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Design and Development of Solar Powered Compost Bin Low Cost Automation

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Abstract: *The waste management is very important thing or task to control and reduce amount of waste. And composting has been acknowledged as a main stay for the proper waste management. There are compost bins and that are worked on electricity. But the only problem we might face is its cost and increase in electricity bills. The aim of this project is to enhance the interactivity in household levels by making it easier and cheaper and enabling the user to interact with it as well as making the entire process user friendly. The 'Solar Powered Compost Bin' will be definitely a great work got proper waste management at houses. And the parameters like temperature, humidity as well as moisture are also controlled. The problem of increased in electricity bills is overcome, as this compost bin is totally worked on solar power supply. Also the 'Solar Powered Compost Bin' will enhance the public health as well as health of soil.*

Keywords: Automation, Sensor, Solor, Automation, Microcontroller.

I. INTRODUCTION

The waste management is very important thing or task to control and reduce amount of waste. And composting has been acknowledged as a main stay for the proper waste management. There are compost bins and that are worked on electricity. But the only problem we might face is its cost and increase in electricity bills. The aim of this project is to enhance the interactivity in household levels by making it easier and cheaper and enabling the user to interact with it as well as making the entire process user friendly. The „Solar Powered Compost Bin" will be definitely a great work got proper waste management at houses. And the parameters like temperature, humidity as well as moisture are also controlled. The problem of increased in electricity bills is overcome, as this compost bin is totally worked on solar power supply. Also the „Solar Powered Compost Bin" will enhance the public health as well as health of soil. In ancient Athens each household was responsible for collecting and transporting its wastes. They used to place their wastes, covered periodically with layers of soil, in large pits. These practices basically are fundamentals of waste management nowadays. Most waste still ends up in landfill. However, before the industrial revolution the human population was about 1 billion people, now it is 7.5 billion. Before the demographic explosion humans could afford to simply take the trash somewhere out of the abode, today it is impossible. Mankind needs new solutions immediately. Waste management systems based on the collection of waste and transportation to disposal sites are outdated. It has been estimated that collection costs range between 40 and 60 % of a community"s solid waste management costs. Moreover, garbage trucks are involved in more than 5 fatal accidents per 100 million miles travelled. Elimination of waste collection could also prevent CO2 emissions of 4.2 to 12 kg CO2 per tonne of waste, depending on the types of vehicles employed in the various stages of waste transportation and the estimates of payload and average journey distances. Disposing food waste into the landfill can cause the organic matter to react with other materials and create toxic mixtures Unfortunately, the use of some of these solutions such as dumping and waste burning in the home is disastrous. For a considerable time a large variety of waste management practises have been studied and developed. Some of them were adopted as key solutions in waste management, namely: source reduction, collection, recycling, composting, incineration

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(burning), landfilling and simply dumping. The higher the income per capita, the more effective and safe for environment and population are the solutions used in a particular region.

II. Literature Review

Composting is not only a modern age matter, this practice took place long time ago. The earliest records state evidence that before the introduction of modern sewage systems, the major fertilizers were animal manure and composts of garden and kitchen wastes. Composting existed 10 000 years ago through the Akkadian empire which was located in modern day Iraq. When the citizens noticed that their plants grew better in area where there was manure they started putting manure in their soil. The history of composting also states that early farmers in Scotland, during the Stone Age, used to put manure and vegetable compost in their soil. Moving to Ancient Asia, there is evidence that the tools found in Neolithic sites in northern china contained similar features as those used by the Scottish farmers. The Greeks, Romans and Egyptians used composting too. In Egypt, after observing the worms‟ composting abilities, Cleopatra enacted a law that states that anyone who removes earthworms from Egypt was punished by death. During the 12th century, the Handbook Kitab Al Falah written by Ibn AL Awam gave detailed information about composting and the use of manure. . In 1943, George Washington Carver said “Make your own fertilizer, compost can be done with little labor and practically no cash outlay”. Yet, composting was soon replaced in the early 20th century. Justus Von Liebig, a German scientist, proved in 1840 that the plants can get nourishment from the chemicals. Therefore, the vegetables‟ and animals‟ waste mixture was replaced quickly by artificial fertilizers, and that was the beginning of the scientific method of farming. But like all the artificial solutions, fertilizers had their opponents.

