HYBRID POWER GENERATION FOR FUTURE EV STATION USING IOT

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Keywords:

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Introduction:

Electricity demand is increasing in the modern world. Natural resources will deplete one day, and a replacement must be found. The use of fossil fuels pollutes the environment. The greenhouse effect and global warming must be avoided. To accomplish all these one must focus on shifting energy away from conventional resource usage and toward non-conventional power generation methods such as wind and solar energy.

Vertical axis wind turbines that generate power on highways have a low cost and efficiency. When compared to traditional power generation methods, VAWT is both environmentally friendly and cost effective. For power generation, we have two efficient and renewable energy sources. There are two entities in this design: one for power generation via solar panels and wind turbines, and another for street light control via ldr and ir sensors.

Vertical turbines which are placed at highways, will rotate with the wind speed so that the wind force due to vehicle movements can be converted into electric energy. Solar panels, placed at highways, will use solar energy at day time and convert it into electric energy and during night time they will use vehicles headlights which acts as light energy. LDR is used to detect the day/Night time.

Objectives:

- Design of Hybrid Power Generation at Highways for future EV Station Using IoT.
- Develop an integrated renewable energy system combining wind and solar power to generate sustainable energy for road infrastructure.
- Install VAWTs on highway dividers to capture vehicle-induced wind energy using aerofoil-shaped blades.
- Place solar panels above the VAWTs to harness sunlight during the day and headlight beams at night.
- Implement battery systems to store the generated energy, supply the battery for EV stations for future use

Methodology:

This proposed project is to design and develop the generation of power on highways using Vertical axis turbine and solar energy.

The design involves three stages:

a. Energy generation

b. Energy monitoring

c. Energy conservation

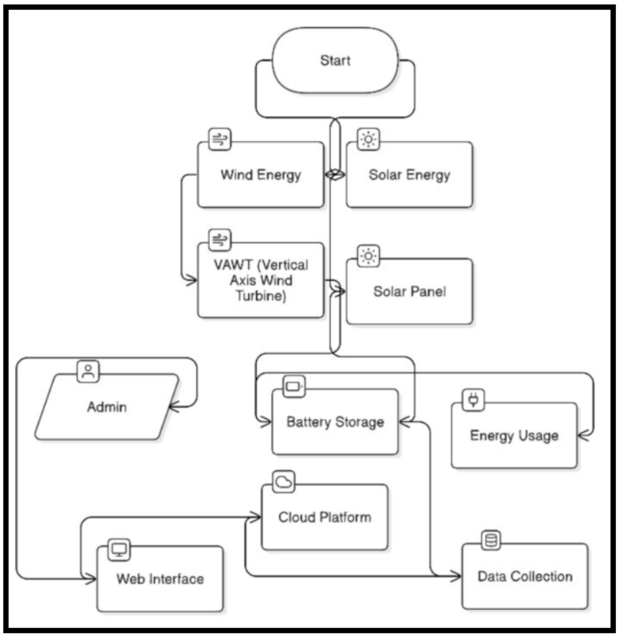

Figure 1: Use case diagram

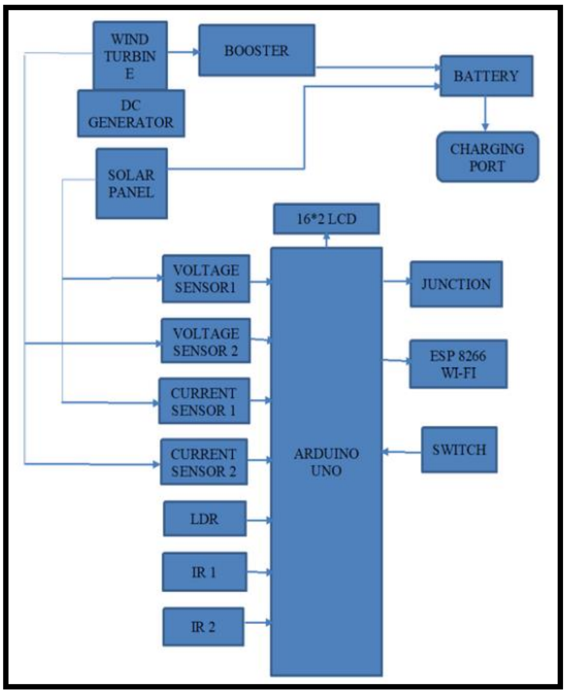

Figure 2: System Architecture

First stage involves:

• Design of vertical axis turbine.

• Optimal placement of the solar panel over the VAWT operating the solar panel on the concept of MPPT (maximum power point tracker).

• Power generation with help of vertical windmill and solar system.

• Produced energy should be used efficiently i.e storage of energy onto the battery

Second stage involves:

Monitoring the power generated by the renewable source of energy and uploading it to cloud using thingspeak, where the data is stored and analysis will be done for the set duration.

