



# SMART HIGHWAYS AND GREEN ENERGY RESOURCES USING IOT

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## ABSTRACT

Worldwide issue to mitigate the hovering electricity disaster introduces all countries to the small-scale renewable electricity era as a maximum well-preferred sanctioning deliver for direction lighting. Production of renewable electricity from highways victimization big name pursuit panel is utilized in several applications. at some point of this undertaking we have a tendency to apply big name panels to give you renewable electricity which is probably preserve in atomic variety three batteries. The IOT commentary gadget in interfaced with Adafruit software program bundle this is hired to take a look at the pollutants and shops the day by day usage in cloud. The SOS alarm is hired beside the tool to factor the twist of fate happened in faraway regions to the close to toll gate. SOS message can ship IFTTT to the area mail ID toll gate. This version makes use of Node MCU for dominant utility and records commentary. In destiny the undertaking is prolonged with the aid of using imposing opportunity renewable assets like wind electricity.

**KEYWORDS**—Solar tracking panel, Adafruit, Renewable energy

## INTRODUCTION

Highway is referred to as Any public street or other public path on land, as the term suggests. It usually refers to large roadways, although it can also apply to public walkways and walks. The Indian highway system which spans 33 lakh kilometers and includes the world's largest highways, is the second largest in the world. road network, yet it carries around 40% of overall traffic. The no of autos has climbed by an average of 10.16 percent per year during the last five years. The magnitude of fuel (petrol, diesel, etc.) consumed by those cars increases as the number of conveyances increases. Vehicle fuels create harmful gases including hydrocarbons, nitrogen oxides, carbon monoxide, and Sulphur dioxide, among others, and these fuels are in short supply in nature. These fuels (utilized as a source of energy for automobiles) will undoubtedly vanish from the face of the globe today or tomorrow. As a result, certain radical adjustments in the highway concept are required. So, in this study, we're attempting to provide some light on methods for using green energy successfully on Indian roadways. We will find out several strategies for gathering green energy on highways, which will eventually provide us with electrical energy. In this paper, we will cover numerous effective strategies for transforming green energy towards electric energy and applying it to build smart highways [1]. A "Smart Highway" is a concept aimed at making roads smarter, safer, and energy efficient.

One of the most difficult components of deploying. The energy supply is managed by a hybrid energy-driven lighting system. Despite the fact that it is normal practice to develop controllers based on various logic algorithms to manage energy in

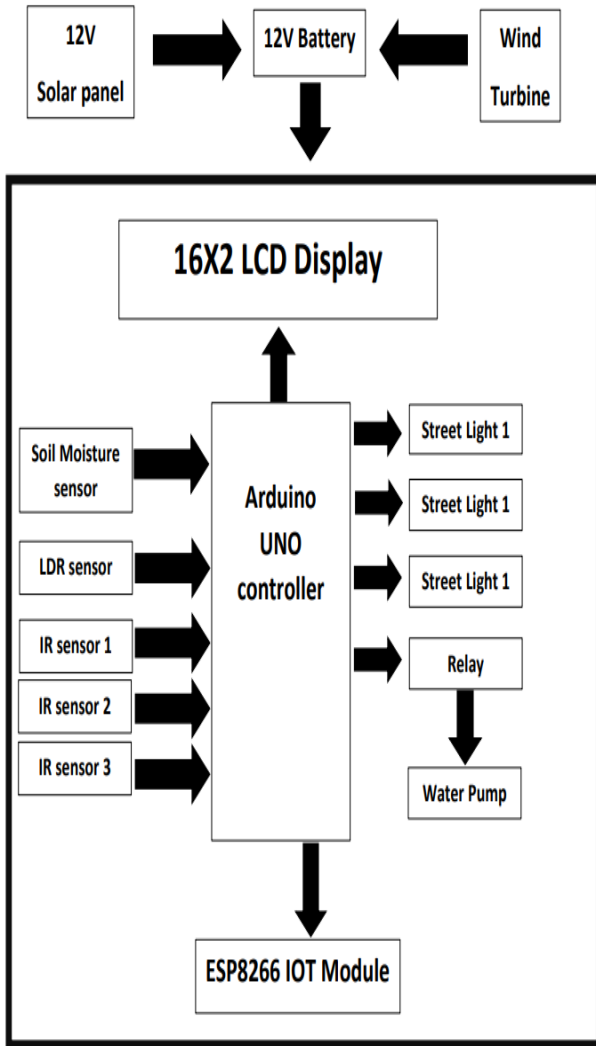
hybrid systems, adding. The idea of using the Internet of Things to control energy in hybrid systems could be a promising way to increase energy management's reliability and efficiency. The Internet of Things allows the system to recognize its own behaviors based on its own threshold levels. IoT-enabled hybrid energy management systems for highway lighting appear to have received little attention in the literature [2]. An IoT-enabled hybrid system including solar and Peltier plates was developed with the purpose of generating and managing numerous energy sources as part of this limited endeavor.

