

# Generation of Electricity from Waste Materials

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**Abstract**--This project is about combusting a waste to produce an electricity. This waste to energy uses trash as a fuel such as waste from home, companies and school and hospitals etc. As in today's time solid waste have been a major problems for pollution. Electricity has been generated from various ways and using various fuels so, a main objective of our project is to burn down the waste and convert it into electricity from light energy through a solar panel and supply it to various sources while controlling the pollution using a pollution control filter, roller filter. The main goal is to reduce pollution, recycle and reuse garbage and eventually generate electricity from wastes. This project presents an innovative approach for the generation of electrical energy from waste materials by utilizing the light energy produced during waste burning and supplementing it with solar energy. The generated energy is converted into electrical power using solar panels and stored in a 12V rechargeable battery. An ESP8266 microcontroller is used for monitoring purposes, where the generated voltage is measured using a voltage sensor and displayed on an LCD with I2C interface. The stored energy is further utilized for operating an automatic street light system using a 12V LED and Light Dependent Resistor (LDR). The system operates efficiently, focusing on real-time monitoring and automation. This project contributes to sustainable waste management, renewable energy utilization, and energy-efficient public lighting systems.

**Index Terms**--LDR, Arduino IDE, 12v battery, voltage sensor, ESP8266 controller, solar panels, light energy, recycle and reuse garbage.

## I.INTRODUCTION

Energy scarcity and improper waste disposal are two major challenges faced by modern society. Conventional energy resources such as coal, oil, and natural gas are depleting rapidly and contribute significantly to environmental pollution. At the same time, large quantities of waste materials are generated daily, which are often disposed of by burning or

dumping, causing air and land pollution. The conversion of waste into useful energy offers a dual benefit: effective waste management and renewable energy generation. When waste materials are burned, a significant amount of light and heat energy is released. By strategically placing solar panels near controlled waste-burning areas, the emitted light energy can be captured and converted into electrical energy. This harvested energy can be stored and reused for low-power applications such as street lighting.

In this project, an ESP8266 controller is used solely for monitoring the voltage generated and stored in the battery. An automatic street lighting system is implemented using an LDR to ensure efficient energy usage by switching the lights ON during nighttime and OFF during daytime.

With an increasing population of India from 124.06 crores in 2010 to 140.76 crores in 2021, the demands is also increasing such as food, clothes, medicine etc. and this causes an increase in waste materials. India generates around 3.4 million tonnes of plastic waste and only 30 percent of it is recycled. So, the growth in a amount of waste material produces in India which results in human health which causes many diseases. In India, the garbage era is predicted to expand dramatically in the future. Consumptions levels are likely to climb as more people migrate to cities and as wages rise, as are waste technology charges. It includes the waste material collected by Municipals Corporation which includes wrappers, rotten food stuffs, treated biomedical solid waste etc. This is the great way to generate electricity, as we know that in coming times fossil fuels is also going to get decline and it also produces less harmful gases as compare to other methods of generation. As only the 30 percent of waste is been recycled the rest of waste is send to landfills or aquatic dump which is very harmful to aquatic lives and it also contaminate underground

water systems by releasing poisonous chemicals into the water. As the demand for electricity is also increasing day by day.

## II. EXISTING SYSTEM

In the existing system, waste materials are primarily disposed of through open burning or dumped in landfills, which leads to serious environmental pollution and health hazards. The light and heat energy produced during waste burning is completely wasted and not utilized for any productive purpose. Street lighting systems generally operate either manually or based on fixed timer controls, resulting in inefficient energy usage, especially during varying weather and daylight conditions. These street lights rely entirely on conventional grid electricity, increasing power consumption and operational costs. Additionally, there is no provision for real-time monitoring of energy generation or battery voltage, making the system inefficient, non-automated, and difficult to manage effectively. Waste materials are disposed of through open burning or landfills.

