ELECTRICAL MOUNTAIN BOARD

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Abstract:

Environmental protection and energy conservation are the main concern of the 21st century, which has accelerated the pace to plan and develop electric vehicle technology. New automobile industry establishment, economic development, efficient and smart transportation system. This project has a foot-controlled steering system to control the vehicle easily. It is designed to suit any road conditions and reduce the effort of a rider to drive a skateboard easily. Initially, the design of the vehicle in CAD and simulations models are done. Equipment and cost analysis is done. It deals with the fabrication of vehicles. This includes assembly of skateboard and electric motor drive and designing the controllers. Thus, the final stage is to improve the design model of the e-board for off-road conditions and suitable for physically challenged persons. The objective of this project is to improve the driving mode of a skateboard in off-road conditions by centring an electric wheel on the board and reducing the skateboard's effort even in uphill areas and designing it with foot steering to improve the steering sensitivity of the skateboard. Dependence on non-renewable resources using the latest technology. The implementation involves the development of an E-board that runs on the battery as well as manual propulsion of the vehicle.

I. Introduction:

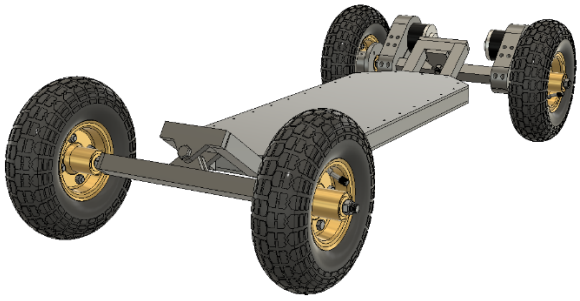
Around 93% of today's automobiles run on petroleum-based products, which are estimated to be depleted by 2050. For the preservation of gasoline for the future and to increase the efficiency of vehicles, an electric vehicle can be a major breakthrough. An electric vehicle is pollution-free and is efficient in low-speed conditions mainly in high traffic areas. But battery charging is time-consuming. Moreover, it cannot provide the high power required by drives during high-speed conditions or on slopes of hilly areas. Gasoline engine proves their efficiency at higher speeds in high ways and wastes a lot of energy in urban areas. Since the skateboard cannot be driven at high speeds this propulsion is best suited for the applications. [1]

The basic design consists of a dc power source battery. The battery is connected to the motor through a motor driver module The motor is attached to the rear two-wheel of the vehicle. As the motor rotates the attached wheel rotates too, thus, leading to vehicle motion.

EVs have been vehicles of numerous advantages. The problem of environmental pollution can be avoided to a certain extent. This encourages the method of sustainable development that has been the topic of concern in modern society. Moreover, EV's mode of operation is maximum efficient to the conditions, i.e., at low speed and high traffic areas where the gasoline engine is least efficient with a lot of energy wasted, EV moves with power from the battery. At up slopes where high power is required to skate the board hence electric power is used for vehicle motion to achieve the top easily. Thus, the advantages of EV make it superior to any other vehicle of today.

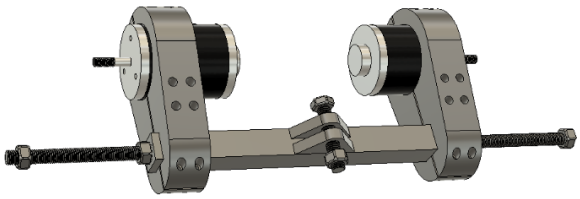
II. Technical content/ Model:

The main components of this project are the electric motors and the battery. These are the key parts that are the cause of the propulsion of the vehicle. the motor which is used in the vehicle is MY6812, 12v, 150W DC brushed motor, two motors are driving the rear wheels of the vehicle which has enough torque to propel a person riding the vehicle the below figure shows the CAD model and placement of the motor.

