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Solar-Powered Kitchen Waste Recycler for Fertilizer Development with Energy Generator

Ms. Tejaswini Chandrakant Kamble[1], Prof. Bhanu Pratap Singh[2]

[1]PG Scholar, Dept. of Electrical Engineering, ZCOER, Pune, Maharashtra, India
[2]Assistant Professor, Dept. of Electrical Engineering, ZCOER, Pune, Maharashtra, India

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Abstract - *This paper demonstrates the design and development of a solar-powered composting machine using food waste as the main raw material. The increasing concern about waste management and the need for sustainable agriculture have led to the search for new solutions to utilize waste materials into valuable products. The proposed system uses a two-stage process: first, the waste is an aerobically digested to produce biogas and digestate, and then the digestate is thermally processed using solar energy to produce organic fertilizer, reducing operating costs and environmental impact by reducing reliance on conventional power. The system is designed to be easily usable by urban households, encouraging local waste management and engaging communities in cultural activities. Experimental studies have shown that food waste is reduced and organic fertilizers are produced that can improve soil health and crop yields. The aim of the project is to contribute to the circular economy by transforming waste into resources and to find solutions to both waste management and agricultural sustainability problems*

Key Words: fertilizer, pesticides, Photovoltaic, Generator, solid waste etc.

1.INTRODUCTION

The rapid urbanization and population growth in recent decades have led to a significant increase in food waste, particularly in households. According to the Food and Agriculture Organization (FAO), approximately one-third of food produced for human consumption is wasted each year. This not only represents a lost resource but also poses serious environmental challenges, including greenhouse gas emissions and increased landfill usage. Simultaneously, the demand for sustainable agricultural practices is rising, driven by the need to enhance soil health and reduce reliance on chemical fertilizers. In response to these pressing issues, this project proposes the development of a solar-based fertilizer manufacturing machine that utilizes kitchen waste as a primary raw material. The machine, which transforms organic waste into nutrient-rich food, solves both waste management and perm culture problems. The use of solar energy in this process further strengthens its sustainability by reducing the carbon footprint associated with traditional energy sources. The new system uses a two-stage conversion process: anaerobic digestion produces biogas and nutrient-rich digestive, followed by solar-powered thermal processing to produce organic fertilizer. Suitable for urban families, the design encourages community participation in recycling and supports environmental stewardship. The aim is not only to reduce food waste, but also to encourage communities to support sustainable agriculture and ultimately support a circular economy that transforms product waste into valuable resources.

The increasing amount of food waste produced by urban households is causing a major environmental problem, leading to waste disposal, greenhouse gas emissions and the consumption of discarded products. Modern waste disposal methods are often inadequate, leading to unsustainable waste management. At the same time, agriculture is facing a growing need for alternative fertilizers that can improve soil health while reducing environmental impact. Current solutions such as composting and chemical fertilizers are labor intensive, time consuming or harmful to the ecosystem. We need new, efficient technologies that can transform waste into valuable food while using renewable energy. This project addresses the two challenges of organic waste disposal and sustainable agriculture by implementing a solar-powered fertilizer using food waste, offering a solution to urban families.

2. METHODOLOGY

Comprehensive review of existing technologies related to organic waste conversion, anaerobic digestion, and solar energy Radiant Energy. The difference in the process is the design that combines solar energy with anaerobic digestion and thermal processing. System Design Machine Components: Design a system consisting of three main components: Anaerobic Digester: Produce biogas and digestate byproducts by digesting food waste. Solar Thermal Unit: Use solar energy to heat and dry digestate byproducts. Size, material and power required for everything. Building the Model¢ Material Selection: Select environmentally friendly and durable materials for construction, ensuring the product is resistant to corrosion and abrasion. plates, storage tanks and piping systems for biogas and liquid management. Testing and Optimization Finished Products: Sampled a variety of food wastes including fruit and vegetable scraps, coffee grounds and egg shells. Operate the anaerobic digesters under controlled conditions to monitor biogas production and digestate quality. Monitor temperature, pH

and storage time. Measure nutrient content of the resulting compost. Data collection and analysis Data collected on biogas production, digestate composition and compost quality during the experimental period. Efficiency in converting waste into compost. Community Assessment and Participation. Performance Evaluation: Evaluate all aspects of the system in terms of waste reduction, energy consumption and good composts. Gather user input on usability and practicality. Include feedback to improve design.

