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Review on Automated Wheelchair

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Abstract: ***The persons who are paralyzed dependent on others due to loss of self-mobility. The main objective was to design and build a cheap, intuitive and practical powered wheelchair. The proposed system presents a user-friendly human machine interface (HMI) for hands-free control of an electric powered wheelchair (EPW). Its two operation modes are based on Mode 1 four head movement through accelerometer, and Mode 2 voice command through speech recognition in MATLAB. Proposed Wheelchair can also detect the slope elevation and accordingly control the speed which helps to avoid the accidents.***

Keywords: Electric power wheelchair (EPW); speech recognition, Micro-electromechanical systems (MEMS), Accelerometer, DC motors.

1. Introduction

The physically challenged people who use a normal wheelchair for navigation, usually requires an external person to move around. In this busy world, the elderly people may be left alone at home and also may not find any person for external help. Here comes the need of an automated home navigation system, which consists of a wheelchair which can be used by the elderly and the physically challenged people without the help of an external person. The wheelchair automation system can be operated using voices which is recorded into it.

Some elderly or physically challenged people may find problems in talking while others may find problems in their body parts or find disability in moving their body parts. These problems are also taken into consideration, as there is an option in wheelchair automation system to customize it with voice. Another important feature is that the personal security of the person who is using the wheelchair is also taken care. If the person feels uncomfortable or insecure, he can call the emergency service like police or hospital by making use of messaging facility provided by GSM module.

2. Contribution by Previous Researchers

Here different papers are studied based on the approaches used by the different researchers and modifications are made to provide more reliability in the proposed system.

By Benjamin Romero, Abraham Camacho, Jorge Varona, Carlos Delgado in [1]Approach used here is the design, implementation and experimental platform of a low-cost intelligent wheelchair for the physically disable persons. Manual operation is depend on a joystick and is especially for people who are well capable of guiding the wheelchair. Autonomous operation relies on a mobile robotics which is a computer vision system to navigate through corridors, halls, indoors/outdoors, among other structured environments. In autonomous mode, the electronic power wheelchair uses a vision system to navigate autonomously along corridors, halls and a wide variety of indoor/outdoor environments. A colour camera obtains images and transmits them to an on-board laptop computer. The PC takes the best decision based on image processing algorithms and sends the corresponding signals to the electronic drive.

D. J. Kupetz, S. A. Wentzell, B. F. BuSha in [2]design a power wheelchair with a novel control system for quadriplegics with head and neck mobility. The control system translates the position of the user's head into speed and directional control of the wheelchair. Head movement was measured using camera-based motion-tracking of an infrared LED array on the back of the user's head. The control system included a standby mode that was activated by pressing the head back against the headrest, which activated the braking system while deactivating the drive train, allowing for manual control of the wheelchair via a rear support system.

Prof. Vishal V. Pande, Nikita S.Ubale, P.Masurkar, Nikita R. Ingole, Pragati P. Mane in [3] develop a wheel chair control which is useful to the physically disabled person with his hand movement or his hand gesture recognition using Acceleration technology. It is wheelchair which can be controlled by simple hand gestures. It uses a sensor which controls the wheelchair hand gestures made by the user and interprets the motion intended by user and moves accordingly. In Acceleration we have Acceleration sensor. When we change the direction, the sensor registers values are changed and that values are given to microcontroller. Depending on the direction of the Acceleration, microcontroller controls the wheel chair directions like LEFT, RIGHT, FRONT, and BACK.

Nathalia Peixoto, Hossein Ghaffari Nik.in [4] developed a wheel chair control by means of voice command. The inputs to the system are two AC signals: voice commands, acquired through one channel of amicrophone, and vocal cord vibration, acquired by means of a single axis accelerometer. The output of the controller is given to the joystick of the wheel-chair. In the case of an analog joystick, it is usual that the forward–reverse direction is controlled by a DC-coupled signal. The function of the controller is to interpret voice and humming commands and generate the two appropriate voltage levels for the respective output signals.

