Smart Compost Barrel

Thesis

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Sincerely,

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DECLARATION

We certify that N. P. Fernando, O. S. K. Yapa, and K. A. Nimnadi Dilsika Kumbhalathara are the author of this thesis and that no part of the thesis has been published or submitted for publication.

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ABSTRACT

Sri Lanka generates 7000 tons of solid waste per day and disposes of it in landfill, contributing to greenhouse gas emissions. Out of 65-66, present consists of degradable organic materials. Accordingly, 3963 tonnes of food waste are generated per day. Many farmed fields ceased producing or saw a halving of their output when the government forbade the purchase of artificial fertilisers. Since many farmers are not accustomed to utilising carbonic fertilisers, the government encourages their usage. Due to this predicament, people start growing in their gardens and utilise composted fertiliser for their landscaping. Many individuals still utilise outdated compost processing methods and compost bins to generate manure. It does need supervision and moister for better results, but most people neglect these procedures because they have other things to do. The resources of the existing system are also expensive, ineffective, and fraught with problems. To solve this problem, the research aims to provide quality manure created from household organic waste using the smart composting barrel. The composite barrel will need 14 days for composting process. During this process, the smart compost barrel collects the moisture content and barrel emptiness by scanning barrel depth. With Arduino UNO microcontroller for automated water motor and Norde MCU collect depth data and inform user next step need to proceed by collecting data via WIFI. After the process is complete, the user can collect manure. With this prototype we will improve quality and improve user manageability and automation to the higher level.

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LIST OF ABBREVIATION

Table 1:List of Abbreviations

IoT	**Internet of Things**
IDE	Integrated Development Environment
Wi-Fi	Wireless Fidelity
pH	Potential of hydrogen
USB	Universal Serial Bus

CHAPTER 1

1.1 Introduction

Solid waste management is a significant issue in Sri Lanka. In metropolitan regions, solid garbage is collected by the City Council once weekly; however, this service is typically unavailable in rural areas. In Sri Lanka, 7000 tonnes of solid waste will add to garbage pits and landfills every day, and landfill gases generated from the decomposition process consist mainly of methane (CH4) and carbon dioxide (CO2), approximately 60 and 40%, respectively, contributing to greenhouse gas emissions [1]. Out of it, 60-66 percent of trash is organic material generated 3963 tonnes a day, and the government will process some organic waste at waste management facilities to compost. In contrast, some organic waste will be recycled for animal fodder. Additionally, many urban agricultural areas still generate manure using the outdated composting technique since the level of organic waste is too high to meet the goal. Therefore, it is preferable for the ecology to compost at home and utilizes the waste [2].

Compost bins come in a broad range thanks to the work of several businesses. However, most compost bins are difficult to operate, or users must monitor to see if manure was created. Therefore, the prototype design will decrease the user's involvement in composite monitoring and autonomous control. Measuring the soil's level will alert the user when to add extra water for composting. Additionally, it will control the water pump and monitor the moisture level so that the user does not have to keep track of when to water the composting area. To remind the user, a notification will be sent to their smartphone.

1.2 Research Gap

Many foreign countries use smart systems for better results and processes, but in Sri Lanka, most compost bins are custom-made by households or buy from sellers. There are limitations in design, techniques, and automation. Most compost barrels are needed human intervention for the full degradation process to complete. Because of that, most people do not use

composing bin in their life. Further research and usage gaps in Sri Lanka are higher than in other high-end economic countries.

1.3 Research Problem

The Sri Lanka market has a standard compost barrel. That barrel can use it for organic waste composting. However, it needs to water time to time to keep its proper moisture manually, and need to remove resident water because most barrels do not have a water drainage facility. Some barrel do not have a breathable environment for the process to be fast.

Waste collecting is essential, but the disposable waste rate will depend on personal income levels. In the high class, most products include more disposable parts, and people do not care how they dispose of them. Most middle-class and lower-class people dispose of low organic waste because they control their food consumption. Also, Sri Lanka is a middle-income country; it generates 53 percent and 57 percent of food and green waste products daily.

According to studies (Arachchi 2016 and Samarasinha et al. 2015), more than 59 percent of garbage collected from,

- Household: kitchen waste, garden waste, etc.
- Market: a waste of markets that trade large quantities of agricultural items (vegetables, fish, meat, Etc.).
- Agro industry: trash created at animal farms, crop fields, and sales centres for agricultural goods, raw materials, and food processing.
- Waste from institutions and industries.

They are, nevertheless, gathered in rubbish heaps and garbage cavities. Composite bins are developed for garbage management in urban areas however present composite bins have usability issues and concerns in other places, such as

- Moisture cannot be regulated.
- They have no control over garbage consumption.

- Ignore emptying manure after a period.
- An odour may be produced.

However, there is no creative product that uses IoT base bins for compost production, and our research project will design an IoT-based smart compost barrel that notifies the customer in real-time.

1.4 Significant of the projects

1. Why is this research project critical?

It will enhance the everyday lives of urban families by lowering the working time for composting and waste production from dwellings, as well as improving the process's controllability, automation, and usage for gardening vegetables in the garden.

2. What are the benefits of conducting the study or project?

It will upgrade the present outdated compost barrel with new smart features and minimize pollution in the environment. It will also aid in the development of automated industrial compost machines.

3. Who will benefit from the study or project?

Our initiative assists urban families, individuals living in flats, and others, as well as the industrial sector in the construction of automated compost machines. Also, assist the next generation in contributing fresh ideas related to our project.

4. Why did this problem need a solution?

Vegetable prices are growing on a daily basis, and due to fuel shortages, vegetable transportation is restricted by more than half, thus people must find another option. As a result, more individuals are growing vegetables in their gardens. As a result, they require

fertilizer for this, and our prototype will assist people in becoming accustomed to composting and waste management.

1.5 Research Objective

1.5.1 Main Objective

An ultrasonic sensor is employed to create an automated and intelligent compost barrel that informs the user about organic waste input and manure disposal time. A mobile application can also be used to obtain data for the composite period.

