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ARM 7 BASED VOICE CONTROLLED WHEELCHAIR AND PATIENT MONITORING SYSTEM USING GSM

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ABSTRACT

This paper describes about the controlling of wheelchair by means of human voice and patient monitoring using GSM. In earlier, people use joysticks to control the powered wheelchairs. Wheelchairs with the standard joystick interface are unable to control by many people. Speech recognition is a prominent technology which can give an alternative, people to interact with machines especially those who are quadriplegics. We have resolved the disabled problems by implementing voice control interfacing, over a microphone for the wheelchair. The powered wheelchair depends on the motor control and drive system which consists of ARM Processor and DC Motor. In addition with the wheelchair the patient monitoring system (pressure, heart beat, and temperature) is provided. The abnormal conditions are intimated by sending message using GSM Technology and also the system detects the opposite object using ultrasonic sensor.

INTRODUCTION

There are many reasons; the people may not be able to travel freely, including spinal injuries, and amputation. Wheelchair is a mechanical device that can often assist. It effectively uses wheels and mechanical support to overcome a loss of legs or leg control. Manual wheelchairs can be operated by persons who have the use of their upper body or someone available to assist. Powered wheelchairs have been developed for when either of these cases does not apply. However, these devices typically require a high level of user control and this is something precluded by many severe forms of disablement. Our Endeavour's are aimed at creating 'intelligent' devices that can sense information from their environment and respond in useful ways. In this paper, we describe our effort in designing and building an economical voice controlled wheelchair that automatically avoids obstacles in real-time and patient monitoring system is provided to monitor the patient's blood pressure, temperature and heartbeat using GSM technology. The direction of the wheelchair is controlled by the ARM processor which receiving the voice command from the user and make use of motor it can control the direction of the wheelchair (Suryawanshi *et al*., 2013; Shaheen and Umamakeswari, 2013 and Sudheer *et al*., 2012). The microphone is used to receive the commands from the user. The collision avoidance can be done by the use of ultrasonic sensor (Sudheer *et al*., 2012). In addition with the wheelchair the keypad, obstacle sensors are used to operate the wheelchair and also if any abnormal conditions are monitored it can be intimated to their caretakers or doctor's through GSM Technology (Shaheen and Umamakeswari, 2013 and KaretiSambasivarao *et al*., 2012).

The Canasta 3D sensor is used for the obstacle avoidance (KaretiSambasivarao *et al*., 2012). The patient health conditions such as pressure, temperature, heartbeat are monitored by using appropriate sensor technology (Rajakumar *et al*., 2012 and Niteen Deshmukh, Pravin N. Matte, 2014). The voice controlled wheelchair technologies have the potential to improve the lifestyles of the people suffering from one or more disabilities. They attempt to restore human abilities that have been reduced or lost by disease, accident, or old age. Mobility is one such function. This paper is organized as Section II introduces the proposed system, Section III presents the hardware description of the proposed system, Section IV expresses the experimental results, and the paper is finally concluded in section V, Section VI provides the information about the Future Scope this system.

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Proposed System

The powered wheelchair act as a boon for the disabled people. The proposed system overcomes the drawbacks of Joystick movement. The voice-activated powered wheelchair supplementary with keypad control allows physically disabled person to operate the wheelchair easily without the need to use hands. The voice controlled wheelchair is operated based on the voice given by the user. The voice is the verbal instructions such as left, right, forward, reverse and stop. Advances in sensor technology and wireless communications the patient monitoring system is developed and that can monitor the patient's health conditions continuously. If there is any change in patient's health condition it sends message to their caretakers using GSM. The microphone is used to pick up the commands from the user. The commands such as left, right, forward and reverse. The ARM processor which generates the control signal according to the command given by the user and control direction of the motor. In addition with the voice controlled wheelchair the patient monitoring system is provided to monitor the health conditions of the patient such as temperature, pressure, and heartbeat. If any abnormal conditions are detected it can be intimated to their caretakers by sending a SMS through GSM Technology. The collision avoidance system is provided by using ultrasonic sensor which detects the opposite object which is in a predefined distance the system automatically stops the wheelchair.

Hardware Description

The Fig.1 Shows the block diagram of the proposed system. The each block of the proposed system is explained below.

Battery

The wheelchair is a movable part, so we cannot supply it continuously. The 12V, 4A lead acid battery is used to give supply to each unit in the block diagram.

