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Engineering

SMART HEALTH MONITORING WHEEL CHAIR USING IOT APPLICATIONS

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ABSTRACT Physically disabled persons face many difficulties associated with their mobility problems and they depend upon external aids for daily activities. Smart machines are vast in markets to reduce such difficulties. But the usage of such machines consumes more power as conventional energy sources are used. This paper proposes a solar based health monitoring system which reduces the power consumption and efforts of physically challenged people and ensures an independent and better quality life for them. The electric wheel chair is integrated with motion, ECG, ultrasonic, LDR and EMG sensors. Natural gesture of the head and upper body parts, as well as muscular activity, is measured using motion sensor and electromyography. The multifunctional medicinal aid focuses on the improvement and self-reliability of disabled people which makes solar powered electric wheel chair an intelligent one. The patient staying in both urban and rural areas can be remotely monitored using IOT.

KEYWORDS : Electric wheel chair, pulse sensor, LDR sensor, ultrasonic sensor, electromyography, inertial sensor, motion control, IOT

INTRODUCTION

This paper describes a multimodal body-machine interface to help individuals with upper-limb disabilities. Natural gesture of the head and upper-body parts, are measured using IMU [1]. The electric wheel chair with health monitoring system to ensure more comfortable in travel and life for the physically challenged people. The main advantage is, it is environment friendly as it uses solar energy to recharge the

battery. The power to the electric motor of the wheel chair is given by a rechargeable battery which requires a conventional power supply to recharge it [2]. Patient staying in both urban and rural areas can be remotely monitored using IOT. The main objective of the system is to focus on people who are handicapped and the ones who are not able to move freely. Therefore, with the design of the smart wheelchair can be an asset for medical department. Moreover, user can control this wheelchair with the help of joystick. It will allow the user to interact with the wheelchair at different level of control. The different level of control can be left, right, forward, and backward and stop [3].

The model of an automatic wheelchair that moves with respect to the patient's head movement. Here, an accelerometer is used to decide the direction of motion of the head of the patient [4]. This focuses on the measurement and evaluation of vital parameters, e.g. ECG, heart rate, heart rate variability. It presents a personal healthcare system that is both flexible and scalable. Employing embedded wearable low-power sensors, the system measures health parameters dynamically. Raspberry-Pi is used as a controller [5].

METHODOLOGY

The controlling of wheel chair is through a raspberry pi which is connected via Wi-Fi module and through motion sensor which is fixed on the head of the user; using these two will decrease the dependency of the user or another person. We have also equipped the chair with ultrasonic sensors which will help to avoid accidents happening due to obstacles. Sensors will respond to the nearing obstacle and eventually commands will be forwarded to the controller enabling desired further motion. This system also includes a health monitoring system which monitors health of the user and forward that to the application. Sensors like ECG and EMG sensors are used for continuous evaluation of the patients health and to notify about the same to its guardian through the mobile app. The load cell in the system ensures the presence of the person on the wheel chair. The datas are remotely monitored from the hospital.

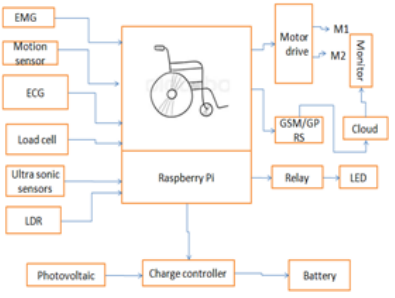


Fig.1 Block Diagram of proposed model

Fig shows the functional block diagram of solar wheel chair. This diagram represents how the solar wheel chair works. The battery is charged by the solar power. Battery charge controller or charge regulator saves the battery from overcharging. The direction controller is also connected with battery bank.

The system has two main components control unit including driver system on the wheel chair and sensing unit including ADXL345 unit placed on the users head. When the disabled person moves the head in the three axis (X Y and Z) the sensor will read the orientation in angles and readings wirelessly to the power control unit that will run the wheel chair. The sensor will read the users movement and send the readings to the wheel chair driver unit. The wheel chair motor system

will move according to the commands send from the user wirelessly.