1.5.2 sub-Objective

- The humidity sensor will determine whether or not to switch on or off the water supply based on soil moisture.
- If the distance sensor detects that the barrel is full, it will alert the user to add more organic waste.
- A shredder connected to a composite barrel may shred organic trash.
- Users will receive data on composting time as well as other valuable information.

1.6 Research Questions

1. How can a prototype detect whether the barrel is filling up or whether the biodegradable waste is incorrect moisture or not?

If the ultrasonic sensor detects that the barrel is full and check manure is full or not in bottom compartment, it will transmit a notification to the mobile application through Wi-Fi. Furthermore, user data will be kept in a database to present statistics on the composite barrel's usage.

2. What are the approaches used in the in-house compost barrel monitoring system?

For notice, use a mobile application and web site. There will also be openings in the barrel for breathing, and water will flow through a spiral tube to ensure that water is uniformly distributed within the barrel.

3. What components should we use for a prototype?

Arduino UNO, Norde MCU, soil moisture sensor, ultrasonic sensor, relay, and other components and this component will be configured with two modules: one for water pumping and the other for monitoring barrel fill levels.

1.7 Overview of the Thesis

In this thesis we hope to develop a product with low-cost with durable material and use intelligent code to gather monitoring data and automating the water inlet to create smart compost barrel for everyday usage by assisting users in determining when to dispose of organic waste and when to gather manure from the compost bucket. Later, we hope to adapt the compost to detect non-biodegradable items when a user attempts to place them in a barrel, add a sensor to gather depth levels, and develop a mechanism to eliminate stink once manure is created.

CHAPTER 2

2.1. Introduction

This part provides a review of the smart compost barrel literature in order to identify the aspects to consider in residential solid waste monitoring systems, identify gaps in the literature, provide a theoretical and conceptual framework, and lay the basis for empirical research. The study's data findings would be utilized to improve the research's usefulness or as a reference for future research and the construction of a prototype.

2.2 Compost

Organic waste (such as wasted fruit and vegetable leftovers, grass clippings, leaves, and some forms of animal feserce) and compost bins are buildings meant to harness the decomposition process as a starting point. Compost bins increase organic material digestion by providing appropriate aeration and moisture retention. The correct quantity of both moisture and air can help aerobic bacteria develop the high temperatures required to break down organic substances into manure.

2.2.1 Why should we need to make a compost bin

According to the US Environmental Protection Agency, the individual American generates 1,500 pounds of garbage each year, with lawn waste and moist debris accounting for around 25% of that total. Every year, we squander 24 million tons of leaves and grass clippings that might be composted, saving landfill space, and reducing our reliance on fossil fuels. Composting reduces the amount of rubbish we send to landfills, which benefits both the environment and our finances.

Composting may improve the aesthetic of your yard while also benefiting the environment. The compost material you create may replenish hard, depleted soils, allowing flowers,

vegetables, and fruit trees to thrive in an area that is suddenly nutrient-rich. Composting improves the soil and reduces precipitation runoff by increasing the soil's ability to keep moisture and texture.

Purchasing composite material is fairly expensive. Anyone with a little more garden space, a little extra time, and a trustworthy source of compostable waste, on the other hand, may make solid, high-quality compost for free in as little as four weeks. Composting can help your plants grow better since it recycles nutrients from the ground back into the soil. Plants that are healthy are considerably more resistant to pests and diseases. Instead of tossing away organic waste, compost it.

2.3 Collecting Components for Waste Monitoring System

The following statistics can be used to further highlight the current trash monitoring system, even in nations with very high waste levels and low and medium economic levels.

5. We must appropriately collect and store domestic garbage, which accumulates in the majority of houses.
6. Compost may be made from home recyclable garbage.
7. We collect general garbage and send it to a recycling center or community bin.
8. Possession of the common trashcan or transfer station. Secondary waste collection and transfer to a disposal site
9. Waste disposal in landfills.

One of the most important actions we must take to store our garbage is proper waste segregation and disposal. In order to do this, the domestic human society gathers garbage, which is then properly kept and recycled. If public garbage can be properly kept and recycled, it should be done so that the waste can be reused. When waste management is done correctly and swiftly, disposable garbage should also be disposed of properly and methodically. When

a country is active in this way, it may live a very healthy existence without jeopardizing the health of its population.

2.4 Waste Composition

Standardizing a production line for fermenting food waste is difficult since waste composition varies widely across food supply chain sectors. Can employ a significant quantity of food waste to make bioethanol, but further research is required to produce other higher alcohols. Despite the fact that there are several study articles in this subject, only a few studies have demonstrated good alcohol yields. Future generations will generate more food waste; therefore, it must be used carefully. An industrial ecology method should map the food waste resource flow in a given location and estimate the fraction of food wastes that may be used to make various alcohols. A complete understanding of generation and composition, as well as generation amounts, would aid in the standardization of a manufacturing process. Before contemplating employing food scraps for large-scale biofuel production, it is critical to assess the life cycle energy needs and environmental effect of the production process. Because integrating food waste might drastically reduce the cost of raw materials and output, a detailed economic examination of the technology, particularly for upstream processing, is critical.

