A SURVEY TO FIGURE OUT THE PERFORMANCE OF MICRO FOLIAGE WITH INTELLIGENT ILLUMINATION SYSTEM

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Abstract — A hybrid tree is an artificial structure mimicking a natural tree with branches where on top, the solar plates and wind turbines are affixed. A framework that combines renewable (solar and wind) energies is mentioned as a hybrid energy generation system. Its components are solar panels, a Helical model, a Battery, an LCD Display, a Regulator, Arduino IDE, etc. It can provide power to electrical devices, household appliances, and lighting needs across both small and expensive areas, making it the optimal solution for modern societies in electricity generation. Within the considered system in harnessing the dual forces of solar radiation and wind energy during daylight hours, the stored power in the batteries is subsequently harnessed by LED lights at night to illuminate streetlights, and concomitantly, wind turbines play a role in replenishing these batteries, thereby establishing a sustainable loop for powering streetlights. This unique approach not only circumvents daily operational expenses but also facilitates the full disconnection of the system from conventional power grids, thereby exemplifying the advantages of an Internet of Things (IoT)-based hybrid street lighting system which by leveraging on renewable resources, assumes a vital role in the infrastructure of a smart city, playing an important part in enhancing both road safety and pedestrian well-being. Provided creative fixes just not only facilitate more straightforward control, monitoring, and anomaly identification but also transform conventional street lighting into an intelligent and highly efficient network.

Keywords— Internet of Things (IoT), Arduino IDE, LED, Solar Panel, Wind Turbine, electric vehicles.

I. INTRODUCTION

Power is a vital factor in our daily life. There are two resources from which the electric power can be extracted, namely, (i). Non-Sustainable energy resources (ii). Sustainable energy resources. In response to the growing necessity for energy, a pressing international mandate has arisen to progress the frontiers of non-conventional energy. The overarching philosophy of sustainable development serves as a catalyst, propelling us to delve into substitute energy resources which go beyond just free accessibility but also abundant. This commitment to seeking sustainable solutions underscores a collective dedication to lessening the ecological footprint and fostering a resilient energy future.

Among the biggest problems or challenges that humanity is currently facing is climate change. This challenge will significantly impact the economy's growth. Increased usage of non-conventional materials is a great option in addressing these issues. Natural processes continuously produce these unconventional sources. Many types of non- conventional energy resources have the potential for power production. While solar energy possesses the drawback of being unable to generate electrical power during rainy seasons, a viable solution to overcome this limitation involves harnessing the benefits of two complementary energy resources. By using a dual-resource approach, the uncertainty of energy extraction failure due to adverse weather conditions is eliminated, as the alternative source can seamlessly take over. Moreover, during optimal weather conditions, the simultaneous utilization of both energy sources becomes a calculated advantage.

Plugin vehicles are tied to artificial intellect and composite software stacks pointing to understanding the real world and performing decisions and task-making activities without the interference of humans. A procedure has been regarded for good allocation of power charging facility in the electric power structure without negotiating the system's performance. The main advantage of the sustainable system is overcoming the carbon-dioxide footprints at different levels, therefore, employing non-conventional energy power lower the carbon-dioxide footprints because the units crafted along the aero-photo power system need not be taken by the thermal-based plant. In recital of the continued rise of aero and photovoltaic generators, granting renewable energies in

grid networks is increasing.

A. Solar Energy:

Solar energy is a non-conventional resource of energy. Solar energy refers to capturing of the sun's energy and converting it into electricity. The sun's radiation is an uninterrupted source available at least for a few hours. Solar power is available throughout the day.

B. Wind Energy:

Another source of non-conventional energy available is Wind Energy. Wind turbines are important in harnessing this power source by converting the dynamic energy present and using it to generate electric power via the rotation of turbines. When blades rotate, they drive a motorized shaft, which, in turn, activates an electric generator. This sophisticated process enables the transformation of mechanical energy into electricity, making aerodynamic energy an environmentally friendly and efficient benefactor to the global energy landscape.

C. Hybrid Energy:

A hybrid system typically involves the assimilation of multiple non-conventional resources that simultaneously work to enhance overall system performance, also achieve a more balanced energy supply. This strategic combination of multiple renewable sources not only optimizes the application of each technology but also contributes to a more reliable and resilient energy infrastructure. Among the current number of renewable energies available, these (solar and wind) energies hold the potential to become the largest and most developed values. They are an inexhaustible renewable energy. Every crossbreed power application is novel and can incorporate environmentally friendly sources with each other, like wind and sunlight based.

D. Solar-Wind Power and Electric Automobiles:

Electric automobile electrification with grid-connected renewable resource systems replaces their reliance on fossil fuels. Using sustainable energy-based power systems reduces the carbon footprints, as their unit need not be consumed by thermal power plants. Therefore, electrification of electric automobiles with grid-connected wind-solar energy systems plays a noteworthy role in decreasing the greenhouse effect. When solar panels are set off at night, wind turbines start in, hence it works both day and night. No necessary condition to add the extra storage system to the proposed system.

