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MultipurposeWheelchair For Physically Challenged People

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ABSTRACT: Many disabled people use manual wheelchairs but it is difficult for them to use a manual wheelchair. An assistive technology known as a wheelchair is used to deal with the loss of mobility for the patients who are not able to walk normally. There is a lot of research on such wheelchairs where intelligent control algorithms and sensors are used to automate the wheelchair and decrease human intervention.This project addresses the design of an accelerometer-based wheelchair. In this project we use Accelerometer, ultrasonic sensor systems, fingerprint scanner and GPS have been integrated into the wheelchair. We have a previously fabricated chair which can be driven using Accelerometer and with the possibility of avoiding obstacles using Ultrasonic Sensor, a fingerprint scanner to provide safekeeping and to avoid theft of the wheelchair and a GPS for real-time tracking.

KEYWORDS: MPU6050 (Accelerometer), Arduino Uno(Processor), RKI-1341 (Motor Driver), C programming on Arduino IDE, HC- SR04 as Ultrasonic sensor.

I.INTRODUCTION

In today's time, an estimated 1% of the world's population needs a wheelchair.An increased percentage of elderly and disabled people who want to enhance their mobility, a wheelchair is the best assistive device. Generally these wheelchairs are pushed by another individual or propelled by physical force. Traditional wheelchairs have some limitations in context to flexibility, bulkiness and limited functions. Some existing wheelchairs are fitted with a laptop for gesture recognition. But the use of the laptop along with the chair makes it bulkier and less flexible.Often after paralysis or physical disability this type of wheelchair is the most common means of locomotion for such people. But to navigate through one's own house without the help of someone every time can be demoralizing for the person as well. A robotic wheelchair has added control and navigational intelligence to a traditional powered wheelchair. Many disabled people's life gets easier with such intelligent devices.This paper Multipurpose Wheel Chair aims to resolve the above-mentioned issue. In this project, we present a wheelchair that can be controlled automatically. This wheelchair can be controlled automatically through hand gestures of the person sitting on it. He/ she just needs to move his/her hand into the direction it wants to move by using an accelerometer. This system provides a feature of controlling the motion of a wheelchair-using hand gesture. The system is mounted on a primary functioning body part to control the wheelchair movement i.e. hand.

II. LITERATURE REVIEW AND PREVIOUS WORKS

A. Existing technologies:
Various researches have been made in this area, several technologies have been developed such as SENARIO, VAHM, Rolland, SIAMO, Wellesley, and Omni wheeled platform. The prominent companies that develop wheelchairs are Invacare, Permobil AB, and Ottobock.

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Invacare power wheelchair
Invacare TDX SP Power Wheelchair boasts superior ride quality, quieter chassis, and built-in technologies. It has TrueTrack motors or G-Trac Technology available to keep wheelchair tracking straight, also quiet stability lock provides stability and shock absorption while in motion and traction Control Design for climbing in reverse over obstacles up to 1".
Permobil F5 VS wheelchair
The F5 Corpus VS is a durable, powerful and stable front-wheel drive power wheelchair combined with the best seating system on the market– the Corpus seat. The seating system is designed to effectively support the clinical, functional and lifestyle needs of active users.

B. Conventional Method:
To control wheelchair bio-signal or non-bio-signal based devices are used. No bio-signal based devices provide 100% accuracy and require less training for patients. In general, non-bio-signal based techniques contain Head Orientation Tracking Technique, Chin Control Technique, Eye Tracking Technique, Tongue Controlled, Image Processing Algorithm, and Brain Actuated Wheelchair using Brain Wave Sensor.