Third stage involves:

Usage of generated power for the two end applications:

1. EV charging stations.
2. Street light control.

Results & Conclusions:

This section deals with the results obtained from implementation of the project, and discussing their implications. The proposed project was designed and implemented and the mentioned objectives were met and the wind and solar powers can be taken on daily basis for further analysis. The power results are taken from the thingspeak and are as such:

	A	B	C	D	E	F	G	H	I	J
2	2022-06-2	1	7	1	2.5	2.5	17.5	2.5	20	
3	2022-06-2	2	8	3	2.49	2.49	19.92	7.46	27.38	
4	2022-06-2	3	0	2	2.49	2.48	0	4.96	4.96	
5	2022-06-2	4	0	1	2.21	0.59	0	0.59	0.59	
6	2022-06-2	5	0	1	2.42	0.6	0	0.6	0.6	
7	2022-06-2	6	0	1	2.36	0.64	0	0.64	0.64	
8	2022-06-2	7	0	1	2.35	0.35	0	0.35	0.35	
9	2022-06-2	8	1	1	2.34	0.31	2.34	0.31	2.66	
10	2022-06-2	9	0	1	2.45	0.35	0	0.35	0.35	
11	2022-07-0	10	0	0	2.48	2.47	0	0	0	
12	2022-07-0	11	0	0	2.48	2.48	0	0	0	
13	2022-07-0	12	0	0	2.47	2.47	0	0	0	
14	2022-07-0	13	0	0	2.48	2.46	0	0	0	
15	2022-07-0	14	0	10	2.47	2.49	0	24.9	24.9	
16	2022-07-0	15	0	0	2.5	2.5	0	0	0	
17	2022-07-0	16	0	0	2.51	2.51	0	0	0	
18	2022-07-0	17	0	0	2.5	2.5	0	0	0	

Figure 3: Wind and solar power output

The 2-D plot of voltage, current, power of wind and the voltage, current, power of solar and the total power can be viewed in thingspeak by creating respective fields in a channel created and the previous data can be exported in Excel format as shown in the figure 3.

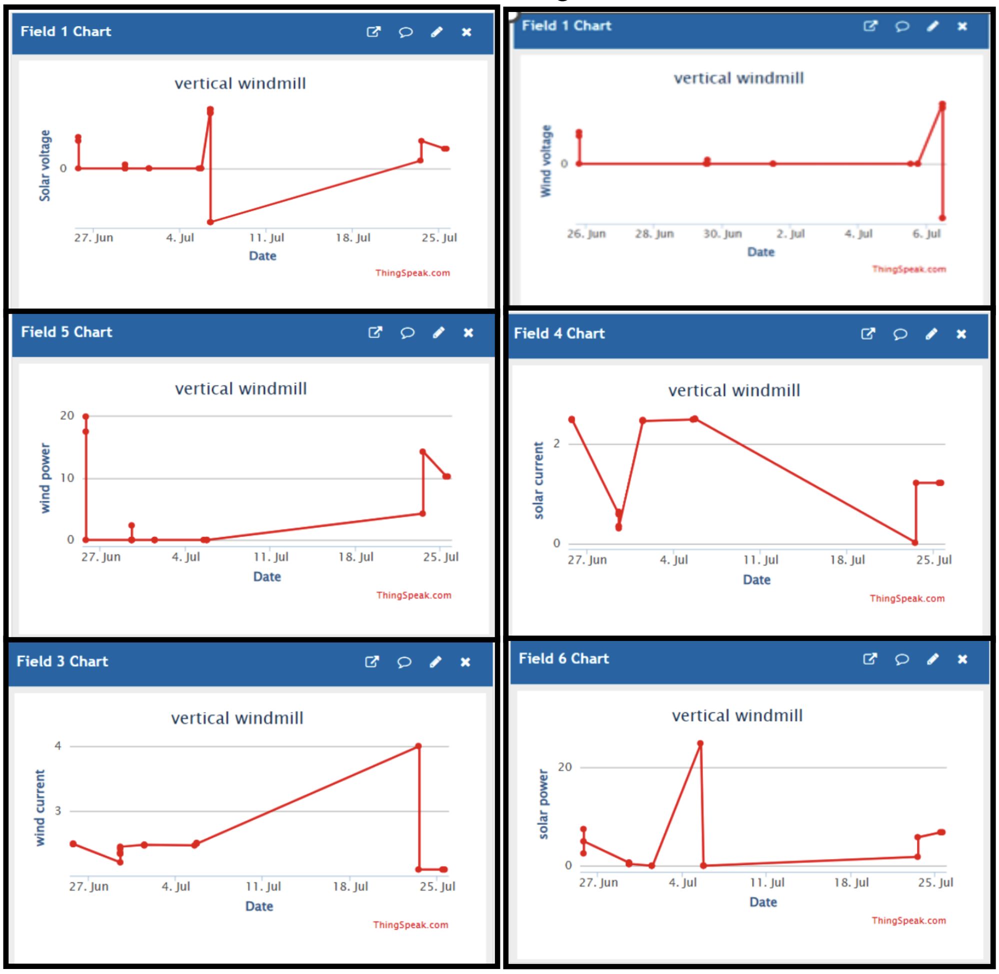

Figure 4: Graphs Wind and solar voltage, power, current

The voltage and the current from the respective sources gets multiplied to get a power and the total power is obtained by summing those two.

