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HANDICAP WHEELCHAIR WITH HEAD MOVEMENT CONTROL SYSTEM USING GYROSCOPIC SENSOR

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Abstract - Manual wheelchair propulsion in daily life is increasing day to day. So, preliminary study of human factors engineering is important in designing the wheelchair to be more ergonomics for them in doing daily activities. The main objective of this project is to improve the existing wheelchair in term of daily usage. It focuses on the use of simulation in analyzing the critical parts of the wheelchair model and evaluates it in term of daily usage. The health service sector has been continuously trying to improve the service given to the people in need of mobility assistance. As a result, more developers have been directed towards robotic wheelchairs. A robotic wheelchair is an intelligent wheelchair that has capabilities of navigating, detecting obstacles and moving automatically by utilizing sensors and artificial intelligence. We have developed a Robotic Wheelchair for the quadriplegic patients for mobility assistance operated using the head gesture. The main aim of our project is to deliver a design of an innovative wheelchair that will facilitate disabled people in moving. Nevertheless the team had to also take in to account that the wheelchair as a product should be competitive on the market and attractive to potential consumers.

***Key Words*:** Accelerometer Sensor, Gyroscope Sensor, Ultrasonic Sensor, Relay, Battery, D.C. Stepper Motor and Raspberry Pi, Caterpillar Track.

1. INTRODUCTION

The condition of paralysis affecting four limbs (both arms and legs) is alternately termed tetraplegia or quadriplegic. Quadriplegics are individuals whose limbs are impaired. The quadriplegic individuals are not able to perform their everyday activities such as feeding, toilet usage, and locomotion. The central nervous system consists of the brain and the spinal cord. It sends signals throughout our body. The primary cause of quadriplegic is a spinal cord injury, but other conditions such as age, stroke, arthritis, high blood pressure, paralysis and birth defects also contribute to it. The brain cannot properly communicate with the spinal cord as a result of an injury to the spinal cord. Therefore the movement and sensation are impaired. For upcoming search problems, we are trying to design and manufacture wheelchair which can help such patients to move at each and every place.

Wheelchair is a transportation device used by people who have difficulties in walking due to illness or disability. It is moved either by the handles or by turning the wheels. Today there are many options and many different types of wheelchairs such as manual wheelchairs, powered wheelchairs, and transport wheelchair. The electric wheelchair has some limitation it cannot go throw the difficult terrain and cannot be used in hard surface. It faces difficulty to the go through rough surfaces. So our caterpillar track wheelchair is help those who wish to go in nature and daily use also. It's a continuous track system we use in our wheel chair for the pass the difficulty and give the advantages.

This system will show very good results. This will make the usage of a wheelchair very safe. We are trying to put a new concept in this project which will make the patient's journey very safe and also they can go to areas they like. It will enhance the life of such people and make them less dependent on others. Also our motive is to reduce the cost of wheelchair, so that any person can afford it.

2. LITRATURE REVIEW

This project is basically for people who are physically disabled suffer from losing their extremities due to accident, age or disease. The project contributes easy controllable movement with the help of a wheelchair. The movements of this wheelchair are controlled by head motions with the use of gyroscope sensors. The microcontroller is also used and it is programmed to make the wheelchair move according to the corresponding motions from the patient's head. This system will show very good results. This will make the usage of a wheelchair very safe.

We are trying to put a new concept in this project which will make the patient's journey very safe and also they can go to areas they like. It will enhance the life of such people and make them less dependent on others. Also our motive is to reduce the cost of wheelchair, so that poor people also can afford it.

3. PROBLEM STATEMENT

Problems

1. People who are handicap can't go at any place by their own.
2. If he/she wants to travel, they require special vehicle.
3. There are wheelchairs in market, but they are too costly.

Solution

1. We are designing this wheelchair for rough as well as plain road conditions.
2. Trying to reduce the cost of wheelchair.
3. Easy to handle.

4. OBJECTIVE

1. This robotic wheelchair project aims at designing a wheelchair that will work on the basis of head movement of the patient.

2. For normal movement of wheel chair we use hand force. In this project we are using head movement for controlling the wheelchair motion.

3. The reason behind modifying the wheel chair is to reduce the human effort and bring ease in the patient's journey.

5. SCOPE

If the person wants to move somewhere, all they have to do is look in this direction. The user interface trace out the path you want to drive, you would simply wink twice with your left or right eyes and the wheelchair start driving. To stop wink again.
Introducing home automation in the system would be an added feature of the wheelchair where a disabled person can turn on/off home appliances without getting up from his/her position.
Finding a way to automatically charge the battery with the help of motion of the wheelchair.

