Design and Fabrication of Sensors Assisted Solar Powered Wheelchair

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Abstract*- Latest advancement in the technology is a boon to the society. This project is based on helping the physically challenged people by designing a solar powered wheel chair with additions of different type of sensors. As it is named as smart wheel chair it consist of PIR sensors, ultrasonic sensor and accelerometer. We have used two D.C. motors and solar plates for charging the battery. Lead acid battery is used being safe and harmless. As partially blind people are unable to see properly, actuator is added for their convenience to sense obstacles through vibrations. This work also concentrate on the intelligence of sensing the obstacles in front and back of the wheelchair via. ultrasonic sensor and PIR sensor. This wheelchair have the ability to run both indoor and outdoor environments. While this wheelchair has been brought to live by adding maximum technological advancement.*

Keywords-*solar plates, D.C motors, batteries, PIR sensor, ultra sonic sensor, accelerometer, actuator.*

1) INTRODUCTION

Independence is the major concern for physically challenged people, they want to take their own decision. Thus this wheelchair gives them free dome to take their own decisions. Wheelchairs are used by people who has difficulties in walking, muscular pain etc. Different types of variation according to different problems are available in market ranging in cost price. These have particular handling styles with joystick or headphone driven, rear wheel or front wheel driven drives. Our project paper focuses on creating a solution to all those problems. Our proposed wheelchair is used for people who is having walking disability, people who are partially blind(about 50%-60%), people who are aged having muscular problems and people who are paraplegic and quadriplegic. This wheelchair is the combination of all wheelchair such as automatic wheelchair, electric wheelchair, solar wheelchair etc. This is generally designed for person who has difficulty in operating manual wheelchair due to arm,hand,shoulders disabilities.The most important part are the sensors which senses obstacles either physical or in sound waves form such as sound, we have included an emergency buzzer alarm to call upon any help in emergency. The possible best outcome of our project paper is its multipurpose use for a variety of problems.

2) DESIGN CONCEPT

2.1) Solar Charged:

A common problem faced all over the world is the scarcity and depletion of energy resources. So solar power eco-friendly energy resource can be an alternative to electrically driven vehicles to a massive amount . Rated solar radiation power received by the earth surface is (global radiation flux) 1000 W/m² (AM 1.5, sun at about 48 °c from overhead position).Availability of solar energy has encouraged us to develop a solar driven wheel chair.

2.2) Motor and battery driven:

In addition to solar drive, batteries are also attached to wheelchair in case of emergency. During night time if the solar charge got exhausted then batteries can come into handy. Two motors are attached to left and right side respectively. The input being 0.25 HP 12v each.

3) SENSORS

3.1) Passive Infrared Sensor

In this project passive infrared sensor is used to measure the light radiations which are being emitted

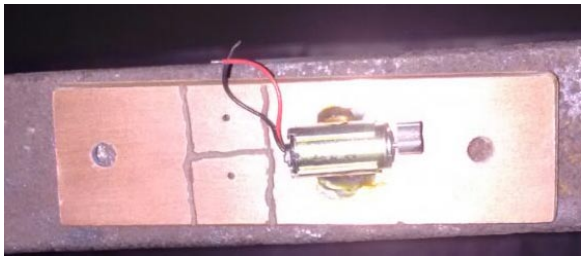
by a body.It detects and senses it and notifies the user with the obtacles in front of it As all objects emits heat energy above a temperature of absolute zero.

3.2) Ultrasonic sensor

In this project ultrasonic sensor is used to detect obstacles within a range of 2 meters. A buzzer is activated and vibration can be sensed by the person sitting on the wheelchair. The time range can be calculated by the interval between the sending signal and receiving echo signal.

3.3) Actuator

The most important part of our project is the movement and control of the system.Actuator plays a major role for automatic movements of the wheelchair without any human effort.It consist of relays,control signals and vibration system.It coverts the signal receives through an electric medium into a mechanical motion.

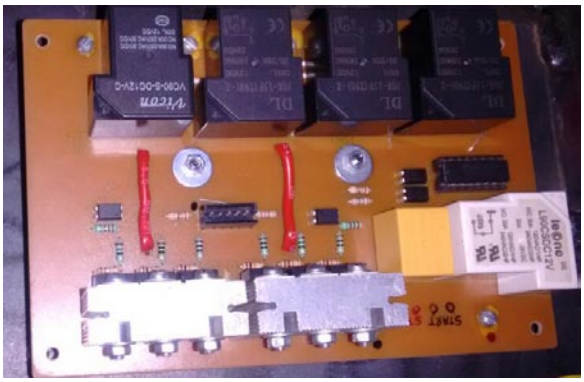


3.4) Accelerometer

In this project accelerometer will give the movement direction to wheelchair in two ways i.e head motion and joystick motion to bend left or right or forward or backward. An accelerometer is a sensor that measures the physical acceleration experienced by an object due to inertia forces or due to mechanical excitation. It sends analogue signals to microcontroller and the microcontroller has inbuilt analogue to digital converter. While head motion works in three direction i.e X-Y-Z where the additional Z axis is for diagonal movements. The execution of this process is done by a microcontroller and relay circuit system.The power supply is achieved in two ways as mentioned above via. Solar plates and batteries.

3.5) Microcontroller

Microcontroller is the heart of our project. It is a small computer mounted on a single integrated circuit.It contains one or more CPU's along with memory and programmable input/output peripherals.