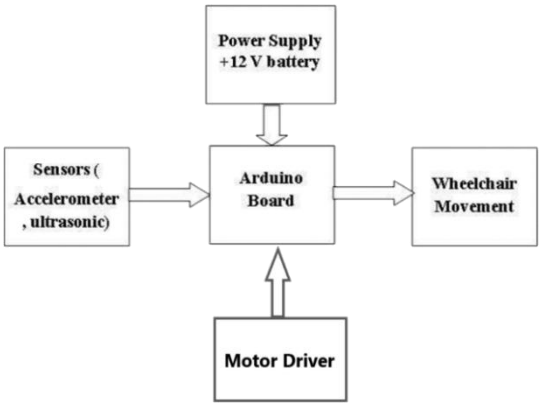
C. Accelerometer Based [2]:
In an accelerometer-based wheelchair, we have an acceleration sensor that is also known as a tilt sensor. When we tilt the object, the values registered by the sensor are changed and these values are given to the microcontroller. Depending on the direction of the tilt, the microcontroller controls the wheelchair directions as LEFT, RIGHT, FRONT and BACK.

III. RESULTS AND REPORT

A. Hardware details:

3.1 Block Diagram:
The Sensor unit consists of MPU6050 which is a combination of accelerometer and gyroscope which are the actual units which measure the movement and the reads are interpreted by the microcontroller unit in terms of angles which are mentioned in the code, HC-SR04 as an ultrasonic sensor, NEO-6M as GPS module.

For control of a wheelchair: For control of motors:



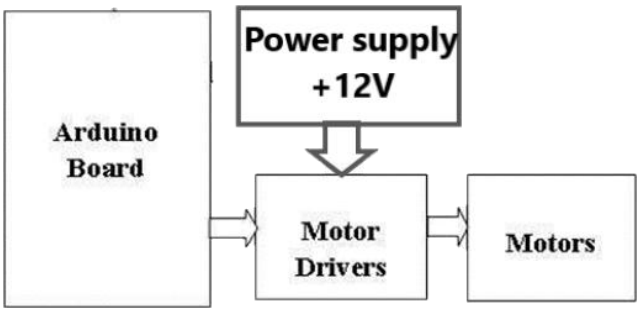


Fig 3.1.1: Block diagram for control of a wheelchair Fig. 3.1.2: Block diagram for controlling motors

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3.2 COMPONENTS DESCRIPTION:
For posture monitoring system

(1)MPU6050

The MPU6050 sensor module is a complete 6-axis Motion Tracking Device (Figure 2.2). It combines 3-axis Gyroscope, 3-axis Accelerometer, and Digital MotionProcessor all in a small package.

Fig 3.2.1: MPU6050

(2) Arduino UNO

The Arduino UNO is a microcontroller board based on the ATmega328P microcontroller with additional ports. The board contains fourteen Digital pins, 6 Analog pins, and programmable with the Arduino IDE. The power supply is given through the USB cable or an external 9-volt battery. It accepts voltages between 7 and 20 volts. Its biggest advantage is it's ready to use structure. Arduino package has many components which include the 5V regulator, an oscillator, a microcontroller, serial communication interface, LED and headers for the connections. You don't need any other interface. Just plug it into a USB port of your computer and that's it.

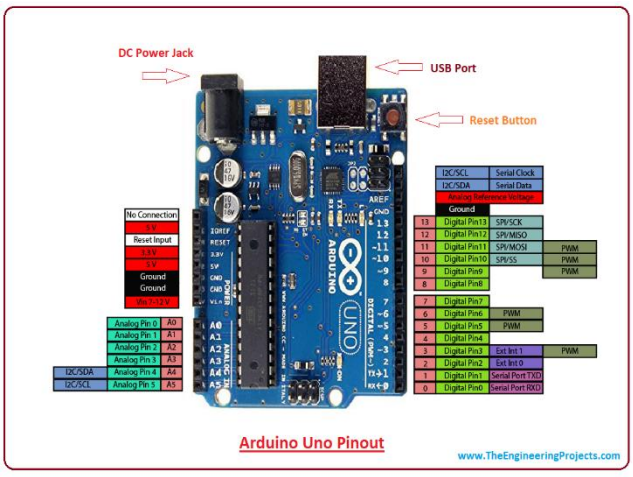

Fig 3.2.2: Arduino UNO

(3) Dual H Bridge driver (RKI-1341)

For raw power and simple connectivity to your robotics applications with this 6V - 18V compatibleV20A capable Dual DC motor driver. It is ideal for applications where two motors are required for up to 20 Amperes of current during start and during normal operations.It has a TTL/CMOS based interface which connects to the IOs of an MCU. For breaking it has a feature that can guarantee immediate halt on the shaft of motors even in high power applications and it also includes protection circuitry to avoid any electrical fluctuationsaffecting the normal operation of an MCU.