To provide the controller both with relevant inertial data and EMG signals, enabling different smart and adaptive control strategies. Two types of sensors have been designed, namely an accelerometer sensor node and EMG sensor node .As depicted in fig. EMG records the movement of four muscles contracts a bursts of electrical activity generated which propagates through an adjacent tissue and bone and can be recorded from neighboring skin areas.

COMPONENTS

Sl.no	Components
1	Raspberry Pi
2	ADXL345
3	ECG Sensor
4	100W DC Motor
5	Motor drives
6	EMG Sensor
7	Solar panel
8	Ultrasonic Sensors
9	Battery
10	LDR
11	Relay
12	LED
13	Load cell
14	GSM Module

1. Raspberry pi

The credit-card-sized computer has become even smaller! The Raspberry Pi Zero W is still the Pi you know and love, but at a largely reduced size of only 65mm long by 30mm wide and at a very economical price. With the addition of wireless LAN and Bluetooth, the Raspberry Pi Zero W is ideal for making embedded Internet of Things (IOT) projects. The Pi Zero W has been designed to be as flexible and compact as possible with mini connectors and an unpopulated 40-pin GPIO, allowing you to use only what your project requires.

At the heart of the Raspberry Pi Zero W is a 1GHz BCM2835 single-core processor, the same as the B+ and A+, with 512MB RAM. Quite frankly, this Pi is about four times faster that the original Raspberry Pi and is only a fraction of the cost of the current Rpi3.

The setup for the Raspberry Pi Zero W is a little more complicated than on other Pis. Because of the small size, many of the connectors on the Pi Zero are not standard. For starters you will want a mini HDMI to HDMI cable or adapter to connect to your monitor.

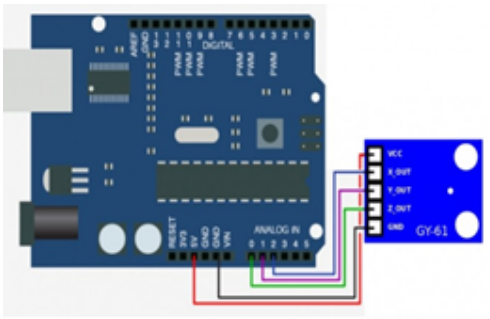
Raspberry pi zero

Specifications

- 1GHz, Single-core CPU
- 512MB RAM
- Mini HDMI and USB On-The-Go ports
- Micro USB power
- HAT-compatible 40-pin header
- Composite video and reset headers
- CSI camera connector
- 802.11n wireless LAN
- Bluetooth 4.0

2. Accelerometer

In this device Active and Inactive detection detects the presence or absence of motion by comparing the acceleration on any axis with a user-set threshold. Percussion detection function can detect any direction of single vibration and double vibration action with free fall detection function.



Arduino Adxl345 Accelerometer

Specification:

- Main chip: ADXL345.
- Model: GY-291
- Power supply :3-5v.
- Means of communication: the iic / spi communication protocol.
- Measuring range: ±2g /±16g

3. DC Motor

This motor designed for 12 Volt motors up to 100 Watts. Universal motor for bikes, scooters and tricycles. This electric motor with gear reduction produces more low-end torque than any standard motor.

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor.

DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances.

DC Motor

Specifications:

- Speed: 3550RPM
- Supply Voltage: 12V.
- Current(No Load) 1.0A.
- Current(With Load) 11.9A.
- Rated (constant) Torque: 0.35 N.M.
- Power: 100W
- Efficiency: 70%.
- Weight: 1.06 Kg

4. Motor drives

The Speed and Direction of the DC motor are controlled by PWM and DIRECTION digital interface. It provides Smooth and quiet operation at all speeds with Zero-Backlash DC Servo Motor Performance. This drive is fully compatible with RMCS-2002, RMCS-2003, RMCS-2004 RMCS-2005, RMCS-2006 and RMCS-2007 motors.

DC motor drive

Key Features:
- Smooth and quiet operation at all speeds.
- Zero-Backlash DC Servo Motor Performance.
- Input supply voltage from 12VDc to 40VDC
- Selectable Gain Multiplier.
- Selectable Error Limit.
- Pots for tuning of Speed, Back Emf and Dampness.
- LED indication for power and error states.

