

Model for Conversion of Biodegradable Waste into Organic Fertiliser

Dr.P.M.Ghate¹, Harshad B. Balekundri², B.D.Jadhav³, Ajay Paithane⁴, S.D.Shirbahadukar⁵

¹ Department of Electronics & Telecommunication, JSPM's Rajarshi Shahu College of Engineering, Tathawade, Pune, India; pmghate@gmail.com

² Department of Electronics & Telecommunication, JSPM's Rajarshi Shahu College of Engineering, Tathawade, Pune, India; harshad.balekundri@gmail.com

³ Department of Electronics & Telecommunication, JSPM's Rajarshi Shahu College of Engineering, Tathawade, Pune, India; bdjadhav1979@gmail.com

⁴ Department of Electronics & Telecommunication, JSPM's Rajarshi Shahu College of Engineering, Tathawade, Pune, India; ajaypaihane@gmail.com

⁵ Department of Electronics & Telecommunication, Zeal College of Engineering and Research, Narhe, Pune, India; shir_sd@yahoo.com

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Abstract

In the last few years there has been considerable interest in the conversion of waste into the best. We have found a new approach to convert biodegradable waste into organic fertiliser. The effectiveness of the approach new has been demonstrated in the paper, we are proposing a solution at household and municipal level to recycle the organic green waste into two sections of the article section one consist limitations of existing systems and section two , we propose a new approach to reduce the time for conversation , instead of dumping into the grounds. The explication is to engineer a model which converts organic green waste to fertiliser. It is designed around an Arduino Mega 2560 microcontroller board. Designed Proposed model consists of a separate chamber for cutting, drying the organic kitchen waste is happening simultaneously with mixer chamber consisting of a mixing blade, soil container. The drying waste will be mixed with output of soil container in 1:1 ratio. Sensors like Weight, US, PH and Moisture, etc. gives information about compost ready material. The system uses NodeMCU to send this information on android application. Also, the same data will be displayed on LCD. This automatic recycler makes sure easy to use, easy continuation and easy to operate. The proposed model along with significant value adds will replace the kitchen waste bins.

Keywords: Arduino Mega 2560, Design, Food waste, NodeMCU, Recycle.

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Introduction

At local, regional and global levels, solid waste generation is a huge problem. Solid waste is generated combined from inorganic and organic waste materials which are produced by various factors of the community. Due to the improper dispersal of the solid waste, it leads to land, air and water pollution, which contributes to the important factors of environment at global and regional extent. Compared to developed countries, developing countries face

the problem at larger scale because of modernization and financial growth (Nikam and Ingole, 2015).

India is second largest populated country in the world; it contributes to more than 100 tons of solid waste a day. It is the mixture of organic food waste and inorganic waste. Around 78% is food waste, which can be recycled. Some of them is land filled but it is not segregated properly and it mixes organic and inorganic waste, which produces bad odour, and it will spoil the soil. To manage the solid waste,

it should be properly segregated at the source (houses) (Jayaprakash et al., 2018).

At present situation challenges faced where customers have run out of composting technologies which incurs more expenses, more space availability, more complex methodologies offering large vessel capacity organic composters, which differs from what actually is required at small scale or household levels. Natural processes take up to 6 to 8 months which is far longer duration for composting process (Sailesh and Shinde, 2015, A. N. Paithane et.al, 2016).

The motive of the proposed model is to reduce waste at household and municipal levels by recycling and processing of organic green waste. This design will help customers have their own fertilisers prepared from unwanted green waste in the form of compost ready material. This can be useful for personal gardens at home or around society (A. N. Paithane et.al, 2020) .

The proposed model shows in fig 1 aims to convert organic kitchen waste into compost ready material. The Design of this system involves working to make it compact to accommodate in the modern kitchen. The system should also be user friendly by making the sensor information available to use all the time and enables the user in making a decision to control it in an optimal way (A. N. Paithane et.al, 2017). The Objectives are:

- To provide an effective mechanism to handle and maintain indoor based kitchen waste.
- To provide a cost efficient and low maintenance waste recycler which can be adopted by the majority of people and would be portable for household use. And also, to make it power consumption effective.