In this work, however, the application and implementation domains in which the system is supposed to work are lacking. Similarly, in the business sector, a hybrid system was presented based on the Internet of Things (IoT) concept for energy management and performance monitoring, with HAWT serving as the primary application for hybrid energy generation. [3] This paper also reviews to promote the use of Electric Vehicles by providing charging stations which makes this entire system environmentally friendly. Trees planted near roadside are also irrigated by this system which helps in controlling air pollution near roads/ Highways.

## TECHNOLOGY USED

Green energy, such as solar, vibration, and wind energy, may be converted into electricity, which can then be used in a variety of ways on highways, including charging electric vehicles, lighting, and monitoring road conditions. There is plenty of open area between the two lanes that might be used to install wind turbines and solar panels

**BLOCK DIAGRAM**



This lighting system's major source of energy is a PV panel, but the HAWT is employed to lessen solar dependency. and improve system reliability in inclement weather. PV panels charge the battery during the day when sunshine is available, but HAWT charges the battery continuously for 24 hours using wind waves generated by vehicle motion. The battery stores the energy that will be needed to light the LED at night. People's safety on the highway by installing panic buttons on every light pole, so that if a traveler encounters an emergency and requires immediate assistance at that specific location, the traveler can press the panic button, and the system will send the traveler's current location to the nearest help center, allowing for immediate assistance and support. All sensor data will be sent to The ATmega328-based Arduino microcontroller board contains 14 digital input/output pins (6 of which can be used as PWM outputs), 6 analogue inputs, and a 16 MHz crystal oscillator, and an operating voltage of 5 volts. Wi-Fi Module - ESP8266 enabled system on chip (SOC) module built by Espressif system will transport data from Arduino to the desktop/android phone. It's primarily used to build embedded IoT applications. It is powered by a 32-bit RISC CPU based on the Ten silica xtensal106 and runs at 80 MHz (or over clocked to 160 MHz). A 64-kilobyte boot ROM, 64-kilobyte instruction RAM, and 96-kilobyte data RAM are all included. External flash memory can be accessed using SPI. The LDR

sensor will be used by the microcontroller to determine whether it is day or night. A LDR(Light dependent resistor) is a component that is sensitive to light. The resistance changes when light shines on it The LDR's resistance varies by orders of magnitude, with resistance reducing as the amount of light increases. With such a vast fluctuation in resistance, it is not uncommon for the resistance of an LDR or to be several mega ohms in darkness and then drop to a few hundred ohms in high light. With such a wide change in resistance, all lights will turn off automatically during the day. At night, all lights will glow at 30% intensity; however, if the system detects a vehicle, just the street lights closest to the car will switch on at 100% intensity, while the remaining lights will shine at 10% intensity.. Mathematically, the flow of current through the LED can be written as

$$IF = Vs - VD/Rs$$

'IF' stands for forward current; 'Vs' stands for a voltage source; 'VD' stands for the voltage drop across the light-emitting diode; and 'Rs' stands for a current-limiting resistor. The moisture level of the soil is also sensed using a The soil moisture sensor is made using of two probes that monitor water volumetric content. Using the two probes that helps the current to flow through the soil, the resistance value is utilised to calculate the moisture content.. When there is more water in the soil, the electrical conductivity of the soil increases Because poor electricity is conducted by dry soil, when there is less water, the soil conducts less electricity, resulting in higher resistance. As a result, the product's moisture content will be lowered. The following are the specifications for the FC-28 soil moisture sensor: The moisture level can be measured using an LCD 16\*2 with a 4.7V-5.3V operational voltage. in less resistance. As a

Input Voltage	3.3-5V
Output Voltage	0-4.2V
Input Current	35mA
Output Signal	Analog and Digital

result, the moisture content will be increased.

**Hybrid Energy  
Solar Energy**

Solar energy is a universally available renewable and clean energy source for the entire planet, at least for a few hours depending on the earth's rotation. During the day, solar electricity is accessible from 9 a.m. until 6 p.m. This energy can be used to power motorways. Only the centre of the street has street lights, not the shady portions. Even though the solar panel is in the middle, the power generated by the panel will not fluctuate and will remain as a default output. The sun is a massive energy source. Solar energy is the energy emitted by the sun in the form of radiation. Solar energy can be used in three different ways:

- I. It can be converted into thermal energy.
  - II. By transforming it into electrical energy.
- Photosynthesis is the third method.

