicles often prevent clinicians and rehabilitation practitioners from prescribing powered mobility. One obstacle to safely operating a vehicle is impaired vision. So we are introducing an intelligent vehicle for blind. This vehicle is powered by rechargeable battery and the time of charging is very less. It can be operated in automatic as well as in manual mode. A lot of features are there in this vehicle which makes it distinguishable from other suggested vehicles. The vehicle can be used for blind, handicapped and elders.

2. SYSTEM DESIGN

The design of an electric vehicle is divided into several systems and which are again subdivided into several Subsystems to reduce complexity

- Sensor technique
- Speech to text and text to speech interface
- Interfacing of GSM
- Voice commands

3. HARDWARE DESCRIPTION

a) Sonar (Ultrasonic sensor)

Ultrasonic transducers are transducers that convert ultra sound waves to electrical signals or vice versa. Those that both transmit and receive may also be called ultrasound transceivers many ultrasound sensors besides being sensors are indeed transceivers because they can both sense and transmit. These devices work on a principle similar to that of transducers used in radar and sonar systems, which evaluate attributes of a target by interpreting the echoes from radio or sound waves, respectively. Active ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor, measuring the time interval between sending the signal and receiving the echo to determine the distance to an object. Passive ultrasonic sensors are basically microphones that detect ultrasonic noise that is present under certain conditions, convert it to an electrical signal and report it to a computer. Figure-1 shows ultrasonic sensor.

Figure-1. Ultrasonic sensor.

GSM module

GSM is a cellular network; The coverage area of each cell varies according to the implementation environment GSM (Global System for Mobile communications) is an open, digital cellular technology used for transmitting mobile voice and data services. GSM differs from first generation wireless systems in that it uses digital technology and Time Division Multiple Access (TDMA) transmission methods GSM modem requires a SIM card from a wireless carrier in order to operate. SIM 900 which is shown in Figure-2. GSM has services like SMS (Short message service) which uses AT commands to send messages. SMS service is suited for remote control

application that requires small amount of data like emergency commands.

Figure-2. GSM module.

b) Voice recognition kit

Voice or speech recognition is the ability of a machine or program to receive and interpret dictation, or to understand and carry out spoken commands. For use with computers, analog audio must be converted into digital signals. This requires analog-to-digital conversion. For a computer to decipher the signal, it must have a digital database, or vocabulary, of words or syllables, and a speedy means of comparing this data with signals. The speech patterns are stored on the hard drive and loaded into memory when the program is run. A comparator checks these stored patterns against the output of the A/D converter. In practice, the size of a voice-recognition program's effective vocabulary is directly related to the random access memory capacity of the computer in which it is installed. A voice-recognition program runs many times faster if the entire vocabulary can be loaded into RAM, as compared with searching the hard drive for some of the matches. Processing speed is critical as well, because it affects how fast the computer can search the RAM for matches. Figure-3 shows voice recognition kit.

Figure-3. Voice recognition kit.

c) LCD (Liquid Crystal Display)

A liquid-crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. The LCD screen is more energy efficient and can be disposed of more safely than a CRT. Its low electrical power consumption enables it to be used in battery-powered electronic equipment. It is an electronically modulated optical device made up of any number of segments filled with liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in color or monochrome. The CRT became obsolete for most purposes. Each pixel of an LCD typically consists of a layer of molecules aligned between two transparent electrodes, and two polarizing filters (parallel and perpendicular), the axes of transmission of which are (in most of the cases) perpendicular to each other [Figure-4]. Without the liquid crystal between the polarizing filters, light passing through the first filter would be blocked by the second (crossed) polarizer.

Figure-4. LCD display.

d) RELAY

A relay is an electrically operated switch. Electric current through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double-throw (changeover) switches. A simple electromagnetic relay, such as the one taken from a car in the first picture, is an adaptation of an electromagnet. It consists of a coil of wire surrounding a soft iron core, an iron yoke, which provides a low reluctance path for magnetic flux, a movable iron armature, and a set, or sets, of contacts. The armature is hinged to the yoke and mechanically linked to a moving contact or contacts. It is held in place by a spring so that when the relay is de-energized there is an air gap in the magnetic circuit. In this condition, one of the two sets of contacts in the relay pictured is closed, and the other set is open. When an electric current is passed through the coil it generates a magnetic field that attracts the armature and the consequent movement of the movable contact either makes or breaks (depending upon construction) a connection with a fixed contact. If the set of contacts was closed when the relay was de-energized, then the movement opens the contacts and breaks the connection, and vice versa if the contacts were open. When the current to the coil is switched off, the armature is returned by a force, approximately half as strong as the magnetic force, to its relaxed position. Figure-5 shows that relays.