A. Ruíz-Serrano, R. Posada-Gómez, A. Martínez Sibaj, G. Aguila Rodríguez, B.E. Gonzalez-Sanchez, O.O. Sandoval-Gonzalez in [5] develop a wheel chair control to make a

magnetic control interface using a magnet and a voice control interface using a microphone with the elements of a prototype wheelchair that it can perform a simple command control, for that a magnetic control system and a speech recognition system were implemented. The sensors are placed on the tongue inside the mouth and these are then detected by either a dental retainer used in the mouth or by a separate device worn outside the mouth. In voice control part the voice commands were programmed and trained to respond according to the recognition system, to be applied to a wheelchair using the speech recognition board "EasyVR" that uses classic speech recognition algorithms.

3. Proposed System

In the proposed system movement of wheelchair is done by head movement as well as speech commands. And also making the system to avoid accident due to slope on the way. This can be done by detecting the slope and according to it system controls the speed of the motor of wheelchair. Its two operation modes are based on Mode 1 Four types of head movement, and Mode 2 speech recognition in MATLAB for given voice command.

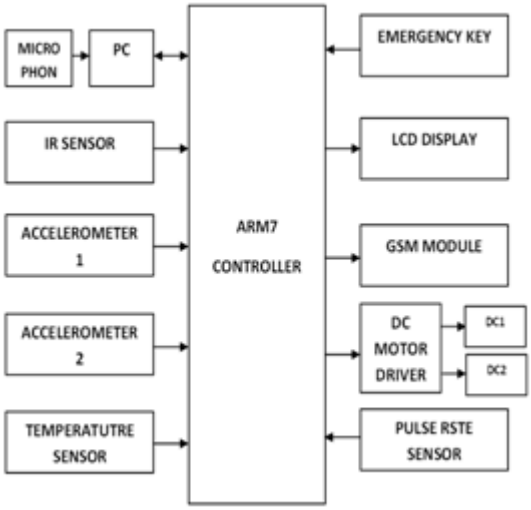

Figure 1: System Block Diagram

3.1 ARM Controller

ARM architecture is designed to allow very small, with high performance implementation. This simplicity leads to very small implementations which allow devices with very low power consumption. Now a day's most industries are using this controller to develop their product. One of the examples includes the I-phone 5 mobile which uses ARM 7 processor.

ARM is a RISC architecture which has the following features:

- A large uniform register file.
- A load-store architecture, where data processing operations only operate on register content, not directly on memory contents.
- Simple addressing modes.
- Uniform and fixed length instruction fields.
- High performance, low code size.
- Low power consumption and silicon area.
- ARM based embedded system has good performance and portability; therefore it has been widely used in various industries. Different operating systems can be ported easily on this controller.
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3.2Accelerometer

An accelerometer is an electromechanical device that will measure acceleration forces. These forces may be static, like the constant force of gravity pulling at your feet, or they could be dynamic caused by moving or vibrating the accelerometer. By measuring the amount of static acceleration due to gravity, you can find out the angle the device is tilted at with respect to the earth. By sensing the amount of dynamic acceleration, you can analyze the way the device is moving.

3.3 Temperature Sensor

Temperature sensor is used to sense the temperature [6]. We have used a Temperature sensor called LM35. This temperature sensor can sense the temperature of the atmosphere around it or the temperature of any machine to which it is connected or even can give the temperature of the human body in case if used. So, irrespective of the application to which it is used, it gives the reading of the temperature. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. Temperature sensor is an analog sensor and gives the output into form of analog signal. This signal is feed to ADC which will convert it into digital form. Once converted into analog form, the microcontroller can process the digital temperature signal as per the application.

3.4 GSM Modem

GSM (Global System for Mobile communication) is a digital mobile telephony system. With the help of GSM module interfaced, we can send short text messages to the required authorities as per the application. GSM module is provided by SIM uses the mobile service provider and send SMS to the respective authorities as per programmed. It operates at either the 900 MHz or 1800 MHz frequency band.

3.5 DC Motors

DC motors are used to physically drive the application as per the requirement provided in software. The dc motor works on 12v.To drive a dc motor; we need a dc motor driver called L293D. This dc motor driver is capable of driving 2 dc motors at a time. In order to protect the dc motor from a back EMF generated by the dc motor while changing the direction

of rotation, the dc motor driver have an internal protection suit. We can also provide the back EMF protection suit by connecting 4 diode configurations across each dc motor.

3.6 IR Obstacle Sensors:

Here we are connecting an IR based obstacle sensor to detect the obstacle in the way. But to increase the range of the obstacle sensor we are using a lower range resistor (50 ohm).On the receiver side we have connected the IR receiver in reverse bias. So as soon as the light falls in the IR receiver, the anode voltage increases and when the anode voltage is more than the cathode voltage then the LED are in forward bias mode and start conducting.

