Wheelchair for Quadriplegia Patients (Feb 2017)

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Abstract— today number of people, who need to move around with the help of some artificial means, because of an illness or accident, is continuously increasing. This means have to be increasingly sophisticated, taking advantage of technology evolution, in order to increase the quality of life for these people and facilitate their integration into their working world. This project intends to the smart wheelchair for quadriplegia patient for those people who have disabilities in their upper and lower extremities to enhance their daily activities of living (DAL), without any assistance. This patient can only move their head. The patients most often lost their confident level for their survival. So eradicate this quadriplegia patients tribulation by this wheelchair helps to boost the confident level of the patients. It includes head movements with the LED indication and the patient monitoring system which includes heart rate measurement with messaging service via global system mobile communication (GSM).

Key words: GSM, Head Movement, Heart Rate Measurement and Quadriplegia

I. INTRODUCTION

In a contemporary world, the person who needs to survival is difficult with any hindrance from the ecological conditions (temperature, light and navigation path obstacles and barriers etc.,) and people's physical conditions (heart rate, pressure and temperature etc.,). If consider any person in the world need a navigation for their Daily Activities of Living (DAL). This is done for healthy person is simple. But in the case of disability persons can't be navigate as easily they must have be deficient in of their self confidence. So they need some navigational assists like wheelchairs. In this project mainly intend towards the wheelchair for quadriplegia patients and to improve their self confidence as simply.

II. METHODOLOGY

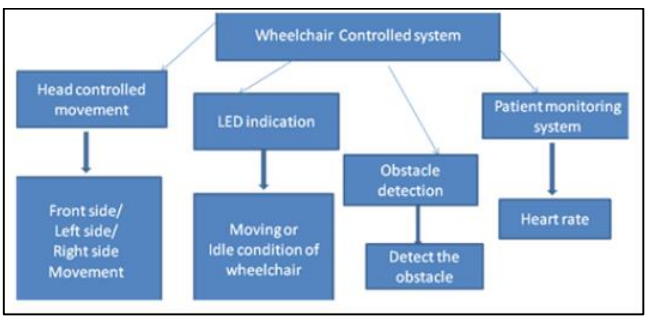

Fig. 1: Methodology

The tree diagram describes the implementation of a wheelchair with head controlled movement, LED indication, patient monitoring system and obstacle detection. This design is mainly developed for quadriplegia patients. In this project, the head controlled movement which helps to moves the wheelchair in a specific direction as similar to the head movement of the wheelchair. In LED indication which indicates the moving/ idle conditions of a wheelchair for patient convenient. The patient monitoring system helps to measure the heart of the patient and the obstacle detection helps to detect the obstacle in a navigational path.

III. HARDWARE SYSTEM

The proposed wheelchairs for quadriplegics can use the following four mechanisms.

- Head controlled wheelchair movement
- LED indication
- Patient monitoring system
- Obstacle detection

The main objective is to develop the self-assurance and eradicate the social problems faced by the Quadriplegia patients. So, providing a wheelchair for those patients with head control, LED indication, obstacle detection and patient monitoring with heart rate measurement are essential for comfy navigational troubles without necessitate of any nurture from outside.

IV. HADRWARE SYSTEM DESCRIPTION

A. Head Controlled Movement

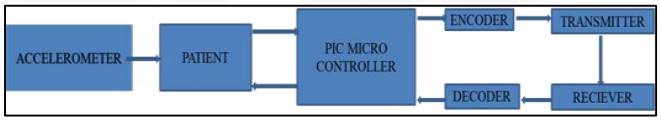

Fig. 2: Block diagram of Head controlled movement

In this head controlled movement (shown in fig1) is a system in which have the components like accelerometer sensor, PIC microcontroller, encoder, decoder, transmitter and receiver.

1) Accelerometer

Accelerometer which is attached to the head cap and the power supply is provided 5V. One of the most common inertial sensors is accelerometer, a dynamic sensor capable of a vast range of sensing. Accelerometers are available that can measure acceleration in one, two or three orthogonal axes. They are typically used in one of three modes.

- As an inertial measurement of velocity and position.
- As a sensor o inclination, tilt, or orientation in 2 or 3 dimensions, as referenced from the acceleration of gravity (1g= 9.8m/s2).
- As a vibration or impact (shock) sensor.

Micro-Electro-Mechanical Systems (MEMS) is the integration of mechanical elements, sensors, actuators and electronics on a common silicon substrate through micro fabrication technology. MEMS are typically defined as microscopic devices designed, processed and used to

interact or produce changes within a local environment. A mechanical, electrical, or chemical stimulus can be used to create a mechanical, electrical or chemical response in a local environment. These smaller, more sophisticated devices tat think, act, sense, and communicate are replacing their bulk counterparts in many traditional applications. Here MEMS is used to sense the patients head movement. These MEMS accelerometers are much smaller, more functional, lighter, reliable, and are produced for a fraction f the cost of the conventional macro scale accelerometer elements. (Refer Appendix for features). Sensor Accelerometer place on the patient's head sensed the movement made by the patient head. This movement corresponded to the analog voltage. Using this voltage control signals were generated for three directions of the wheelchair.