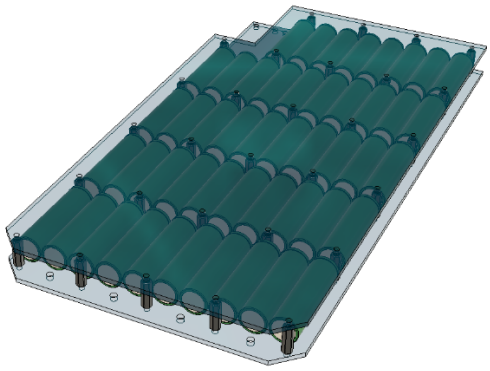


Frame design; *the frame is made from 1inch mild steel with a 1.6mm thick wall and sandwiched between two 5mm acrylic sheets which house all the components (battery, electronics, etc.) the wheels are attached through a square tube with a hinge mechanism in middle, the hinge is placed at an angle of 35 degrees which helps to turn the skateboard when leaned towards left or right.*

Motor assembly; *The below CAD model shows the motor assembly of the vehicle the M12 threaded rod acts like a shaft to hold the wheels in place it has bearing inserts that make it rotate smoothly and spin with less drag. The motor is held in place with a custom 3D printed motor mount which is attached to the shaft tube and securely holds the motor in place. [2]*



Battery pack construction; *Battery which are used in the vehicle are lithium-ion batteries, particularly 18650 cells, there are a total of 48 cells that are enclosed in a clear acrylic sheet which holds all the cells in their right place, the pack is placed a little bit forward from the center to compensate the weight of the motor, battery individual connection are made using a nickel strip spot welded to the terminals of each individual cells and the end leads are given to a barrier terminal connector for further connections. [3]*



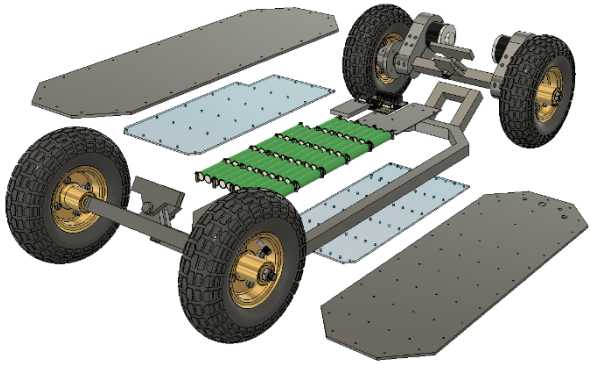
Battery calculations;

Required motor currents A=

$$A = \frac{W}{V} = \frac{150}{12} = 12.5$$

Each motor requires 12.5 amps rounding it to 15 amps, hence 2 motor needs 30amp 12v of battery supply with 12v

Each individual cells provide 2amps 3.7v, hence we need 3 sets of 15cells which are connected in parallel we get a 3.7v 30amp pack, if the 3 sets are connected in series we get a total of 11.1v 30amp battery which is the requirement for the load, 3 extra cells are taken to supply microcontroller and other small modules, so the total cell count is 48.



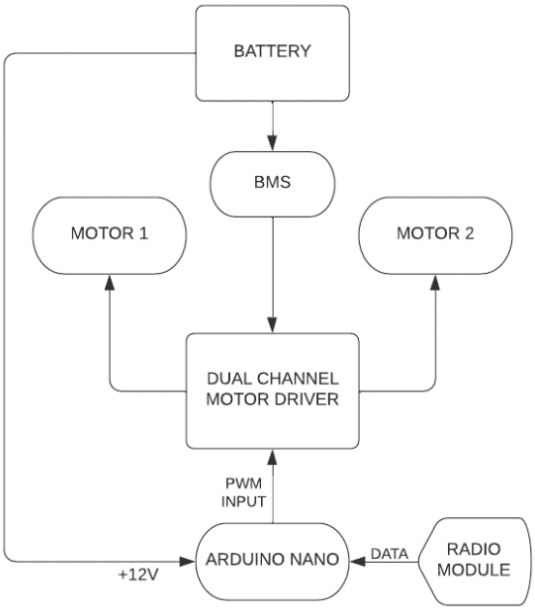
The dissected view of the skateboard is shown above the top and bottom cover are laser cut from 5mm acrylic and the frame is drilled and tapped on which the plates are screwed in

The below figure shows the perspective of size of the vehicle with respect to the human

The vehicle can easily carry a person with a weight of up to 70kg the wheels are air-filled and help in the absorption of shocks even though there is no shock absorber the wheels with rated pressure can improve the shock-absorbing property of the vehicle,