- Energy generated during waste burning is completely wasted.
- Street lights operate manually or on fixed timers.
- Conventional electricity from the grid is used for street lighting.
- No real-time monitoring of energy generation or battery voltage is available.

### 2.1. DISADVANTAGES OF EXISTING SYSTEM

- Wastage of potential energy produced during waste burning
- Increased dependency on fossil fuels
- Higher electricity consumption and operational cost
- Manual or inefficient street light control
- Environmental pollution due to unmanaged waste disposal
- Lack of monitoring and automation

## III. PROPOSED SYSTEM

The proposed system generates electrical energy from waste materials by utilizing the light energy produced during burning, along with solar energy. Solar panels capture this light and convert it into electrical energy.

The generated voltage is monitored using a voltage sensor and displayed on an LCD I2C. The ESP8266 controller processes the sensor data. The stored energy in a 12V battery is used to power an automatic street light system controlled by an LDR.

Electricity generation by burning waste materials, also known as thermal waste-to-energy, is a process that involves converting waste materials into electricity by burning them in a combustion chamber. This process is a sustainable solution for waste management as it reduces the volume of waste sent to landfills while producing renewable energy. The methodology for electricity generation by burning waste materials typically involves waste collection, handling, and preparation, incineration, energy recovery, and ash management. The generated electricity can be used to power local communities or industries or fed back into the national grid. The process of electricity generation by burning waste materials provides a reliable source of electricity while reducing greenhouse gas emissions by avoiding the release of methane gas from landfills. Overall, electricity generation by burning waste materials is a promising solution for waste management and renewable energy production. However, it is important to carefully consider the potential benefits and drawbacks of this method and to ensure that appropriate regulations and technologies are in place to minimize any negative environmental impacts.

Block diagram:

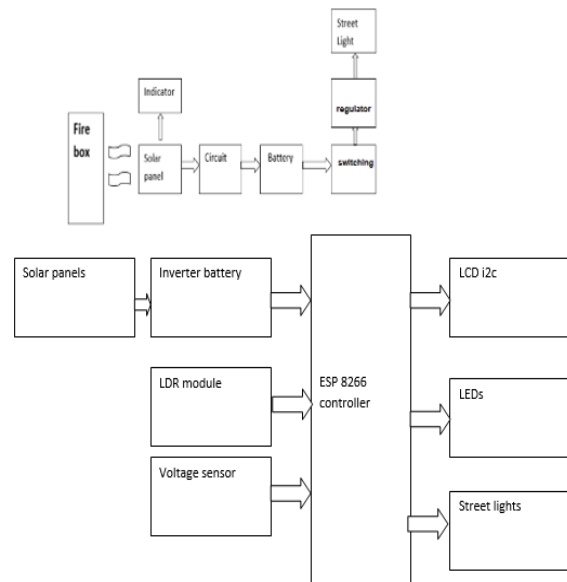


Fig.1. Block diagram of proposed system

### 3.1. Working Methodology:

- Waste materials are burned in a controlled manner.
- Light energy emitted during burning is captured by solar panels.
- Solar panels convert light energy into electrical energy.
- The generated voltage is measured using a voltage sensor.
- ESP8266 reads the voltage values from the sensor.
- Voltage readings are displayed on the LCD I2C.
- The generated power is stored in a 12V rechargeable battery.
- An LDR detects ambient light conditions.
- During night, the LDR activates the 12V LED street light using stored energy.
- During daytime, the street light automatically turns OFF.

### 3.2. Advantages of Proposed System

- Utilizes renewable and waste-based energy
- Reduces electricity consumption from the grid
- Automatic operation of street lights
- Real-time voltage monitoring
- Low-cost and eco-friendly solution
- Efficient energy storage and utilization
- Reduced environmental pollution

## IV. PROBLEM STATEMENT:

The increasing demand for electrical energy and improper waste disposal methods lead to environmental degradation and energy scarcity. Conventional street lighting systems consume a large amount of grid electricity and operate inefficiently. There is a need for an alternative solution that can utilize waste-generated energy effectively while reducing electricity consumption and promoting automation.