A solar collector can be used to generate thermal energy from the sun. Electricity is created directly from solar energy in a solar photovoltaic system. Its operation is based on the photoelectric effect principle. Photovoltaic cells can help solar cars achieve this (PVC). PVCs are the materials used in solar panels to convert sunlight into electricity.

They are constructed out of light-absorbing semiconductors, most often silicon. The energy from the sun frees electrons in the semiconductors, resulting in an electron flow. The electricity that fuels the battery is generated by this flow.

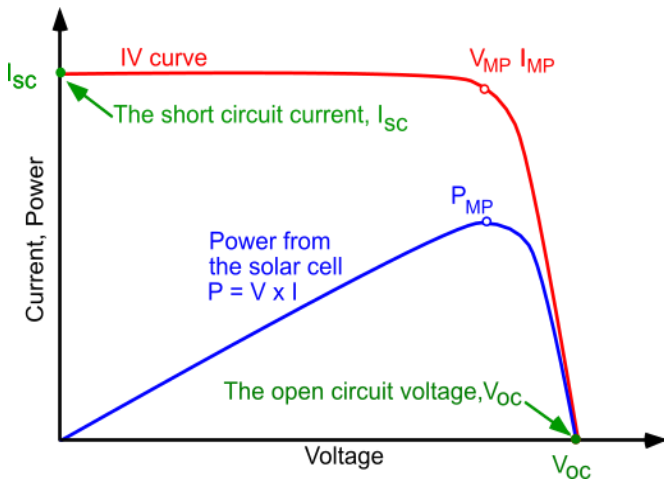


Fig :-output graph for solar panel

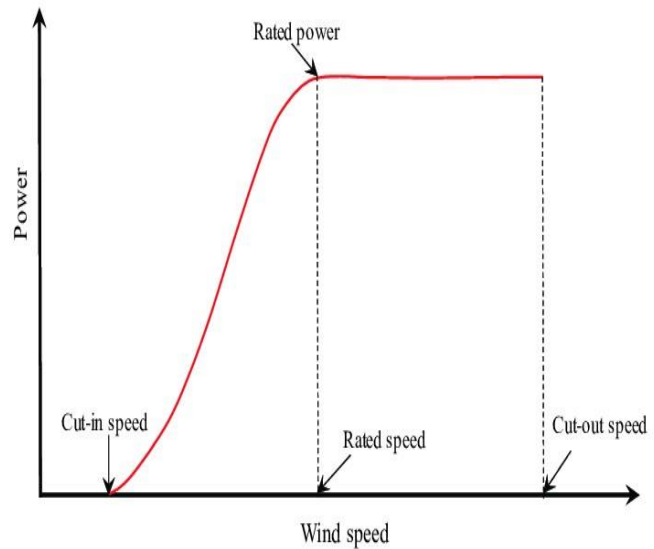


Fig:- wind energy output graph

### Wind Energy

Wind energy is one of humanity's oldest sources of energy. The kinetic energy of the atmosphere is represented by wind. Wind is created by a force that develops as a result of pressure changes in the atmosphere. Wind energy is the energy produced by wind turbines using the movement of the wind. It is a renewable energy source that can be used as a substitute for fossil fuels. Wind energy is a non-polluting and non-emitting source of energy that does not pollute the environment or produce hazardous elements like greenhouse gases.

### WIND ENERGY IN ACTION

Vehicles on the move When a free-moving air particle is disrupted by a powerful item along its path, a pressure is created at the object's body, which is then supplied to nearby objects. This phenomena causes a wind turbine to be put on the top of a street lamp[5]. All large wind turbines, in general, have the same structure, which is a horizontal axis wind turbine. with a three-bladed upwind rotor. Between the turbine generator and the collection system, we now use. There is a combination of variable speed generators and partial or full scale power converters in wind turbines. A wind turbine is a mechanism that converts kinetic energy from the wind into electricity. When running automobiles on the highway cross each other from the left and right, a strong wind can be generated when two vehicles cross the blade evenly. The blades of a wind turbine are connected to a synchronous generator in order to maintain a constant rotating RPM (rotation per minute). Because of its motion, wind has energy that can be used to generate electricity. As a result, kinetic energy is converted into electrical energy by a wind turbine.

Because vehicles generate a significant quantity of wind, we can use a windmill application on the highway. Because the wind turbines will be installed on medians, air movement from both sides of the highway will be taken into account in the design.