Electrical designs; *below components are the list of main parts*

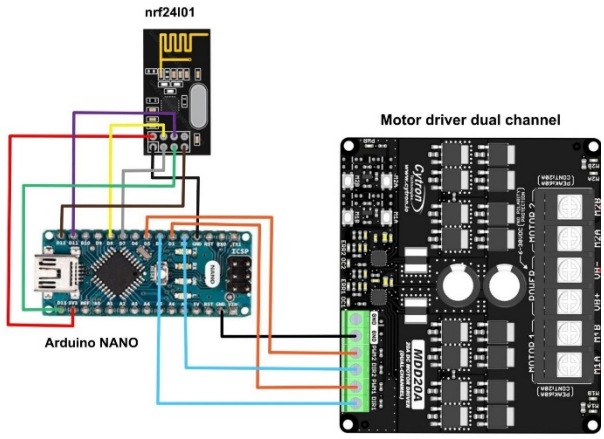
1. *Dual-channel motor driver [4]*
2. *Battery management system (BMS) [5]*
3. *Microcontroller [6]*



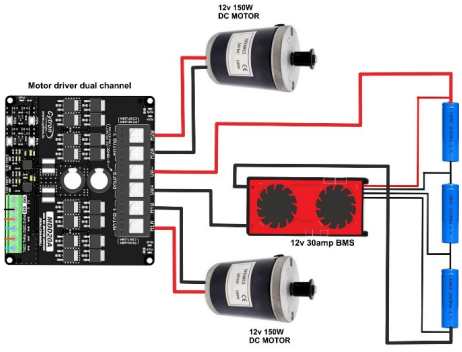
The above flow chart shows the connection of all the electrical components. The dual-channel motor driver controls the amount of current flowing to the motor and limits according to the PWM input signal given by the microcontroller it can also protect the motor from overcurrent conditions keeping the motor safe in abnormal conditions, the motor driver helps to control the high power circuit with low power input it has 6pins for input PWM1, DIR1, PWM2, DIR2, GND, GND. PWM pins are used to set the speed of the motor whereas the DIR pins are for setting the direction of the motor.

The battery is custom made for the power requirement of the vehicle the cells are placed within a closed structure and have features like temperature monitoring and balance charging, balance charging and temperature monitoring, these features are critical for the battery health if the battery is put in high load conditions and abnormal temperatures there is a risk of fire and danger to the rider, to prevent accidents the voltage of each cell should be monitored and discharged/charged accordingly, this is done through the help of Battery management system, in short, the "BMS", this module is the key for battery monitoring it monitors the voltage of each cell while charging/ discharging and maintains the voltage within the threshold.

The signal for the motor driver is given by a microcontroller (Arduino nano) which receives the signal from a radio receiver module (NRF24L01) there is a pre-made library made by the manufacturer of dual-channel motor driver called "CytronMotorDriver.h" which is used in microcontroller program to control the motor speed.



The above circuit shows the circuit diagram of the microcontroller with radio communication and motor driver, this part of the circuit is of low power and there is no high current flowing in this section of the circuit, the Arduino communicates with the radio to set speed, the receiver gets signal from handheld joystick controller which acts as a transmitter and sends the value for the speed of the motor, the handheld controller uses the single one-handed joystick and makes it easy to use, the joystick is linked with a potentiometer and the reading are sent using radio communication



The high-power circuit of battery connection and motors are shown above this part of the circuit doesn't affect the low power components like the microcontroller and other parts the figure also shows the connection of BMS with cells.

III. Result:

When the joystick is pushed forward the motors start to rotate forward with a speed proportional to the joystick and when pushed backward motor rotates in reverse, and propels the rider forward/ backward according to the direction of the joystick, and when leaned toward left/right the vehicle can be steered according to the lean direction.

IV. Conclusion

Electrical vehicles are the future of transportation, it is efficient, pollution-free, eco-friendly, compact, and safe, this vehicle is one of the leaps toward the eco-friendly future, which a rider can drive without any effort, the device is smaller than a 2-wheeler or 4-wheeler cars making it ideal for shorter distance and saving fossil fuels for the future

V. Reference:

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