The remaining part of this document is structured as follows. Part II Overviews the approaches of Nano Tree with Smart Lighting. Part III Challenges of Nano Tree with Smart Lighting Technology. Part IV concludes the paper.

II. APPROACHES FOR NANO TREE WITH SMART LIGHTING

Within this segment, allotment methods for Nano Tree with Smart Lighting have been projected.

E. Photovoltaic tree as Intelligent Highway Pedestrian Light with Atmospheric Monitoring

It explains a connected multi-server Internet of Things (IoT) infrastructure engineered for overseeing and managing an intelligent solar tree, as included in reference [1]. The IoT-enabled photovoltaic tree is presented as an intelligent streetlight with embedded ambient air assessment capabilities, and its deployment has been realized at the Central Electronics Engineering Research Institute in Pilani. The proposed system adopts a tri-layer architecture, featuring a sensory point at the lowest line for data collection. Positioned above, the photovoltaic tree server orchestrates data sampling by activating the sensor node's software. Following accurate information acquisition, the photovoltaic tree server transmits the information to the main server, which assumes responsibility for aggregating, visualizing, storing, analyzing, and controlling all interconnected photovoltaic trees. The reference comprehensively explores the system's implementation intricacies, presenting a trove of data derived from the photovoltaic tree, while also delineating an IoT network blueprint aimed at transcending the solar tree's conventional role as a power generator, expanding its utility to encompass multifaceted applications spanning security, observation, pollution monitoring, and beyond. At its current juncture, the focal point of the discourse centers on the development of a self-sufficient streetlight endowed with adept supervisory functionalities.

F. Intelligent Street Light System Powdered by Foot Steps

According to the proposed system in [2], An introduction to the execution of automatic Streetlights will switch ON

with full intensity. This takes place only if there are pedestrians on the road otherwise remain off. Huge electricity power loss across the whole place would be minimized by loss of energy. But this is an expensive process. During installation and maintenance, it may cause traffic jams, etc. Streetlight gets electricity out of the sun's radiation which is captured from solar radiated blades and this solar energy is converted to electricity which is used by streetlights at night and early morning.

G. Nanoscience to enhance solar energy

Nanotechnology has tremendous applications in different fields and has a wide range to implement. Presently, to create new techniques in research nanotechnology has been applied. Even though, researchers are interested in this field to develop new materials and applications. Nanoscience has become a diverse and unique field of scientific and technical activity, the reasons being the unique properties of nanostructures and the outstanding performance of Nanoscale devices. At the nanoscale, the attributes of a material can undergo dramatic changes, offering distinctive design possibilities and characteristics that captivate the interest of researchers across the globe. After some time, the energy problem will stand in front of us as recently lot of devices and humans have wasted energy somehow. This manuscript explains how nanotechnology can help the world to enhance maximum energy out of the device or material. The paper also explains the advantages and disadvantages of Nanoscience in producing solar energy. It also describes the brief introduction of promising solar energy according to [3].

H. Role of Photovoltaic Technology

Sun's radiation energy is a widely discussed renewable energy resource. Recently with the rising human population and energy demand, new technologies and improvements should be made in the photovoltaic energy field to fulfill the global energy demand and increase energy efficiency. Solar radiation technique is employed to gain a high- efficiency level with minimum investment cost and less environmental pollution. These use solar cells to generate electricity. As explained in [4], it is exclusively considered. Since only solar irradiance is used, electricity cannot be generated at night with the help of traditional solar cells.

I. Dual-Source Street Light Generation

Implementing a holistic strategy, hybrid structures seamlessly merge renewable(solar and wind) energy resources to control the functionality of streetlights, including essential elements like a photovoltaic panel, Helical model, Battery, LCD Display, Regulator, Arduino IDE, and so on. Daytime solar radiation absorption by photovoltaic panels culminates in the storage of current within batteries, subsequently utilized by LED lights during night times when Light Dependent Resistors (LDRs) activate in response to the deficiency of sunrays. Simultaneously, wind energy contributes to charging the batteries, enhancing the radiance of streetlights and establishing wind as an important force in urban street illumination. The fundamental asset of this forward-thinking approach lies in its characteristics to circumvent daily operational costs, creating a fully self-sufficient off-grid setup. The integration of the Internet of Things (IoT) into dual source street lighting systems plays a central role in realizing a smart city, significantly contributing to the realms of safe driving and pedestrian security, as emphasized in [5]. Given the substantial energy consumption associated with pedestrian lighting, primarily owing to the multitude of lamps, this manifests as significant utility costs. The infusion of IoT into hybrid street lighting solutions not only enables seamless control, monitoring, and anomaly identification but also changes these systems into insightful and streamlined networks. This study meticulously delves astute grid solutions designed to enhance street lighting infrastructure and hands free charging tech utilizing both photovoltaic and aerodynamic energy. The photo-aero streetlight, distinguished by its intelligence, compact design, and off-grid functionality, relies on the rotational dynamics of wind turbines to charge batteries, ensuring continuous streetlight illumination even during the night. In this sample, a 12V direct current system is employed to supply energy for illumination.

