

IoT Based Hybrid Street Light Generation using Solar and Wind Energy

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Abstract - Hybrid power system that uses solar and wind energy sources to control street lighting. Its components are solar panel, Helical model, Battery, LCD Display, Regulator, Arduino IDE, etc. The energy stored in the battery during the day due to the solar panels is extracted by the LED lights during the night (because LDRs get activated due to absence of sun light). Wind also charges the batteries due to which wind is used for glowing street light. The advantage of this idea is to avoid the daily operating cost and to bring the system completely off-grid. IoT-based hybrid street lighting systems that use renewable resources are one of the key infrastructures of a smart city and are important for safe driving and pedestrian safety. Also, considering the large number of lamps, street lighting accounts to high energy consumption and thus a significant cost to the utilities. IoT based Hybrid street lighting solution help controlling, monitoring and fault detection easier turning these systems into intelligent and efficient network. This paper presents a comprehensive analysis of smart grid solutions for street lighting and automatic charging technologies through solar and wind energy. Solar-Wind Street light is a smart, compact, and off-grid lighting system. Since Wind turbines rotate with the wind the batteries are charged and thus the wind turbine make the street light glow even at night. In this prototype, we used 12V DC system to provide energy to the lights.

Key Words: Internet of Things (IoT), Arduino IDE, LED, Charge Controller, Photo Transistor (LDR), Solar Panel, Wind Turbine

1.INTRODUCTION

Electricity is a vital factor our day to day life. There are two ways of electricity generation i.e. (i). conventional energy resource (ii). Non-conventional energy resource. With the global increase in the energy demand there has been a worldwide need for the development in the fields of renewable energy. The drastic consumption and exhaustible sources of energy can soon lead to their depletion from earth. The concept of sustainable development has motivated us to search for the alternative sources of energy which are freely and abundantly available. The hybrid street light systems are self-sustaining and standalone solutions and it also reduces the transmission and distribution losses. This proposed system will be one of the best solution in many

rural and urban areas. Solar energy has drawback that it could not produce electrical energy in rainy season, so in order to overcome this problem we can use two energy resources so that if any one source fails from both other source can generate the electricity. And in preferable weather conditions both sources can be used together.

2. WORKING OF PROPOSED SYSTEM

Wind turbine and Solar Panel are connected to a Charge regulator circuit and the charge controller circuit is connected to a battery. Charge regulator circuit will show if solar panel and wind turbine is working properly or not. We can attach different types of LEDs on ESP32 and collect the data. Using ESP32 the data collected can be sent to the server, and can check the working status of solar panel as well as wind turbine, also we can check whether the LED is glowing or not. We will also mount temperature sensor, in case of any high heat (temperature) it reduce the damage to LED. We will also mount a voltage regulator sensor, so that voltage supplied doesn't exceed the required amount of voltage. The main idea of combining the two types of systems together was to try to achieve a constant power production, by eliminating the need for the power to be drawn from the grid and isolate the street lighting system which would be available most of the time. Due to the proposed model being iot based it is comparatively less reliable on human resources. 5V output is given to Arduino R and Raspberry pi & 9V is given to GPRS model. Here we are taking two modem GPRS modem WIFI module ESP8266. Whatever data is coming from sensors will send the data to the Arduino R3 and Arduino R3 will send the data to raspberry pi and will send that to cloud. We are continuously monitoring battery voltage if it increase or decrease, it will send an email alert.

3.TECHNOLOGIES

3.1 Solar Energy

Solar energy is a renewable source of energy. Solar energy refers to capturing the energy from the sun and subsequently converting it into electricity. The solar energy is an uninterrupted source available at least for a few hours. Solar power is available during the day hours. Recently the researchers has made a record by utilizing 44.4% of the energy from solar energy at highways. Thus,

solar energy can be used to provide energy to the street lights alongside the highways.