2) PIC16F877A Microcontroller

The PIC16F877A microcontroller is a 16 bit microcontroller which helps to control the patient with above mentioned directions. This microcontroller has RISC instructions with 35 instructions. The encoder contains the encoding signal tends to the transmitter side. Then the transmitter transmits the signal tends to the receiver side. In the receiver receives the signal from the transmitter and tends to the decoder which helps to decode the signal. And the decoding signal tends to the controller. This controller drives into the driver unit. This driver unit connected to the motor. Motor helps to move the wheelchair in a desired direction as mentioned above.

B. LED Indication

A Light Emitting Diode (LED) is a two- lead semiconductor light source. It is a p-n junction diode, has anode and cathode terminals. Principle of LED is when a suitable voltage is applied to the leads; electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor.

In this project has the LED indication for the movement of wheelchair. This wheelchair can moves in three directions in right, left and forward directions of movements. The controlled navigation of the wheelchair to indicated through this LED indicators. LED is known as the Light Emitting Diode. This LED indication helps to indicate the movement of wheelchair in the above mentioned directions or in idle condition to be indicated. Table1 shows the LED indication with ON and OFF conditions with respect to the wheelchair movements.

Head Controlled Switch	Condition of the Wheelchair	LED Indication
1st press	Moving (forward/left/right)	ON
2nd press	Idle	OFF

Table 1: LED Indication

This LED indication system is directly proportional to the head controlled switch. This head controlled switch is attached to the patient head part. The 1st press of this switch helps to indicate the ON condition of the LED and moving condition of wheelchair. And the 2nd press helps to indicate the OFF condition of the LED and shows the idle condition of the wheelchair.

C. Patient Monitoring System

The patient monitoring system (shown in *fig2*) is very important for quadriplegia patient. The patient survived without help from any assistant. The patient continuous body parameters are measured. This 24/7 patient monitoring system is attached in the patient wheelchair.

1) Parameter Measurement

In this monitoring system is consists of one important parameters. The main parameter is heart rate which is monitors the heart functioning via the carotid artery sensor. The selection of artery is important, because of the quadriplegia patients body parameters are not measured via the brachial artery. This measurement is not accurate those patients. Thus why choose the carotid artery here for measurement. This measurement is accurate compare to the brachial artery measurement. The parameter measurement is done in a sensing manner.

2) Heart Rate Measurement

In this heart rate measured sensor is IR sensor. It is a reflective optical sensor with both t he infrared light emitter and photo transistor placed side by side and are enclosed inside a leaded package, so that there is minimum effect of surrounding visible light.

Using the concept of IR changes of blood volume can be measured during each heart beat. It is based on the determination of optical properties of vascular tissue using a light source and a photo detector (PD).

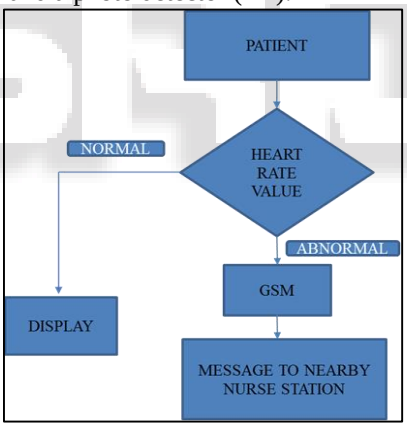

Fig. 3: Flow chart for Patient monitoring system

In contrast to oximetry, only one led light is used to transmit light in PPG. As the light is emitted, blood levels and tissues absorb various amounts of the light, causing different detections sensed from a photo detector. There are 2 different types of detection modes using the photo detector: transmission and reflection.

3) Modes in Heart Rate Measurement

Transmission mode occurs when the led source is transmitted through the skin and detection occurs on the other side of the skin. This method can only be done through areas of the body thin enough for the photo detector to read a measurable signal. For example, possible implementations can be done through any finger, earlobes, and the toes.

The second mode, reflection, occurs when both the led and photo detector are on the same side of the skin. As the led emits light, the backscattered optical radiation from the blood pulsations is detected and measured. Whether the two components are placed across from each other through

the skin or in parallel to each other on the same side of the skin, the photo detector measures the variations in blood pulsations and outputs a current that is then amplified, filtered, and outputted as a voltage for further analysis.