## V. LITERATURE REVIEW:

P. S. Patel, V. Kumar, and S. Roy [16] introduced an eco-friendly dry and wet waste separator named “Eco Sort” using Arduino technology. Their system focused on segregating waste at the source level, thereby improving recycling efficiency and reducing landfill

dependency. The study emphasized the environmental and economic benefits of automated waste separation, making it a crucial step toward sustainable waste management practices.

A similar approach was presented by A. S. Rao, K. P. Singh, and M. G. Nair [17], who developed an automatic waste segregator capable of classifying waste materials with minimal manual effort. Their work demonstrated how automation can significantly reduce operational complexity and improve waste processing efficiency. The authors also discussed the potential integration of such systems with advanced waste treatment and energy recovery methods.

Research on energy generation from waste materials has also gained significant attention. P. Patel [18] investigated electricity generation from municipal solid waste and highlighted various techniques such as incineration, gasification, and landfill gas recovery. The study concluded that waste-to-energy systems not only help in reducing waste volume but also contribute to renewable energy generation, making them an effective solution for urban energy demands.

M. Al-Salem et al. [19] conducted an extensive study on thermal waste-to-energy systems for municipal solid waste management. Their research analyzed incineration and thermal conversion technologies, emphasizing their ability to recover energy while reducing environmental pollution. The study highlighted the importance of controlled waste burning systems to optimize energy recovery and minimize harmful emissions.

## VI. HARDWARE DESCRIPTION

### 6.1. NodeMCU Firmware:

Node MCU ESP8266:

The ESP8266 is a low-cost, high-performance microcontroller with integrated Wi-Fi capability, widely used in embedded and monitoring applications. In this project, the ESP8266 is utilized as the main controlling unit for data acquisition and system monitoring without implementing IoT connectivity. It reads the voltage values from the voltage sensor connected to the energy generation and storage system and processes the data efficiently. The controller also interfaces with an LCD using the I2C protocol to display real-time voltage levels, reducing wiring complexity and improving system reliability. Due to

its compact size, low power consumption, and sufficient processing speed, the ESP8266 is well suited for renewable energy monitoring applications and automatic control systems such as the proposed waste-to-energy-based street lighting system.

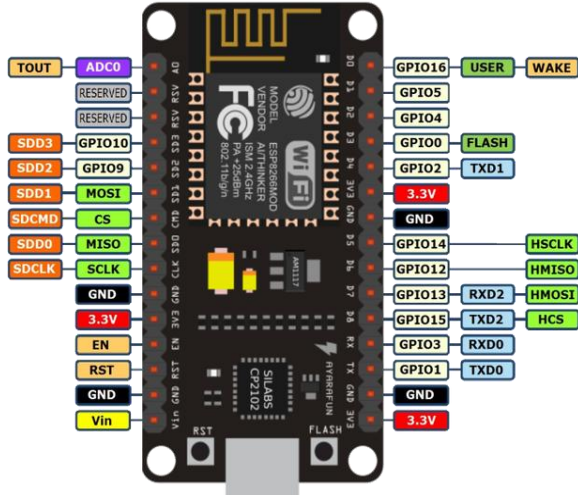


Fig. 2. Pins of NodeMCU

6.2. Heating Panel:Solar panel:

Three 5V solar panels are used in this project to generate electrical energy from available light sources, including sunlight and the light emitted during controlled waste burning. Each solar panel converts incident light energy into electrical energy through the photovoltaic effect. The panels are connected in an appropriate series or parallel configuration to obtain the required voltage and current for charging the energy storage system. The combined output from the three 5V solar panels ensures improved power generation efficiency and reliability under varying light conditions. The electrical energy produced by the solar panels is supplied to the voltage sensor for monitoring and then stored in a 12V rechargeable battery for later use in operating the automatic street lighting system.