Power and Motor Terminal Assignments

Terminal No.	Terminal Name	Description
Terminal 1	GND	Power Ground or Power –Ve
Terminal 2	+V	Power +Ve (12VDC to 40VDC Max wrt. GND)
Terminal 3	Motor 1	DC motor connection 1
Terminal 4	Motor 2	DC motor connection 2

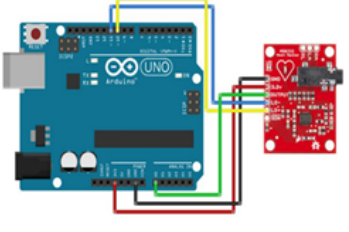
5. ECG Sensor

The AD8232 Single Lead Heart Rate Monitor is used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram and output as an analog reading.

ECGs can be extremely noisy, the AD8232 Single Lead Heart Rate Monitor acts as an op amp to help obtain a clear signal from the PR and QT Intervals easily. The AD8232 is an integrated signal conditioning block for ECG and other bio-potential measurement applications. It is designed to extract, amplify, and filter small bio-potential signals in the presence of noisy conditions, such as those created by motion or remote electrode placement.

The AD8232 Heart Rate Monitor breaks out nine connections from the IC that you can solder pins, wires, or other connectors to. SDN, LO+, LO-, OUTPUT, 3.3V, GND provide essential pins for operating this monitor with an Arduino or other development board. Also provided on this board are RA (Right Arm), LA (Left Arm), and RL (Right Leg) pins to attach and use your own custom sensors. Additionally, there is an LED indicator light that will pulsate to the rhythm of a heart beat.

Features :
- Operating Voltage - 3.3V
- Ana log Output
- Leads-Off Detection
- 3.5mm Jack for Biomedical Pad Connection



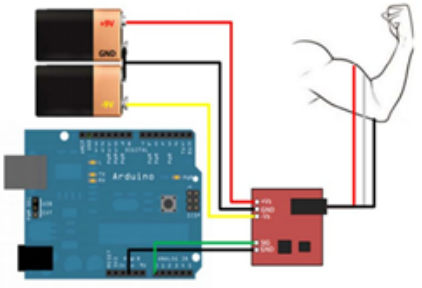
ECG sensor with arduino

6. EMG Sensor

This sensor will measure the filtered and rectified electrical activity of a muscle, depending the amount of activity in the selected muscle.

By detecting the electromyogram (EMG), measuring muscle activity has traditionally been used in medical research, however with shrinking but more powerful microcontrollers and integrated circuits advent EMG power Road and sensors can be used for various control systems.

Sensor will measure electrical activity of the muscle output 0-Vs volts, the output size to take Depending on the amount of muscle activity is selected.



EMG sensor with Arduino

Features :
- Power Supply : Normally ±9V dual power supply, minimum voltage is ±3.5V.
- Small Form Factor.
- Adjustable Gain.
- Supported with Arduino, Breadboard mountable.

6.Load cell

Electronic Balance Weighing Load Cell Sensor 5Kg SS. This is a barrel set, built in hasp and staple for locking by padlock.

Features:
- Rated Load: 5Kg
- Rated Output: 1.0mV/V±0.15mV/V
- Zero Output: ±0.1mV/V
- Creep: 0.03%F.S./30min
- Input End: Red +(power), Black -(power)
- Output End: Green+(signal), White-(signal)
- Recommended operating voltage: 3 ~ 12 VDC
- Maximum operating voltage: 15 VDC
- Input Impedance: 1115±10%Ω
- Output Impedance: 1000±10%Ω
- Protection class: Ip65
- Total Size: 3.16 x 0.51 x 0.51 inch
- Cable: 0.8(diameter) X 20 cm
- Material: Aluminium Alloy

CONCLUSIONS

The solar powered wheel chair with health monitoring system and head motion control is proposed for fully paralyzed people, an alternative to conventional control interfaces. The proposed system is low power and uses an embeddable based on a RPi which makes it suitable for utilization in dynamic context. The persons electrical activity, muscular activity etc are measured using various devices in the system and are sent to the doctor using IOT. The physician can verify the given data and can be remotely monitored from the hospital if the person is not admitted to.

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