Fig -1: System design

Table -1: storage battery charging time for prototype hardware model when only pv is connected

Time	Battery charging voltage pv connected	Charging current
7am	12v	0.2A
8am	12.6v	0.33A
9am	12.9v	0.6A
10am	13.0v	0.8A
11am	13.34v	0.9A
12pm	13.65v	1A
1pm	14v	0.9
2pm	14.4v	0.6
3pm	14.5v	0A cutoff

System develops 20kg of organic fertilizer within a month time period from approximately 50kg of kitchen/food waste which can be selling to 20rs per kg in india. One kilogram of organic fertilizer is sufficient for one pot. So 20kg fertilizer can be utilize for 20 pots per month.

Present the findings in a comprehensive report outlining the design process, test results and user feedback. Provide guidance for future developments and potential expansions 3]so that these technologies can be used more widely in society. burning in the field produces harmful gases. In this article, we will present a solution for recycling household waste. The solution is to create an environmentally friendly machine that turns waste into fertilizer. Using recycled waste materials as effective fertilizer can improve soil health and structure, reduce drought and reduce the need for additional water, fertilizer and pesticides. The composting process is fully automated and includes several steps based on environmental controls to speed up the process. A concept aimed at reducing food waste was studied and experiments were conducted to determine the optimum temperature, humidity and volume enhancing agents to produce quality household products within hours. We produced the prototype by giving importance to aesthetics and created a stylish machine that can fit into every kitchen.

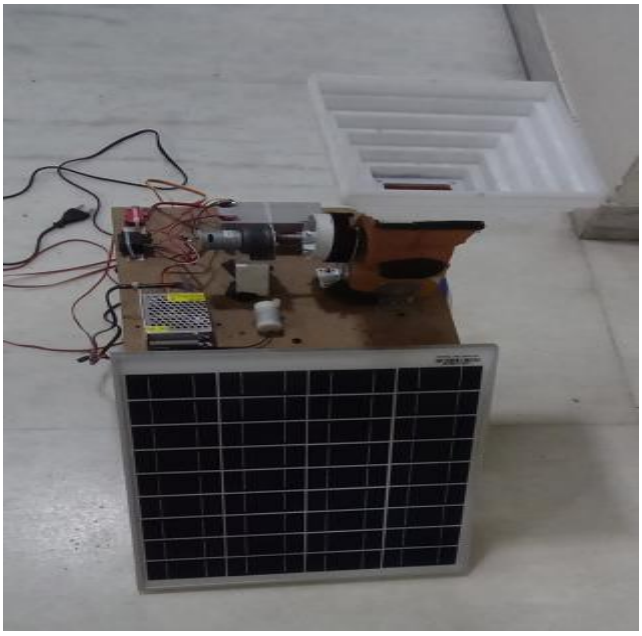

Fig -2: setup design

Setup in figure2 consist of crusher assembly, solar panel 20w, manual operation, 12v 2ampere dc electric supply, 12v 12ampere lithium ferro phosphate battery, charge controller, dynamo.

1- Materials: Different materials have different carbon and nitrogen contents. The optimum C:N ratio is between 25:1 and 30:1, above 30:1 heat production slows down and decomposition slows down (Smith et al., n.d.). Not only does it vary according to the type of organic matter, but also different formulations of the same chemical. The higher the content of the material, the more nitrogen supply is needed (Swarthout, 1993). Many bacteria, including aerobic bacteria, need oxygen. They need oxygen to produce energy, grow rapidly and use more materials. Natural ventilation is the process of warm air rising in the compost pile during composting, bringing in fresh air from the surrounding environment (Smith et al., n.d.). Lack of oxygen causes odour and slows down the process; this process can be accelerated by adding cornstalks to provide oxygen (Compost and Food Waste Guide, 2013). In aerobic composting, the aim is to

