EMBEDDED BASED HOUSE HOLD SOLID WASTE MANAGEMENT SYSTEM

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ABSTRACT

An essential service in every society is solid waste management. The term solid waste encompasses the various garbage materials produced from both human and animal activities that are deemed unwanted and useless. This type of waste is produced through industrial, residential, and commercial activities within a specific area, and it can be managed using different methods. Consequently, landfills are generally categorized into sanitary, municipal, construction and demolition, or industrial waste sites. A proposed electronic solution for managing household solid waste involves the use of Bioculum chemical.

KEYWORDS: Solid waste, Arduino, Bioculum.

INTRODUCTION

Waste can be classified according to its material, which includes categories like plastic, paper, glass, metal, and organic waste. Additionally, classification may consider the potential hazards associated with the waste, such as radioactive, flammable, infectious, toxic, or non-toxic types. Furthermore, the origin of the waste can also determine its categorization, encompassing industrial, domestic, commercial, institutional, or construction and demolition sources. Solid waste management is essential for maintaining environmental hygiene and should be integrated into environmental planning. No matter its origin, content, or potential hazards, solid waste must be handled in a systematic manner to promote best practices for the environment.

Household waste is often called garbage or trash. With the growth of the global population, the quantity of waste generated also rises. Typically, as societies become more industrialized and automated, their waste production increases. The industrial revolution, for instance, brought about new manufacturing processes and products that contributed to both household solid waste and industrial waste. Additionally, contemporary consumerism and the excessive packaging associated with many goods play a major role in the escalating levels of solid waste. The

majority of solid waste from households is collected by community garbage services and transported to landfills. Although the refuse is buried in these landfills, it can still emit unpleasant odors. Moreover, landfill sites can allow rainwater to infiltrate and extract pollutants from the waste within. Subsequently, these contaminants are transported into adjacent water bodies. Groundwater can also become tainted by pollutants, which ultimately results in the contamination of drinking water.

COMPOSTING WASTE AT HOME

Composting is the best way to handle food waste; it needn't ever leave apartment or head to the landfills. It can convert dustbin contents into rich, organic manure and grow flowers, vegetables or plants with it.

Compost (/ˈkɒmpɒst/ or /ˈkɒmpoʊst/) is organic material that has completed a full decomposition process known as composting. In this process, various organic materials, which from another perspective are considered waste products, are recycled into a soil conditioner (the compost). Other materials in the right proportions will also "feed" the organisms so that they "work" fast enough to generate heat within the pile. For example, active pile management (turning) is necessary to keep a high-enough supply of oxygen and the right moisture level. This balance of air and water is needed to sustain the high temperatures (about 130–160 °F or 54–71 °C) until the materials break down.

With the right combination of water plus oxygen, carbon, and nitrogen, micro-organisms break down organic matter and produce compost. In the composting process, organic matter is dependent on micro-organisms to break down into compost. There are many types of microorganisms found in active compost of which the most common are [10]:

- **Mesophilic phase:** An initial, mesophilic phase, in which the decomposition is carried out under moderate temperatures by mesophilic microorganisms.
- **Thermophilic phase:** As the temperature rises, a second, thermophilic phase starts, in which the decomposition is carried out by various thermophilic bacteria under high temperatures.
- **Maturation phase:** As the supply of high-energy compounds dwindles, the temperature starts to decrease, and the mesophiles once again predominate in the maturation phase.

Slow and rapid composting

There are many proponents of rapid composting that attempt to correct some of the perceived problems associated with traditional, slow composting. Many advocate that compost can be made in 2 to 3 weeks. Many such short processes involve a few changes to traditional methods, including smaller, more homogenized pieces in the compost, controlling carbon-to-nitrogen ratio (C:N) at 30 to 1 or less, and monitoring the moisture level more carefully. However, none of these parameters differ significantly from the early writings of compost researchers, suggesting that, in fact, modern composting has not made significant advances over the traditional methods that take a few months to work. For this reason and others, many scientists who deal with carbon transformations are skeptical that there is a "super-charged" way to get nature to make compost rapidly.

BIOCULUM

BIOCULUM is a mixture of **CULTURES OF MICRO ORGANISMS** specifically developed for accelerated aerobic composting of organic waste. It contains cultures of bacteria, fungi and actinomycites along with enzymes, which facilitate bio conversion of organic waste into a bio stabilized compost speedily. It is free from any toxic or hazardous material.

