International Journal of Scientific Research in Computer Science, Engineering and Information Technology
ISSN : 2456-3307 (www.ijsrcseit.com)
doi : https://doi.org/10.32628/IJSRCSEIT

Mini Hand Gesture Controlled Mobility System

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Article Info

Publication Issue :
Volume 9, Issue 1
January-February-2023

Page Number : 80-89

Article History
Accepted: 01 Jan 2023
Published: 15 Jan 2023

ABSTRACT

Micro-mobility transportation systems forindividual usage have grown in popularity recently, with the "Hoverboard" device being the most well- liked [1]. These systems are flexible, small, and efficient for personal transportation in a range of settings. With the use of a gyroscope, an Arduino UNO, an Arduino Pro-mini, a lithium battery, and a BLDC motor, this project will construct a personal micro- mobility system electric vehicle in the shape of a rectangular grid. Two folding pads make up this rectangular grid, which when opened forms a semicircle. The system also includes a seating configuration. With the sensor imprinted on gloves, the operator may control the system's speed and direction by making hand gestures. The goal of this project is to create and manage a straightforward, inexpensive self- transportation system.

Keywords - Micro-mobility, Gyroscope, Arduino Pro- mini, BLDC motor, Hand-gestures.

I. INTRODUCTION

An electric vehicle is a vehicle that is propelled by one or more electric motors (EV). It can be powered by extravehicular sources of electricity, a collector system, or a battery to function independently. Or, to put it another way, electric vehicles have electric motors instead of internal combustion engines. In the EU, micro-mobility vehicles are classified as L vehicles. The phrase "micro-mobility" refers to a range of small, lightweight vehicles driven by persons and moving at rates of under 25 km/h (15 mph) (unlike rickshaws). Examples of Micro-mobility equipment include bicycles, e-bikes, electric scooters, electric skateboards (hoverboard), shared bicycle fleets, and electric pedal assisted bicycles [1] – [5].

The goal of this project is to create an electric vehicle that can be operated by hand gestures. For the vehicle to receive the proper instruction and travel in the desired direction, a small transmitting device in the hand that includes an acceleration metre is necessary. This serves as the overarching principle of the Personal Micro-Mobility System.

II. OBJECTIVES

- The objective of this project is to construct a compact, personal micro-mobility vehicle based on 'Hoverboard Technology' using hand-gestures.

- To establish relation between Speed and Power, in accordance with the calculations related to Torque.
- To provide an electric vehicle with comfort, safety, cozy design architecture.
- Enabling an additional feature.

III. SYSTEM OVERVIEW

The personal micro-mobility system has been specifically designed to make the transportation quick. The vehicle comprises of two methodologies such as Mobility and Compactness [6] – [10]. In Mobility, gyroscope is responsible for the movement of the vehicle in multiple directions, this in turn interconnected with the nRF24L01 and this section is fed to the microcontroller, Arduino UNO (Figure 1). Compactness of this system is designed based on the Speed- Power relation (Figure 2). Speed is the factor which decides the innovation in this project. Similarly, power is the deciding thing for the required speed. These two factors together play a direct role on the compactness of this system [3].

