NANO TREE WITH SMART LIGHTING TECHNOLOGY

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Introduction

Power plays a crucial role in our daily lives and can be sourced from either non-sustainable or sustainable resources. There exists a global momentum towards alternative energy sources, driven by the imperative for energy security and the ethos of sustainable development. Climate change stands as a formidable challenge, exerting significant pressure on economic growth, yet innovative solutions are emerging from the realm of non-conventional materials. Consequently, our project harmonizes both solar and wind energies to generate electricity. Through a strategic arrangement, solar panels in conjunction with a compact windmill contribute to fulfilling our daily energy needs, meaning if there is unavailability of solar energy due to the presence of clouds then we can use wind energy to generate electricity. Moreover, we have augmented the system with additional functionalities powered by the generated electricity, such as coin-operated charging point which can be used to charge any electric device and intelligent street lighting system meaning a smart street light which only turns itself ON when it is night and intensifies itself when some object is detected. To optimize solar energy harnessing, we have implemented a mechanism for the rotation of solar panels. Furthermore, in a commitment to fostering a cleaner environment, we have integrated carbon capture technology into the system, enabling the absorption of harmful gases from the surrounding air. Notably, while previous systems have explored the integration of solar and wind energies for electricity generation, our project distinguishes itself through the incorporation of supplementary applications, thus exemplifying its innovative advantage**.**

Objectives

The main objectives of our project are given as follows:

- To produce electricity using solar and wind energy – We employ solar panels on a tree-like structure and a compact windmill just beside it for the efficient production of energy through them.

- To produce maximum amount of electricity using solar panel providing it with rotation mechanism – The rotation mechanism is achieved by implanting two LDRs on either side of the solar panel so that when each LDR detects high intensity sunlight, it rotates the panel to that particular direction so energy generation is at its peaks.
- To utilize the generated electricity to power a smart street lighting system and run a coin-based charging point.
- To provide air filtration using carbon paper.

Methodology-

a.

