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Generation of Electricity Via Incinerator

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Abstract: Traditional fuels for the manufacture of strength are becoming scarcer by the day and it is becoming increasingly important to identify potential assets that can be utilized as fuel for the production of energy, particularly in emerging countries like India.
The main goal of the project is to utilize the waste material and convert to energy by using TEG module by reducing air pollution by using carbon converters. As a consequent of the oil prices rises and climate change being attributed to the GHGs emissions caused by fossil fuel burning, one of the innovative energies harvesting techniques is the use of thermoelectric generators, which exploit the thermoelectric effect to generate electricity from temperature difference, this opened the way for a reliable waste heat recovery through installing this device wherever it is possible to increase the system efficiency.

I. INTRODUCTION

The demand for energy is increasing rapidly due to population growth and industrial development. Conventional energy sources such as fossil fuels are depleting and also cause serious environmental pollution. At the same time, large amounts of municipal solid waste are generated every day, creating disposal problems. Proper waste management has become a major challenge in modern society.

Converting waste into energy is an effective solution to both energy shortage and waste management issues. Incineration is a process in which waste materials are burned to produce heat energy. This heat can be further utilized for generating electricity. In this project, thermoelectric generators are used to convert heat directly into electrical energy. The system works based on the Seebeck effect, which depends on temperature difference. The generated voltage is then boosted and stored for practical use. This method reduces pollution and utilizes waste efficiently. Therefore, this project provides an eco-friendly and cost-effective solution for power generation.

II. HARDWARE AND COMPONENTS

A. Hardware

TheThe hardware setup of this project consists of several important components such as the incinerator, thermoelectric generator (TEG), boost converter, battery, inverter circuit, and carbon filter. The incinerator acts as the burning chamber where waste materials are combusted to produce heat energy. The thermoelectric generator is placed near the heat source and converts thermal energy into electrical energy based on the Seebeck effect. This conversion requires a temperature difference between the hot and cold sides of the TEG.

The output obtained from the TEG is a low DC voltage, which is not sufficient for direct use. Therefore, a DC-DC boost converter is used to increase the voltage to a usable level. The boosted voltage is then stored in a battery for future use. The battery ensures a continuous power supply even when heat is not available. An inverter circuit is used to convert the stored DC voltage into AC voltage.

The inverter produces an output of approximately 220V AC, which can be used for electrical appliances. A carbon filter is included in the system to reduce harmful gases produced during combustion. It helps in minimizing air pollution. All components are properly connected to ensure smooth operation.

The system is designed to be efficient and reliable. Proper insulation and safety measures are also considered. This hardware setup enables effective conversion of waste heat into useful electrical energy.