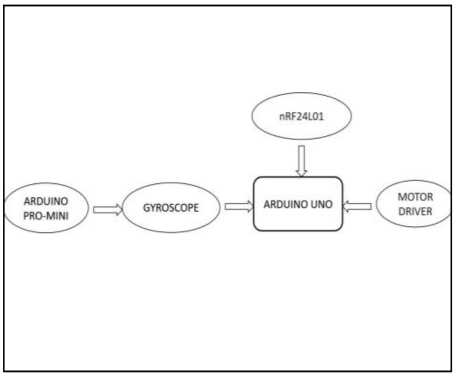

Figure 1 Block Diagram of the System

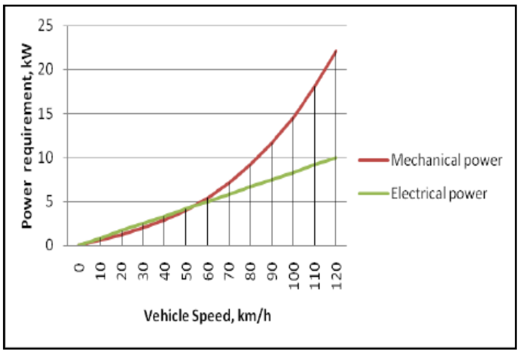

Figure 2 Speed-Power relation of a vehicle

IV. NEED FOR THE SYSTEM

A brand-new and rapidly expanding form of transportation is the use of hoverboards. Hoverboards are mostly used to travel to places that take a long time to get by other means of transportation. Due to its portability and compactness, hoverboards can reach places that cannot be reached by any other form of transportation technology. They are playing a more and bigger role in our hectic lives as a means of getting there swiftly. They have been put to many different uses, including deliveries, commercial purposes, monitoring, and assistance in crisis circumstances. In light of conventional hoverboards, the aim of this research is to develop rules that will allow hoverboards to be used safely without endangering people's lives [6].

The hoverboard project offers a solution to the issue of being unable to arrive at a location in time. The hoverboards can balance themselves. Hoverboards can be IR-controlled or programmable software can make them move on their own propelled by hand motions. They serve a variety of functions, including security, military operations, travel, and commerce. Although there are many different kinds of hoverboards, the self-balancing kind with two wheels and IR control is the most common. Hoverboards can be utilized for a variety of tasks, including data collection, surveillance, in hospitals, and even parcel delivery. The program is one of the several measures the government has launched to familiarize Indians with electric automobiles [11] – [12]. The project is being carried out because there is a need for more affordable and effective transportation options, as accidents are more likely to occur while using conventional vehicles. The idea involving electric vehicles will aid in boosting productivity and cutting costs. The usage of electric vehicles instead of gasoline-leaded automobiles, which are more expensive and inefficient than EVs, is the primary goal of this project. The project seeks to improve the effectiveness and efficiency of travel. There are numerous benefits to this project. It will assist users in saving time, protecting the environment, and lowering their environmental effect [14] – [20].

One of the most crucial technologies for achieving the sustainable development objectives is the hoverboard project. This initiative has the potential to reduce pollution and ensure that everyone switches to electric vehicles. [2]. A conventional hoverboard is shown below:

Figure 3 Conventional Hoverboard

The Personal Micro-mobility system can beused in three different ways:

- To increase electric vehicle production by increasing the battery capacity.
- To overcome the accidents that happened in conventional hoverboard systems.
- To increase the demand for hoverboards in the market.

II. COMPONENTS REQUIRED

Components that are required for this project are:

A. Arduino UNO

The ATMEGA328P microcontroller series, 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analogue inputs, a 16 MHz quartz crystal, a USB port, a power jack, an ICSP header, and a reset button are all included on the included Arduino UNO board. It can be powered by simply plugging a USB cable into a computer or by using an AC-to-DC adapter. In contrast, a separate power supply unit is constructed in this work to power it. The Arduino Integrated Development Environment's embedded C-language is used to program the Arduino Uno microcontroller (IDE). The hex file is loaded into the controller's memory through the compilation and linking of the source code handled by the IDE. Due to several characteristics, like flexibility, RAM size, number of programmable I/O lines, programmable serial channel, etc., Arduino Uno microcontroller (ATMEGA 328P-PU) is chosen to efficiently carry outthe system coordination.

Figure 4 Arduino UNO

B. Jumper Wires

These wires are used with breadboard and development boards and are generally 22-28 AWG solid core wire. Jumper wires can have male or female ends, depending on how they need to be used.

Figure 5 Jumper wire

C. Soldering Iron & Lead

A hand instrument used in soldering is a soldering iron. In order for the solder to flow into the joint between two work parts, it needs heat to melt. In electronics, where heat-sensitive components might melt, break, or warp at a range of high temperatures, tin lead wire solder is frequently employed. In addition to having strong mechanical qualities, it also has good electrical properties. Metal pieces are joined using the soldering technique to create a mechanical or electricallink.

D. Roller Skates Wheels

A wheel is a rotatable circular component that rests on an axle bearing. One of the essential parts of the wheel and axle, one of the six fundamental machines, is the wheel. Via enabling motion by rolling coupled with the use of axles, a wheel significantly minimizes friction. Wheel rotation requires applying a moment to the wheel about its axis, either through the application of gravity or through the application of another external force or torque.