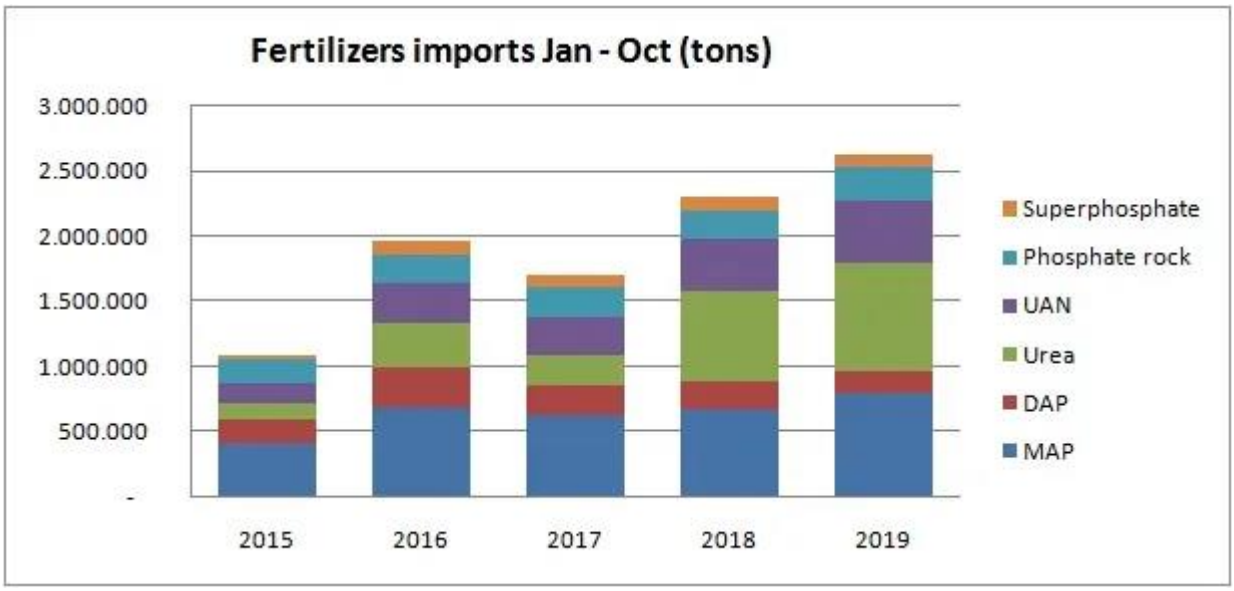
HW contains the biggest quantity of trash and is one of the most easily accessible commodities. As a result, we will have no trouble obtaining the components required to manufacture compost.

2.5 History

Throughout history, our forefathers employed a variety of methods to create manure for agriculture. They previously employed biodynamic agricultural practices. For agriculture, they combine animal manures, crop leftovers, and green manures with water and cover them with coconut twigs. They gather them after 2-3 months and sprinkle manure on the field. Crop

rotations, shifting cultivation, and crop diversification are also used to regulate soil fertility so that soil quality does not deteriorate over time.

They changed indigenous subsistence agricultural methods into export-based commercial plantation agriculture after gaining control of the Portuguese, Dutch, and British. Later, high-yielding crop types and synthetic fertilizers for nutrient control are introduced. Because changing the present composite techniques is difficult to apply, farmers resort to alternative foreign approaches to boost crop productivity and harvest. Farmers, according to studies, utilize imported fertilizer for crops.



need to update

2.6 Smart compost past projects

2.7 Result of that project

The Penang Hill Corporation is in charge of all development on the hill in order to sustain and extend it into a well-known eco-tourism destination. The PHC works with this role to improve and reinvent Penang Hill so that it may continue to serve both visitors and residents, the hill's environment, and the habitat for local fauna. As a result, the PHC has noted that as Penang

Hill has attracted more tourists over time, it has also attracted more trash production: what was originally a few rubbish bags of debris that were burnt every day has expanded to one pick-up truck every day. To collect and carry garbage, two full-sized vehicles must now ascend and descend the slope every day.

Because everything here is done manually, we can use this product more efficiently by developing an automated system that accomplishes this artificially so that we can use these things. When compared to these designs, the unique element of our design is that it works with an automated system, which is why we are confident that we can produce effective and high-quality goods through our method.

CHAPTER 3

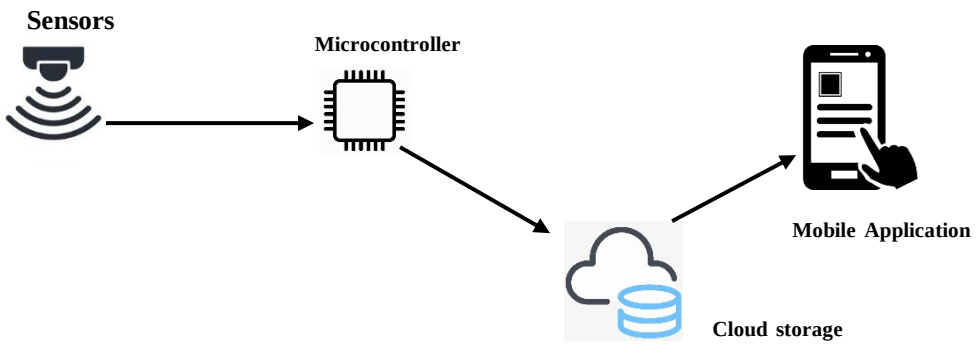
Research Methodology

This section discusses how the smart compost bin will be developed and executed, including the location of sensors and the functionality of each in the smart compost bin, as well as the technologies needed for execution.