### THE SOLAR PHOTOVOLTAIC LED LIGHTING TECHNOLOGIES FOR HIGHWAY

The project is basically a multi-functional prototype that can replace the manual operation of the old street lighting system with a self-automation strategy. Soledad Escobar, "Estimating Energy Savings in Smart Street Lighting by Using an Adaptive Control System." Its goal is to create and implement advanced embedded system development for energy conservation and roadway maintenance lighting at a lower cost using modern development. The PIR is used to determine the movement of cars on the road, and the Light Dependent Resistor (LDR) is utilised to show day/night time. The ARDUINO UNO (ATMEGA328T) serves as the brain of the road light system, with ARDUINO serving as the programming language for the microcontroller's software[7]. The proposed technologies offer a solution for energy conservation, which is commonly accomplished by sensing a forthcoming vehicle using an infrared transmitter.[8]

When the sensor detects movement, it sends the information to the microcontroller, which tells the light to turn on[9]. Similarly, when a vehicle or a barrier moves out of the path, the sun shifts. The state (ON/OFF) of the road light may be accessed from anywhere and at any time over the internet since the sensor detects any object at the same time[10]. The Wi-Fi ESP (8266) MODULE is used to upload critical time data to the cloud using an IOT panel. The pole number is displayed on the crystal display LCD screen with the help of the IOT panel[11], and if any of the poles is shifted, it will display the information that the pole is finally shifted.





## PLANT WATERING MANAGEMENT ON HIGHWAY

Water management is crucial in locations where water is scarce. This has an influence on agriculture, as agriculture consumes a substantial amount of water. Water adaptation solutions are being investigated as a result of the anticipated impacts of global warming to ensure that enough water is available for food livelihood. As a result, lowering water use have been conducted. in the plant watering system on highways Over time, the procedure has become more complex. On highways, Sensors for agriculture plant irrigation systems that are commonly used commercially Smaller farmers are unable to implement these systems because they are prohibitively expensive. Manufacturers, on the other hand, are already offering sensors that can be connected to nodes to build economical plant irrigation, highway management, and farm resolving systems; recent developments in IoT and WSN is utilized in the design of these systems, we offer a survey focusing on summarising the current state of the art in modern cities. On highways, there is a mechanism for watering plants. Water amount, soil qualities, and weather conditions are all factors to consider. are all considered in these systems. We give a rundown of the most often used nodes and wireless technologies. Finally, we'll talk about the obstacles and best practices for installing sensor-based plant watering systems on roads. Fresh water scarcity is becoming more of an issue, Particularly in Mediterranean countries and countries in southern Asia. A relationship stand between climate policies and water management. A multitude of factors influence water management, including water demand from diverse regions and effects of varying warming on groundwater resources. In articles regarding water resources and agriculture, climate change and its repercussions are frequently explored. Water adaptation techniques are being examined as a result of the probable impacts of global warming to secure water supply for food production and people, as well as ecosystem sustainability Furthermore, the water that humans will consume and return to the ecosystem must be safe. Climate change could lead to a rise in water scarcity, a drop in water standard, a loss of diverseness, scale in plant watering system on highways, or an increase in the expense of emergency and remedial actions. Studies focusing on lowering water utilization in plant watering systems on road procedures has increased as a result of these variables. Some of these studies recommend that, To improve water management, social, economic, and weather change policies, as well as technical improvements, must be implemented. One of these countries' most important economic resources is agriculture. emphasizing the need of effectively managing existing water resources to ensure the economic sector's survival. Rice crops cover ten percent of India's total land area. Immense Indian population lives in indigence, with 15% of the population experiencing food insecurity. Low food production has a detrimental influence on both the population and the economy as a result of this. The monsoon season has produced the least quantity of precipitation in the recent 130 years. As a result of the scarcity of fresh water, rice output declined. The drought caused by anomalies in surface water was measured using the Standardized Precipitation Evapotranspiration Index (SPEI). Water management and reuse systems are already being used in countries with higher resources in order to optimise water consumption and reduce environmental effect. of using large amounts of water. However, these methods