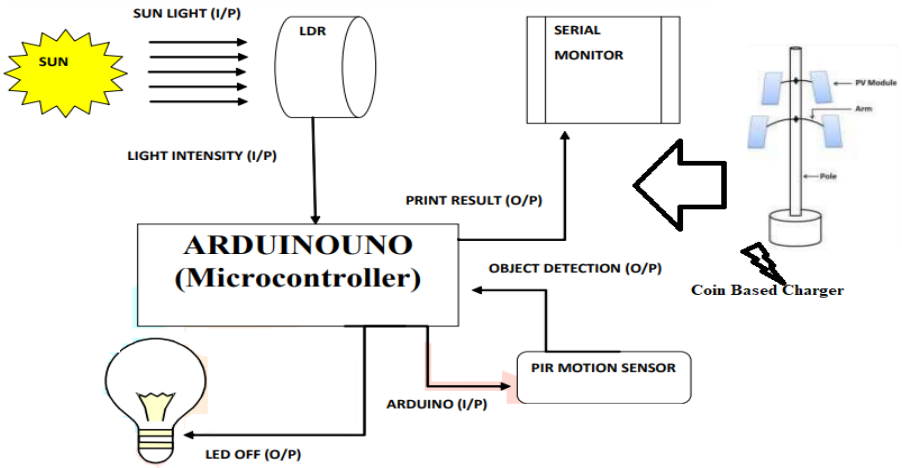

Figure 1: System Architecture

The diagram above delineates the entirety of the energy generation process using solar panels and a windmill. Within the illustration, several solar panels are interconnected in series configuration. Wiring the solar panels in series combination enables us to increase the voltage in order to meet the minimum operating requirements of any device. But we encounter a serious problem due to periodic changes in the sunlight intensities because of which even if one solar panel does not generate the required amount of energy then overall system will not generate the expected energy meaning though other panels are producing energy, overall production will nullify because of that one particular panel which is unable to generate energy. Hence, each solar panel is equipped with two Light Dependent Resistors (LDRs) and a Direct Current (DC) motor, facilitating automated rotation based on sunlight intensity. Complementing the solar setup, a small windmill is integrated to convert wind energy into electrical power. Now, even if there is unavailability of solar radiation for energy production, we can still generate electricity using wind energy, this application of our project comes in handy mostly in rainy season. As due to rain, the winds blow stronger and faster making it easier for the windmill to rotate and generate electricity. The resultant electricity, generated from both the solar panels and the windmill, is stored within a 12V, 1.2Ah lead-acid battery which has the capability to recharge itself when the setup generates at least 16V altogether. Subsequently, this stored energy is allocated to power various other applications within the model. Notably, a coin-operated charging point, featuring an Infrared (IR) sensor to detect deposited coins and initiate charging, is implemented.

Additionally, a smart street lighting system, employing IR sensors and LDRs, discerns objects and distinguishes between day and night for optimized operation, meaning if it is day the LDR detects it and turns the street light OFF and when it is night automatically the street light is turned ON but with less intensity. Once the IR sensor detects any moving object it immediately turns the street light intensity to maximum so that the energy is saved all the time. Lastly, carbon papers are strategically positioned to enhance air filtration around the model, underscoring the commitment to environmental sustainability. A carbon paper due to its special structure absorbs all the heavy dust particles into it and releases clean air to the environment. Also, all the functioning of the model is undertaken by Arduino UNO Atmega238p. With the board, other components like multiple relays, voltage regulator, generator, Motor Driver IC, LED strips, and power supply are used.

Results

As explained in the previous sections, an intelligent street lighting system is developed that integrates different sensors to identify the sunlight presence and object detection offering ease of maintenance and energy savings. The proposed system is appropriate for street lighting in remote as well as urban areas where traffic is low and high at times. Besides the production of electricity to enlighten the street, it also employs a charging point for electrical devices that run on electricity as well as promotes the filtration of air using carbon paper from different harmful gases. Also, the clean energy that is being used by all these applications is successfully generated by the solar tree and the windmill. Rotation mechanism of solar panels adds to the system's efficient energy generation. As the objectives specified in the previous section, the first objective to produce electricity using solar and wind energy using solar panels and a compact windmill has been achieved. The second objective being to produce maximum electricity by providing the solar panels with the rotation mechanism has been achieved successfully. The third objective being to utilize the generated electricity to run coin-based charger and a smart street lighting system is fulfilled successfully. The final objective to provide air filtration using carbon paper has been successfully implemented with the other objectives.

Innovation In Project:

In comparison with the existing systems, our project's main innovation lies in the integration of all the different technologies to generate and utilize the generated electricity. The rotation mechanism employed on the solar panel to automatically rotate to the direction where the maximum sunlight is present is quite an innovation in itself. Coin based charger is also our own touch to our project making it an innovation. Using the produced energy to power a smart street lighting system is another innovation of our project. Final idea being the inclusion of carbon paper for the filtration of air keeping in mind the promotion of cleaner environment.

Scope Of Future Work:

Our project can be further more developed to produce the following outputs in the future:

- Inclusion of safety measures - we can add a security system which could include CCTV, a watchman etc. for the surveillance around the future model built to ensure security of the system and the society.
- Remote Monitoring and Maintenance – we can control and maintain the system without being personally present on site.
- Integration of digital payment methods for the Charging Infrastructure.
- Data Analytics and Predictive Maintenance - Implementing data analytics tools to monitor the system's performance and predict maintenance needs. This can help in reducing downtime and extending the lifespan of the system components.
- User Interaction and Feedback - Developing user interfaces and mobile applications to allow citizens to interact with the system, report issues, and provide feedback, thus promoting community engagement and better maintenance practices.
- Smart Grid Integration - Integrating the street lighting system with smart grid technology to optimize energy distribution and usage, allowing for real-time monitoring and management of energy resources.
- Advanced Materials for Air Filtration - Investigating new materials and technologies for air filtration to improve efficiency and longevity. This could include the use of nanotechnology or advanced carbon composites to enhance the system's ability to remove pollutants from the environment.