Fig. 1. The Proposed Model Conceptual Design (Bennbaia et al., 2018).

Methodology

Existing waste recycler (household and Industrial), various composting process, identifying drawbacks in the existing compost bins and processes. Carrying out an ethnographic research focusing on product study, market study and user study wherein interview will be conducted with user to understand the drawbacks of the existing compost bin. To develop a full-scale working prototype using suitable materials of waste recycler for Kitchen waste. To carry out user validation of the waste recycler to identify the success rate of product and collect the suggestion of the users (A. N. Paithane et.al, 2018)

Customer's identification

Currently proposed project model holds possible customers like hotels, mess, cafes, etc. However, our main intend is for customers at small scale mainly households. The objective is to meet the basic demands of customers.

Understanding customers' needs

Primarily, in phase of new development of any product the first questions to look at are – who my customer is? What is his basic need for my product? Is my product rightly valuable to suffice his needs? Others ask from my product will be – is it worth at the cost we market at? Any nearly competitive product in market for this? Probability for my product to gain interest in market personally and financially? Hence, we any new features added, must be valuable for the market and its customers (A. N. Paithane et.al, 2020).

List of customer needs

We carried out a market survey to define preferences for our proposed model. We came across 100 customer reviews and feedbacks, wherein customers jotted down their requirements. Thus, preferences were counted and defined for our proposed model. Below tabular representation is based on our survey.

Table 1. List of Customer Needs

Customer Need	Number of Reviews	Priority
Usability and ease	90	3.5
It doesn't smell or stink	100	5
Doesn't attract flies	95	4.5
Time required to decompose	75	2
Capacity of waste intake	60	4
Worth for money	90	3
Simple door mechanism	80	1
Attractive Design	55	2.5

Design criteria

- Product size: The Proposed model size should be compact to accommodate itself in a regular size modular kitchen.
- Odourless: The Proposed model would not give out any bad odour.
- Low noise: The Proposed model noise level should be within specified decibels required for home appliances.
- Easy process: The Proposed model to be operable by everyone in the house.
- Portable: The Proposed model to be easily movable inside the kitchen.
- Aesthetic Ecosystem: This leads to integration into modern homes, the design of the Proposed model would be a part of the other kitchen appliances.

Product Description

The motive of proposed model shows in fig 2 is to integrate a solution for ease of usability of appliance in modern kitchen, also it should decompose and recycle the organic green waste for households. Usually the composting process takes approximately 40 days for compost fertilizer. Initial 20 days are required for the pre-composting process. Our proposed system is designed to process pre-compost in 3 to 4 hours. Our system is mainly focusing on time saving in the pre-composting process.

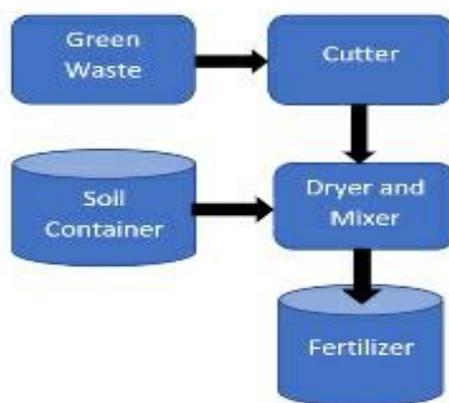


Fig. 2. System architecture

In our system 3 process takes place that are cutting, drying & mixing.