maintain oxygen levels at 8% or higher (Anon, 2017). , excessive moisture will slow down decomposition (Anon, 2017). Low moisture limits bacterial activity, while high moisture can lead to anaerobic processes and cause unpleasant odours (Smith and Friend, n.d.). However, there is no universally accepted moisture content for compost materials. This is because all materials have physical, chemical and biological properties that affect the relationship between moisture content and its associated factors (water availability, particle size, porosity and permeability). 4- Temperature Factors: The rate of decomposition is between 90°F and 140°F, lower temperatures mean the process is slower, while temperatures above 140°F reduce the activity of most diseases. Regular turning of the mixture should be done to ensure that the material always reaches a warm place (Compost Yard and Food Waste Guide, 2013). The organization also states that to reduce the risk of serious illness during composting, the temperature of the pile should be maintained at a minimum of 40°C for five days and above 55°C for at least four hours. Most microbial organisms cannot survive above temperatures of 60-65°C (Trautmann, 1996). The interface between the surface and the air. For small objects, bacteria can produce enough heat to digest them (Smith and Friend, tt). To achieve this, composters must undergo certain processes such as chopping, shredding or cutting the compost material (Guide to Composting Sites and Food Waste, 2013).

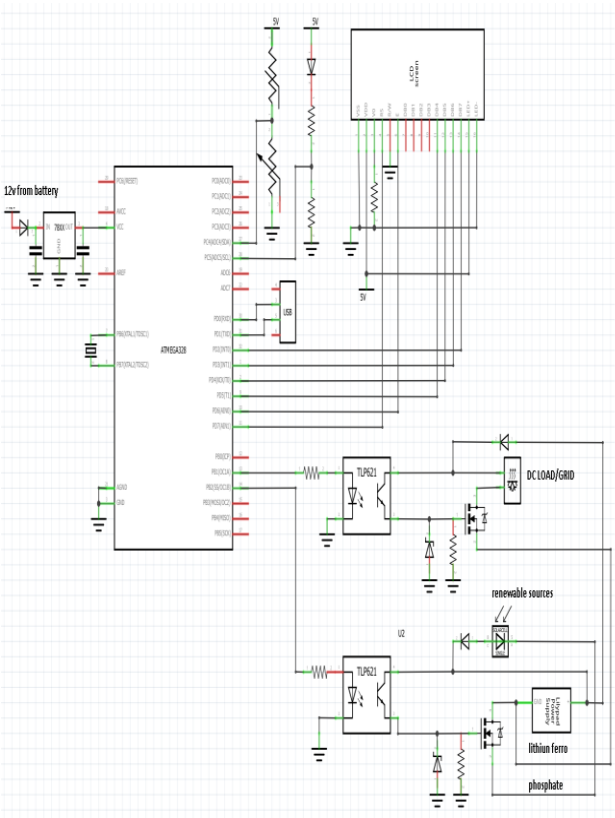

Fig -3: Circuit diagram

3. CONCLUSIONS

All in all, this paper aim is to show the importance of recycling food waste and helping the environment by building a machine that converts food waste into compost. The machine is completely manufactured in Qatar. This food waste recycler machine is to be built and used at home safely. The design methodology and the engineering solutions that will be used in this project were explained in the engineering design process. Followed by the identifying the customers, knowing their needs and taking their feedbacks, which are considered important since our purpose is to satisfy the customer's needs. Furthermore, a quality function deployment was used to translate customer needs into design specifications. In addition, the external and internal constraints and the design standards were identified. Moreover, the conceptual design for the machine, the design alternatives, alternatives evaluation, and the machine's final design all were discussed briefly and shown in detail in this paper. Since the world is seeking sustainability, our machine aims to lessen the food waste that is thrown into the landfills, which pollute the environment by recycling the food waste and turning it, in less than 24 hours, to compost that can be used in fertilizing the soil to plant healthy and organic food, and contributing in creating a safe and sustainable world.

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