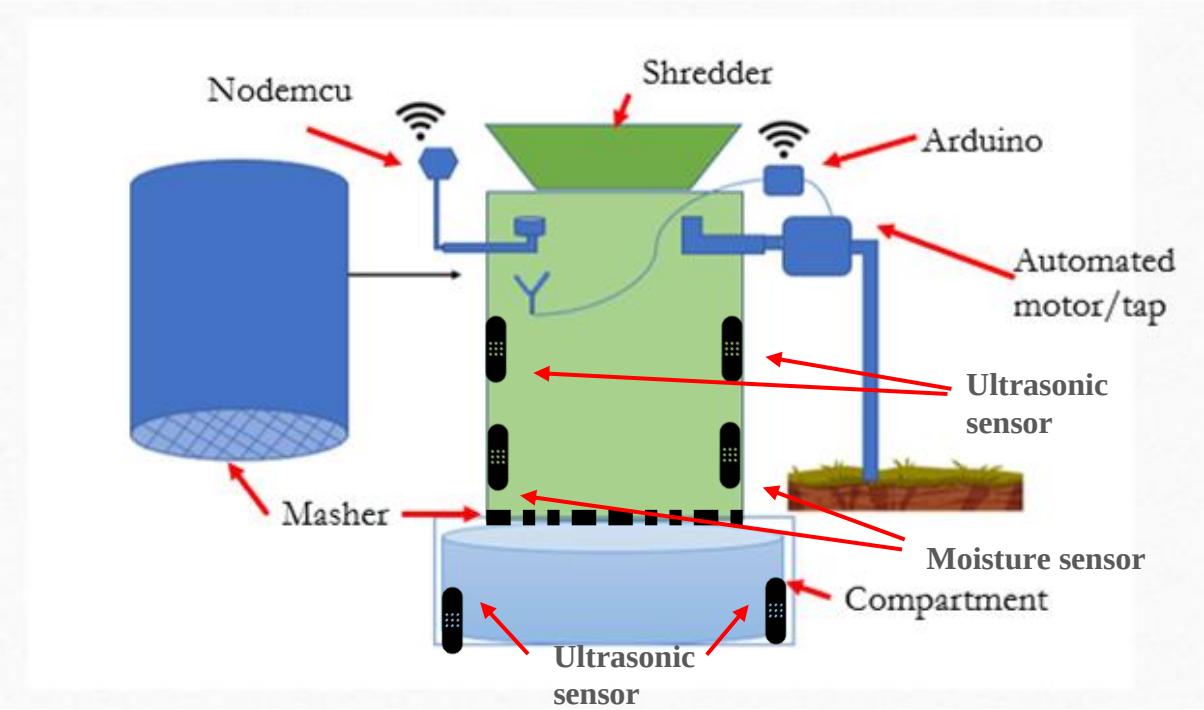
3.1 Proposed System Overview

This device is designed to compost various sorts of biodegradable materials and produce high-quality manure. Stakeholders may place any biodegradable garbage in the smart compost bin and receive high-quality fertilizer in exchange. Various sensors are installed within the bin to collect data while the composting process is in progress. These sensors monitor the moisture level in the compost bin, the water level in the compost bin, and the amount of biodegradable trash. The system includes an automatic water tap that adjusts the water level in the compost container based on sensor data. The smart compost bin is divided into two sections: biodegradable garbage and compost collection. All biodegradable garbage is placed in the biodegradable waste container, and all processed waste (compost) is placed inside the compost container. A shaft blade (shredder) is inserted inside the biodegradable container to minimize the size of the trash. All of the sensors are linked to a microcontroller, and all sensor readings will be saved in the cloud. The user has a smartphone application that is linked to the smart compost bin system. Users will get cautions, alerts, and notifications about the compost bin via the mobile app based on sensor readings.

The microcontroller linked to the smart compost bin will collect all sensor data and transfer them to the cloud storage. The measurements will be collected from the cloud storage by the mobile application and then computed and processed. Users will receive numerous messages on the compost bin through the mobile application. The schematic below depicts how the sensors and microcontrollers will function within the system.



The image below depicts a visual illustration of the smart compost bin we want to construct.



The compost bin is made up mostly of two pieces. The biodegradable container component is on top. This section has a shredder to reduce the size of the trash, and the majority of the sensors are located inside the compost container. The bottom section is a compost container. This container holds all of the processed compost, and the user may take it out. The compost fertilizer collecting system is at the bottom. To separate the biodegradable trash and the compost fertilizer, a masher has been installed between the top and bottom sections.

3.2 Expected Functionalities

3.2.1 Data Capturing and Data Handling

When the user places biodegradable garbage in the compost bin, the compost barrel's sensors monitor all of the conditions inside the bin. Inside the compost bin, two types of sensors are available to gather moisture and biodegradable waste levels. As the first stage in this operation, the system collects all moisture and waste level information from the sensors. A sensor is a device that detects and responds to physical environment input [1]. One microcontroller (NodeMCU) is connected to waste level sensors, while another microcontroller is attached to moisture level sensors (Arduino Uno). Each microcontroller has a specific software hardcoded to gather raw data, which can then be processed to generate information on the smart compost barrel.

This function is the most critical component of the system since we need to collect the most exact and correct information in order to get the best results from the smart compost bin. We employ two sensors of each type to obtain reliable raw data from the sensors. All raw data will be sent to microcontrollers for further processing. The illustrations below show how the data collecting component will function in the system.

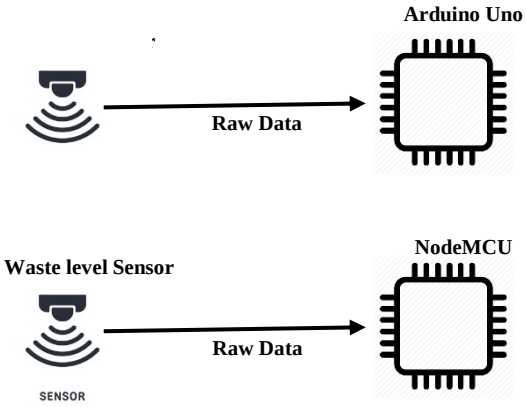


Figure 8: data capturing

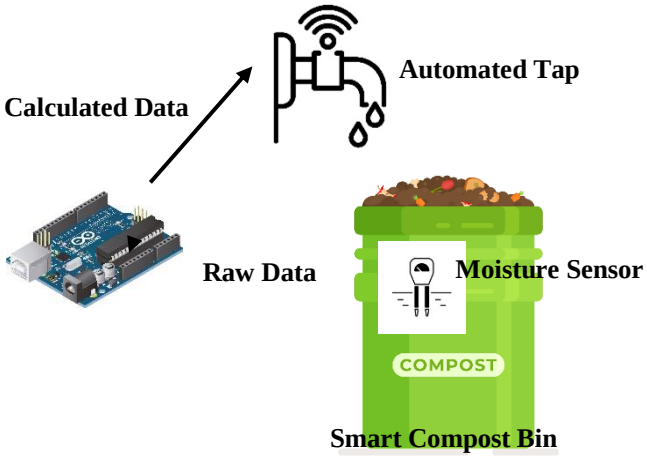
3.2.2 Data Processing

Data processing is the function that converts all recorded data into relevant information for the user. Each duty is hardcoded into both microcontrollers. The raw data processing is handled by the microcontrollers. The system monitors the moisture and waste levels. Moisture sensors transmit raw data to the microcontroller, which uses the average value to determine the right moisture level at the time. The waste level sensors send data to the microcontroller, which uses the average value to determine the right waste level at the moment. The acquired raw data values are first processed by the microcontrollers, and the derived data is then saved in the cloud. To aid the user, calculated data will be used for further processing and decision-making. The mobile app will provide users with information and cautions regarding the compost bin based on this data. Part 3.2.4 goes into further detail about this. Some of this data will be utilized for automatic operations within the compost container. Part 3.2.3 goes into much detail on this.