• It is obtained that around **25 watts to 30 watts** of total power can be obtained from this single model depending on the windspeed.

• From wind turbine maximum upto **10 to 12 volts** can be generated and from solar upto **8 to 10** volts can be obtained so total of around **25watts to 30watts** can be obtained at its peak.

Conclusion:

In today's technology most of the human made machines are designed with the objective of limiting greenhouse effect which causes climatic changes. Renewable energy sources dominate over non renewable energy sources. With many innovative ideas renewable energy sources can be made use of in many types of applications to provide kind of clean energy. It also reduces the cost and avoids the damage to the earth.

VAWT's design allows for low-cost operation because no fuel is used, as well as testing to meet environmental pollution challenges. Its application is for small-scale maintenance and operations investments.

Project Outcome & Industry Relevance:

This project focuses on generating renewable energy using a combination of vertical axis wind turbines (VAWT) and solar panels. It contributes to sustainable energy solutions for highways by using wind and solar power to support applications like EV charging stations and smart street lighting. The energy generation is optimized through MPPT (Maximum Power Point Tracking) and stored in batteries for later use. Monitoring and analyzing power generation is done using IoT and cloud technologies, ensuring efficient management. The smart street lights only activate when vehicle movement is detected, conserving energy. This approach can be implemented in smart city projects and transportation infrastructure, reducing reliance on traditional power sources, lowering carbon footprints, and promoting sustainable urban development.

In industries, this project could be applied to highways, smart cities, and transportation infrastructure, reducing carbon footprints and improving energy security. The real-time data monitoring and conservation methods open avenues for further research and improvement in energy management systems for public and private sector applications.

Working Model vs. Simulation:

The hardware model i.e. wind turbine is designd using cad-solid works software and the arduino microcontroller is coded using Arduino IDE software hence the proposed project's hardware and software implementation is as such:

The three bladed savonious wind turbine is first designed using Solid works with the height of around, width of meters, 2.5 ft, with circumference of around 1.6 m and angle of inclination of 33.33 degrees. The voltage and current of wind as well as solar voltage and current which is generated is displayed on the LCD the wind and solar power will be calculated and the same data will be displayed and is uploaded to the cloud using a ESP8266 WIFI module through ThingSpeak.

Project Outcomes and Learnings:

The key outcomes of this project include the successful integration of vertical axis wind turbines (VAWT) and solar energy systems to generate renewable power for real-world applications, such as EV charging stations and smart street lighting. The system was able to efficiently harness both wind and solar energy, store it in batteries, and utilize IoT technology for monitoring and data analysis. Additionally, the smart street lighting system demonstrated energy conservation by activating only when vehicle movement was detected, making it more efficient and sustainable.

From the process of designing and implementing the project, I learned the importance of optimizing system components for efficiency—such as the strategic placement of solar panels on top of the wind turbine to minimize space and maximize energy capture. I also gained valuable insights into the use of MPPT for solar power optimization and the complexities of integrating various energy sources into a single system.

The process of monitoring energy generation and consumption using IoT technologies reinforced the significance of real-time data collection and cloud analysis in improving system performance and management. Furthermore, working with energy storage systems highlighted the need for efficient battery management and energy conversion processes to ensure the system's reliability.

Overall, this project taught me how to combine different renewable energy technologies effectively, apply smart energy management techniques, and optimize power usage in real-world applications. It also provided a deeper understanding of the challenges and opportunities in creating sustainable energy solutions for urban infrastructure.

Future Scope

Future development of a country depends on the self-dependency for energy demands. It will free a country from its dependency on other countries for energy generation. Wind and solar energy are the best method and efficient to generate power. But there are some limitations in implementing the wind turbines like the capitol cost. Therefore, cost of wind turbines should be less so that they can be easily planted in more areas. For this the modification of rotor blade areas and turbine's axis that is rotational can be coupled with a large rating generator for producing power in wide range as it can

compensate with the initial cost. In order to outpace the current solar cells, a different design need to capture more light transform it into electricity and must be less expensive to be built compared to current designs.

The proposed project can be applied to:

- Hydrokinetic applications.
- Power nearby villages.
- Can be incorporated in Remote areas.
- Street light control.