- Cutting: All the input kitchen waste is cut or shreds before being transferred to the drying.
- Drying: After cutting, material will be pass for drying. In drying, the material will dry out but, make sure that material will have desired moisture level.
- Mixing: In mixer section, depending on the weight of the dried material that amount of soil which is coming from soil container will be added into the mixer section.
- Collection tray: After mixing all the material, collected in a Collection tray.
- Display: On completion of all process in the system, when compost ready material gets collected in the collection tray, the system shows values of compost ready material on LCD display of system and also will trigger notification through android app on customer mobile and will display sensor related parameter values. Also, it will indicate material levels of collection tray.

System Design

Designed Proposed model in fig 3 consists of a separate chamber for cutting or shredding, drying the organic kitchen waste is happening along with mixer chamber, soil container and a collection tray. The output of drying chamber (drying waste) will be mixed with output of soil container (dry soil) in 1:1 ratio. It is designed around an Arduino Mega 2560 microcontroller board, and comprises some simple hardware components and sensors. The system consists of Load cell (weight sensor) to gauge the waste material and The Ultrasonic sensor will gauge the level of compost ready material inside the collection tray. The system also contains LCD display to show all information about PH, Moisture, Temperature value and final product level inside the collection tray of compost ready material. Also, these values will be notified to customer on Android App triggered by the system after the process completion. The block diagram of proposed model is shown in Figure 3.

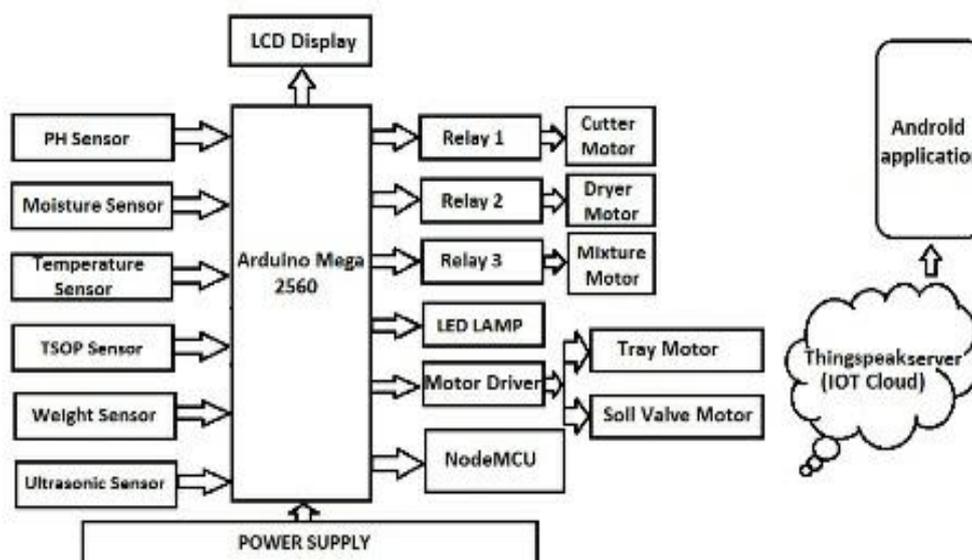


Fig. 3. Block diagram

Methods of processing: Traditional and Industrial.

In traditional method, it takes 40 days or more to get compost ready material. It requires landfills and multiple other resources.

Whereas industrial methods engage heavy machinery, large space, chemical enzymes and multiple other power resources.

But our proposed model consumes less time for processing as compare to traditional and industrial methods. It consumes minimal household space and it is feasible to operate within household limits.

Drawbacks of the prototype cannot be assured as the quality and applicability of fertiliser produced depends entirely on the green organic waste feed.

Results

- In this Proposed model shows in fig 4 Temperature, Soil Moisture sensor readings are sent from Node MCU to Thing Speak cloud. So that according to the reading's graphs are generated. The Figure shows the Temperature, Soil Moisture sensor readings graph.

