Real-time Breath Processing based Wheelchair using GSM Unit

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***Abstract*—We have proposed a "real time breath processing based wheelchair for quadriplegic people" which is basically a wheelchair, controlled with the help of normal inhaling and exhaling of breath using MIC(microphone) and signal conditioning circuit. The system is divided into two main units: Micro-electro mechanical systems(MEMs) Sensor unit and wheelchair control unit. we have proposed a microcontroller system enabled with standard electric wheelchair control by breath and head motion. Incase if the breath rate increases abnormally, with the help of GSM unit, doctor or any related person to the patient is notified in the form of phone call and SMS alerts.**

I. INTRODUCTION

Quadriplegics (people with physical disabilities) often find it difficult to work or move without the help of someone. For people with such disabilities wheelchair is the most common means of locomotion. With the rapid expansion in field of robotics, embedded systems and artificial intelligence, it is possible to develop a design which is flexible and cost friendly. In this project control of wheelchair can be initiated with the help of human breath and head motion. Wheelchairs can be fitted with PC but this makes them bulky and increases their complexity. We can overcome this disadvantage by using an accelerometer which is compact and can be placed on the head of the person using a cap [1],[2], [3]. Some systems make use similar sensors that are wired and increase the complexity of system. So we use ZigBee technology to transmitsignals wirelessly irrespective of any obstructions in the path .

In this paper, the designed wheelchair can be controlled by inhalation and exhalation of breath using a MIC and head movements [3] [4]. Wheelchair can be moved with the help of accelerometer. The user has to breathe in and out to activate the system and the direction of wheelchair depends on how user tilts his head. The system prototype consists of (Accelerometer and MIC) which is the control unit and a wheelchair unit. The accelerometer collects head motion data and MIC measures the breath pressure. This data is further processed using a microcontroller. Output is then given through ZigBee to the wheelchair unit along with the user's response. Thus head motion data is sent to the wheelchair unit and the user controls the wheelchair motion. A GSM unit is further added to the system to alert the doctor or any related person if the breath rate of the user on the wheelchair crosses a certain threshold.

II. SYSTEM ARCHITECTURE

The proposed system architecture is divided into two main parts:

A. Control Unit:

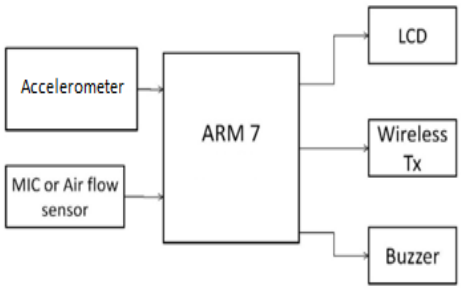


Fig 1. Control Unit

The control unit consists of an accelerometer, MIC, LCD and a Buzzer. Accelerometer controls the head movements whileMIC detects the breath pressure. LCD is used to display the breath rate while Buzzer indicates if there is any obstacle's in the path. The Buzzer generates a sound in situations when the breath rate of user increases or decreases below a certain level. Wheelchair motion stops automatically in case of an abnormal breath rate. Accelerometer collects the headmotion information and its output is connected to the microcontroller and processed data is further transmitted to wheelchair unit through ZigBee module[5].

B. Wheelchair Unit

The control system output is connected to the wheelchair unit, which is used in positioning the wheelchair using user's command. The command's transmitted by the control unit is received by wheelchair unit using ZigBee module. DC motor interfaced with the controller through motor driver IC controls the wheelchair motion in certain directions. All commands are displayed on the LCD. A proximity sensor is placed on the front side of the wheelchair and an obstacle sensor is placed on the other sides. They protect the wheelchair from walls and other obstacles.

