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IMPLEMENTATION OF BATTERY SWAPPING STATION USING IOT CONCEPT

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ABSTRACT:-This paper focuses on the utilization & harvesting of wind energy available on highways & expressways with the help of vertical axis wind turbines & implements the battery swapping station with the help of renewable energy using IoT. When the vehicle passed on the highway it produces a considerable amount of air due to its speed. This air tangentially strikes the blade of the Vertical axis wind turbine and thus turbine rotates in only one direction. Consequently, the electrical energy generated from the Vertical axis wind turbine is further harvested & lithium battery is charged subsequently the battery charging parameters are uploaded on the cloud using Blynk and thus realizing the battery swapping station without using conventional energy wherein the discharged battery is swapped with an available charged battery at Battery swapping station.

Key Words:- vertical axis wind turbine, renewable energy source, battery charging, highway medium, battery swapping station, IOT.

1. INTRODUCTION

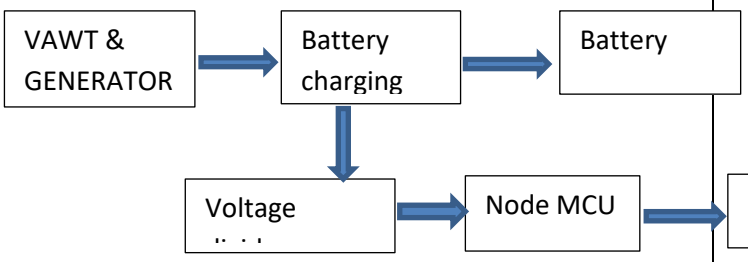
In a day to day, life vehicular movement is increasing in proportion to economic growth also keeping in mind global warming & carbon release there is a paradigm shift in fuel consumption as the electric vehicle is emerging so there is a huge demand for battery charging infrastructure, as the electricity supplied to the charging station is also generated from a non-renewable energy source such as coal which releases carbon product, to compensate this problem and to provide solution we will utilize wind energy available on roads such as highways, expressway, etc.

The main motive behind this project is to provide solution to both battery charging system for electric vehicle and net zero carbon release , in this project we will utilize the movement of air i.e called wind energy by the vehicular drag on both side of road according to NHAI standard we have enough space on medium (divider) of 4/6 lane road on that we can install VAWT which moves in one direction as the force applied by both the opposite lane is tangential and opposite to each other which cause rotation in one direction ,here VAWT is used because it can extract maximum energy compared to horizontal axis wind turbine ,the energy extracted from wind energy using VAWT is now harvested and lithium ion battery is charged using charging module TP4056 consequently its charging status and other specification is stored on cloud using blynk ,the future of this project is that a vehicle owner need not to wait for charging his EV and vehicle owner just need to avail cloud service which gives information about battery swapping station ,hence cloud service should be accessible to all after paying some premium amount.

2 PROPOSED SYSTEM

2.1 Block Diagram

The overall block diagram of power generation using VAWT from vehicular movement and harvesting it at the battery swapping station and uploading its status on the cloud.



2.2 Hardware Components

- VAWT
- DC generator
- TP4056 protection & charging module
- Li-ion Battery
- Node MCU
- Voltage divider

2.2.1 Software used

- Arduino IDE
- Blynk app

2.3 Description of components

2.3.1 VAWT

In this project, VAWT is used. The VAWT is placed in the median of the highway. The turbine used here in the prototype is made up of plastic and its type is H-Darrieus as plastic is very light compared to other materials when subjected to air drag in prototype testing and free to run even at low speeds of air. The turbine consists of four-blade, discs at the top & shaft in the middle for support the height of the blade is approximately

2.3.2 DC generator

Dynamo powerful motor and generator in one works as motor and generator. It produces electricity by converting rotary motion into electric current. A dynamo is a type of electrical generator that converts mechanical energy into electrical energy. It uses a rotating coil of wire and a magnetic field to generate electricity. Dynamos were widely used in early electrical systems, but have largely been replaced by more efficient generators. A generator is a device that converts mechanical energy into electrical energy. It using a rotating shaft to turn a magnetic field, luces an electric current in a coil of wire. It consists of two permanent magnets and a rotating coil attached between these two magnets. The commutator converts the alternating current into direct current by reversing the direction of current every alternate cycle. It is lighter and more reliable to work as a generator. It generates a direct current as an output, it is made up of metal for protection it can run up to 1000-2000 rpm to generate voltage in a range of 4-12v.