5v Heating Penal

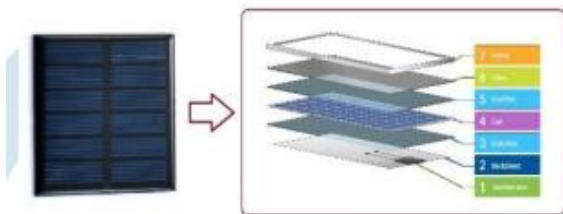


Fig.3. Solar panel

6.3. LED Indicators:

A “Light Emitting Diode” or LED as it is more commonly called, is basically a specialised type of PN junction diode, made from a very thin layer of fairly heavily doped semiconductor material. When the diode is forward biased, electrons from the semiconductors conduction band recombine with holes from the valence band releasing sufficient energy to produce photons which emit a monochromatic (single colour) of light. Three LED’S are visible in the design as indicators.

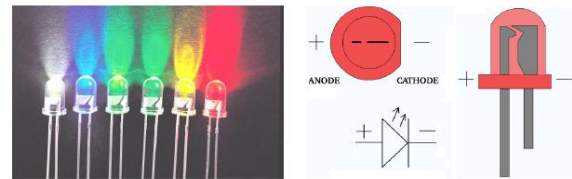


Fig.4. Light Emitting Diode

6.4. Rechargeable Battery:



Fig.5. Lead Acid Battery

12V 1.3AH Sealed Lead Acid Battery The 'Online' range of sealed lead acid batteries are maintenance free, valve regulated and leak proof ideally suited to all 'standby applications' There will be no loss in power output over the battery life. Low self-discharge of about 2-3% per month compared with 20-30% for more common battery systems. Quality construction with no compromise on materials to ensure a long service life. Low internal resistance means a high discharge rate. Wide operating temperature range operating between -15° C to +50 ° C when fully charged.

6.5. LDR module:

The Digital LDR Module is used to detect the presence of light / measuring the intensity of light. The output of the module goes high in the presence of light and it becomes low in the absence of light. The sensitivity of signal detection can be adjusted using the potentiometer. Can adjust the threshold (sensitivity) of the digital output by tuning the onboard variable resistor (potentiometer). Simple usage as it is the digital output, so you will know is the light present and decide what to do with it. It comes with an M3 mounting hole for ease of attaching it to an object. Onboard, it provides an LDR, high sensitivity and commonly being used for light detection. The module comes with a power LED and a status LED as an indicator. LDR Module Photosensitive resistor module most sensitive to environmental light intensity is generally used to detect the ambient brightness and light intensity.



Fig.6. LDR module

6.6. voltage sensor:25V Voltage Detection Sensor Module



Fig.7. Voltage sensor

This is a simple but very useful module which uses a potential divider to reduce an input voltage by a factor of 5. The Voltage Detection Sensor Module 25V allows you to use the analog input of a microcontroller

to monitor voltages much higher than it capable of sensing. For example with a 0-5V analog input range, you are able to measure a voltage up to 25V. This voltage sensor module also includes convenient screw terminals for easy and secure connection of a wire. This module is based on the principle of resistive voltage divider design, can make the red terminal connector input voltage to 5 times smaller. Arduino analog input voltages up to 5 v, the voltage detection module input voltage not greater than  $5V \times 5 = 25V$  (if using 3.3V systems, input voltage not greater than  $3.3V \times 5 = 16.5V$ ).

6.7. LCD1602:



Fig.8. LCD i2c

This is LCD1602 Parallel LCD Display that provides a simple and cost-effective solution for adding a 16x2 White on RGB Liquid Crystal Display into your project. The display is 16 character by 2 line display that has a very clear and high contrast white text upon a blue background/backlight. This is the great blue backlight LCD display. It is fantastic for Arduino-based projects. This LCD1602 Parallel LCD Display with Yellow Backlight is very easy to interface with Arduino or Other Microcontrollers.