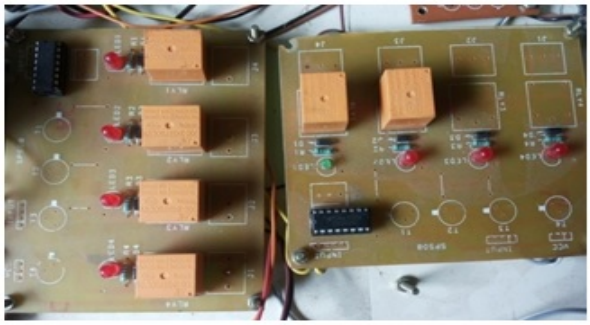

Figure-5. Relays.

e) PIC Microcontroller

PIC16F877 is a 40-pin 8-Bit CMOS FLAS Microcontroller from Microchip. The core architecture is high-performance RISC CPU with only 35 single word1 instructions. Since it follows the RISC architecture, all single cycle instructions take only one instruction cycle except for program branches which take two cycles. PIC16F877 comes with 3 operating speeds with 4, 8, or 20 MHz clock input. Since each instruction cycle takes four operating clock cycles, each instruction takes 0.2 µs when 20MHz oscillator is used. It has two types of internal memories: program memory and data memory. Program memory is provided by 8K words (or 8K*14 bits) of FLASH Memory, and data memory has two sources. One type of data memory is a 368-byte RAM (random access memory) and the other is 256-byte EEPROM (Electrically erasable programmable ROM). The core feature includes interrupt capability up to 14 sources, power saving SLEEP mode, and single 5V In-Circuit Serial Programming (ICSP) capability. The sink/source current, which indicates a driving power from I/O port, is high with 25mA. Power consumption is less than 2mA in 5V operating condition. PIC16F877A shown in the Figure-6.

Figure-6. PIC16F8877A microcontroller.

f) WEB camera

A webcam is a video camera that feeds or streams its image in real time to or through a computer to computer network. When "captured" by the computer, the video stream may be saved, viewed or sent on to other networks via systems such as the internet, and email as an attachment. When sent to a remote location, the video stream may be saved, viewed or on sent there [Figure-7]. Unlike an IP camera (which connects using WiFi), a webcam is generally connected by a USB cable, or similar cable, or built into computer hardware, such as laptops. The camera is to capture the traffic signal while the chair is moving.

Figure-7. Web camera.

g) MAX 232

The MAX232 is an IC, first created in 1987 by Maxim Integrated Products, that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual Driver/receiver and typically converts the RX, TX, CTS and RTS signals. The drivers provide RS-232 voltage level outputs (approx. ± 7.5 V) from a single + 5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS-232 in this case.

4. SOFTWARE DESCRIPTION

a) Embedded C

Embedded C is a set of language extensions for the C Programming language by the C Standards committee to address commonality issues that exist between C extensions for different embedded systems. The Embedded c supports access to I/O and provides ease of management of large embedded projects. Embedded C programming requires nonstandard extensions to the C language in order to support exotic features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations. Embedded C uses most of the syntax and semantics of standard C

b) MPLAB IDE

MPLAB IDE is a software program that runs on a PC to develop applications for Microchip microcontrollers and digital signal controllers. It is called an Integrated Development Environment (IDE), because it provides a single integrated "environment" to develop code for embedded microcontrollers. It also serves as a single, unified graphical user interface for additional Microchip

and third party software and hardware development tools. Moving between tools is a snap, and upgrading from the free software simulator to hardware debug and programming tools is done in a flash because MPLAB IDE has the same user interface for all tools.

5. PROPOSED SYSTEM

The vehicle can be operated automatically with the help of voice commands. There are two modes

- Voice mode
- Video mode

a) Voice mode

A voice operated system for wheelchair navigation as in would be very much user friendly and comfortable for elders with limbs impairments. This method can be of much benefit to people who are unable to perform simple movements with their hands. This technique is language unbiased and hence can be considered universal. A voice recognition IC can be used, which is interfaced with a microcontroller. This IC accepts the input from the user as voice commands which are then converted to signals that a microcontroller can process. The microcontroller then produces the desired output which controls the wheelchair. If the vehicle is in voice mode, then while starting sonar start to sense obstacles, if the obstacles are not present in front of the vehicle. If any obstacle is detected then it will checks there any sonar non-active. If yes, then vehicle will move to that direction to avoid obstacle else vehicle stops. The person can use keypad for GSM communications. With the help of GSM person can send the messages. Figure-8, 9, 10, 11 shows voice command.

Figure-8. Forward command.

Figure-9. Left command.

Figure-10. Right command.

Figure-11. Stop command.

b) Video mode

For video mode web camera is attached with the vehicle which is programmed to capture the image once in 6 seconds. If it is in road then vehicle will check for traffic signals. If any traffic signal is found then traffic guidance unit guides the vehicle movement. Where if the image captured is processed then and there, when the camera process the red light it stops the vehicle and when processing green light it starts moving forward. If any obstacle is detected then it will check is there any sonar non-active. If yes, then vehicle will move to that direction to avoid obstacle else vehicle stops.