J. Intelligent Street Light empowered by piezoelectric sensors

According to [6], The system comprises an Ethernet-based communication interface, an LED lamp module, and a multiphase digital control driving system designed for LED lamps. Working according to principle of harnessing vibration energy produced by the motion of automobiles on the road, this innovative system aims to generate electricity. Its primary objectives include achieving significant power savings and reducing carbon dioxide emissions. Notably, the enactment of intelligent streetlights involves the substitution of sodium vapor lamps with energy-efficient LEDs, yielding a substantial reduction in overall energy utilization. The fusion of IoT and piezoelectric sensors supports sustainable particles, contributing to reducing carbon footprint by optimizing energy usage and harnessing energy from ambient vibration. However, the installation of these different components is expensive as it empowers piezoelectric sensors. Dependence on piezoelectric sensors for energy harvesting introduces a reliance on ambient vibration. In areas with minimal vibrations, the consistency of the energy source could be a worry.

K. Impact of Integrating Plugin Vehicles and Sustainable Energy Resources

Because of the invaluable attribute of nil carbon footprints, the power system, incorporating electric automobiles and non-conventional energy resources, has garnered increasing attention. However, the consistency of associated components remains a significant concern. This paper introduces a novel incentive-based fuzzy fault tree analysis (NIBFFTA) approach for an updated power structure that integrates electric vehicles and a hybrid structure. The proposed approach considers the consequences of different component failure rates and the incentive Gaussian distribution under a fuzzy fault tree environment, specifically tailored for grid-integrated non-conventional materials and plugin vehicles. Unlike basic fault tree analysis, the NIBFFTA method addresses the challenges posed by vague and inaccurate events, such as system switches and low-power component failures, ensuring a more competent identification. Additionally, it accounts for the probability values of fault occurrences throughout the entire power system. Surmounting the challenges linked to accurate evaluations due to data deficiencies in grid- connected wind energy frameworks and electric automotive configurations, the NIBFFTA method, grounded in Gaussian distribution and fuzzy set models, provides a more accurate evaluation of failure probabilities and the likelihood of undesired actions in the comprehensive system, as elucidated in [7].

L. Control of Pedestrian Lights Using Deep Learning for Enhancement of Energy expenditure during late hours

This proposed system develops an adaptive control system of pedestrian lights that reduces energy resources. Here, the structure identifies the vehicles and pedestrians and can track their movements. The YOLOv5 is employed to regulate the brightness of streetlights via an intensity control unit, as detailed in [8]. It consists of motion sensor streetlights and these motion sensor streetlights help improve safety by illuminating areas where people and vehicles are present. The adaptive control system enhances the utilization of streetlights, thereby reducing energy consumption. However, the flexibility and availability of these sensors can be suitable for certain situations, as noted in [8]. The suggested system does not include the installation of any sensor other than a camera.

M. Photo-Aero Hybrid Renewable energy tree

A hybrid tree is an artificial structure resembling a natural tree with branches on top of which are mounted solar modules or wind turbines. It can help supply power to electric devices, home appliances, and lighting loads covering small or large areas. As elaborated in [9], 3 kW hybrid tree design consisting of 2 kW solar and 1 kW wind to be installed at Vaddeswaram, Andhra Pradesh (16.26◦N and 80.36◦E) which can generate maximum energy using a two-axis tracking system. Different designs and applications of energy trees available worldwide are also presented. P–V and I–V characteristics of solar panels were gained at different irradiance and temperature values. The study focused on examining the wind turbine's power characteristics at various wind speeds and investigating the coefficient of power at different tip speed ratios. The power generation study for the hybrid tree was conducted at different tilt angles from 10◦ to 20◦ for solar panels. Structural optimizations are performed to validate whether the structure can withstand the loads applied. The proposed solar-wind hybrid tree can generate 4709 kWh/year with the two-axis tracking system instead of generating 3763 kWh/year when solar panels are fixed at an 18.25◦ tilt angle.

III. CHALLENGES OF NANO TREE WITH SMART LIGHTING TECHNOLOGY

The challenges in nano tree with smart lighting technology include:

- Production of electric power using rainwater is a challenge because storage of this rainwater requires huge space.
- Without sunlight and wind, the creation of current becomes a challenge as a requirement of non- conventional energies is essential.
- Constant surveillance of the framework is not possible, especially regarding harmful gases. Without calculating the carbon content, carbon dioxide is monitored.

IV. CONCLUSION

In this context, Internet of Things (IOT) stands as a promising and fascinating technology that senses the environment through sensors and transparently communicates with the actuators to decide an action plan. In an approach towards smart cities, building energy-saving and cost-effective solutions for the issues faced by conventional outdoor lighting systems has become the need of the hour. The notion of a solar-wind hybrid tree is quickly gaining popularity since it can produce more energy occupying less ground space. An automated pedestrian lighting system, seamlessly integrating cutting-

edge technologies to provide not only ease of maintenance but also significant energy savings. Customized for use in pedestrian lighting scenarios in both remote and urban areas with intermittent low traffic, the regarded solution addresses energy conservation but also effectively combats power theft. Additionally, its adaptive capabilities allow for corrective actions in reactions to unforeseen climatic changes, ensuring resilience and optimal performance under diverse conditions.

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