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Design and Development of Hybrid E-Tricycle

Naveen Varghese V[1] and Sreenivas Parameswaran[2]

[1,2]*Dept. of Mechanical Engineering, Gov. Model Engineering College, Kochi, India*

Abstract - *A balance problem is a condition that causes the inner ear's balancing centres to malfunction. Driving and cycling become practically impossible, and you lose a significant amount of personal liberty. Adaptive tricycles can help improve joint motion, muscle function, circulation, core development, coordination, and balance. Here we convert the conventional bicycle into a hybrid electric tricycle. The hybrid tricycle was designed specifically for balance disorder people. Here we design the tricycle as an environmentally friendly ride that is fossil fuel independent, eco-friendly and cost-effectively. Hybrid tricycle is an electric mode of transportation, it can charge with a solar panel and direct from a power plug. Using solar panel convert the solar energy into electric energy and store in the battery. Using this energy we ride our tricycle. In case of emergency or fast charging, the rider can charge using an adapter. We've included a reverse facility, which is extremely useful for physically challenged people. For the safety aspects, we are using a GPS module, so it can monitor the real-time location details of the rider.*

Keywords: Hybrid tricycle, Adaptive tricycle, GPS Module.

1. INTRODUCTION

A tricycle has a low risk of falling over because it always has three wheels on the ground, which provides a secure sensation. You can either pedal with electric pedal support or use 100 percent electric power assist to ride it. With a balance condition, cycling on a standard bike is quite tough. You're losing confidence because you're afraid you'll fall down at any moment. It's impossible to land with both feet on the ground, and keeping your balance is challenging. An adaptable bike could be the answer. The main advantage of a tricycle is small children or adults who have never ridden a tricycle before simply ride it. Adults have to get used to a completely different cycling behaviour. Most time-efficient ways to combine regular exercise with your everyday routine. Cycling can help to protect you from serious diseases such as stroke, heart attack, some cancers, depression, diabetes, obesity and arthritis. The main feature of this tricycle is, it can use as both bicycle as well as a tricycle.

Numerous studies have proven that the supply of fossil fuels including coal, natural gas, and oil is finite. The effects of using fossil fuel energy on global climate change have also been studied. Energy consumption is rising as the global population expands. The energy supply is determined by the energy growth of the country. Currently, carbon dioxide emission is increasing day by day, one of the main factor is exhaust from the IC engine. Carbon dioxide can produce a variety of health issues and it causes ozone layer depletion. So we need a clean source of energy that can achieve only through renewable source methods. Hence solar energy can provide a long term solution for global warming. The solar panel converts the solar energy into electrical energy to the required voltage to charge the battery. Using this energy we ride our tricycle. The DC motor is attached to the rear wheel of the tricycle. The motor is converted this electrical energy from battery to mechanical energy, using a chain drive mechanism it rotates the wheel of the tricycle. The speed of the tricycle depends on the acceleration (throttle) given by the rider. As a safety application, we incorporate the GPS module for location identification.

2. METHODOLOGY OF HYBRID E-TRICYCLE

The major components of the adaptive hybrid tricycle are solar panel, DC motor, battery, controller and throttle.

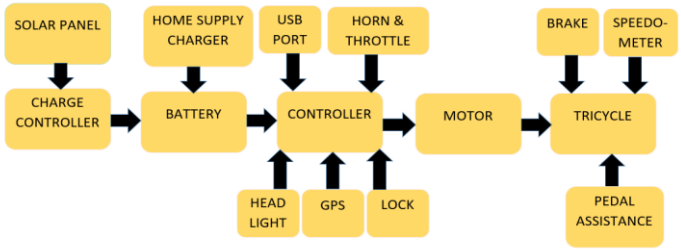

Fig - 1 Block Diagram of Hybrid E-Tricycle

Figure 1 shows the block diagram of the hybrid E-tricycle. The hybrid electric tricycle is powered by direct solar energy and in case of emergency condition, you can charge the tricycle from the direct plug using an adapter. The solar panel (50W) converts the solar energy into electrical energy and stored in the battery (24V 35ah) using this energy we ride our tricycle. Here we use two 12V, 35 ah lead-acid battery has connected in series. The DC motor (24V, 250W) is attached to the rear wheel of the tricycle using a chain drive mechanism. The tricycle controller controls all the electronics components such as motor, throttle, etc. The throttle is used as the accelerator, when we accelerate the throttle the motor starts to rotate simultaneously. During slope or climbing the pedal assistance help the rider for an easy riding experience. As a safety application, we incorporate a GPS module for identifying the location of the tricycle.