1) Block Diagram

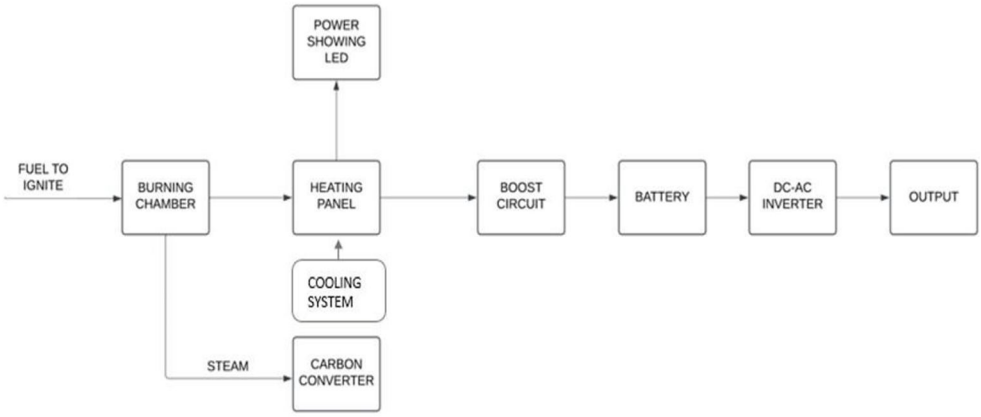

Fig-1- Block Diagram

2) Circuit Diagram

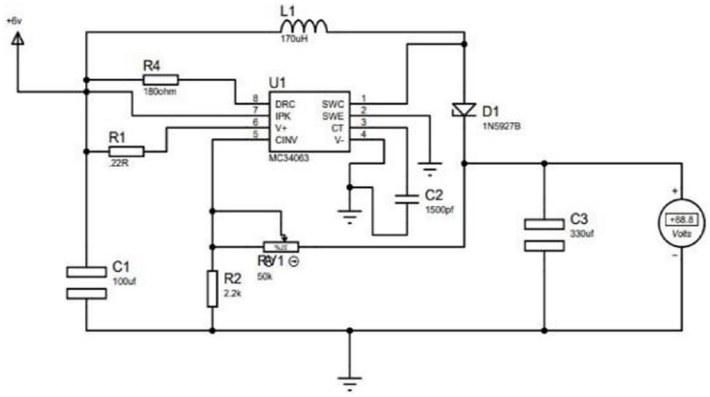

Fig-2- Circuit Diagram of Dc-Dc Boost Converter

This circuit diagram represents a DC-DC boost converter used to increase low input voltage to a higher output voltage. It is built around the MC34063 IC, which controls the switching operation of the circuit. The input voltage is supplied to the circuit and passes through an inductor (L1), which stores energy. A switching transistor inside the IC rapidly turns ON and OFF, allowing energy transfer. The diode (D1) ensures current flows in one direction toward the output. Capacitors (C1, C2, and C3) are used to filter and stabilize the voltage. Resistors and the variable resistor (RV1) help in setting the output voltage level. The output voltage is higher than the input and is used for further applications in the system.

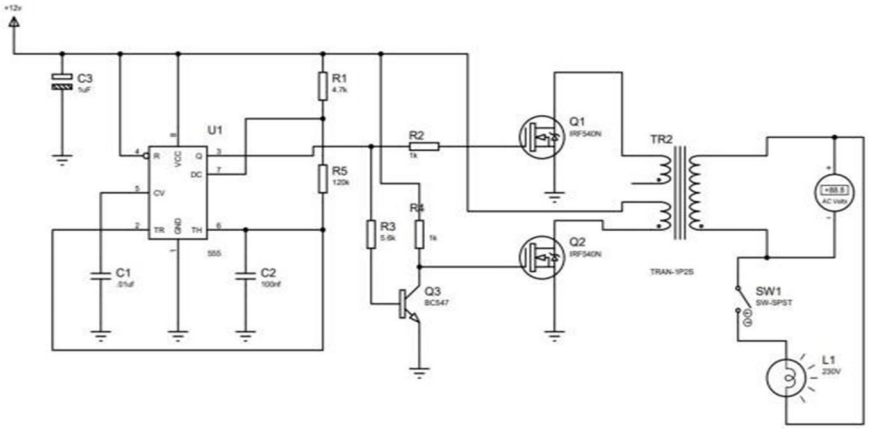

Fig-3- Circuit Diagram of Inverter Circuit

This circuit diagram shows a DC to AC inverter circuit used to convert low DC voltage into high AC voltage. The main component is the IC 555 timer, which generates square wave signals. These signals control the switching operation of MOSFETs (Q1 and Q2). The MOSFETs act as electronic switches and drive the transformer. The transformer (TR2) steps up the low voltage (12V) to high voltage (around 220V AC). Resistors and capacitors are used to set the frequency and stabilize the circuit operation. The transistor (Q3) helps in signal inversion for proper switching. The output obtained can be used to power AC loads like lamps or small appliances.

B. Components

1) Burning Chamber

Incinerator is used for waste treatment process that involves the combustion of substances contained in waste materials. Industrial plants for waste incineration are commonly re- ferred to as waste to energy facilities. Incineration of waste materials converts the waste into ash, flue gas and heat. The ash is mostly formed by the inorganic constituents of the waste and may take the form of solid lumps or particulates carried by the flue gas. The flue gases must be cleaned of gaseous and particulate pollutants before they are dispersed into the atmosphere. In some cases, the heat that is generated by incineration can be used to generate electric power.

Fig-4- Burning chamber

2) Boost Circuit

A boost converter (step-up converter) is a DC-to-DC power converter that steps up voltage (while stepping down current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) containing at least two semiconductors (a diode and a transistor) and at least one energy storage element: a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter).