3.2.3 Automated Functions inside the Compost Bin

To get appropriate tasks, processed data will be supplied into the automated operations within the smart compost bin. The compost bin is divided into two portions, the top of which is known as the biodegradable container component. This section has an automatic water tap that will water the biodegradable garbage to keep it wet. The user must connect this tap to a water source before it will operate automatically based on the moisture content of the biodegradable trash.

Moisture sensors within the bin will measure the humidity and provide the raw data to the microcontroller. The microcontroller will compute the precise moisture level at that moment. These data will be sent to the automatic tap system based on the moisture level. The tap will automatically blow water to maintain the proper moisture level within the biodegradable container. The graphic below depicts how the automatic water system operates within the smart compost container.



3.2.4 Notifying the User

This function is mostly concerned with the mobile application component. Notifications concerning the smart compost bin will be sent to the mobile application. The bin is divided into two sections, each with two ultrasonic sensors that measure the level. Two ultrasonic sensors are installed inside the biodegradable container to measure the biodegradable trash level. To measure the compost level, two ultrasonic sensors are put within the compost container. These sensors will feed raw data to the microcontroller (NodeMCU), which will calculate the average level at that moment. This data will be sent to cloud storage for further processing. Because this data must be uploaded to the cloud storage, we utilized a NodeMCU microcontroller with an integrated Wi-Fi module.

The user will receive messages and cautions concerning the smart compost container based on this information. The smartphone application will warn the user if the biodegradable container is opened. Similarly, when the Compost container is full, the mobile application will tell the user. According on this information, customers can receive a monthly report on the compost bin and much more information.

3.3 Specific Functions

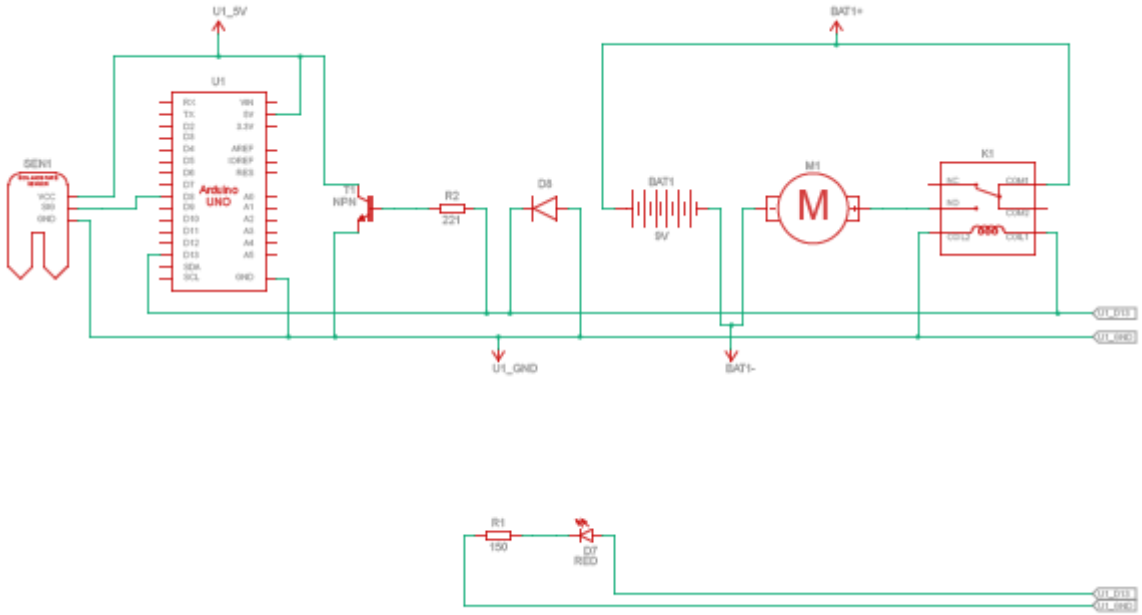
- Inform the user of the smart compost bins compost level.
- If the biodegradable waste container is empty, send a warning message to the user via the mobile application.
- Provide a monthly report on the compost processes occurring within the smart compost bin.
- Notify the user if the automatic water tap is not receiving water.
- Maintain the proper moisture level within the biodegradable waste container to create high-quality compost.