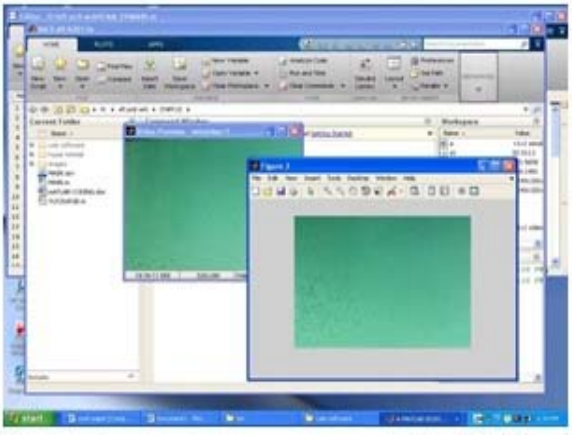

Figure-12. Green signal.

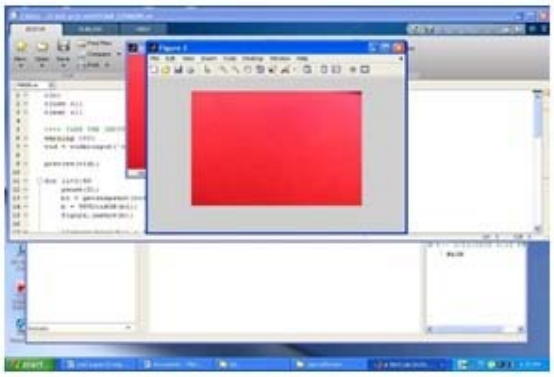

Figure-13. Red signal.

6. RESULTS AND DISCUSSION

The developed prototype of the project is shown in Figure-14. This is specially developed for the physically impaired people and partially sighted persons. This can also be used in road side environment in which the traffic signal is detected and works accordingly.

Figure-14. Prototype of developed system.

a) Obstacle detection

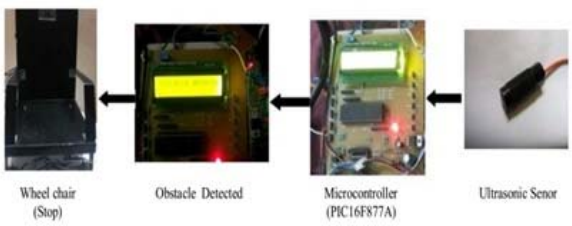

Figure-15. Obstacle detection using ultrasonic sensor.

The ultrasonic sensor is used to detect the in-front obstacles. In road side environment this ultrasonic sensor is used to measure the distance of in-front object. The range of ultrasonic sensor is 3cm to 3.3m (Figure-15). the sensor information is sent to the microcontroller, and then the controller stops the wheel movement and the obstacle detection is displayed in LCD.

b) Wheel Movement using video mode

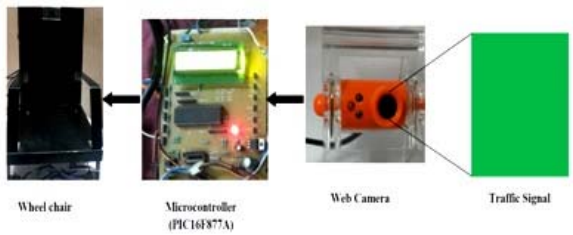

Figure-16. Recognize the traffic signal.

The webcam captures the traffic signal and send the information to the PC. Using Matlab process the information if it is in green signal, the PC sends the output to the microcontroller as input. Then microcontroller immediately ignites the motor to move forward to the desired location. Recognizing the Traffic signal is shown in the Figure-16.

c) Wheel movement using audio mode

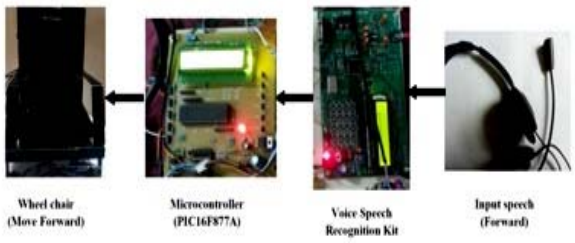

Figure-17. Wheel movement using audio mode.

The Microphone captures the user input speech signal (Forward) and the signal is processed using voice recognition module (Figure-17). After that, the data is forward to the microcontroller, if it is authorized the wheelchair can be moved forward.

7. CONCLUSIONS

This paper presents the architecture of Intelligent Electric vehicle using embedded system and image processing techniques. Features associated with it are Obstacle avoidance, GSM, traffic light guidance, voice commands and the design of the vehicle. The future prospects in relation to electric vehicle is to improve its mechanical properties, reliability and clinical feasibility.

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