Fig-5- Boost Circuit

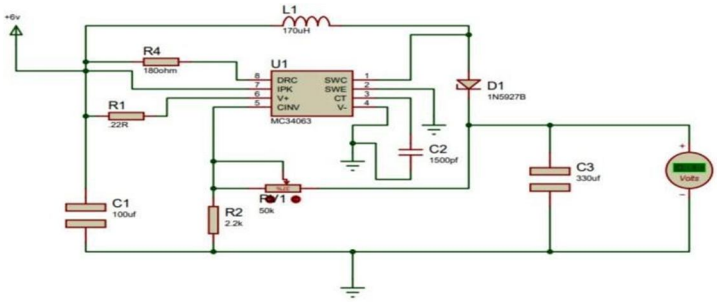

Fig-6- Simulation Diagram of Boost converter

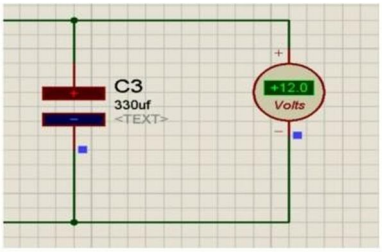

Fig-7- Simulation Result of Boost Converter

The simulation of the DC-DC boost converter shows that the circuit successfully increases the low input voltage. The input voltage from the thermoelectric generator is in the range of 3V to 6V. The boost converter raises this voltage to approximately 12V DC. The circuit operates based on switching action and energy storage in the inductor. The diode and capacitor help in maintaining a steady output voltage. The output waveform is stable with reduced ripple due to filtering components. The simulation confirms proper functioning of the boost converter circuit. Thus, the converter efficiently provides usable DC voltage for the system.

3) Inverter Circuit

An inverter is one of the most frequently used electronic circuits in most of the applications. It's a circuit that converts fixed DC supply to alternating AC supply to feed AC loads. Widely used in commercial, aviation, residential and industrial applications. It could be regarded as the backbone for most of the applications. It is frequently used as an interfacing unit between DC supply and load. In many cases, it acts as an interfacing unit between AC supply and load also. For example, in the speed control of induction motor, the supply is AC, but AC supply is converted to DC by a rectifier circuit and again DC is converted to AC by inverter and fed to the induction motor. It helps to improve power quality by overcoming the harmonic content. The input of the inverter circuit is the output of the boost circuit which is 12V. And the expected output is 220V, 50/60Hz, 45 Watt. Relays are used in the circuit so that it can be used to control both AC and DC appliance which comply with output rating. The expected cost of circuit is rupees 700.

The resistors used in the circuit are in the range of 4.7K Ohm, 120 Ohm , 380K Ohm. The resistors are used in the circuit to limit current to the IC. The design of the resistor R2 is taken as 8.6 times of R1.The capacitor used in the circuit are in the range of l00µF and 0.0lµF. It is used to filter the current in the circuit.

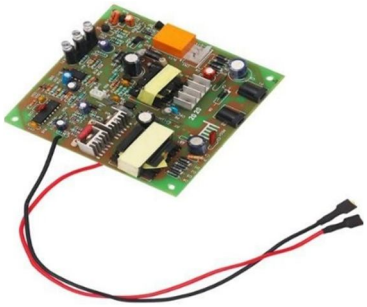

Fig-8- Inverter Circuit

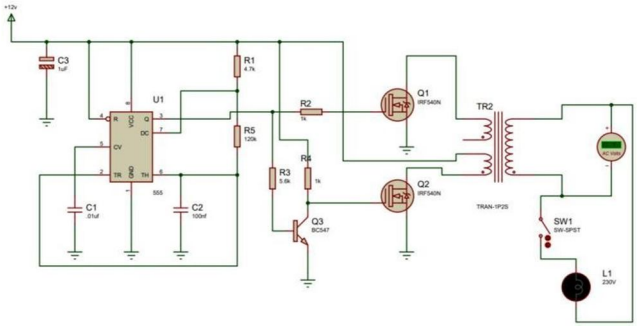

Fig-9-Simulation Diagram of Inverter Circuit

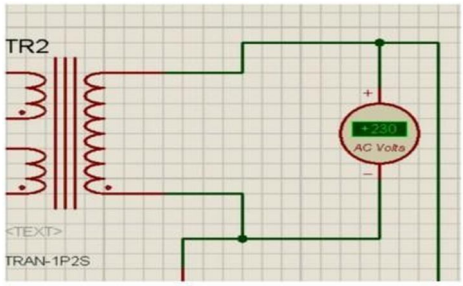

Fig-10-Simulation Result of Inverter Circuit

The simulation result shows the working of the inverter circuit in converting DC to AC voltage. The input DC voltage is supplied from the battery to the inverter. The IC 555 generates square wave signals to control the switching process. The MOSFETs operate alternately to drive the transformer. The transformer (TR2) steps up the voltage to a higher AC level. The output voltage is observed as AC on the meter. The waveform produced is suitable for basic electrical loads. The simulation confirms that the inverter circuit works effectively to produce AC output.