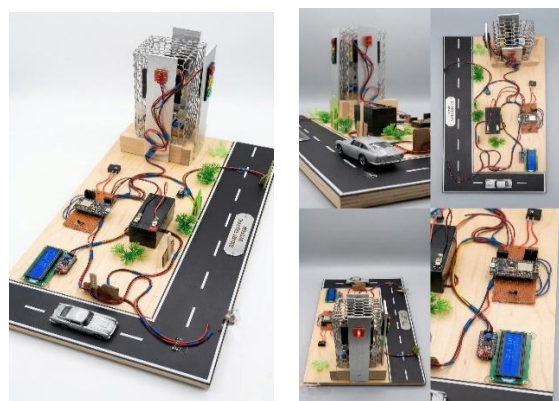
VII. RESULTS AND DISCUSSIONS

The developed system was tested to evaluate its performance in generating and utilizing electrical energy from waste materials combined with solar energy. During experimentation, the solar panels successfully captured light energy from both sunlight and the light produced during controlled waste burning. This light energy was effectively converted into electrical energy and stored in the 12V rechargeable battery, demonstrating the feasibility of the proposed waste-to-energy concept at a small scale. The ESP8266 microcontroller performed reliably in monitoring the system parameters. The voltage sensor accurately measured the generated and stored voltage

levels, and the readings were continuously displayed on the LCD with I2C interface. This enabled real-time observation of system behavior, confirming the effectiveness of the monitoring unit without the need for IoT connectivity. The stable display output also verified proper communication between the ESP8266 and peripheral components. The automatic street lighting system functioned efficiently using the stored energy. The LDR accurately detected ambient light conditions, switching the 12V LED street light ON during low-light or nighttime conditions and OFF during daylight. This ensured optimal energy utilization and prevented unnecessary power consumption. The system's automation significantly improved efficiency when compared to conventional manually operated or timer-based street lighting systems.

Overall, the results indicate that the proposed system reduces dependency on conventional grid electricity while promoting renewable energy usage and effective waste management. Although the amount of power generated depends on light intensity and waste-burning conditions, the experimental outcomes validate the practicality of the concept. The system is suitable for small-scale applications and can be further enhanced for higher power generation and broader implementation in real-world environments.

Screenshots:



### VIII. ADVANTAGES

- Renewable energy utilization
- Energy-efficient street lighting
- Reduced operational cost
- Simple design and easy implementation
- Low maintenance
- Environment-friendly system

### IX. APPLICATIONS

- Smart street lighting systems
- Municipal waste management plants
- Rural and remote area lighting
- Industrial waste disposal units
- Public parks and highways
- Educational and research projects

### X.CONCLUSION

The project successfully demonstrates the generation of electrical energy from waste materials using solar panels and its effective utilization in an automatic street lighting system. By integrating voltage monitoring using ESP8266 and LCD display, the system ensures efficient energy management. The proposed system reduces dependency on conventional power sources, minimizes energy wastage, and contributes to sustainable development. This project highlights the importance of renewable energy and intelligent automation in addressing modern energy challenges.

### XI. SCOPE FOR FUTURE WORK

1. Integration of IoT for remote monitoring and data logging
2. Use of higher-capacity solar panels for increased energy generation
3. Hybrid energy systems combining wind and thermal energy
4. Implementation of MPPT charge controllers
5. Expansion to power additional loads
6. AI-based energy optimization
7. We can make high quality heating penal for generate high electricity
8. We can make large level burning box with easily heating penal connecting system
9. We can make best storage system by generate electricity by waste materials
10. Reduction of pollution: Recycling helps to reduce energy usage, consumption of virgin raw materials, air and water pollution.
11. Reduction of energy consumed by processing virgin raw materials partially counterbalanced by energy consumed for recycling.

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