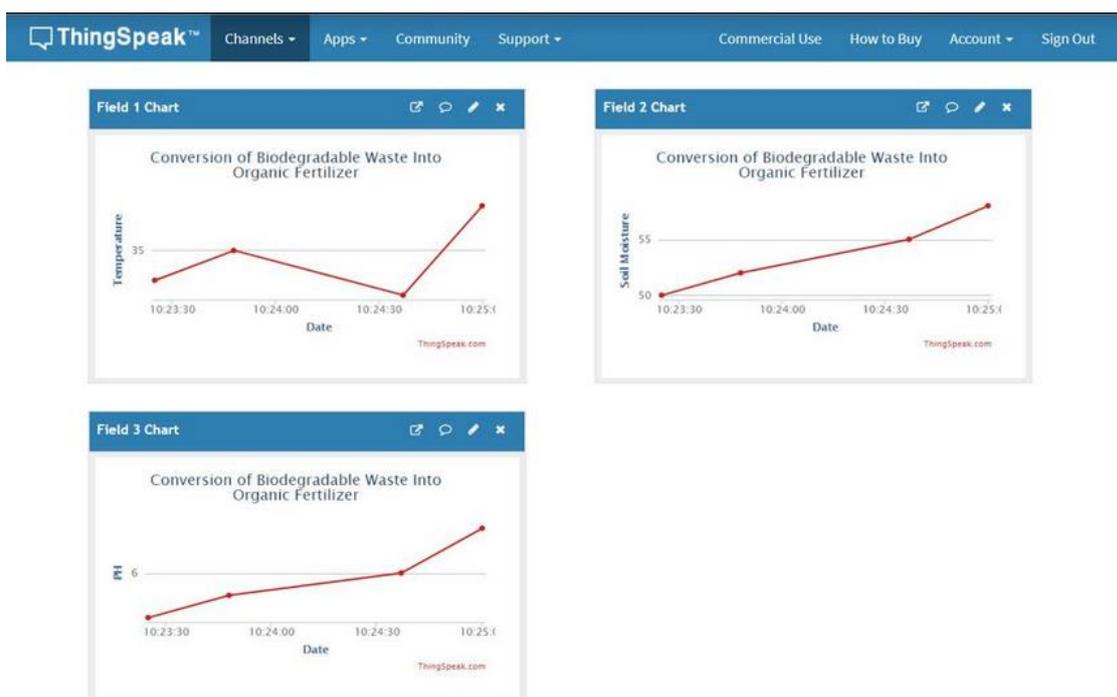


Fig. 4. Temperature, Soil Moisture sensor readings graph

- Temperature, Soil moisture and PH sensor values of final product display on Blynk application as shown in Fig 5.



Fig. 5. Temperature, Soil moisture and PH sensor values shows on Blynk application

- Resources and Utilisation

Table 2: Resources and Utilisation

Sr.No.	Resource Name	Resources Used
1	Arduino Mega 2560	MCU with peripherals
2	Arduino Mega 2560 shield	Extension board
3	Node MCU	WiFi
4	SMPS	Power Supply
5	LCD display	Control & Data register

- In this project various sensors produces various outputs using various inputs as shown in the Table 3.

Table 3: Sensor inputs and its outputs

Sr.No.	Inputs	Outputs
1	TSOP sensor	If we put green waste into the proposed model then TSOP sensor detects motion of the hand and starts the cutter motor.
2	Load cell (Weight sensor)	It measures the weight of dried material and send to the MCU.
3	Ultrasonic sensor	It measures the level of compost ready material inside the collection tray.
4	Temperature sensor	It measures the temperature of compost ready material and send to MCU.
5	Soil Moisture sensor	It measures the moisture content of compost ready material and send to MCU.
6	PH sensor	It measures the PH value of compost ready material and send to MCU.

- Hardware setup

Fig 6 shows the actual model used 500-gram green waste (spinach leaves, onion peels, garlic peels, and potato skin) for test run. In first stage, it went through cutting phase. At second stage, it was passed on to drying to extract the moisture. And at third stage dried material was mixed with equivalent quantity of soil. At later stage, we got compost ready material in

the collection tray and then temperature, moisture and PH sensor gave readings were collected. We tested compost ready material in household plantation which yielded better results.