III. System Overview

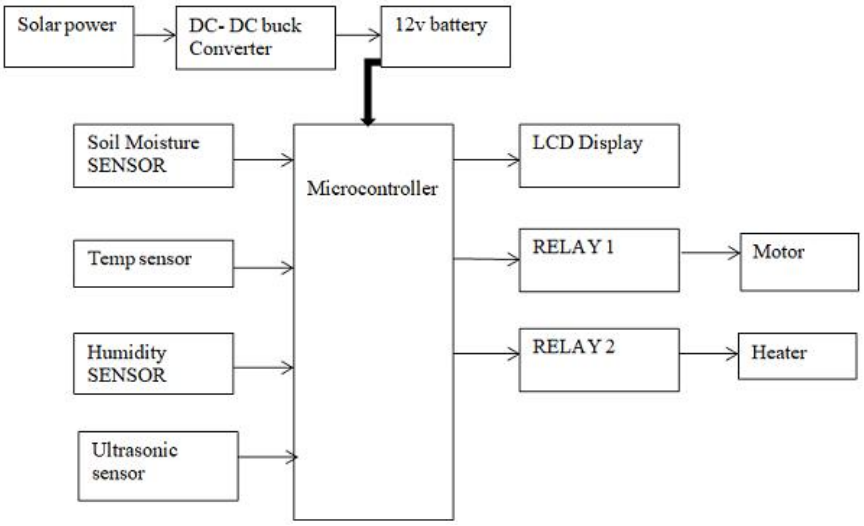

Figure 1: Bock diagram of system

The composting process has received much attention in recent years because of pollution concerns due to increase in volume of waste. This project report describe a smart way for the mitigation of the waste generation which is smart compost bin. The characteristics of the smart compost bin and its structure are also explained. Composting is a microbiological anaerobic process. Smart compost bin is a system which comprises of several components such as, metal and plastic detector, composting unit and outlet provision for produced fertilizer. Composting process is controlled by some parameters such as temperature, moisture and oxygen content Maintaining temperature fluctuations during composting period could allow adequate control of the process in case of any difficulty. Moisture content is the factor which makes the nutrients bioavailable. To be successful, we will need to provide the microorganisms in the system. This system totally works on solar energy. Smart compost bin can

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enhance public health by returning vital nutrients to the soil. This project reviews information on the composting for waste as a means of addressing the environmental pollution concerns Composting has been used as a means of recycling organic matter back into the soil to improve soil structure and fertility..

3.1 Microcontroller

PIC18F4520 is a low-cost, low-power, high-speed 8- bit, fully-static Microcontroller unit with 40 pins, 36 of which can be used as I / O pins. It has power-on- reset (POR) and the WDT circuitry (Extended Watchdog Timer), which can be programmed for 4 ms to 131 s. Introduction toPIC18F4520 PIC18F4520 is a low-cost, low-power, high-speed 8-bit, fully-static Microcontroller unit that has 40 pins out of which 36 pins can be used as I/O pins. It has Power-on-Reset (POR) as well as the Extended Watchdog Timer (WDT) circuitry, which can be programmed for 4ms to 131s. It has Power Management Features, which is useful for low-power applications. It has 3 power management modes.

1. RUN mode
2. SLEEP mode
3. IDLE mode

PIC18F4520 also comes with 3 programmable external interrupts & 4 Interrupts- On-Change (IOC) pins, which are reliable features for interrupts related applications. Also, the system has a 13-channel 10-bit ADC converter module.
It has a wide operating voltage range, from 2V to 5.5V., Thus it can be used in 3.3V or 5.0V logic level operations. The below image is showing the detailed pin diagram of the PIC18F4520.

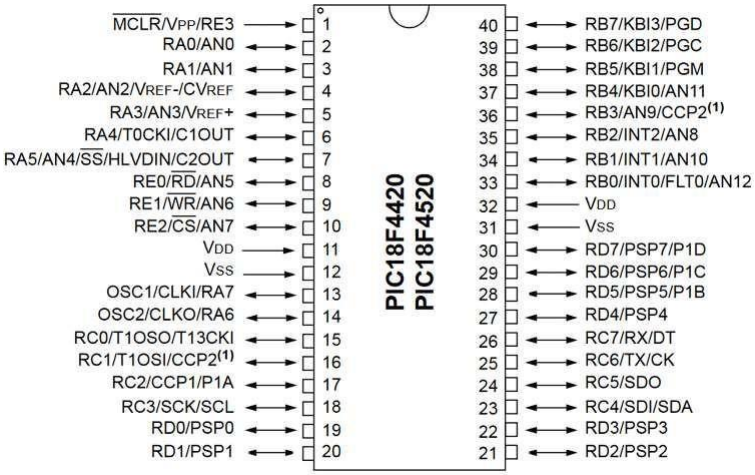

Figure 2: Microcontroller

3.2 LM 35 Temperature Sensor

Outputs 10mV per Degree that can also be read directly on multimeter or read in to microcontroller. For example at 30 degree celcius it will output 300mV at linear scale. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full -55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self- heating, less than 0.1°C in still air. The LM35D is rated to operate over a 0° to +100°C temperature range.