Composting serves as an effective substitute for incineration and landfills when it comes to certain biodegradable solid waste. Materials such as vegetable scraps, leaves, grass clippings, straw, horse manure, wood chips, and other similar plant-based items are all suitable for composting. By decreasing the volume of waste directed to landfills, composting benefits the environment. Proper composting transforms biodegradable materials into a nutrient-dense soil amendment, ideal for use in gardens or landscaping. This process returns essential nutrients back to the ecosystem, supporting plant growth. For successful composting of biodegradable waste, it is crucial to achieve sufficiently high temperatures to eliminate seeds or organisms present in the compost. However, if not executed properly, compost piles may emit unpleasant odors.

IMPLEMENTATION

The Figure 1 shows the block diagram of solid waste management system in which Arduino-uno is the microcontroller which monitors the system. Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. Along with ATmega328P, it consist other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. DHT11 is a Humidity and Temperature Sensor, which generates calibrated digital output. DHT11 can be interface with any microcontroller like Arduino, Raspberry Pi, etc.

and get instantaneous results. DHT11 is a low cost humidity and temperature sensor which provides high reliability and long term stability.

One of the main applications of connecting DTH11 sensor with Arduino is weather monitoring. Now DHT11 sensor is interface with Arduino which sense the humidity and temperature and display on the LCD display. But for the system to be work we required the 65 degree for that we are using the heater which increased the temperature upto 65 degree.

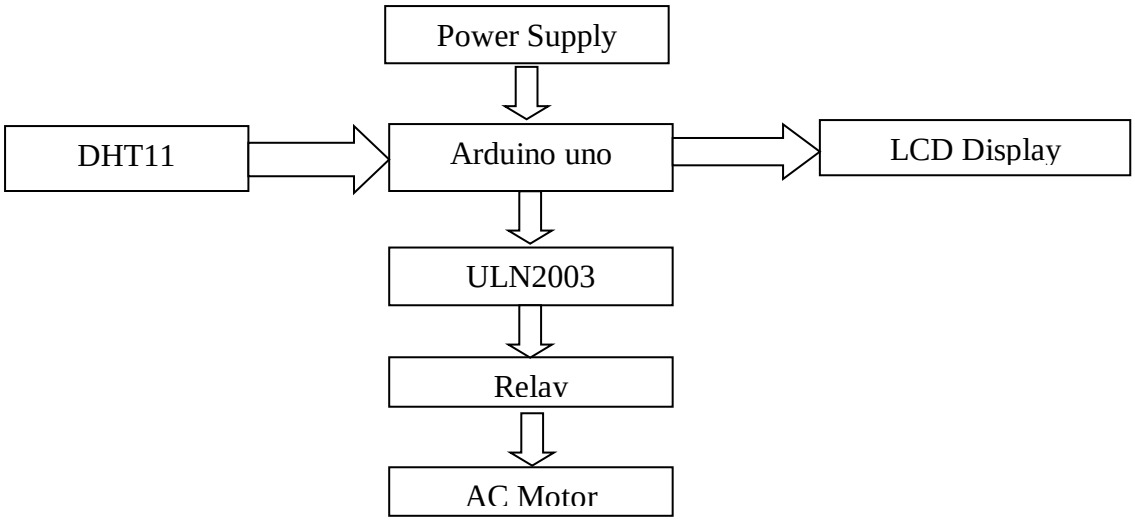


Figure 1. Block Diagram of Solid waste management system

The following Figure 2 shows all the necessary connections required to implement this work.