may be prohibitively expensive for other countries. Commercial sensors for agricultural systems and its plant watering system on highways are prohibitively expensive for smaller farmers to implement. Furthermore a water turbidity sensor constructed of coloured and infrared led emitters and receptors, soil moisture sensor consisting copper rings, a water salinity monitoring sensor made of copper coils, or a leaf water stress monitoring sensor, are among the modern economic sensors utilized in research. We will present an overview of the current status of research counting review that summarises the current state of the art in smart plant watering systems on highways systems, as a result of recent advances in sensors for plant watering systems on highways systems for agriculture, as well as the evolution of WSN and IoT technologies utilized in advancing this system. plant watering systems on roads systems in this survey. We'll figure out what criteria are monitored in highway plant watering systems in terms of water amount and quality, soil qualities, weather situation, and fertilizer consumption. We'll go over the most often used nodes and wireless technologies for implementing WSN and IoT-based smart plant watering systems on highways. Finally, we'll talk about the obstacles and best practices for installing sensor-based plant watering systems on roads. Other researchers focused their research on plant watering systems on roads, water monitoring, and precision agriculture systems. Other published review on smart plant watering systems on highways systems, on the other hand, analyzed a large number of publications and thus do not give an in-depth examination of the state of the art in terms of plant watering systems on motorways systems. Others are focused on plant watering system on highways such as software for plant watering system on highways, pivot center specific plant watering system on highways or plant watering system on highways. Finally, there are surveys that comment on plant watering systems on highways agriculture and precision agriculture crop monitoring. We present an overview of current improvements in plant watering systems on highways systems, as well as the sensors and actuators that are used, in this survey. We also go over the most commonly used nodes as well as the wireless technologies that are used to communicate and transmit the data collected by the sensors. This paper fills a vacuum in the literature by conducting a survey that provides an overview of an IoT-based smart plant watering system on a highway.

### Soil Moisture sensor

Soil moisture sensors are used to determine how much moisture is present in the soil. Soil moisture sensors use another sensor to detect the volumetric water content. Because direct gravimetric measurement of free soil moisture necessitates the removal, drying, and weighting of a sample, a soil property such as electrical resistance, dielectric constant, or neutron interaction can be employed as a proxy for moisture content. The link between the measured property and soil moisture must be calibrated, and it can vary depending on environmental factors including soil type, temperature, and electrical conductivity. things. Solar panels are used to convert solar energy into electricity. The energy generated by the solar is stored in batteries and is used to provide electricity to dc lamps. Additional benefits can be obtained by saving fuel using this improved program. A lot of research work needs to take advantage of possible. The state of renewable energy sources



such as solar systems is satisfactory in India but needs more attention in order to better develop renewable energy sources.

## PROPOSED METHODOLOGY

In this proposed system, green renewable energy is used to make the highway smarter. Here the solar panel is connected to the battery. Internet of Things (IOT) is the ability of a controller or a computer-controlled system to perform tasks normally performed by humans because it requires human ingenuity and understanding. Performance intelligence where integrated all actions and components are directly and indirectly connected to the controller. Infrared sensor connected to the controller, any car that crosses the sensor automatically makes the sun street light a high intensity. Smoke sensors detect environmental pollution along the road through renewable energy. For sunlight to be achieved by using DC lamps. With IoT technology, all information is sent to the website via Artificial Intelligence. Automatic solar tracking is done using light sensors and AI algorithms. Mems sensor provides an intelligent solar panel angle. Nodemcu and Arduino microcontrollers are used. In that case it has built a Wi-Fi module with which it is accessible.

## RESULT AND DISCUSSION

Internet of Things (IoT) and green energy with which we manage the project and receive updates quickly. Iot is used to get updates on the sensor of the sensor and WIFI. We have connected the internet to Nodemcu's microcontroller and Adafruit is the IoT platform for that level of pollution that continues to update this website. The DC light bulb is automatically adjusted with the Iot algorithm for any emergency on the side of the road with an IFTTT email notification sent to the emergency team. This work can be done on all sidewalks using renewable energy. This will help to reduce the use of fossil fuels and provide a green space.

## CONCLUSION AND FUTURE WORK

### CONCLUSION

Solar panel is a good and effective energy efficiency solution. In this project internet of things based on automatic street lighting control and solar panel movement based on sunlight are all actions controlled by internet of things. Solar panels are used to convert solar energy into electricity. The energy generated by the solar is stored in batteries and is used to provide electricity to dc lamps. Additional benefits can be obtained by saving fuel using this improved program. A lot of research work needs to take advantage of possible. The state of renewable energy sources such as solar systems is satisfactory in India but needs more attention in order to better develop renewable energy sources.

### FUTURE WORK

As a smart integrated highway it is a system based on green energy and internet of things. These two are a real and temporary state of renewable energy in India. This intelligent integrated highway is very important and useful for the production of easy-to-use electricity. These renewable energy sources are based on renewable energy sources that will replace the current demand for fossil fuels leading to a reduction in greenhouse gases, CO<sub>2</sub>, pollution. This generated energy is used by the charging station (ECS) and will be used to replace mixed electric vehicle.

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