Waste to Energy: Arduino based Thermoelectric Energy Harvesting

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Abstract

With the increasing amount of Solid Wastes globally, the development of alternative energy sources from this waste stream has gained significant interest. Presently demand for energy sources, change in conflicts over energy and the global environment had a devastating impact on society at all levels. Due to increase in population and technology energy needs had increased and result in the energy crisis. The main goal of this project is to produce electrical energy from various waste products, such as plastic, paper, rubber, trash, and e-waste materials, and then to store that energy in a battery through a circuit before using it to power the entire system. In this study, we have successfully demonstrated how to create power from waste materials. This innovative idea leads to decrease pollution by stopping production of dangerous gases .

Keywords: Thermoelectric generator; Arduino Uno; Thermostat module.

I. INTRODUCTION

About million tons of trash is getting generated in India every year. The major cities produce a significant portion of this waste. The primary cause of environmental issues worldwide is waste. Natural resources are being used up at the same rate as population growth due to technological and scientific advancements. India is experiencing a serious waste management challenge as a developing country. Therefore, rather than controlling garbage, we should seek for different ways to recycle waste. The purpose of this project paper is to create electrical energy out of waste materials such as plastic, paper, rubber, trash, and other waste items, store that energy in a battery using a circuit, and then use that energy to run the entire project. A lit LED light is displayed, and energy production pollution is reduced via the employment of filters. When the burning process in this project begins, heat is produced, and the heating panel begins turning that heat into electricity. In order to this, we are employing a regular battery as a charging unit to feed the circuitry. In this project we are using TEG transducer. Transducer is a device which converts one form of energy into another. We use pollution control filters to reduce carbon pollution since it begins when we burn something. Therefore, when carbon passes through a filter, we store it for later use in a variety of real-world applications. The nonhazardous waste management hierarchy, which rates various management options from most to least ecologically preferable, places energy recovery from municipal solid waste burning as a crucial component.The fundamental idea behind this is the straightforward photoelectric effect, which is used to convert heat energy into electrical energy. We have also installed a catalytic converter since the production of power from heat results in air pollution. A roller filter, water colour filter, water pump, and pollution control filter make up a catalytic converter.

II. STUDY OF FEASIBILITY

An examination of the project's viability determines it s merit.These elements will be used to evaluate the vi ability of our idea.

A. Operational Feasibility

Questions such as how converting garbage to electrical energy will help the nation. The feasibility study considers potential issues as well as the effectiveness and ease of accepting them. garbage to energy technologies have been developed to produce valuable items like electrical energy from garbage. the capacity to increase the nation's electrical generation capacity while also reducing waste emissions. Additionally, a catalytic converter has been connected because the production of electricity from heat pollutes the environment.

B. Technical Feasibility

Technical skill in the area and the accessibility of necessary technologies are both important factors in technical feasibility. Waste, Incinerator, Arduino UNO, Thermo Electrical Generator (TEG), LCD display, battery, inverter, TEP Transducer solar panel, and load are the hardware requirements for this project and are all readily accessible in the market. The project calls for a working knowledge of hardware and fundamental Arduino programming.

C. Economic Feasibility

Comparing expected costs for product development, system integration, and system operation with the project's advantages allows for an economic analysis of the project. The project is therefore financially viable.

III. FACILITIES REQUIRED FOR PROPOSED WORK

A. Waste:

The solid waste (plastics, rubber, paper etc.) is dumped into the incinerator.

B. Incinerator:

In essence, incinerating garbage is a controlled burning process. It decreases the overall amount of waste, which makes it simpler for the government to handle the city's trash. Heat produced by the incineration is later converted to electricity.

C. Thermoelectric generator:

When two dissimilar metal (copper and bismuth) wires are connected at the ends to form a loop, the pair of metals making up the circuit will produce a voltage if the two junctions are kept at different temperatures. A thermocouple is the name for the pair of metals that make up the circuit. The result of the heat energy being converted to Electrical energy.

Fig.1: Thermoelectric Generator

D. Arduino Uno:

Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It is having 16 MHz ceramic resonator, 6 analogue inputs, 14 digital input/output pins (of which 6 may be used as PWM outputs), a USB port, a power connector, an ICSP header, and a reset button. Everything required to support the microcontroller is included. To start up, we are attaching it to a computer using a USB cable or a battery.

Fig.2:Arduino Uno

E. Liquid crystal display (LCD):

LCD is a flat panel display or other electronically controlled optical device that uses polarizers and the light-modulating properties of liquid crystals. Rather than directly emitting light, liquid crystals produce images by employing a backlight or reflector.