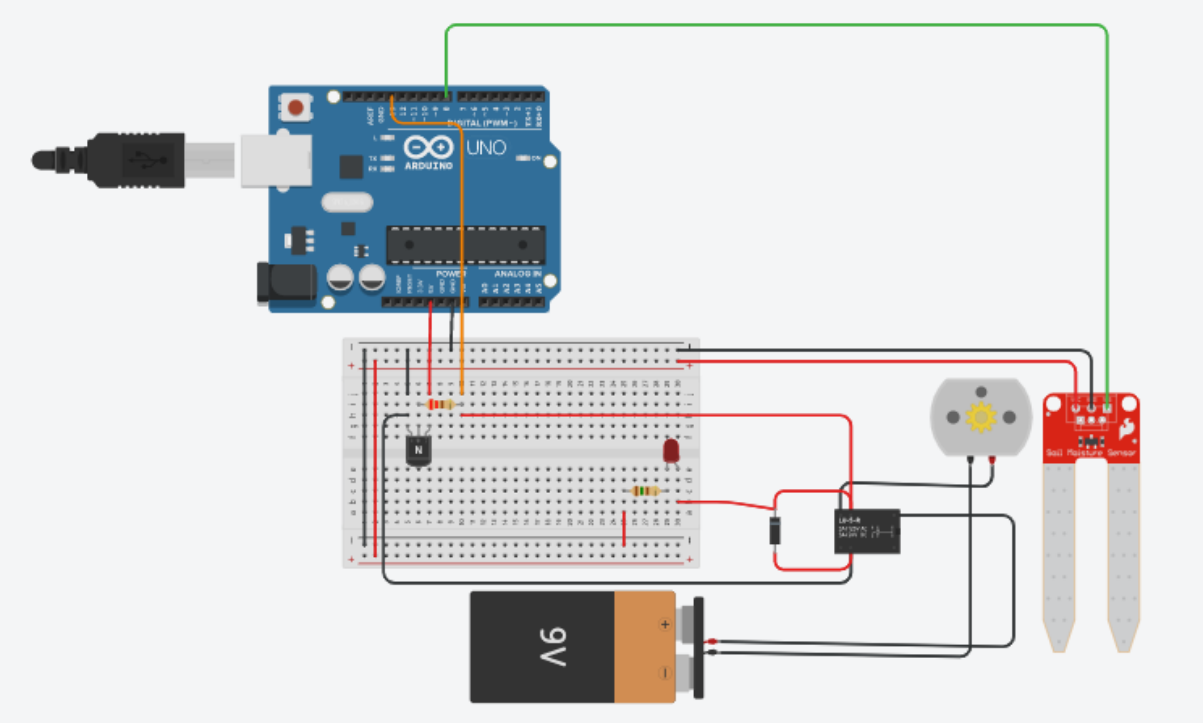
3.4 Requirement Analysis

3.4.1 Hardware Components

Table of components

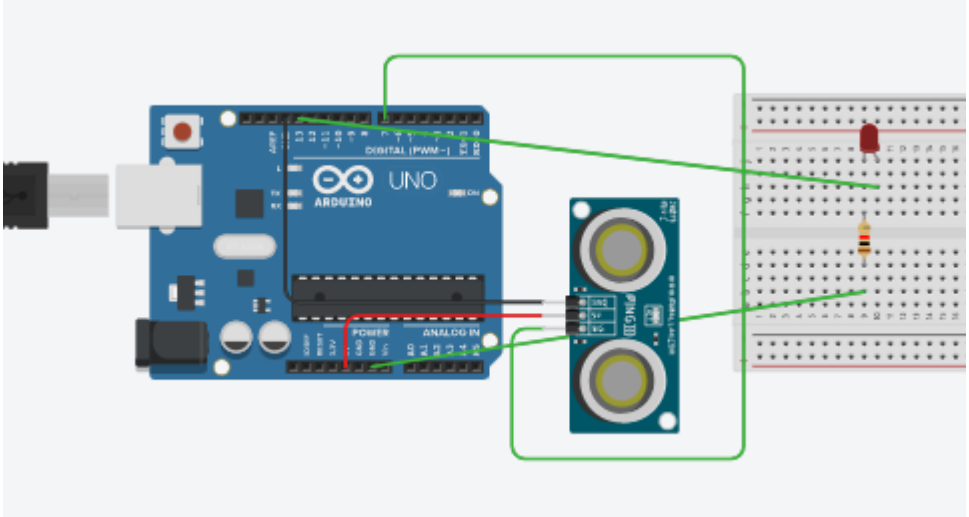
automated water pump circuit diagram

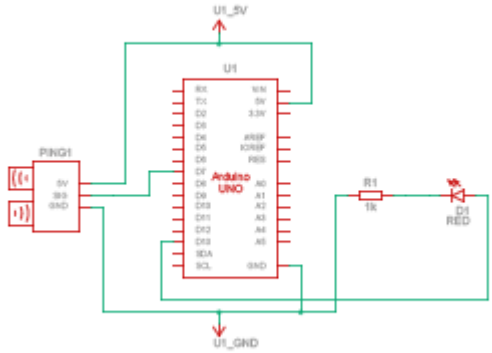




Depth sensor module

need to change to norde MCU





3.4.2 Technologies

- Wi-Fi technology is employed in this suggested system to save data in the cloud storage, and a NodeMCU microcontroller is used to obtain Wi-Fi connectivity in the system.
- The system has employed cloud storage to store the data. We used a cloud database instead of a local database since users may access the data from anywhere when utilizing a cloud database.
- For the mobile application, we utilized Java and C, and for the IDE, we used NetBeans and Android Studio.
- To program the microcontrollers, we utilized C and the Arduino IDE.