TABLE 1.
Parameters of the Module at Different Temperatures.

Temperature °C	20°C	40°C	60°C	80°C	100°C
Open circuit voltage (v)	0.97	1.8	2.4	3.6	4.8
Current (mA)	225	368	469	558	669

4) Thermoelectric Generator

Thermoelectric generator module can be kept on the incinerator where maximum temper-ature is obtained, so that the difference must be above 70°C. Boost and inverter can be kept outside burning chamber. The modules are placed on an adjustable panel, which can be adjusted accordingly for required temperature for specific output. The other side of the panel consist of cooling system, which can improve the overall efficiency of the thermoelec- tric generator by giving more result. Thermoelectric generator modules can be arranged in different configurations such as series, parallel and series-parallel connections. The purpose of thermoelectric generator is to convert heat energy to electrical energy. The model used is SP1848-27145. Maximum operating temperature is 150°C. Operating temperature varies from 0- 150°C. Open circuit voltage is 4.8V. Number of thermoelectric generators used is 15.

Fig-11- Thermoelectric Generator

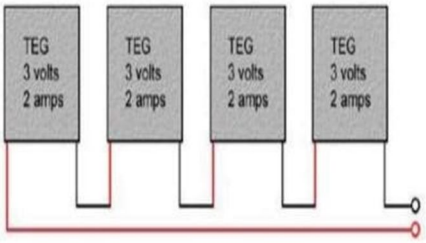

Fig-12-Series Configuration of Thermoelectric Generator

5) Battery

An electrical battery is a device that stores energy in chemical form and converts it into electrical energy to power various devices. Batteries work by creating a flow of electrons through a chemical reaction between different materials within them, usually involving metals and electrolytes. As we uses off-grid system, battery have a important role in the system.The sealed lead acid battery with a capacity of 12 volt, 7 Amp is used. It is also maintenace free.

Fig-13- Battery

III. RESULT AND DISCUSSION

Fig-14- Hardware Model

The Energy harvesting from waste mainly aims at generating electricity from MSW. Burning of MSW produces heat which can be utilized to generate electricity using thermoelectric generators. The electricity thus generated is stepped up into a higher voltage range of 12V by boost circuit. This is further passed through an inverter circuit which gives an output voltage of 220V AC supply. The waste is collected in the incinerator that is the burning chamber, the collected waste is burned using suitable fuel for the process of combustion. This causes production of heat which is utilized by the thermoelectric generator to generate electricity, the voltage generated by the thermoelectric generator is stepped up to 12V and stored in a battery and then inverted to 220V AC supply using an inverter.Nowadays the amount of MSW is increasing rapidly. This results in accumulation huge amount of waste in larger land areas. In order to reduce this excessive amount of waste, this can be burnt and the heat thus generated can be used for electricity generation. Thus the main components of the system are Incinerator and thermoelectric generator. Heat while burning inside the Incinerator can be collected and passed to thermoelectric generator.Energy harvesting from waste can be used for future applications since the amount of MSW will surely be increasing. This method also gives an advantage of carbon fertilizer. It is the phenomena that the increase of carbon dioxide in the atmosphere increases the rate of photosynthesis in plants.

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IV. CONCLUSION

The waste-to-electrical energy project holds significant promise in addressing the dual challenges of waste management and energy generation. By harnessing the potential energy stored in various forms of waste, such as organic matter, biomass or landfill gas and converting it into electricity, this project offers several important benefits.It provides an effective solution to the growing problem of waste accumulation and dis- posal. Rather than simply discarding waste, this project utilizes it as a valuable resource, reducing the burden on landfills and minimizing environmental pollution. It promotes a circular economy approach by transforming waste into a useful energy source, thereby con- tributing to sustainable waste management practices.Energy harvesting from waste is a process where different types of waste is converted into usable form using thermo electric generators. The project has focussed on producing electricity around 4.5V from a thermoelectric generator network of three.Overall, waste-to-electrical energy projects present a promising solution for waste man- agement, energy generation and environmental sustainability. With the right infrastruc- ture, technology and regulatory frameworks in place, these projects can contribute signifi-cantly to a cleaner, greener and more efficient energy future.