2.3.3 TP4056 module

The TP4056 module is a complete constant current constant voltage(CC-CV) linear charger for single cell lithium–ion batteries. Its SOP package and low external component count make the TP4056 ideally suited for portable applications. It also provides battery protection from overcharging. No blocking diode is required due to the internal PMOSFET architecture and have prevented to negative Charge Current Circuit. Thermal feedback regulates the charge current to limit the die temperature during high power operation or high ambient temperature. The charge voltage is fixed at 4.2V, and the charge current can be programmed externally with a single resistor. The TP4056 automatically terminates the charge cycle when the charge current drops to 1/10th the programmed value after the final float voltage is reached.

2.3.4 lithium-ion Battery

Lithium-ion battery is used to harvest energy, it is a type of rechargeable battery that uses the reversible reduction

of lithium ions to store energy. The anode (negative electrode) of a conventional lithium-ion cell is typically graphite made from carbon. The cathode (positive electrode) is typically a metal oxide. The electrolyte is typically a lithium salt in an organic solvent. When the battery is charged, lithium ions from the cathode move through the electrolyte to the anode, where they are stored in the anode material. When the battery is discharged, the process is reversed, with lithium ions moving from the anode back to the cathode, generating electricity in the process. Lithium-ion batteries have become popular due to their high energy density, long cycle life, and low self-discharge rate. They are also lightweight and can be made in a variety of shapes and sizes, making them suitable for a wide range of applications. However, they can be sensitive to high temperatures and overcharging, which can lead to safety concerns. It has a capacity of 1200 mah 3.7V.

2.3.5 Node MCU

- NodeMCU is an open-source firmware and development kit that helps to build IoT (Internet of Things) projects. It is based on the ESP8266 microcontroller and provides a Lua-based environment for programming. The NodeMCU board includes built-in WiFi and can be easily connected to the Internet. It also has several input/output pins that can be used to connect sensors, actuators, and other peripherals. Microcontroller: ESP8266
- Clock frequency: up to 80 MHz
- Operating voltage: 3.3V
- Digital I/O pins: 11 (can be used for PWM or interrupts)
- Analog input pins: 1 (ADC with 10-bit resolution)
- USB interface: Micro USB
- WiFi: 802.11 b/g/n (2.4 GHz)
- Flash memory: 4MB
- RAM: 80KB

2.3.6 Arduino IDE

The Arduino Integrated Development Environment (IDE) is an open-source software that provides an easy-to-use interface for writing, compiling, and uploading code to Arduino boards. It is available for Windows, Mac OS X, and Linux, and supports a wide range of Arduino boards, including the popular Arduino Uno, Mega, Nano, and Due.The Arduino IDE uses a simplified version of the C++ programming language and provides a number of built-in functions and libraries to make it easier to work with the hardware. It also includes a Serial Monitor for debugging and testing, and a Library Manager for downloading and managing third-party libraries. To use the Arduino IDE, you can write your code in the editor, verify and compile it, and then upload it to the board via USB. The IDE will automatically detect the connected board and configure the upload settings accordingly. Once the code is uploaded, the board will execute the program and perform the desired actions based on the code.

2.3.7 Blynk APP

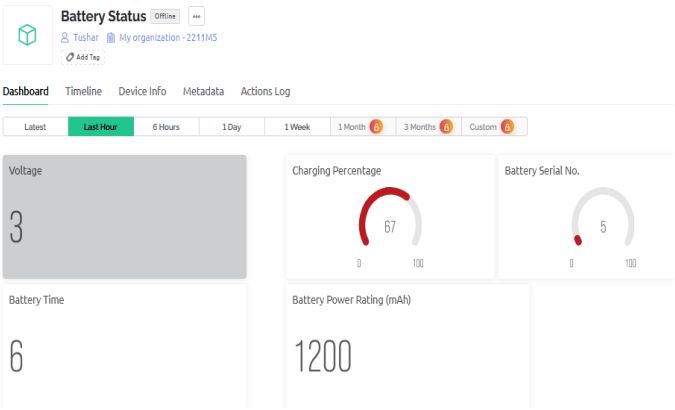
Blynk is a mobile app that allows users to control and monitor IoT (Internet of Things) devices from their smartphones. It works in conjunction with the Blynk cloud service and provides a simple and customizable interface for creating and managing virtual dashboards. Using the Blynk app, you can create custom widgets, such as buttons, sliders, graphs, and gauges, that can be used to control various aspects of your IoT project. For example, you can use Blynk to turn on/off a light, adjust the temperature of a room, or monitor the status of a sensor. Blynk supports a wide range of hardware platforms, including Arduino, Raspberry Pi, ESP8266, ESP32, and more. It also provides a library that can be integrated with popular programming languages such as C++, Python, and JavaScript, making it easy to add Blynk support to your existing IoT projects. Overall, Blynk is a popular and easy-to-use tool for building IoT projects and controlling them from your mobile device.