3.5 Proposed Plan

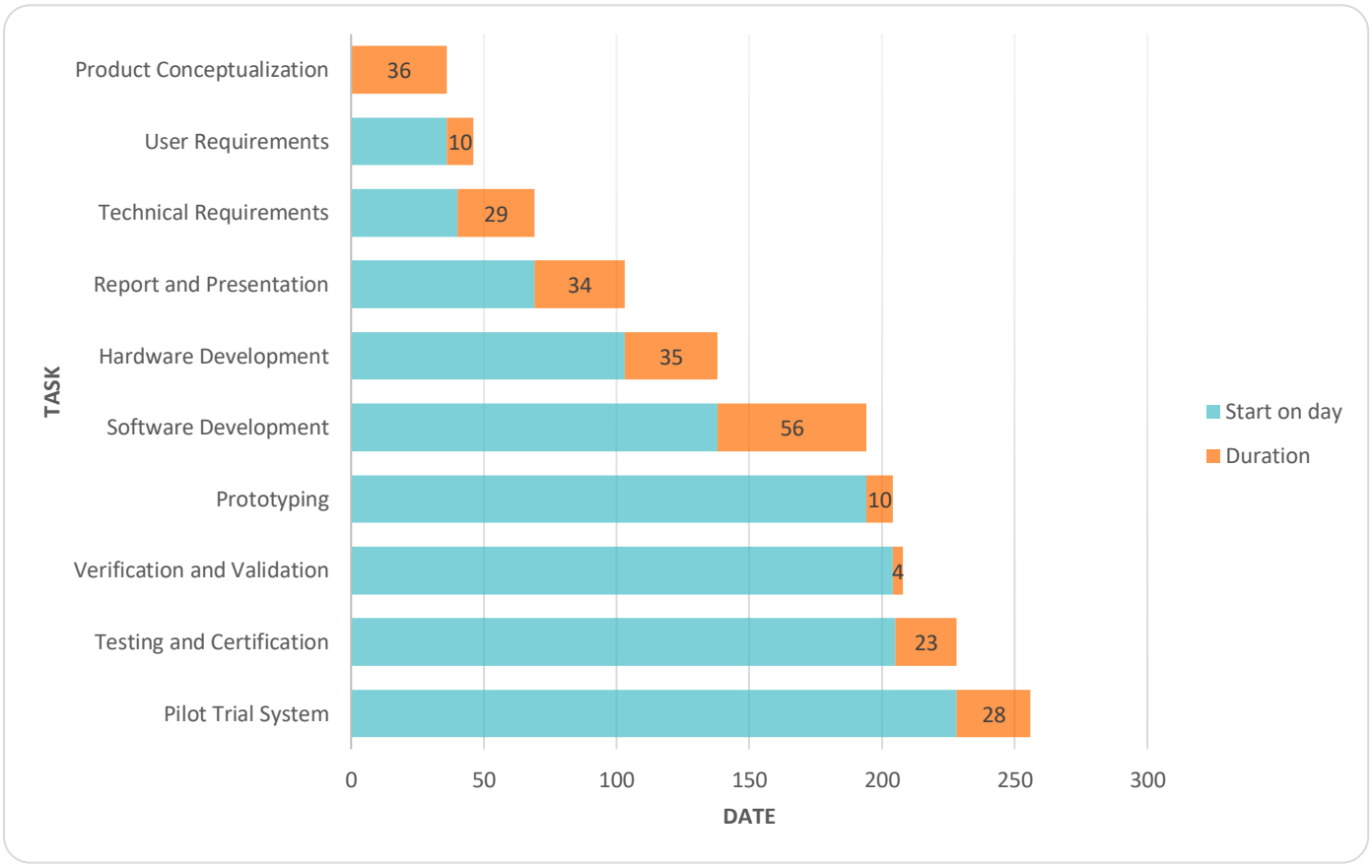
- The project subject was chosen as the first stage in the first semester of 2022.
- We did divide the assignment into two halves. That was the documentation and project implementation.
- We estimated that we would finish the documentation portion of the project by the end of the first semester and the project execution portion by the end of the second semester.

Following table demonstrate the allocated duration for each task with the start time and the end time.

Table 3: allocated duration for each task

Activities	**Start date**	**End date**	**Duration**
Product Conceptualization	3/5/2022	4/10/2022	36
User Requirements	4/11/2022	4/21/2022	10
Technical Requirements	4/16/2022	5/15/2022	29
Report and Presentation	5/16/2022	6/19/2022	34
Hardware Development	6/20/2022	7/25/2022	35
Software Development	7/26/2022	9/20/2022	56
Prototyping	9/20/2022	9/30/2022	10
Verification and Validation	9/30/2022	10/4/2022	4
Testing and Certification	10/2/2022	10/25/2022	23
Pilot Trial System	10/26/2022	11/23/2022	28

Gantt Chart

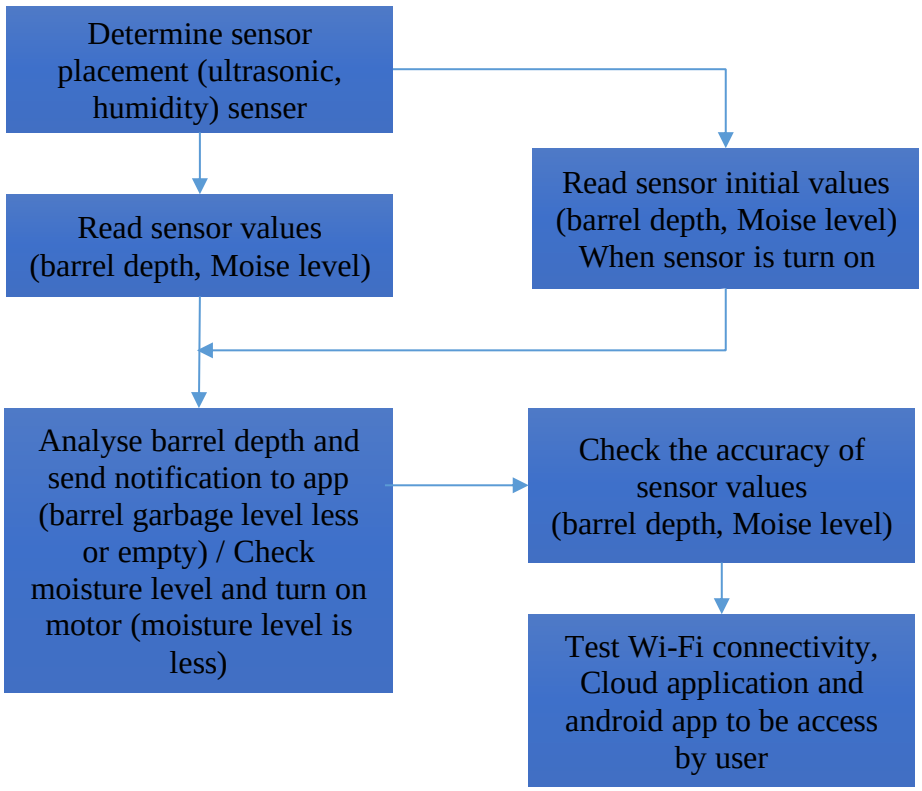

Product Conceptualization
User Requirements
Technical Requirements
Report and Presentation
Hardware Development
Software Development
Prototyping
Verification and Validation
Testing and Certification
Pilot Trial System
36
10
29
34
35
56
10
4
23
28
TASK
0
50
100
150
200
250
300
DATE
Start on day
Duration

CHAPTER 4

4.1 Overview

First, the user will receive a notice on their smartphone to add organic trash; the compost barrel features a shredder for shredding the organic waste, making the process faster. Following that, the humidity sensor will determine whether or not moisture is present, at which point the water system will be activated. After three to four months, the user will receive a message to refill the organic waste bin; after that, it will alert the user to check the bottom tray for manure so the user may utilize it for gardening.