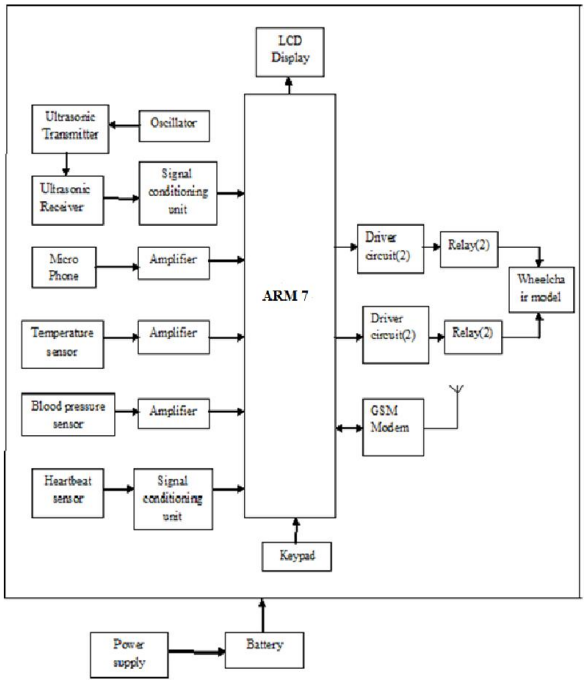

Fig.1. Block diagram of proposed system

The battery is charged by using charging circuit. The charging circuit consists of a step-down transformer, bridge rectifier to convert AC to DC and voltage regulator.

Microphone

The Fig.2 shows the cross section of the microphone. The microphone is used to pick up the commands from the user. The commands such as left, right, forward and reverse.

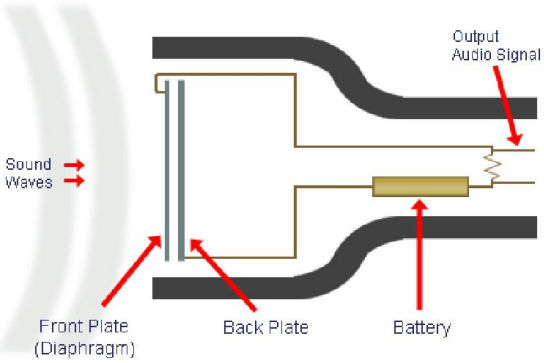

Fig. 2. Cross section of Microphone

The microphone is like a capacitor and it has two plates. The plate vibrates when struck by sound waves, changing the distance between the two plates and therefore changing the capacitance. It generates the voltage between them depending upon the sound waves. The generated voltage pulse amplified using the amplifier then it is given to microcontroller. Depending upon the pulse rate the microcontroller sends control signals to the microcontroller. The pulse rates with the directions are given in the Table1.

Table 1. Direction of wheelchair depends on pulse rate

Directions	Pulse rate
Forward	5 to 7
Reverse	7 to 10
Right	10 to 13
Left	13 to 15
Stop	Above 15

ARM7 Processor

ARM stands for Advanced RISC Machines. An ARM processor is basically any 16/32bit microprocessor designed and licensed by ARM Ltd, a microprocessor design company headquartered in England, founded in 1990 by Herman Hauser. A characteristic feature of ARM processors is their low electric power consumption, which makes them particularly suitable for use in portable devices. ARM processor is a von Neumann architecture which shares both data items and instructions in the same bus. RISC executes the instruction with in a clock cycle at high speed. The processor has a thumb 16 bit instruction which improves the code density.ARM7 has 16 data registers with two processor status register. It has three stages of pipeline such as fetch, decode, execute. The memory storage of the processor includes cache, main memory, and secondary memory

Driver Circuit

This circuit is used to drive the wheelchair based on the input obtained from the micro controller section. This section

consists of number of transistors to produce the 12V required to operate the relays. The transistor is triggered only at the high voltage level. Each driver circuit consists of two relays to produce the required voltage to drive the DC motor. Each motor is operates in the direction based on the directions given by the microcontroller. The different directions of motions possible are:

- Forward: Both the motors in forward direction
- Reverse: Both the motors in the reverse direction
- Left: Left motor stopped/Right motor in the forward direction
- Right: Right motor stopped/Left motor in the forward direction
- Stop: Both motors are in stop position.

Ultrasonic sensor

The ultrasonic sensor is used to detect the objects opposite to the wheel chair, if any object is detected it intimates through LCD. To measure the distance the timer triggers the transmitter which emits a series of pulses, then the timer waits until receiver detects the reflection of the pulses and stop the timer. The time measured is then divided by 2 and multiplied with the speed of sound. The result is the object in front of it.

Signal conditioning unit

Signal conditioning unit consists of signal conversion element and manipulation element. The conversion element is used to convert analog signal into digital signal. The manipulation element is used to produce pure digital signal.