Figure 6 Roller Skates Wheels

E. Gear Motor

A gear motor is an all-in-one combination of a motor and gearbox. The addition of a gear head to a motor reduces the speed while increasing the torque output. The most important parameters in regards to gear motors are speed (rpm), torque (lb-in) and efficiency (%).

Figure 7 Gear Motor

F. Arduino Pro Mini

A microcontroller board based on the ATmega328P is called the Arduino Pro Mini. It contains 6 analogue inputs, an on-board resonator, 14 digital input/output pins (six of which can be used as PWM outputs), an on-board reset button, and mounting holes for pin headers. To supply USB power and connectivity to the board, connect a six-pin header to an FTDI cable or Spark fun breakout board. The Arduino Pro Mini is designed for temporary installation in exhibits or other things. The lack of pre-mounted headers on the board enables the use of several types of connectors or wire direct soldering. The Arduino Mini can use the pin arrangement. The Pro Mini comes in two different versions. One operates at 3.3V and 8 MHz, while the other operates at 5V and16 MHz.

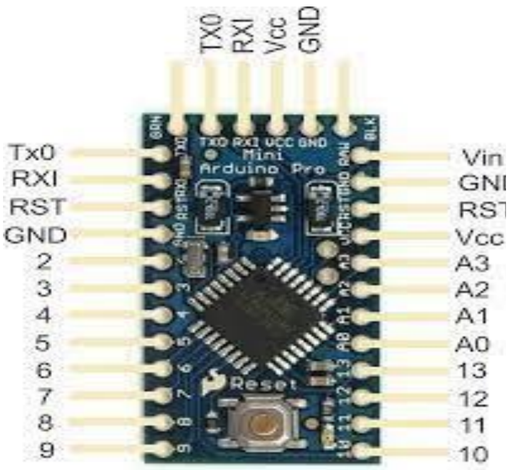

Figure 8 Arduino Pro Mini

G. Motor Driver

A high-power motor driver ideal for operating DC Motors and Stepper Motors is this L298N-based motor driver module. It makes use of the well-known L298 motor driver IC and includes an internal 5V regulator that it can utilize to power an external circuit. It has the ability to direct and speed-control up to 4 DC motors or 2 DC motors. For robotics and mechatronics projects, this motor driver is ideal for controlling motors with microcontrollers, switches, relays, etc. Ideal for powering DC and Stepper motors for robot arms, line- following mice, and other devices.

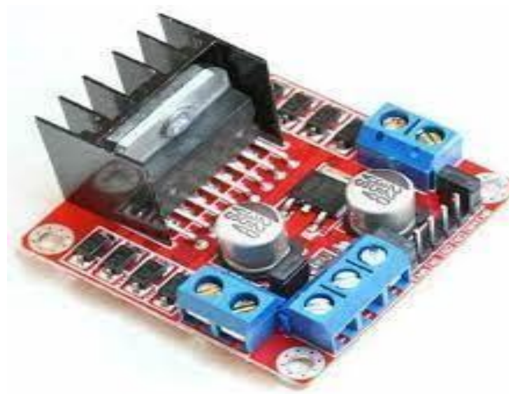

Figure 9 L298N Motor Driver

H. Motor

RS-555 12V Motor is a Low Voltage DC motor with built-in cooling fan. High torque with wide operating voltage 6~20Vdc. It is suitable for motor tools application and DIY projects.

Figure 10 RS-555 12v Motor

I. 18650 Lithium Battery

A Li-ion rechargeable battery with a 1200 mAh capacity is the 18650 battery. Although, it is not a regular AA or AAA battery, this one is highly helpful for devices like cameras, DVD players, iPods, and others that need high current either continuously or briefly. Without significantly losing battery capacity, an 18650 cell can undergo up to 1000 cycles of charging and discharging. They have extended battery lives, are safe to use, and are environmentally friendly. It has a high energy density and offers your device great continuous power sources. It must be used in conjunction with a protection circuit board that safeguards the battery from overcharging, over-discharging the pack, and avo

Figure 11 18650 Lithium Battery

J. NRF24L01 Module

The NRF24L01 is a wireless transceiver RF module, where each module can send and receive data. Since it operates on the 2.4 GHz ISM band, the technology is approved for engineering applications in almost all countries. This module can cover 100 meters (200 feet) when operated efficiently, making it suitablefor wireless remote-control projects