GPS Module

The GPS module is used to identifying the exact location of the tricycle. The ESP8266 is a wifi module, the wifi module act as the communication channel between the GPS module and webpage. Using this webpage link anyone can track the location of the tricycle.

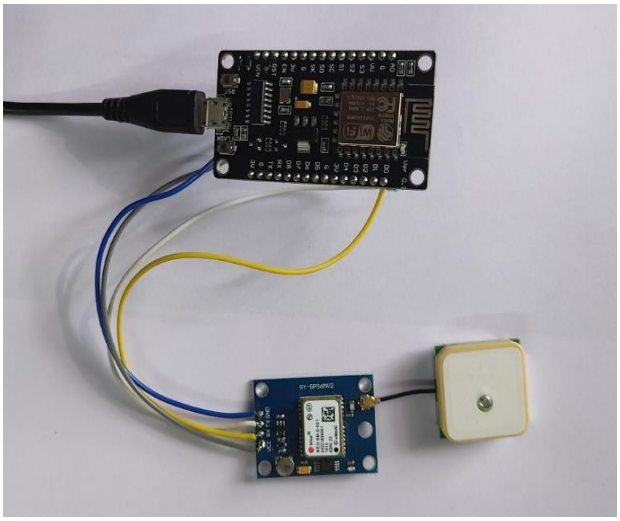

Fig - 2 GPS Module

Figure 2 shows the prototype of the NEO-6M GPS module with NodeMCU ESP8266. The NEO-6M GPS module contains tiny processors and antennas that directly receive data sent by satellites through dedicated RF frequencies. The NodeMCU is an open-source platform, consist of an ESP8266 wifi-enabled chip.

Problem statement

Diameter Of wheel (D) = 60cm

Speed (v) = 22 - 25 kmph

Weight of Tricycle = 26 kg

Weight of Rider = 72 kg

Total Weight = 98 kg

Battery selection

Since the motor selected is 24V, hence battery voltage rating should also be 24. Therefore we select two lead-acid batteries of 12V and 12 Ah connected in a series combination of 24 V and 12 Ah.

Battery backup time

h = Ah / A

P = V I

I = P / V = 250W / 24V = 10.416 Amp

h = 12ah battery / 10.41 = 1.152 at 100% efficiency

Practically 70% is only possible

1.152 hrs * 70 / 100 = 0.806

0.806 * 60 = 48.5 min

Distance

Distance = v * t

= 22 * 1.152= 25.34 km

Velocity range is 22 – 25 km/h

Charging time (Solar panel)

Time required to charge the battery by adapter 24 V 12Ah

P= 24* 12= 288W

T= (24*12) / 288

= 1 hrs.

By using the solar panel

T= (24*12) /50

= 5.76 hrs

It also depends on the intensity of sunlight

Solar Panel selection

We use a single panel of 50 W each having dimension: 23.7 x 19.6 x 1.2 In

Motor selection

DC motor of 250 W 24V is selected.

3. SIMULATION OF HYBRID E-TRICYCLE

To evaluate the effectiveness of charging the battery using a solar panel, a simulation model was created using Matlab Simulink.

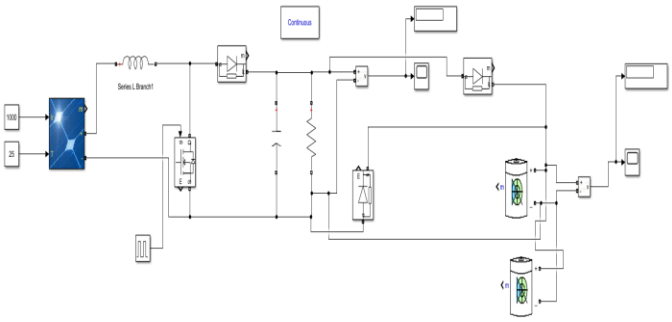

Fig - 3 Matlab Simulink of Hybrid Tricycle

Figure 3 illustrated a simulation model of charging the battery by the solar panel. Because sunlight intensity changes throughout the day, a buck-boost converter is employed to boost the voltage from the solar panel to a constant value of 24 V. The two 12 V batteries connected in series are charged using the output voltage from both converters, which is provided through a controller.