6. TECHNICAL DEPTH OF WORK

SELECTION OF COMPONENTS :

Electric DC Motor :

Ebike MY6812 120W 12V 3350RPM DC Electric Motor for Bicycle

1. Voltage : 12V

2. Rated Power : 120W

3. No load current : < 0.55A

4. Rate torque : 4.58 KgCm(0.45N.m)

5. Rate current : < 7.0A

6. Efficiency : >70%

7. Shaft diameter: 8 mm (milled groove one-sided 1 mm)

8. 100% Ball Bearing construction!

9. Speed: 3350RPM.

10. Weight: 1.06Kg.

Fig. No. 1

MPU-6050 Triple Axis Accelerometer and Gyroscope

The tiny MPU-6050 Triple Axis Accelerometer and Gyroscope was used to sense the head motion. The MPU-6050 has sensing range: ± 2g, 4g, 8g, 16g, ± 250/sec, ± 500 /sec, ± 1000 /sec, 2000 /sec, voltage - supply: 2.3 V 3.4 V and interface: I2C. The Digital Motion Processors (DMPTM) of MPU 6050 is capable of processing complex 9-axis Motion Fusion algorithms which removes the cross-axis alignment problems.

The MPU 6050 has 6 Degree of freedom which means that it gives six values as output, 3 for accelerometer and 3 for the gyroscope that helps to accurately calculate head motions. The gyroscope and accelerometer data is used to sense the head motion. The X-axis for front and back movement, Y axis for the front left and front right movement and Z axis for back left and back right movement are calibrated for wheelchair

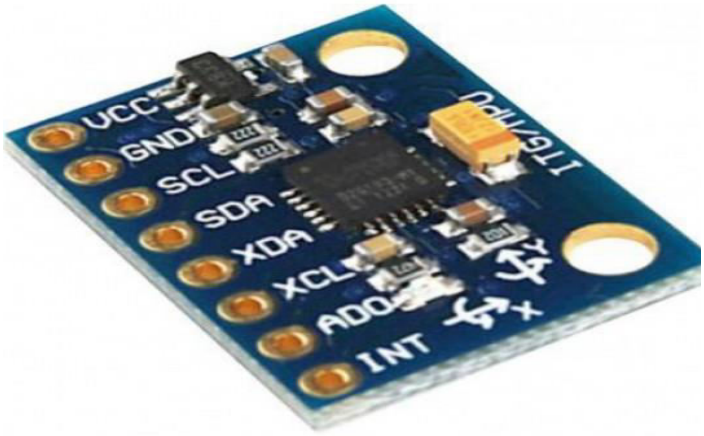


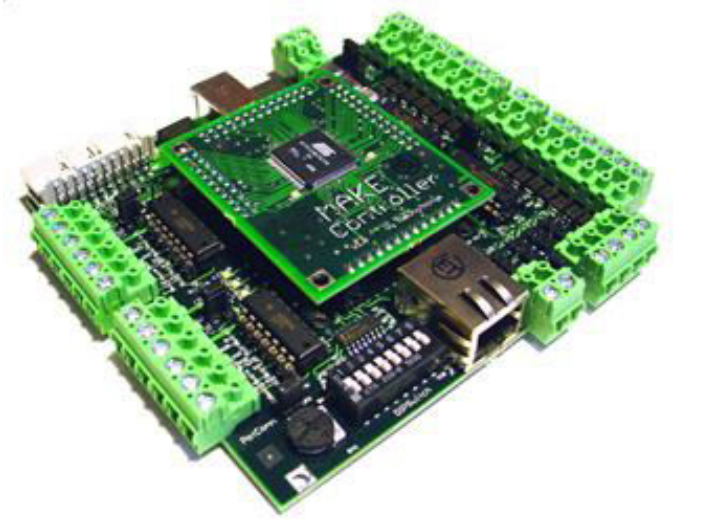
Fig. No. 2

Motor Driver

The IBT-2 driver is using two High current half bridge.
Invidious BTS760 chip for Motor drive application.
Rate of protection and adjustment against over voltage, under voltage, over current, short circuit and over temperature.
Features
Operating voltage between 5V to 27V
Motor speed can be controlled through pwm.
Motor backward and forward motion control.
Over voltage will be lockout while over temperature shut down.

Microcontroller

Microcontroller is small computer on a signal integrated circuit.
It combines 3-axis gyroscope sensor, temperature sensor and digital motion processor (DMP).
There are several types of microcontroller like (mega 2560) Arduino.



Power Supply

The power supply for DC motor of the wheelchair is supplied by a battery.
24V DC supply 26AH battery provides sufficient power to motor.

7. CALCULATION

Gross Wt. vertical = 50 kg
Required speed = 35 km/hr
Wheel size = 10 inch (Diameter) Radius = 5 inch
= 0.127m
Length= 720mm
Width= 400mm
Speed= 35 km/hr.