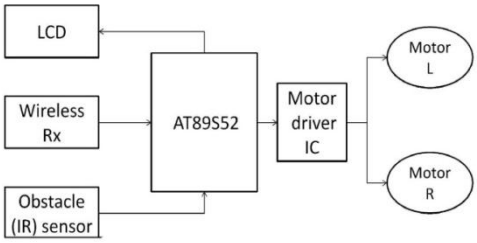


Fig 2. Wheelchair Unit

III. COMPONENTS USED

A. *Microcontroller*

The microcontroller used is a 32 /16 bit ARMTDMI-S CPU that combines microcontroller with a flash memory of 512kb. It has a 128 bit memory interface and a unique structure that enables 32 bit code execution at minimum clock rates. Their tiny size and low power consumption makes them suitable for use in applications which are compact or small in size.

B. *Carbon MIC*

Carbon MIC or carbon button is a transmitter that converts sound signals or vibrations into an electrical signal. The carbon MIC consists of carbon granules present between two metal plates out of which one plate will act as a diaphragm and will face outwards. The sound waves that strike on the plate will change the electrical resistance between the plates and such a varying resistance will result in modulation of current that has same frequency as the sound waves.

C. *Accelerometer Device*

It has several features like low power consumption,compactsize, signal conditioned voltage output. It is a 3 axis device that is used to measure acceleration of gravity in tilt sensing applications resulting from any movement, shock or vibration.

D. *ZigBee Module*

The ZigBee Module is a device that is used for sending data from the control unit and receiving data at the wheelchair unit wirelessly.It is a transceiver that is designed to operate at a range of 2.400 to 2.4835GHz of frequency.

E. *Proximity Sensor*

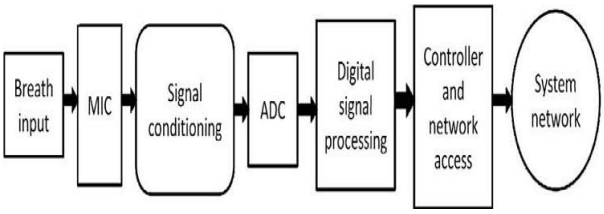
The proximity sensor (HC-SR04) is used in measuring certain obstacle's in the path of the wheelchair and closeness of the walls when the wheelchair is moving. It is an IR sensor that uses an ultrasonic transmitter, a receiver and a control circuitry.We use a 16 x 2 alphanumeric display which is dot matrix display that has potential of displaying 224 different characters and symbols. The health parameters measured by the MIC are displayed on the LCD.

F. *Buzzer*

The buzzer generates sound signals when the breath rate of the user on the wheelchair increases or decreases below or above normal breath rate. Also when the wheelchair is about to collapse to any obstacle the buzzer generates sound signals.

IV.BLOCK DIAGRAM

A. *Breath Processing Block Diagram*



Thebreath pressure given to the MIC will activate the wheelchair and movement of the wheelchair is controlled by motion of head. The any abnormal reduction or increase in the breath will generate sound signal and the varying breath rates are displayed on the LCD monitor. The main component that is used for measurement and control is the circuit board that is placed on the user's head.

B. *Microcontroller System Block Diagram*

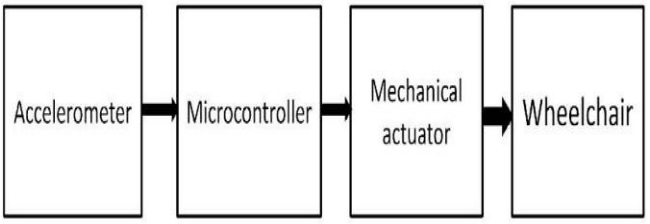


Fig Microcontroller System Block Diagram

The motion of wheelchair and the direction of motion is dependent on motion of the head. If the user tilts his head in any direction the wheelchair motion is initiated in that direction. If he tilts his head in a fast manner, the wheelchair will move faster. As shown in the figure, the accelerometer collects data of head motion and an algorithm is implemented for further processing by using a microcontroller. Its output is given to the wheelchair unit which initiates the motion of the wheelchair on the user's command.

V. CONCLUSION

According to the above survey, we can say that our proposed system will be used for quadriplegic people using normal breath and motionof head. Using GSM unit, doctor or any related person to the patient is notified in the form of phone call and SMS alerts.

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