Fig.3: LCD Display

F. Temperature sensor:

In order to record, monitor, or communicate temperature changes, a temperature sensor is an electronic device that monitors the temperature of its surroundings and then turns the input data into electronic data.

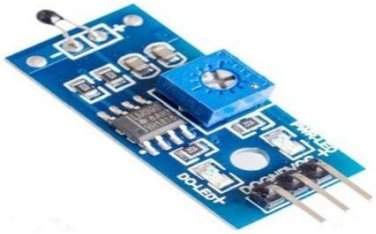


Fig.4: Temperature sensor

G. Smoke detector:

The LPG, Butane, Propane, Methane, Alcohol, and Hydrogen are among the combustible gases that the MQ-2 Smoke Sensor is sensitive to in addition to smoke. Depending on the kind of gas, the sensor's resistance varies. The built-in potentiometer in the smoke sensor enables you to modify the sensor sensitivity to your desired level of accuracy for gas detection. Depending on the amount of smoke or gas present in the air, the sensor's voltage output varies.

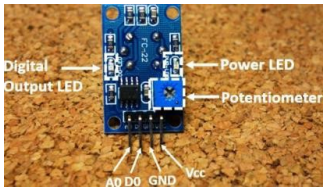


Fig.5: Smoke Sensor

H. W1209 Thermostat Module:

The W1209 is a cheap yet very capable thermostat controller. Based on the temperature read by the high accuracy temperature sensor that is incorporated, this module intelligently manages power to most sorts of electrical devices. 50°C to 110°C is the temperature control range for it.

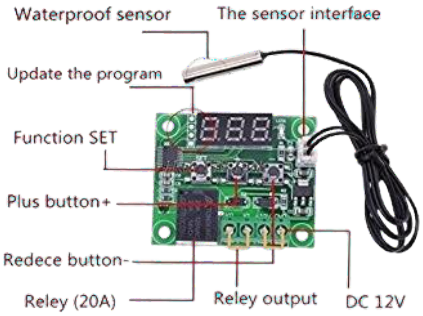


Fig.6: W1209 Thermostat module.

I. Storage Battery:

An example of a rechargeable battery that stores energy through the reversible reduction of lithium ions is a lithium-ion battery, sometimes referred to as a Li-ion battery. The majority of portable consumer electronics and electric vehicles use this type of battery gadgets.

Fig.7: Storage battery

IV. METHODOLOGY

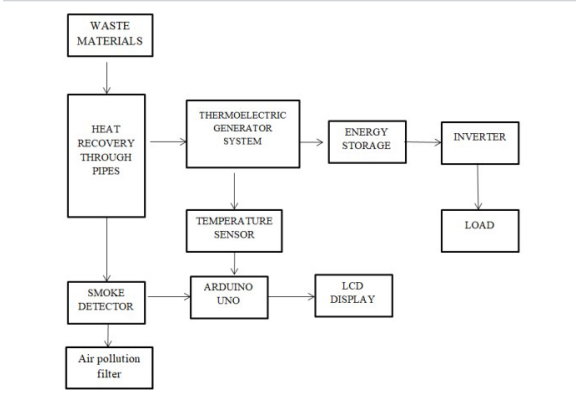


Fig.8: Block diagram

Working:

In our project we have converted the heat energy into electrical energy. Different types of waste materials are burned and heat produced from this is recovered through pipes. The thermoelectric generation system converts this heat energy into electrical energy. Arduino Uno acts as the main controller in this system. The thermoelectric generator is connected to Arduino. The temperature is sensed by the temperature sensor and it is displayed on the LCD display. When the required amount of heat is generated in the incinerator, Thermoelectric Generator activates and it startsto generate electricity. When the temperature exceeds the limit, the temperature sensor sends a signal to the Arduino, responding to the signal, Arduino sends signal to the thermoelectric generator to stop the generation. The generated electrical energy is stored in a battery and it is converted from Dc to Ac to activate the loads. When waste is burned it releases smoke, it is sensed by the smoke sensors, when the smoke exceeds certain limit, the buzzer beeps and this smoke is passed through air pollution filter in order to remove the pollutants before it is released to atmosphere. Overall the entire project is ecofriendly as it manages the waste in a beneficial manner and creates eco friendly environment.