Temperature sensor

Thermistor is a temperature sensor. It is used to measure the temperature of the patient. Thermistor is nothing but temperature sensitive resistor. There are two type of thermistor available such as positive temperature co-efficient and negative temperature co- efficient. Here we are using negative temperature co-efficient in which the resistance value is decreased when the temperature is increased. Initially the reference voltage is set to room temperature level. When the temperature is increased above the room temperature level, the thermistor resistance is decreased so variable voltage is generated.

Blood pressure sensor

This circuit is designed to measure the varying pressure. The pressure is measured by diaphragm which is one type of transducer. When pressure is applied, the diaphragm is moving in the forward side. The diaphragm moving is depends on the pressure. So it generates the voltage pulse depends on the movement of diaphragm. The voltage pulses are in the range of millivoltage. Hence the voltage pulse is given to Instrumentation amplifier section in order to amplify the signals.

Heartbeat sensor

It is used as a tool to measure heart rate through fingertip, in this case. The blood volume inside a fingertip slightly changes with heart beat as the blood is being pumped. This change in blood volume inside the finger artery is detected with a simple optical sensor system and then further amplified using appropriate signal conditioning circuit to generate a pulse of magnitude +5V. These pulses are later counted and the measured heart rate is displayed in the LCD. The normal rate of heartbeat range is 60 to 135.

GSM Modem

This is the part of the output section. It is helpful to intimates the abnormal conditions of the patient. It sends the message to the caretaker when there is a change beyond the thresholds of the temperature sensor, heartbeat sensor and pressure sensor. It uses the RS232 and MAX232. The interfacing between a GSM Modem and microcontroller is done by using MAX232. RS232 is a serial communication cable.

LCD Display

Liquid crystal displays (LCDs) have materials which combine the properties of both liquids and crystals. The LCD is used as output device. A 16×4 LCD is used here. This is used to display the set values given to the Microcontroller and measured value sensors.

Keypad

Keypad consists of five keys such as Set, Enter, Move, Increment and decrement. It is used to give the values to the microcontroller. For example the phone number, to send the patient's abnormal condition is given to the microcontroller through keypad.

RESULTS AND DISCUSSION

The hardware setup for the voice controlled wheelchair is shown in figure 3. The wheelchair moves depending upon the pulse range from the microphone.

Fig. 3. Hardware setup of the wheelchair

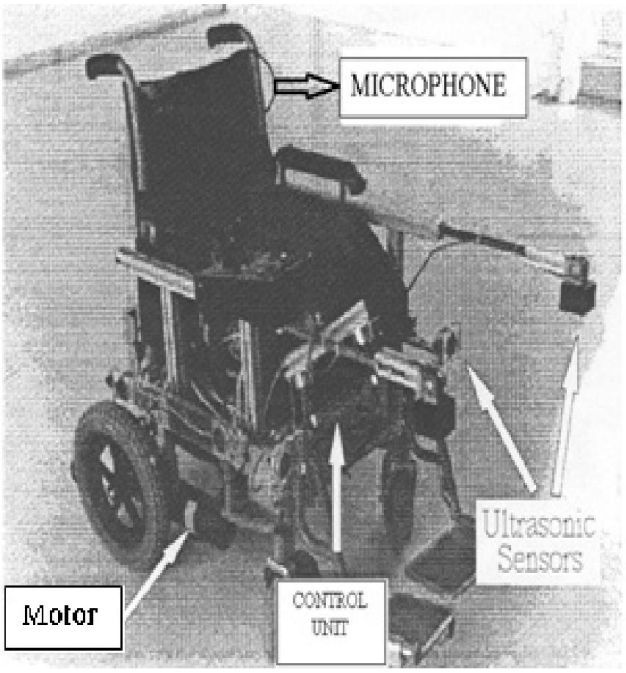

Fig.4. Model Wheelchair System

The ARM processor generates the control signals to operate the wheelchair in a particular direction by getting the voice as an input signal from microphone. If any abnormal condition occurs the patient monitoring system sends the message to the caretakers through GSM. The system also detects the object opposite to the wheelchair and prevent from the collision avoidance.

Conclusion

The progress in science and technology is a non-stop process. The proposed system based on ARM processor is found to be more compact, user friendly, which can readily be used in order to perform several tedious and repetitive tasks. Due to the probability of high technology (ARM7 Processor) used this Voice controlled wheelchair with patient monitoring system using GSM is fully automatically controlled. The voice controlled wheelchair assist system was developed with an idea of serving the people affected with high level Quadriplegia. In this case, the assist system has proven to be of a simple implementation and of low cost. The result obtained clearly implies that the system is easy to handle by the patients and it is easy to their caretakers to handle the patients.

Future Work

The system can be extended by using HM2007 voice recognition IC instead of amplifier circuit. It is capable of providing better voice recognition and it store upto 20 words. The GPS position can be also included with the wheelchair.

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