Fig 3.2.3: Motor Driver

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(4) Global Positioning System (GPS)

The NEO-6M GPS module is a GPS receiver with a built-in ceramic antenna that provides a strong satellite search capability. With the help of its power and signal indicators, the status of the module can be monitored. Thanks to the data backup battery, the module can save the data when the main power is shut down accidentally. Due to its 3mm mounting holes, it is easily assembled.

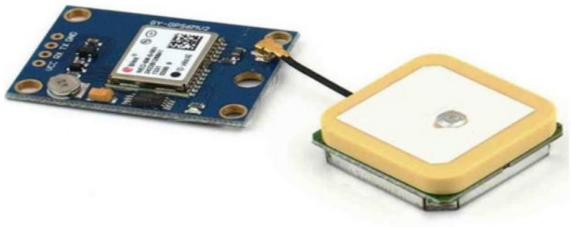

Fig 3.2.4: NEO-6M

(5) Ultrasonic Sensor [6]

An Ultrasonic sensor is used to measure the distance to an object by using sound waves. The distance is measured by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back by this we can calculate the distance. By recording the elapsed time between the sound wavebeing generated and the sound wave bouncing back, it is possible to calculate the distance between the ultrasonic sensor and the object. Since the speed of the sound travels through the air medium is known as 344 m/s (1129 ft/s), you can take the time for the sound wave to return and multiply it by 344 meters (or 1129 feet) to find the total round-trip distance of the sound waves

Fig 3.2.5: HC-SR04 Ultrasonic Sensor

(6) Node MCU

NodeMCU is an open-source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits (Figure 2.3). It is a highly integrated chip that provides full internet connectivity in such a small package. It can be programmed directly through a USB port using the Arduino IDE. ESP8266 can perform either as a standalone application or as a slave to a host MCU. The integrated high-speed cache helps to increase system performance and optimize system memory. Also, ESP8266 can be applied to any microcontroller design as a Wi-Fi adaptor through SPI/SDIO or UART interfaces.

Fig 3.2.6: Node MCU

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B. Software details

3.3 Software algorithm:

1. Start by connecting the power supply of 12 V
2. Check the battery Charging
3. Check if the accelerometer is in stable condition?
4. The owner must scan his finger on the fingerprint scanner and if it matches only then the wheelchair will start moving
5. Move accelerometer in the direction we want to move.
6. Accelerometer moves or tilt his position thus gives an analog signal to Arduino and converts it in an appropriate digital level to move the motors of a wheelchair.
7. Ultrasonic sensors are used to detect the obstacle. If any obstacle is detected then it gives a signal to Arduino and it will stop the motors.
8. GPS helps track the location of the wheelchair
9. Stop the Wheelchair
10. Remove the Seat belt.