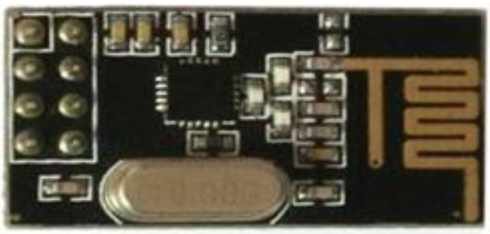

Figure 12 NRF24L01 Module

K. MPU 6050 Gyroscope

A comprehensive 6-axis motion tracking device is the MPU6050 sensor module. In a compact size, it includes a 3-axis gyroscope, 3-axis accelerometer, and a digital motion processor. Additionally, it incorporates an on-chip temperature sensor as an extra function. In order to connect with the microcontrollers, it has an I2C bus interface. To interface with other sensor devices like a 3-axis magnetometer, a pressure sensor, etc., it features an auxiliary I2C bus. A full 9-axis Motion Fusion output can be provided by MPU6050 if a 3-axis Magnetometer is attached to an additional I2C connection.

Figure 13 MPU 6050 Gyroscope

III. SOFTWARE REQUIRED

The following software must be used to complete thisproject:

Arduino Software (IDE):

It often known as the Arduino Integrated Development Environment. A text editor for writing code, a message box, a text console, a toolbar with buttons for frequently used operations, and a number of menus are all included. In order to upload programs and communicate with them, it connects to the Arduino hardware.

Writing Sketches:

Sketches are computer programs created with the Arduino Software (IDE). The text editor was used to create these sketches, which were then saved with the ino file extension. The editor offers functions for text replacement and text searching. When saving and exporting, the message section provides feedback and shows errors. The console shows text generated by the Arduino Software (IDE), including error messages in their entirety and other data. The configured board and serial port are visible in the window's bottom right corner. You may create, open, and save sketches, validate and upload programs, open the serial monitor, and more using the toolbar buttons.

IV. WORK FLOW

The main controller in this system is Arduino UNO, on which the NRF24L01, Gyroscope, and motordriver are all dependent to it.

The following approaches will be used in this system:

- Building the base.
- Making the base foldable with latches.
- Assembling the circuit in both the base andthe gloves using the connected components.
- Using the Arduino IDE to program.
- Examining.

V. SYSTEM DESIGN

The personal micro-mobility system is designed in such a handy manner, where a person can operate the vehicle using the control in their hand itself, enabling them to experience ride in a routine manner (just like holding and driving a bike, car, bicycle, etc.). This application is connected to the wirelessly to the nRF24L01 RX module which is connected to the programmed Arduino Pro Mini. The wheels that help the vehicle to move are connected to the RS-555 12v Motor which is accelerated by the Motor Driver Shield. The Motor Driver Shield has the power supply from batteries and reads the instructions from the Arduino UNO and follows the command given by the operator. (Figure 15) [7].

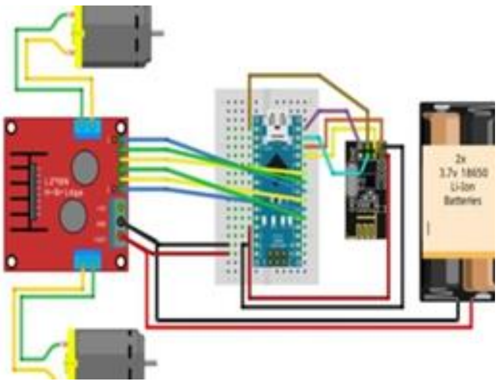

Figure 14 Circuit diagram of the personal micro-mobility System

Also, the secondary circuit (for hand-gestures) present in thegloves is shown by the circuit in the figure 16 [1].

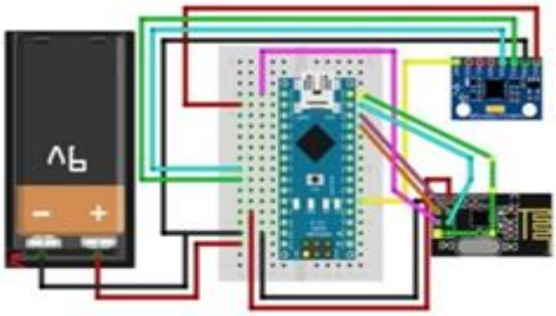

Figure 15 Circuit diagram for hand-gestures

18650 Li-ion battery:

It is connected to the circuit in the form of a 4s battery pack and then attached to BMS module.