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3.3 Methodology

To review household survey of existing compost bin (Household and Industrial) various composting processes, and the interview will be conducted with the users to understand the major problems in waste disposal and drawbacks of the existing compost bin. Based on the Data collected in literature survey and ethnography research, the product design specification is designed. To generate concepts 2D sketch is made on the product design specification.

- **Solar Panels:** Solar panels are the main source for the working of every component of bin. They will be provided along the appropriate direction in order to receive the optimum amount of sunlight. In India generally the solar hours are assumed to be 5 to 6 hours.

Figure: Solar panels

- **Inlet provision:** Inlet will be provided at the upper side of the bin from where the organic waste is feed in the bin.
- **Geared motor:** Geared motor will be provided to rotate the shaft and the blades to required revolution per minute. The motor is powered by the solar energy with the help of solar panels.

Figure: Geared motor

- **Shaft and Blade Assembly:** Shaft will provide to cause the revolving movement of the blades along its vertical axis. One end of the shaft will be connected to the motor and other is needle fixed at the bottom on mesh. The blades will be provided on the circumference of the shaft which reduce the size of the waste and fastened the composting process.

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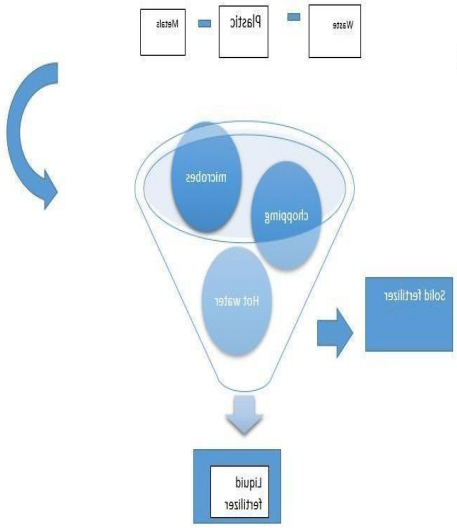
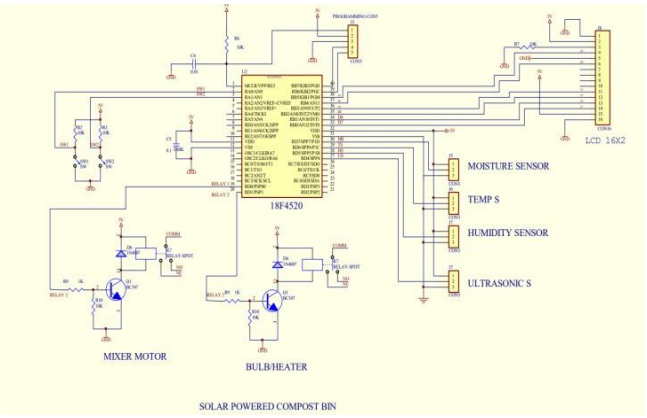
3.4 Compost Bin Working Process:

- Figure shows the composting process used in the compost bin designed for biodegradable waste. The process goes as follows-
- The biodegradable waste is loaded in the composting unit
- Biodegradable waste is chopped finely to increase the area of decomposition with the help of cutting blade setup.
- Addition of compost starter consisting of microbes which Starts the composting process
- Screens are provided at the bottom for separating liquid fertilizer
- The manure is then collected by the opening provided in side wall of composting unit
- Outlets are provided to collect both solid and liquid fertilizers.

3.5 Flow Chart of Working Process



3.6 Circuit Diagram



IV. Conclusion

The proposed strategies for the management and disposal of degradable waste by composting with smart compost bin have shown feasibility in terms of organic matter mineralization and humification. Compost bin plays a major role

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in solid waste management in India as it is easy to use and cost effective, can be implemented at lower rate. The new design of compost bin is aesthetically good looking, it has no odour, keep insects flies away from bin. Based on the study, it can be conclude that composting is the best way to reduce or recycle the municipal solid waste and it causes less pollution and more beneficial to environment as well as economy when compared to the current methods of collection and disposal. It has lots of benefits like reduce surface and water leachates, minimize landfill space, methane emission, air pollution by burning of waste, transportation cost etc. It also reduce load on disposal units. Compost obtained by this can be used as organic fertilizer in agricultural field instead of chemical fertilizer also due to shredding of waste in bin fast process of composting takes place.

V. FUTURE SCOPE

Based on few of the suggestions suggested by the advisors for future improvements of the compost bins, below are some of the future scope of the compost bin they are:

- Wheels can be added at the base so that it is easily transportable.
- Blade setup can be made with multiple size for thick and thin vegetables.
- Composting area to be transparent.
- Blade setup can be removable
- Proper handle for movement of compost bin.

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