The body of the hybrid tricycle was studied using a Matlab simulation model.

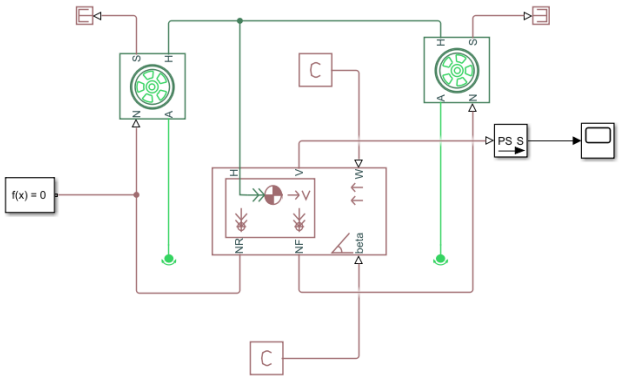

Fig - 4 Matlab Simulink of Hybrid Tricycle

In Matlab Simulink, create the body of a hybrid tricycle with a single axle and three tyres. The vehicle body represents a single axle body in motion, , taking into account parameters such as body mass, aerodynamic drag, grade externally specified mass, angle of gradeability, vehicle velocity, and the vehicle body's centre of gravity.

4. RESULT AND DISCUSSION

The construction procedure entails attaching the various components to the tricycle frame. To begin, construct a carriage with a frame for a solar panel installation on a traditional bicycle. It also serves as a shaded rooftop for the rider. For weight balancing and shading, the solar panel is movable and set above the rider. It protects the rider from sunburn and provides a shading effect. The flexibility of the panel allows it to tilt in response to the situation. Hence we connect the two tyres in the back of the bicycle using axile. This makes balance for the bicycle. The solar charge controller is screwed into place on the carriage. This allows the battery to be charged using solar power. We can charge the battery through the line supply using an adaptor in an emergency. The DC motor is properly aligned to the back wheel shaft, ensuring that the weights are completely balanced. The carriage's battery enclosure, in which two 12 V, 12Ah lead-acid batteries are fitted in series. To transfer power from the battery to the motor, wirings are pulled from the battery and routed through the controller. The tricycle controller connects all of the electrical components of a hybrid E-tricycle, such as the battery, motor, throttle, power socket and GPS module. The handlebar houses the speed controller (throttle), brake lever, headlight, and horn. The total cost for an adaptive hybrid tricycle approximately 17000rs, hence it's economically affordable. As a result, there are no operating costs, no pollution, and no environmental impact. As a new means of transportation, it can be easily embraced.

Fig – 5 Side View of Hybrid Tricycle

Fig – 6 Front View of Hybrid Tricycle

5. CONCLUSIONS

From a future energy system perspective, with the increasing consumption of non-renewable resources such as petroleum, diesel, and other fossil fuels, we must shift our focus to renewable sources such as solar, hydropower, biomass energy, and other alternatives. It is a simple means of transportation that has high torque, is pollution-free, and provides us with a convenient form of transportation for people of all ages. Furthermore, it is a quiet and traffic-free means of transportation.

The hybrid electric tricycle has a top speed of 28 kmph with pedalling and a top speed of 22 kmph without pedalling. On a plane, a road tricycle can travel at a speed of 22-25 kilometres per hour, but on a rough/muddy road, the speed range is decreased to 16-18 kilometres per hour. The battery backup period is about 48.5 minutes. The mileage is determined by the battery's ampere rating. Without the use of a solar panel, it can travel up to 25 kilometres on a single charge. When using a solar panel, the battery is automatically charged based on the amount of sunlight collected. A solar panel's charging period is usually around 6 hours. The charging stations aren't necessary because charging takes place during the ride or parking. As a result, we use a solar panel to charge the battery with solar energy into electrical energy. We recharged with an adaptor in the event of an emergency.

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