Battery calculations that are required to design the vehicle is depicted in the form of a table shown below:

Battery type	Lithium-ion
Nominal Voltage	25.9
Capacity	12 Ah
Minimum charging time	2.5 to 3.5 hours

Table 1: Battery calculations

OBJECT	WEIGHT (kg)
User	20
Vehicle	7

Parameters that are associated with the weight of the designed vehicle is depicted in the form of a table shown below:

Table 2 : Parameters associated with the weight of the designed vehicle

- RPM OF MOTOR: **4000**
- DIAMETER OF WHEELS: **2 INCHES**
- SPEED =**40 km/hr**
- POWER: **11,190 WATTS**
- TORQUE=**6.68 Nm**
- BATTERY DISCHARGE RATE= **4A**

VI. RESULTS

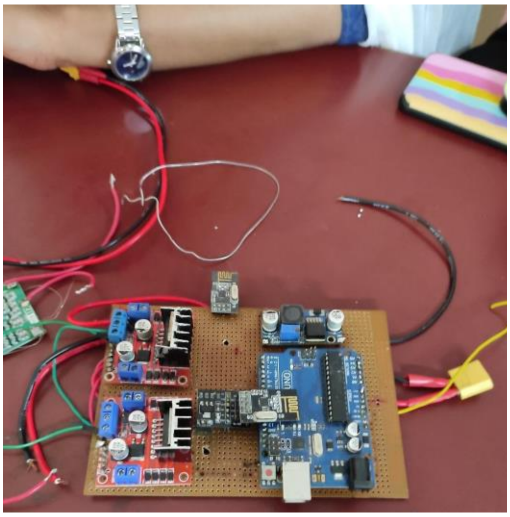

Figure 16. Building Mobility Circuit

Figure 17. Fixing Wheels

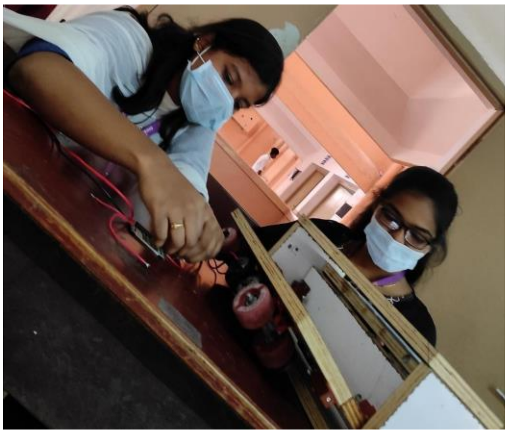

Figure 18. Fixing Motors to Wheels

This paper has aimed at building and running the "Mini Hand Gesture Controlled Mobility System". Here this project is mainly built for using indoors as well as outdoors especially for using inside the institution premises. In future it will be upgraded to a finished product which can be used by the handicapped.

VII. APPLICATIONS

- This can be used to travel to the grocery store and many other neighboring locations because this system can be used outdoors.
- This is suitable for those who are physically challenged especially who lost their leg.

VIII. CONCLUSION AND FUTURE SCOPE

This paper presents a system that helps in movement from place to place in a sustainable manner. Maintaining balance on a hoverboard is like stabilizing a two-wheeler. The specific aim of this system is to satisfy sustainable goals, building additional feature to help physically challenged and compact design. However, this system helps in movement from place to place in a sustainable manner. This system also enables the user to ride in a comfortable manner with the help of the sitting arrangement. This system is cost effective once built and later just the maintenance is required (charging).

Future work of this system includes:

- Controlling the system with the help of hand-gestures.
- Making a seating arrangement.

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Cite this article as :

Ms. G. T. Bharathy, Abinaya K, Jeslene Pershia I, Mrithulla S, Vaishnavi C A S, "Mini Hand Gesture Controlled Mobility System", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 9 Issue 1, pp. 80-89, January-February 2023.

Journal URL : https://ijsrcseit.com/CSEIT2390119