This Sensor for heart rate measurement is fixed carefully in a specific carotid artery location. These sensors gives the signal should be amplified, because our body signal has low amplitude. The signal is transmitted in a signal comparator. This comparator is compares the current signal value to the normal value. The normal value of heart rate is 72 beats/ sec. The plus or minus value is occurs then the error or abnormal signal is present in a particular time of measurement.

If any abnormal signal is acquired then the abnormal signal is send the message to the neighbors/ nurse station. The message will help the persons who have the abnormalities in their normal parameters.

The message sending process is done by the GSM system. This system is known as the Global System Mobile communication system. The data transfer rate is high and easy transfer. GSM is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. There are five different cell sizes in a GSM network—macro, micro, pico, femto and umbrella cells. The coverage area of each cell varies according to the implementation environment.

- Macro cells can be regarded as cells where the base station antenna is installed on a mast or a building above average roof top level.
- Micro cells are cells whose antenna height is under average roof top level; they are typically used in urban areas.
- Pico cells are small cells whose coverage diameter is a few dozen meters; they are mainly used indoors.
- Femto cells are cells designed for use in residential or small business environments and connect to the service provider‘s network via a broadband internet connection.

D. Obstacle Detection

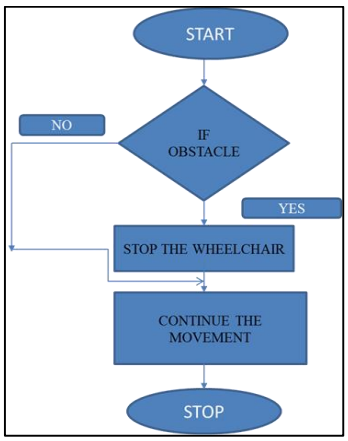

Fig. 4: Flow chart for Obstacle detection

In this obstacle detection, first should know about the obstacle. Obstacle is a barrier which is present in the path. In this wheelchair project has the obstacle detection control system. In which has the detection of barrier like, surface problem in the navigation path. This will cause the problem in the way of movement of the wheelchair. So it should be avoided. The obstacle detection system (shown in fig3) has the obstacle detection sensor which is made up of ultrasonic type. The sensor gives the sensor output signal to the wheelchair driver unit. This sensor output signal is proportional to the detected from the obstacle.

The wheelchair to control in the direction will be controlled easily. Then this obstacle detection is helps to the quadriplegia patient. This obstacle detection has the two conditions. The first, the presence of the obstacle in the navigational path then the wheelchair will stop. The second is in absence of obstacle in a navigational path then the wheelchair continues the movement.

1) DC motor

A DC motor generates torque by creating an interaction between a fixed and rotating magnet field. The fixed field is supplied by high energy permanent magnets. The rotating field is created by passing a DC current through several different windings on the armature (rotating part) and timing which winding is powered through a device called a commutator. Power is applied to the armature by brushes which ride on the commutator. An electro mechanical energy conversion device is essentially a medium of transfer between an input side and an output side.

The energy conversion in a DC motor is like; if electrical energy is supplied to a conductor lying perpendicular to a magnetic field, the interaction of current flowing in the conductor and the magnetic field will produce mechanical energy in the form of force.

V. RESULTS AND DISCUSSION

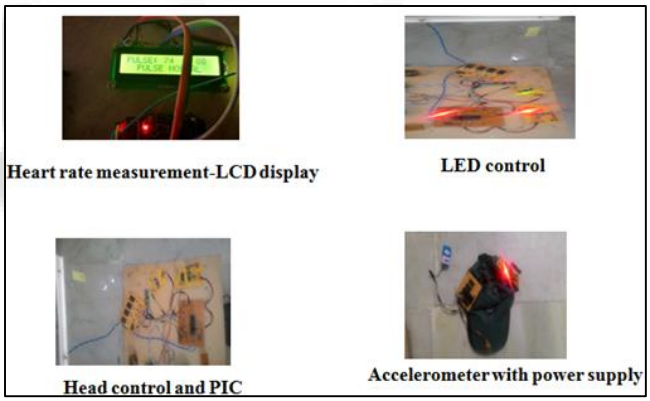

Fig. 5: Hardware setup

In this hardware setup is shown in fig4. The hardware setup has the LED light control, relay board, head controlled PIC microcontroller and accelerometer with power supply. This project helps to the patient in two ways like for easy navigation and during navigation the health condition monitoring. The hardware setup is simple to design and economical one.

VI. CONCLUSION

Thus this project can help the person those who are unable to carry out their daily needs of life independently. It helps them to move with the external environment more easily as like normal persons do. The obstacle detection helps to detect the barrier which is in navigation. The patient monitoring provides a regular report of those patients which helps them to maintain their health and if incase of any abnormalities can be easily detected and treated. This project further developed in a manner of connecting the hydraulic system with the seat of the wheelchair. And

design the standing and sitting positioned wheelchair design is also improves the life style of the quadriplegia patient.

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