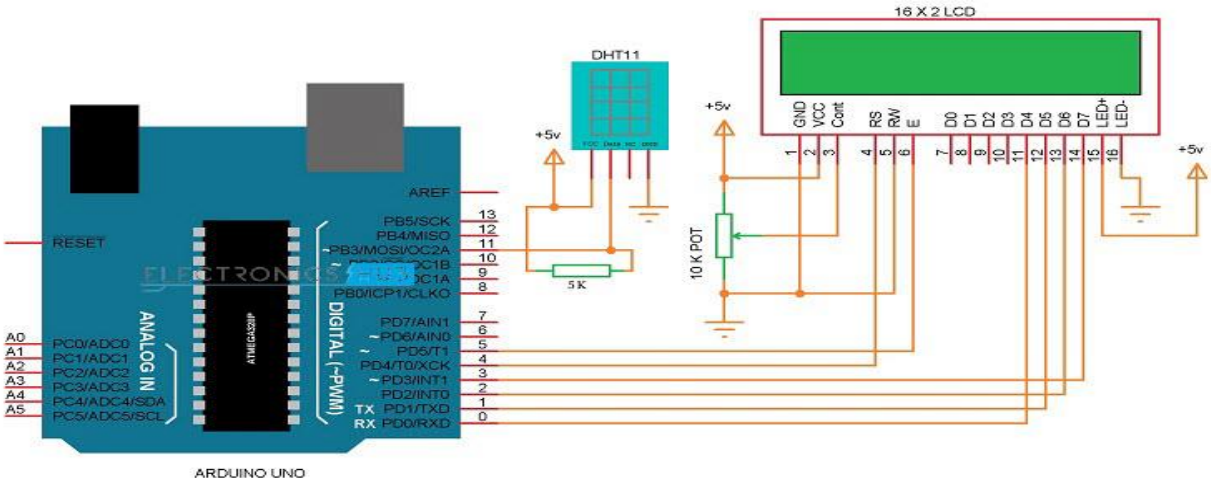


Figure 2. Interfacing of Arduino with LCD and DHT11 sensor

The DHT11 Humidity and Temperature sensor comes in two variants: just the sensor or a module. The main difference is that the module consists of the pull – up resistor and may also include a power on LED.

DHT11 is a part of DHTXX series of Humidity sensors. The other sensor in this series is DHT22. Both these sensors are Relative Humidity (RH) Sensor. As a result, they will measure both the humidity and temperature. Although DHT11 Humidity Sensors are cheap and slow, they are very popular among hobbyists and beginners.

It is suitable for all kinds of organic waste generated by Hotels, Canteens and Restaurant, Slaughterhouse, Municipalities, Food Processing Units, Households, and in agriculture operation. This waste represents a very valuable source of organic matter nutrients. By proper composting, it can be converted into a very rich source of stable organic manure rich in nutrients. The finished product can be used in lawns, nurseries or in farmer's fields. It is suitable for application as bioorganic soil enriches in Agriculture/Horticulture crops. The figure 2 shows the project design in which composting process take place. In this process the component that are used are heater which is used to increase the temperature to the required level which is the 65 degree .Here the DHT11 sensor is used to sense the temperature and humidity. The Humidity range is range from 0-70 degree and the temperature is range from 0-65 degree. So if the temperature is not at the required level for that we are using the heater.

For the proper decomposition, the organic waste is wetted and mixed with sawdust as the sawdust is used to balance the moisture of the mixture. Then the main material bioculum is added for the mixture. After 2 min, the decomposed material is removed from the outlet .As we see there is different process of composting but we are using the process in which the composting is done in just 2 min so it is very convenient process and can be used in the house.

RESULT and DISCUSSION

The system implementation and results are as shown in the figure 3.

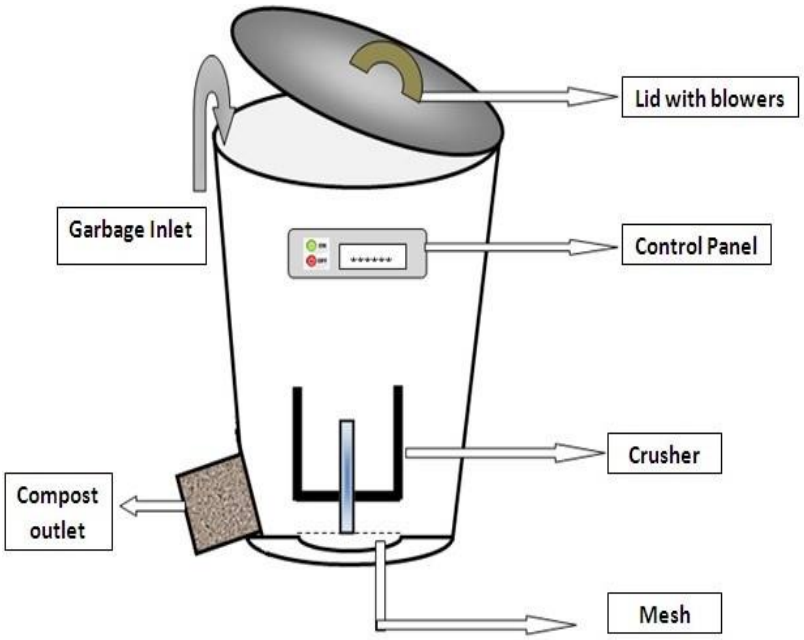
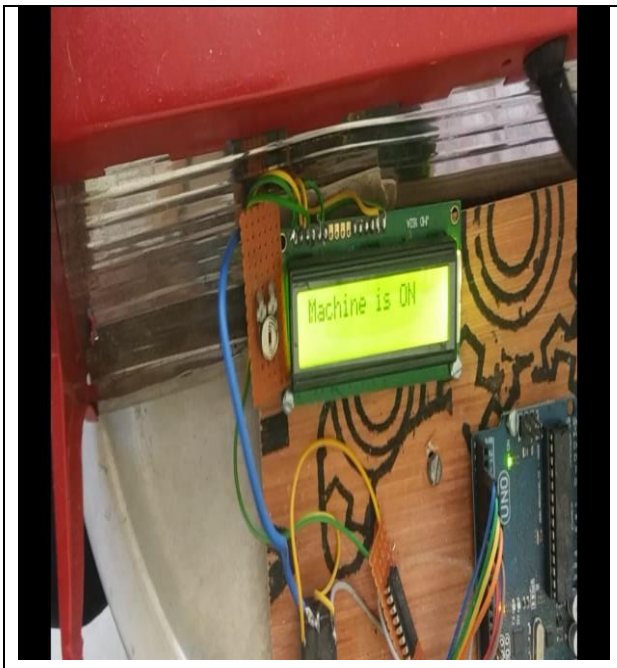