Although the test run was performed, we also obtained satisfactory results. However, the results or the quality of product obtained cannot be guaranteed as it depends on multiple factors. The product

obtained is however observed as useful at household level. Its quality or yield may vary from door to door

basis, depending upon the inputs received.



Fig.6. Hardware setup

Conclusion

The propose model reduce the burden of the environment due to waste, which is not utilized properly. The model reduces waste up to 25%. In the light of these dramatic findings, we believe that our analysis may contribute to implementing ad hoc waste management strategies to reduce waste product coming out from daily uses. We hope that our findings may influence policy planning. Future work will entail refining our model by exploiting data from satellite sensors. Initially, our project objective is demonstration of the value of organic green waste and to help the surrounding by building a model which will convert organic green waste into compost ready material. As the world is constantly evolving and looking for new innovations and existence, our model aims at generating less waste for dump yards and reduce kitchen waste which is another leading factor for pollution. Being easy to use was also one of the design objectives which was met as this proposed model only require putting a green waste into the proposed model to start the process. The new design of the proposed model is aesthetically good looking, can be kept inside kitchen, non-messy, no odour, keeps insects, flies away from proposed model and keeps the plants in the home healthy. Hence the Proposed model is very useful for industries who manufactures organic fertilisers and enabling them to increase their productivity volume. The same can be used in house garden plants for fertiliser replacement. Unfortunately, we could not assess how much of the difference in outcome was due to green waste and other than green waste. Our findings could be applied quite reliably in other engineering contexts without a significant degradation in performance. Future work should give priority to (1) implementation of model using advanced structure (2) different controller Future work should benefit greatly by using data on ...

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The manuscript should be supplemented with the information about all the authors as follows:

The 1st author's Dr.Pravin Marotrao Ghate Working as professor in Electronics & Telecommunication of JSPM's Rajsrshi Shahu College of Engineering, Pune affiliated to Savitribai Phule Pune University.
Department of Electronics &Telecommunication.
Main research area(s): Speech and Signal Processing, Embedded System
Address: Sr.No.80, Near Mumbai Pune, Express Bypass Highway, Tathawade, Pune-33
TEL. +919890720393
E-mail: pmghate@gmail .com

The 2nd author's Harshad Balekundri – Master of Engineering, JSPM's Rajsrshi Shahu College of Engineering, Pune affiliated to Savitribai Phule Pune University.
Department of Electronics &Telecommunication.
Main research area(s): VLSI and Embedded System
Address:S.No.17/2,Shiv colocolony,Wakad road, Thergaon, Pune-33.
Tel.:8626007726
E-mail: harshad.balekundri@gmail.com

The 3rd author's Bhagvant Jadhav – Working as professor in Electronics & Telecommunication of JSPM's Rajsrshi Shahu College of Engineering, Pune affiliated to Savitribai Phule Pune University.
Department of Electronics &Telecommunication.
Main research area(s): Image Processing
Address: Pune-33.
Tel.:9595912897
E-mail: bdjadhav1979@gmail.com

The 4nd author's Ajay Paithane – Working as professor in Electronics & Telecommunication of JSPM's Rajsrshi Shahu College of Engineering ,Pune affiliated to Savitribai Phule Pune University.
Department of Electronics &Telecommunication.
Main research area(s): Medical Signal Processing
Address:, Pune-33.
Tel.:9922837483
E-mail: ajaypaithane@gmail.com

The 5nd author's S.D.Shirbahadukar – Working as professor in Electronics & Telecommunication of Zeal College of Engineering and Rsearch ,Pune affiliated to Savitribai Phule Pune University.
Department of Electronics &Telecommunication.
Main research area(s): Speech Signal Processing
Address:, Pune-33.
Tel.:9766318642
E-mail: shir_sd@yahoo.com