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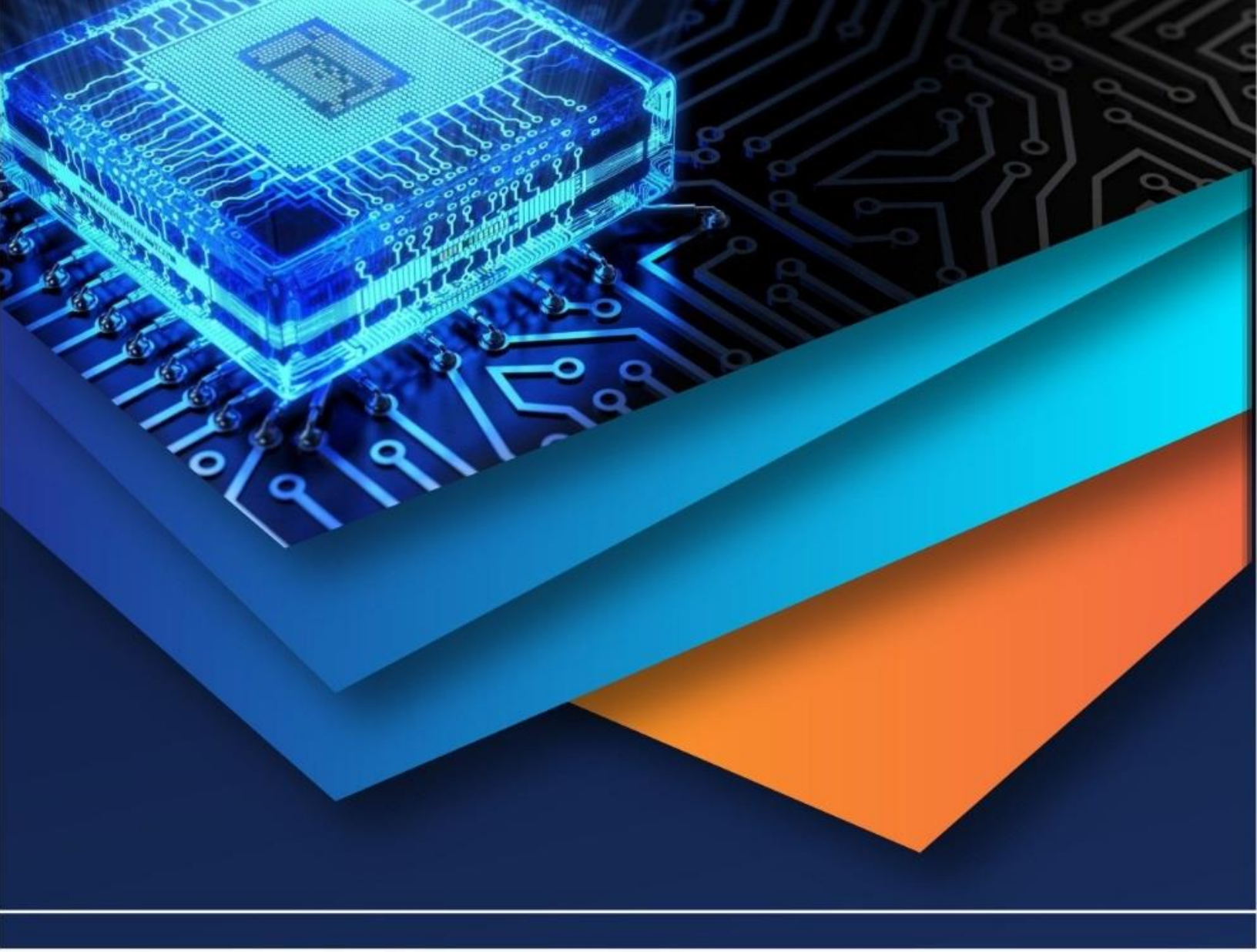

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