Linear Distance travel :-
= 2TTr
= 2×3.14×0.127
= 0.797 m
Speed= 35km /hr.
= 35000/3600
Speed = 9.72m/s
RPM= Revolution per minute
RPM= Total Dist. cover per hr. /linear distance
= 35000/ (0.797×60)
= 731.91
RPM= 731.91

Power Required :-

Power: [mass x (Acc. gravity) x velocity]x Rolling Resistance]
+[Air density x coeff. drag (cd) x Area of vehicle (m2) x velocity 3]
= [50×9.72×9.81×0.01]+ [0.6465×0.96×0.288×(9.72) 3] 0.96
= coefficient drag For wheels
P= 47.67+166.69

P= 214.36 watt

Battery Calculation :-

1.How decide size of Battery :-

Requirement = Dist. Per charge at what speed suppose =40 km/ charge at 35km/ hr
power consumed =214.36 Watt/35km/hr

Now,

Suppose, 1 hr. at 45 km/h power consumption =214.36watt
214.36/35 =6.124 W h/ km
Now, we decide use motor of 24 Volt

A hr used per km= 6.1234 = 0.2551 Ah/Km A hr used per km= 0.2551 Ah/km

To calculate Ah (ampere hr) multiply with watt km

= 0.2551×80×1.25

= 25.51 Ahr. (80%use)

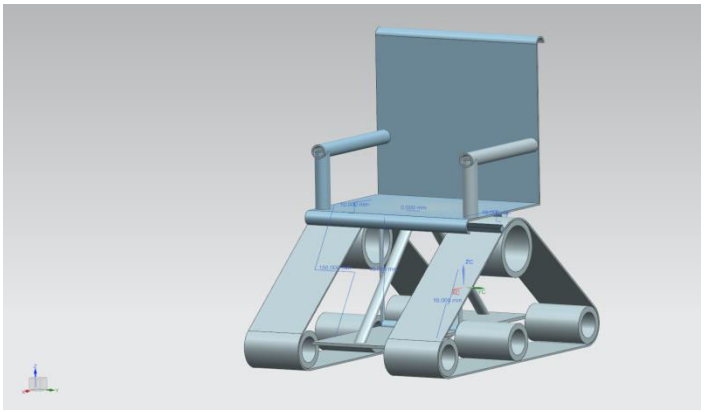
Torque Required:-

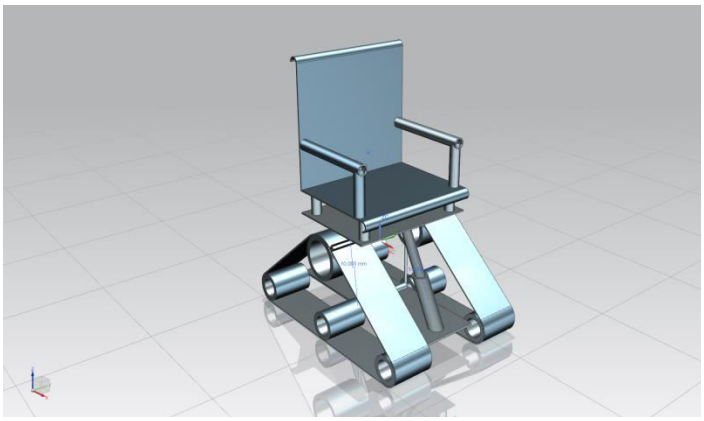
Efficiency

E= Po/ Pi (Pi= 214.36) Po= E ×Pi
T×W= E x 214.36

(Angular speed) W=2TTxRpm/60 W (output speed) = 2TT×731.9/60 w= 76.64 m/s2

T= 0.85×214.360/76.64 T= 2.377 Nm
Torque required for wheelchair move





8. DESIGN

Specification of wheelchair

Total length of track :-223.5cm
Total Width of track :-12.7cm
Drive sprocket diameter :- 45 cm
Wheelchair base length :-720 mm
Wheelchair base width :-400 mm

9. SELECTION OF MATERIAL

The main objective was to choose such a material for the frame which should be characterized by low density, good tensile strength, corrosion resistance, low cost of raw material, and good processing features.

10. CONCLUSION

This study proposed a work of a smart wheelchair for driving safety.
The hardware of the wheelchair is based on the gyroscope sensor interfacing with a microcontroller.
This system employed the gyroscope Gy-521 sensor as the main component of the design to control the movements of the wheelchair according to the user's head gestures.
Ultrasonic sensors are the obstacle detection system that stops the wheelchair as it reaches to an obstacle.
Interfacing all these sensors to the wheelchair was controlled by the microcontroller mega-2560.
The developed system provides a safer environment for the elderly and the disabled; they can travel indoors or even outdoors alone with safety than before.
The robotic wheelchair can be used to help quadriplegic individuals to lead their life without extra assistance
Moreover, the low cost of the assembly parts of this wheelchair has enhanced its affordability.
An optimization design was developed in NX software for the standard mechanical wheelchair.

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