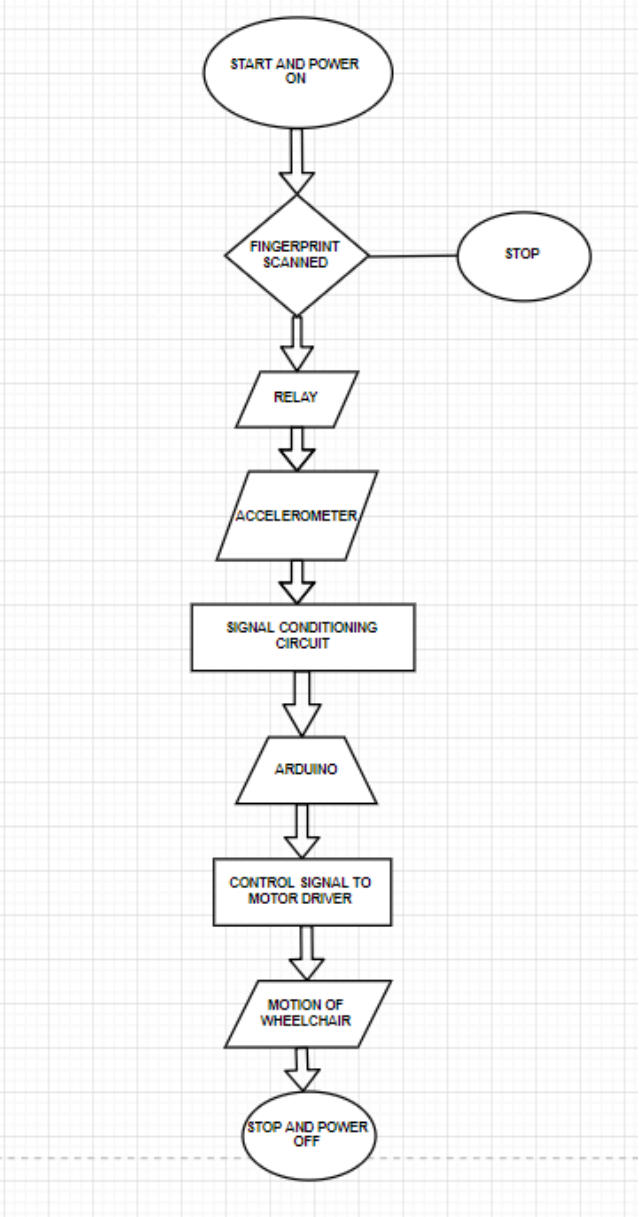

Fig. 3.3.1: Flowchart for movement of the wheelchair

At a given time microcontroller gets the data and compare inside with pre-defined values. As we change the position of the hand, values change automatically and correspondingly we get the direction of wheelchair. An accelerometer, we are getting 1.80V maximum for Positive X, Y directions, then 1.4V minimum voltage for negative X, Y directions, for the stable condition we are getting 1.60V, so by using these values we have given conditions to Arduino board to control the wheelchair. In this project, we have used Ultrasonic sensors for obstacle detection. For that, we have written a code that will detect and the buzzer will turn on, in the wheelchair if there is any obstacle detected between 0-20 cm from both forward and backward direction. So, in this way, we canidentify any obstacle or steps, holes in the way of a wheelchair.

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IV.SCOPE OF THE PROJECT

ADVANTAGES

1. Completely Non-invasive

- Disabled people can use it easily.
- Obstacle detection using sensors for safety.
- Efficient low-cost design.
- No special care needed

2. Inexpensive

- Low-cost hardware
- No maintenance or upkeep on the primary measuring device
- The sensor is an only semi-consumable item – 1000 hours use per sensor
- Reduces the physical strain.

3. No calibration necessary

- No expensive calibration fluids required.
- No daily, weekly or monthly call procedures

DISADVANTAGES

- Speed is comparatively low
- No suspension support

V.CONCLUSION

This wheelchair is economical and is affordable by common people. With the development of this project, it can be successfully implemented on a larger scale for the handicapped people. The low cost of the assembly makes it a bonus for the general public. New technologies can also be added to this wheelchair. From the above-obtained results, we conclude that the developed hand-based gesture control of a wheelchair is tested and works satisfactorily in an indoor environment with minimum assistance to the physically disabled person. It has good response with an accelerometer activating the motors connected to the wheels of the chair. The speed and distance covered by a wheelchair can be further improved if the gear system connected to motors is replaced by a crank and pinion joint which has less friction and mechanical wear & tear. The running cost of this system is much lower as compared to other systems used for the same purpose.

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