Figure 3. Diagram of Hardware implementation

a. Hardware implementation



b. Output on Hardware

c. Output of the system-Compost

Figure 3. Hardware implementation and Results

Utilizing compost for gardening, plants, and farming; completing the ecological cycle by returning food to its source in the soil; and reducing the expenses associated with garbage collection, transportation, and disposal. It promotes zero-waste cities, reduces landfill space consumption, ensures environmental and economic protection, reduces water pollution, and supports wildlife conservation. And also it helps avoid global warming. One limitation of the

work is to avoid putting hard material like coconut or jackfruit shells, wood, iron or steel objects into the machine as they can cause serious harm.

References:

1. Delufa Tuz Jerin , Hasna Hena Sara , Marzuka Ahmad Radia , Prianka Sultana Hema , Shahriar Hasan , Salma Akter Urme , Camilla Audia b, Md Tanvir Hasan , Zahidul Quayyum "An overview of progress towards implementation of solid waste management policies in Dhaka, Bangladesh**"** Volume 8, Issue 2, February 2022,. doi: 10.1016/j.heliyon.2022.e08918
2. Shweta Choudhary , "A Research Paper on Solid Waste Management" Journal of Emerging Technologies and Innovative Research, March 2019, Volume 6, Issue 3, ,ISSN-2349-5162, pp no. 357-662
3. T. J. Sin, G. K. Chen, K. S. Long, I. Goh, and H. Hwang, "Current practice of waste management system in Malaysia : Towards sustainable waste management," 1st FPTP Postgrad. Semin. "Towards Sustain. Manag., 2013.
4. A. Khalid, M. Arshad, M. Anjum, T. Mahmood, and L. Dawson, "The anaerobic digestion of solid organic waste," Waste Management. 2011. L. Matsakas, Q. Gao, S. Jansson, U. Rova, and P. Christakopoulos, "Green conversion of municipal solid wastes into fuels and chemicals," Electronic Journal of Biotechnology. 2017.
5. H. I. Abdel-Shafy and M. S. M. Mansour, "Solid waste issue: Sources, composition, disposal, recycling, and valorization," Egyptian Journal of Petroleum. 2018.
6. Senate Economic Planning Office, "Philippine Solid Wastes," Philipp. Solid Wastes A Glance, 2017.
7. A. Johari, H. Alkali, H. Hashim, S. I. Ahmed, and R. Mat, "Municipal solid waste management and potential revenue from recycling in Malaysia," Mod. Appl. Sci., 2014.
8. M. D. M. Samsudin and M. M. Don, "Municipal solid waste management in Malaysia: Current practices, challenges and prospect," J. Teknol. (Sciences Eng., 2013.
9. U. Arena, "Process and technological aspects of municipal solid waste gasification. A review," Waste Manag., 2012. [9] J. chun Lee and B. D. Pandey, "Bio-processing of solid

wastes and secondary resources for metal extraction - A review," Waste Management. 2012.

10. A. Pires, G. Martinho, and N. Bin Chang, "Solid waste management in European countries: A review of systems analysis techniques," Journal of Environmental Management. 2011.
11. A. Fercoq, S. Lamouri, and V. Carbone, "Lean/Green integration focused on waste reduction techniques," J. Clean. Prod., 2016.
12. C. Ezeah, J. A. Fazakerley, and C. L. Roberts, "Emerging trends in informal sector recycling in developing and transition countries," Waste Management. 2013.
13. J. G. Paul, J. Arce-Jaque, N. Ravena, and S. P. Villamor, "Integration of the informal sector into municipal solid waste management in the Philippines - What does it need?," Waste Manag., 2012.
14. P. S. Murthy and M. Madhava Naidu, "Sustainable management of coffee industry by-products and value addition - A review," Resources, Conservation and Recycling. 2012.
15. D. Victor and P. Agamuthu, "Strategic environmental assessment policy integration model for solid waste management in Malaysia," Environ. Sci. Policy, 2013.