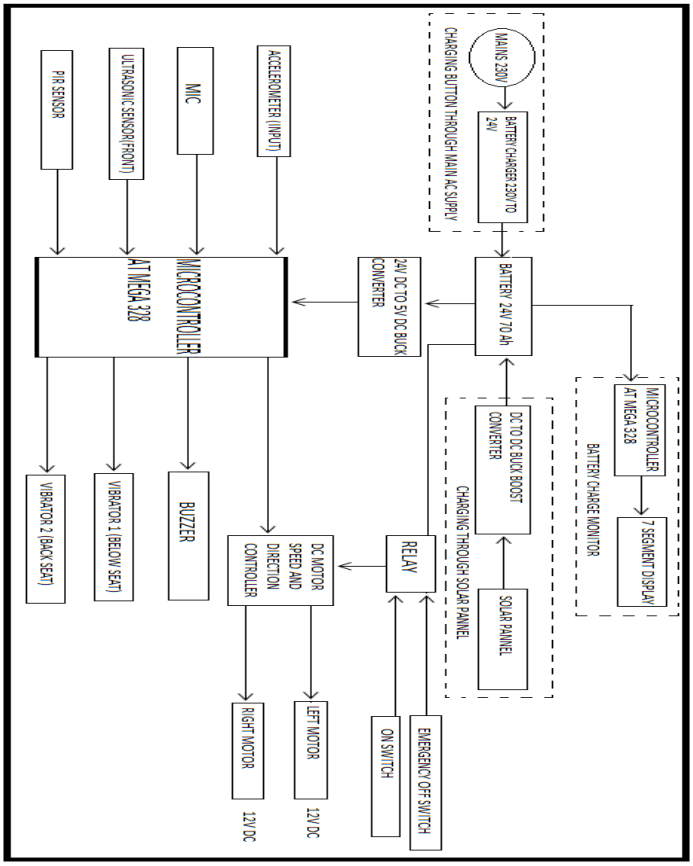


The accelerometer mounted on the head or joystick gives eight possible outputs to the microcontroller considering the x-y-z axis motion . Head motion recognition is based on the force measurements yielded by an accelerometer attached to the head.Te same accelerometer will be used in joystick as per need of user having adjustable connections. As mentioned, there are only eight members of the motion set, which represent head or joystick leaned in eight possible directions. This means that the algorithm needs to estimate when the head/joystick is leaned in one of the eight directions. In other words, it is sufficient to read only the accelerometer data of two axes: in this case, x and y. The thresholds are accelerometer output values that the user defined at system startup. These represent the angles in all directions by which the head/joystick needs to be leaned in order to issue a command to the system.

4) FABRICATING AND ASSEMBLING OF WHEELCHAIR

The design of the wheelchair is such that it should withstand a high amount of load which completely relies on its base construction. So the material should possess the necessary properties to withstand stresses and strains. The material selected for this application is cast iron. The requirements to be satisfied can be weight, stability, rigidity, durability, physical and chemical properties etc. Considering all these factors two plates of 30cm X 25cm are attached at the bottom of wheel chair to withstand the weight of motors, batteries, circuit board and other accessories In addition to this we have used two rods of 5cm X 5cm dimensions for solar plates fitting at a height of 200cm from ground level.

5) BLOCK DIAGRAM OF THE PROPOSED ELECTRIC WHEELCHAIR



6) CALCULATIONS

The total weight of the modified wheelchair is 150 kg (including person).

6.1) Motor

How much power do we need in watts?

Power (watts) = Total weight x g x speed x gradient

Where,

Total weight = 150 kg

Speed = 6 kmph = 6 x 5/18 m/s = 1.66 m/s

Gradient = slope (assume 3%)

Power = 150 x 9.81 x 1.66 x .03

= 73.28 watt

Therefore power required approximately is 80 watt (for single motor).

As we are using 2 motors power required is approximately 160 watt.

Thus a 24 Volt, 160 W motor will be enough for wheelchair.

6.2) Battery

System voltage 24 Volt, Load current = 160w/24v= 6.66 AMP

Estimate 5 hours of wheelchair running per day

Load current = 5 x 6.66 x 1.2 = 40 Ah/day

Assume 20% overall losses,

Size of battery = 80 x 1.2 = 48 Ah/day

Energy required for 250 W motor = 48 Ah x24 V

=1152 Wh/day.

Therefore 48 Ah/day, 24 Volt power is required for the system.

7) CONCLUSION

Developing of a solar powered wheel chair is a blessing for disabled people and will bring a major change in their life styles.The complete design is done with a view to provide maximum facilities to the user-handicapped people.

Table 1) Important specification of wheel chair

General Specification	
Size-	Steering Drive system- headphone sensor/joystick
Height- 200cm	Speed Control- Continuous
Weight (including user)- 150kg	Seat- Cushioned and water proof
Speed- 6 km per hour	Braking System- Friction Type
Power Specification	
Solar Panel-	Batteries – Two lead acid batteries Total – 24v 70 A-hr
Motor- 0-180 watt (DC Motor)	Charge Controller-

Solar powered wheelchair gets its maximum attention due to its eco-friendly nature. Due to such kind of flexibility and design any kind of variations can be easily done as per the user needs. Long range travelling is not possible due to limitations of solar charge and energy. The solar plates cannot be extended due to less space at the roof. Different type of sensors fulfills the need of the user in different ways and the head and joystick motion too for disabled people proving it to be a complete mobility solution for handicapped people in our society.

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