2.4 Methodology

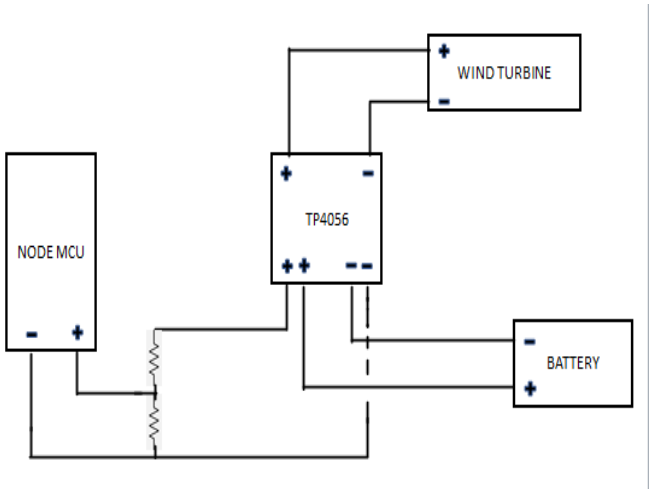
The vertical axis wind turbine is placed on the median of national highways, expressways state highways. Vehicles pass on both sides of the highway road in the counter direction. Due to air and vehicular movement, the wind tangentially strikes on fins or blades of the vertical axis wind turbine making it to rotate in one direction.A dynamo dc generator's shaft is coupled with the blade of the VAWT.once the VAWT starts rotating, the dynamo dc generator starts rotating due to the principle of electromagnetic induction when a coil rotates in the presence of magnetic field it produces EMF and an ac current To convert the AC output of the generator to DC, a commutator is used. The commutator

is a set of brushes that make contact with the rotor, allowing the output to be converted to a unidirectional DC current. The speed of the dynamo dc generator is approximately 1000-2000 rpm. The output voltage generated is approximately 5 volts but the range is between 4-12v.

The output dc voltage is stored in 3.7v-1200 mah battery with the help of TP4056 battery protection and charging module IC which uses a constant current-constant voltage linear charging pattern, here we have implemented a parallel combination of 3 VAWT in the model, consequently, the status of battery charging parameter is measured with the help of Node MCU & TP4056 module after that it is uploaded on cloud and a vehicle driver who is traveling at highway and the battery is going to discharge and he has no time to wait in a queue to charge wait so to facilitate an already charged battery is swapped with previous one with the standard operating procedure, hence the renewable energy is used and commercializes this concept and contribute to zero carbon emission and time-saving.



2.5 Circuit



3.IMPLEMENTATION OF THE PROJECT

3.1 calculation

- Specification of battery=3.7V,1200mah
- Specification of dynamo dc motor=4-12v
- Speed of dynamo dc generator=800-3000rpm
- Three VAWT is connected in parallel so max current<=0.1A
- Resistance=2kohm
- Charging time=Battery capacity*charging efficiency/current
- Input wind velocity=10m/s
- Input mechanical power P = 0.5 x ρ x A x Cp x V^3
  P = input power (in watts) ρ = air density (in kg/m³) A = swept area of the turbine blades (in m²) Cp = coefficient of power (the efficiency of the turbine, which is typically between 0.2 and 0.5) V = wind speed (in m/s)

3.2 Result

Speed of 1 rotor=900rpm

Input mechanical power=P = 3.9W

Generated Output voltage from 1 rotor=7.4v

Output current of 1 rotor=40mA

Total electrical power=V*I=7.4v*120mA=888mW

Charging time=1200*0.9/120=9hrs

4 Conclusion

Thus the project will act as an effective method for harnessing the renewable wind source available on the median of highways. The wind energy produced due to the moving vehicles in the highways is converted to electrical energy by the wind turbine and is stored in a battery for other applications such as charging EVsBattery swapping using IOT, etc. The main advantage of this design is it is sustainable, time-saving, cost-effective environmentally friendly, and robust EV charging infrastructure. If long high-speed express highways are installed with this type of turbines a valuable amount of electrical energy can be produced to solve the issue of the energy crisis to a large extent.

5 Application:

- Available space on Highways can be monetized as it benefits the government.
- Can be used in charging Ev.
- Can be used to perform Rural electrification.
- Can be used in Aviation Industry.
- Reduces traffic at the charging station.

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