V. ADVANTAGES

- Our system is an efficient way to manage waste, and it is also a cost-effective way to generate electrical energy from waste on both a small and large scale.
- Its more dependable and green
- This is a non-conventional system, no fuel is require
- Easy maintenance, portable, charging time is less
- Promising technology for solving power crisis to an affordable extent
- Simple in construction, pollution free

VI. DISADVANTAGES

- Improper variation of temperature gradient differencemay damage the TEG

VII. APPLICATIONS

- This system of ours can be used in both small scale and largest scale production of electric energy.
- As discussed in section TEGs are used to develop electric energy from burning waste materials
- Unconventional energy such as heat can be generated similarly to how electricity is. As a result, it is simple to install and maintain. We may also utilize it in homes and other household buildings. As a result, the power generated may be consumed and stored.
- Our project's advantages include a green way to manage garbage. The process that turns unconventional energy into conventional energy is the most well-known one.

VIII. RESULT

Overall, electricity generation from municipal waste can be a sustainable solution to both waste management and energy production challenges. However, it is important to ensure that the process is done in an environmentally responsible manner and with proper waste management practices in place.

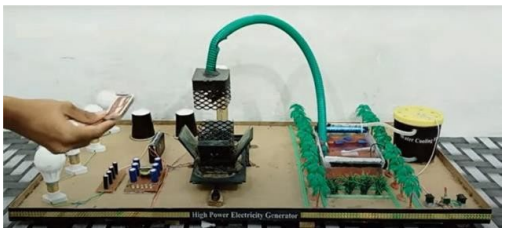
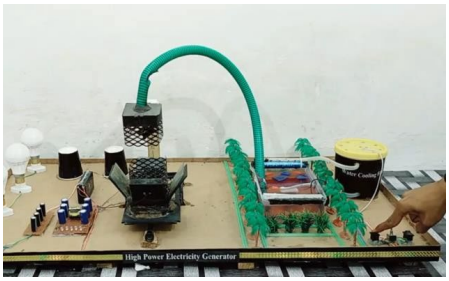


Fig : a



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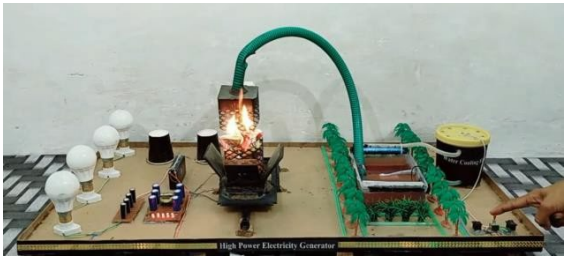

Fig: c

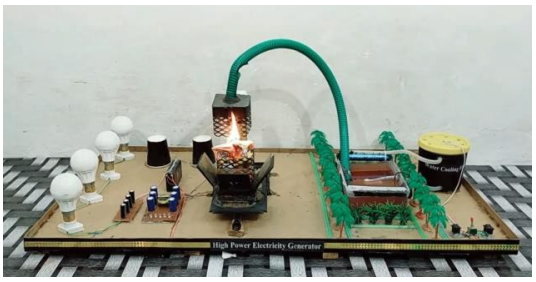

Fig: d

Fig:e

In the above pictures the result and output of our project has beendisplayed.

In fig (a) the waste is segregated.

In fig (b) the waste is submitted for burning.

In fig (c) the heat is generated from theburning process

In fig (d) the TEG activates as it gets the required heat for the generation of electricity

In fig (e) the output shows when the light bulbs turns on .

IX. CONCLUSION AND FUTURE SCOPE

Generation of power from the combustion of municipal solid wastecan be effective solution for managing waste while also producing energy.

After conducting a project on powergeneration from the combustion of municipal solid waste, the following conclusions can be drawn :

This type of project has the potential toreduce the amount of waste that ends up in landfills, while also producingrenewable energy.

A successful project requires carefulplanning, implementation, andmonitoring to ensure that emissions are properly controlled and the environment and human health are not harmed. Additionally, effective community engagement and communication are essential for building support and addressing concern related to waste to energy projects.

Overall, electricity generation from solid waste materials has the potential to contribute to sustainable energyproduction and waste management,making it a worthwhile project to consider for communities and organizations seeking to address these critical issues.

The Future scope of power generation from municipal solid waste is promising, as it offers a sustainable solution for waste management.

1. Improved technology: the use of advance technologies, such as gasification and pyrolysis can increase the efficiency of power generationprocess, reduce emissions and produce higher quality energy products.

2. Recycling and resource recovery:The recovery of metals, plastics, and other valuable materials from MSW can assist in lowering the amount of trash that must be treated, and generate additional revenue streams.

3.Increased Efficiency: The efficiency of MSW-to-energy plants can be increased by optimizing the collection, sorting, and processing of waste, as well as by utilizing waste heat and improving turbine technology.

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