3.7 Pulse Rate Sensor

This is the design of a very low-cost device which measures the heart rate of the subject by clipping sensors on one of the fingers and then displaying the result on a text based LCD. The device has the advantage that it is microcontroller based and thus can be programmed to display various quantities, such as the average, maximum and minimum rates over a period of time and so on. Another advantage of such a design is that it can be expanded and can easily be connected to a recording device or a PC to collect and analyze the data for over a period of time.

3.8 Microphone

It is used for the voice command input to the pc in which speech recognition algorithm is used to detect the command that is left, right, forward and backward. And according to command the controller give controlling signal to the wheelchair motor.

3.9 LCD Display

LCD is used in a project to visualize the output of the application. We have used 16x2 LCD which indicates 16 columns and 2 rows. So, we can write 16 characters in each line. So, total 32 characters we can display on 16x2 LCD.

4. System Flow Charts

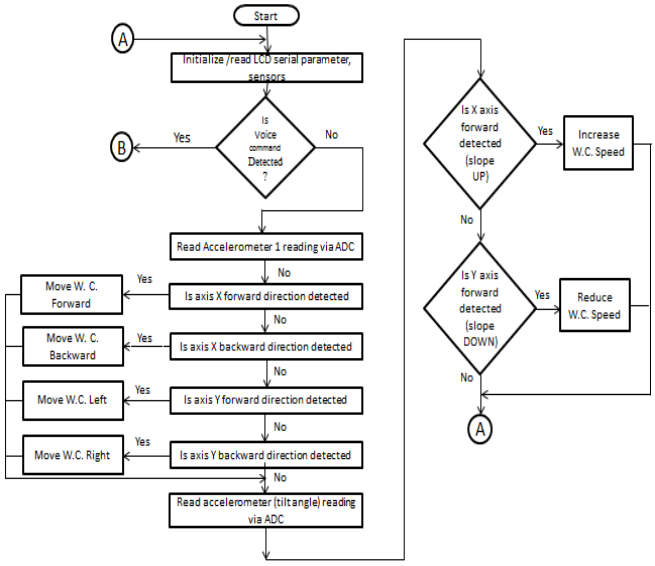

Figure 2: Flow Chart for Accelerometer

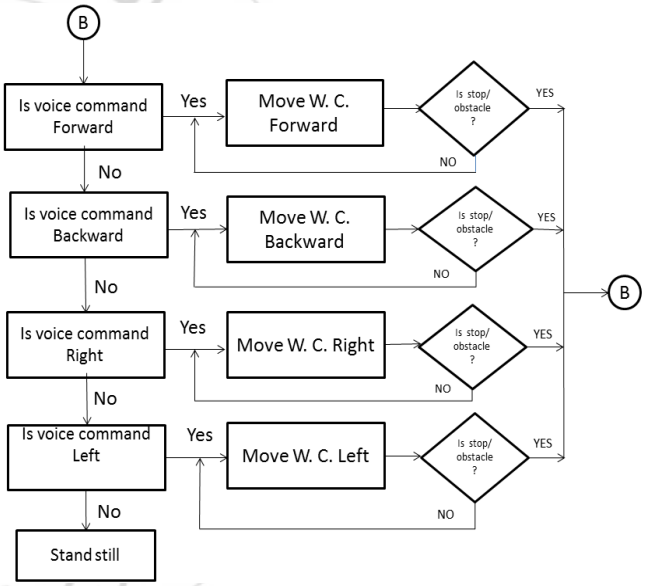

Figure.3 Flow Chart for Voice Command

4.1 L298 (Driver IC)

It's a high voltage and high current dual full bridge driver IC having 15 pin. This is used to drive the DC motors. It operates on 12V power supply. It provides DC current up to 4A. The operating supply voltage is up to 46V. This is having over temperature protection and also having high noise immunity means logical „0" voltage is up to 1.5V.

5. Conclusion

This system uses voice controlled and head movement based principle which improves human machine interaction and makes the control of the system effectively. The use of IR sensors helps the wheelchair to prevent from collision. Temperature and pulse rate sensor used to monitor the patient. Use of ARM microcontroller improves the speed of operations.

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