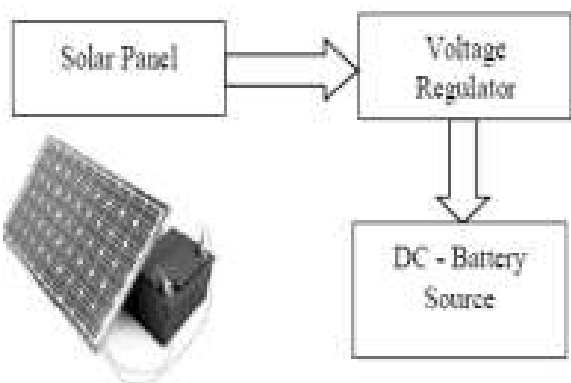


Fig -1: Solar Tracking System

3.2 Wind Energy

Another source of renewable energy is Wind Energy. Wind turbines convert the kinetic energy in the wind into mechanical power by rotating propeller like blades around a motor. The motor turns the drives shaft, which turns an electric generator to convert mechanical power to electricity. The factor that affect the amount of energy a turbine can produce from wind is:

$$\text{Wind power} = 0.5 \times \rho \times a \times v^3$$

Where, ρ = air density in kg/m^3 ,

a = rotor swept area (m^2),

v = wind velocity (m/s)

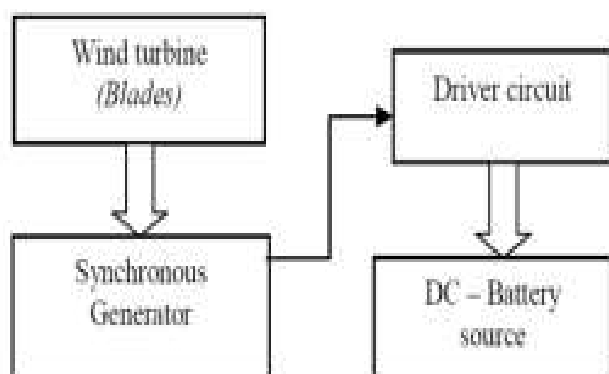


Fig -2: Wind Energy Generation

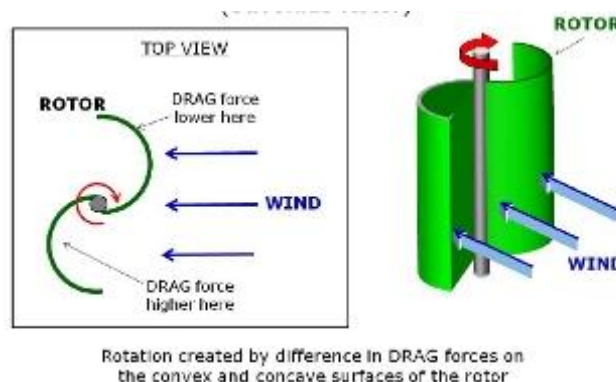


Fig -3: Drag-Based Wind Turbine Concept

Vertical Axis Wind Turbine

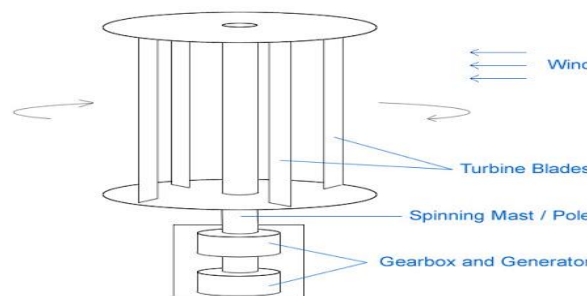


Fig -4: Vertical Axis Wind Turbine

3.3 Hybrid Energy

A hybrid energy system generally consist of two or more renewable energy sources which are used together to provide huge system efficiency as well as increased balance in energy supply. With the quick economic improvements, energy usage has raised year by year. Conventional energy is facing increased demand causing an urgent need for new clean renewable energy sources. Among the current amount of renewable energy, wind and solar energy's potential is the largest, and has the most development value. They are an inexhaustible renewable energy. Environmental friendly power hybrids are the answer for a solid, reasonable incorporation of sustainable power sources, addressing basic necessities. From the mix of sun oriented and wind power, to a mixture of wind and hydropower, these inexhaustible frameworks can drive imperative dependability to the matrix. Every cross breed power application is novel and can incorporate environmental friendly sources with each other, like wind and sunlight based. Sustainable power offers one of the business' broadest arrangement of inexhaustible innovations that can be coordinated to create Hybrid projects, requiring refined skill and capacities.