Furthermore, cutting blades are attached to the bin to minimize trash size and speed up the composting process. To determine the right moisture level, the moisture sensor is linked to the Arduino UNO. The automatic water system helps to keep the composting process wet. A collection pan will be supplied to collect solid fertilizer for later usage. A mobile app will be created for the user's convenience; the user will be able to acquire a clear understanding of the smart compost bin and receive numerous notification alerts regarding the compost bin.



4.2 Testing and Evaluation

The project was done in modulating functions. Designs and testing are done after function is coded or when working properly.

Testing part	testing		Expected outcome	result
Automated water pump:	I.	Tinkercad designing and coding	Simulation should be able to run circuit design.	PASS
	II.	Water distribution design concept.	With spiral water tube design in compost barrel water should be able to distribute in every level in compost barrel.	PASS
	III.	Arduino UNO coding and serial monitor output	Should be able to output message “Water motor is ON” or “Water motor is OFF” message.	PASS
	IV.	Hardware assembles and testing	Circuit should be able to ON or OFF water motor depend on moister sensor reading inside the compost barrel	PASS
	V.	Finalization and assemble to compost barrel.		
Compost barrel capacity check:	I.	Tinkercad designing and coding	Simulation should be able to run circuit design.	PASS

	II.	Arduino UNO coding and serial monitor output	Should be able to output message “Barrel is Empty” or “Barrel is FULL” message.	PASS
	III.	Hardware assembles and testing using NordeMCU	Circuit should be able to output message depend on ultrasonic sensor reading inside the compost barrel	PASS
	IV.	Mobile app design	Mobile app should be able to measure ultrasonic sensor value via Wi-Fi network	PASS
	V.	Finalization and assemble to compost barrel.		
Database and Website:	I.	Firebase workability	Use free firebase website for testing purposes.	PASS
	II.	Database workability	Create database to collect reading data	
	III.	Front-end coding	Front-end coding and design for user GUI	
	IV.	Back-end coding	Back-end coding for database handling	
	V.	Website connectivity with NodeMCU	Data transfer between website and NordeMCU	

When the project is finished, it should be turned over to the testing group, and comments on the smart compost bin should be gathered. Based on this feedback, an evaluation should be made. The testing crew will put the prototype through its paces, collect data, and compute the average manure-making time and water input required to fill the barrel. In addition, the tester will examine the design approach in relation to the study expectations, such as how water should be input into a compost barrel from one location or how to use a water network to disperse water input equally. If the test fails, we will make changes to the present design.

CHAPTER 5

5.1 Conclusion

The project's main purpose is to build a large enough smart compost barrel that will allow for the effective decomposition of all types of organic waste in order to produce high-quality manure. The project has sub-objectives in addition to the primary purpose. In the prototype, the organic waste will be chopped using a cutting blade or shredder to assist widen the region where decomposition would occur. It will also automate the water pipeline system and monitor the moisture level of biodegradable trash. In addition, the user's mobile phone will have an app that will notify them of these events. The proposed composting strategies for handling biodegradable waste using a novel compost barrel have demonstrated efficacy in organic matter mineralisation and humification. Compost barrels are important in Sri Lankan urban solid waste management since they are inexpensive and simple to use. The improved compost barrel system is visually appealing, has no odour, and keeps insects and flies away from the barrel. The research shows that composting is an appropriate choice for reducing or recycling municipal solid waste, creating less pollution, and helping the environment and the economy when compared to conventional collection and disposal methods.

5.2 Future Research direction

In future research direction with an improvement of moisture sensor and with a new efficient water pump smart barrel reading will be more accurate. Also, we like to add smart camara to capture soil compost amount and send message to user according to camara reading. Also, smart composted design will also create a model using an industrial plastic drum will be installed on Penang Hill that have spinning function so it will be easy to collect manure and filter decompose material from compost bin that has integrated mesh cylinder.

PERSONNEL AND FACILITIES

MEMBER 1:	**O. S. K. Yapa**

- **Coding and designing a website for users.**
- **Fire base design**
- **Database design**
- **Back-end coding**

MEMBER 2:	**N. P. Fernando**

- **Code Arduino Uno moisture detection and motor automation module.**
- **Build a suitable compost filter.**
- **Module testing**
- **Build a prototype barrel.**

MEMBER 3:	**K. A. Nimnadi Dilsika Kumbhalathara**

- **Coding and designing a mobile app for users.**
- **Wi-fi connectivity with the website.**
- **Build a prototype barrel.**

For the prototype, we will use,

- Arduino uno
- Humidity sensor
- Relay
- Barell
- Ultrasonic sensor
- NordeMCU
- Water pipes
- tra

BUDGET

Table 4: Budget

	Rs.	Rs.
Electrical MODULE:		
Arduino UNO	1000	
Node MCU	1500	
Ultrasonic	300	
Moisture sensor	250	
hardware parts	500	
Total electrical cost		**3550**
Prototype BARREL:		
Barell	3000	
Water pump	2000	
Water tubes	500	
Aluminium tray	200	
Mesh	300	
Shredder	1500	
Total Barell cost		**7500**
OTHER:		
Research and human resources	2500	
Extra expenditure	1000	
Travel	5000	
Consultant	1000	
Printing	500	
Equipment	5000	
The total cost of other spends		**15000**
TOTAL COST OF THE PROJECT		**26050**

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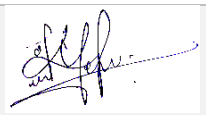
O. S. K. Yapa	20908210	IT20057992@my.sliit.lk	
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