4. HYBRID STREET LIGHT

Hybrid street light is a smart, off grid LED street light system, constructed of solar panels, wind turbines, backup

batteries, controller and a LED. A wind system and solar photovoltaic (PV) cell is the best hybrid combination of all renewable energy systems and is most suitable in all aspects. The charge controller can adjust output power to get longer operating duration according to the capacity of battery, and use the energy for the lighting system during the night. In addition, the intelligent street light switch regulator doesn't need any human activity. Therefore this hybrid system can obtain great popularity and attention.

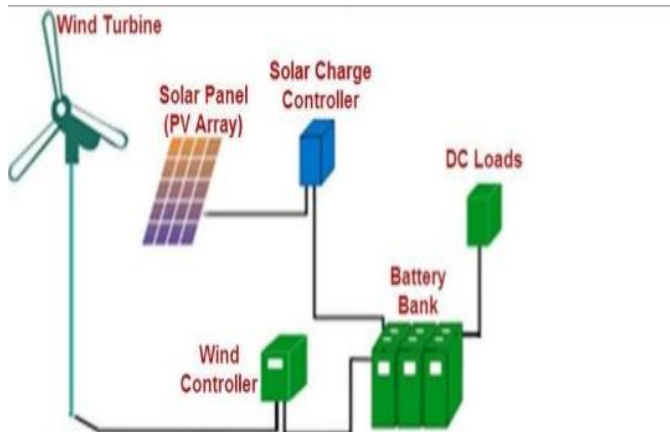


Fig -5: Hybrid Power Generation

4.1 Need of Hybridization

As sustainable energy technologies become more developed, there is a greater interest in the advantages of combining two or more sources. Hybrid energy systems can be integrated alongside existing power generation systems, enabling companies and communities to make full use of their assets and ensure a stable supply. Hybrid energy arrangements can be custom fitted to the climate, adjusting to variations, for example, changing climate conditions for wind and sunlight based sources. It is also a cost efficient technique that can be used by the poor grid connectivity in many distant and rural areas.

5. IMPLEMENTATION

Wind turbine and Solar Panel are connected to a Charge controller circuit. The Charge controller circuit is connected to a battery. Charge controller circuit will show if solar panel and wind turbine is working properly or not. We can attach different types of LEDs on ESP32 and collect the data. Using ESP32, the data collected can be sent to the server, and can check the working status of solar panel as well as wind turbine, We can also check whether the LED is glowing or not. A temperature sensor will also be mounted, in case of any high heat (rise of temperature) in order to avoid or reduce any damage to LED. We will also mount a voltage regulator sensor, so that voltage supplied doesn't exceed the required amount of voltage.

6. CONCLUSIONS

In an approach towards smart cities, building an energy-efficient and cost-effective solutions for the issues faced by conventional outdoor lighting systems have become need of the hour. In this context, IoT stands as a promising and fascinating technology which senses the environment through sensors and transparently communicate with the actuators to decide an action plan.

REFERENCES

- [1] Indian journal of science and technology, vol 11(37), October 2018 , A comprehensive study of internet-of-things (Iot) based smart street lights.
- [2] International journal of advanced research in electrical, Electronics and instrumentation engineering, vol. 6, issue May 2017, Solar and wind hybrid energy system for street lighting.
- [3] International journal of science, engineering and technology research (ijsetr), volume 3, issue 3, March 2014, Solar and wind hybrid power generation system for street lights at highways.
- [4] Srivatsa, d. K., Preethi, B., Parinitha, R., Sumana, G., & Kumar, A. (2013). Smart street lights. 2013 texas instruments india educators'
- [5] IEEE International Conference on Circuits and Systems (ICCS2017), 2017 Fathima Dheena P.P , Greema S Raj, Gopika Dutt , Vinila Jinny S, IOT based smart street light management system.
- [6] 2011 Fourth International Conference on Intelligent Computation Technology and Automation, Wang Guijuan, Wang Zuoxun , Zhang Yingchun, Shao Lanyun Scho, A New Intelligent Control Terminal of Solar Street Light.