KANAK- IoT based Smart-Bin and Reward Based Application.

TEAM ID: 1264

Introduction

Waste management is an issue which is known by all but acted upon by very few. Municipal Solid Waste (MSW) in India has approximately 40-60% compostable waste[Joshi [2016]]. The waste generated in India has more organic content—about 50%–as compared to 30% generated by developed countries[Joshi [2016]]. Allowing organic waste to decay in landfills has negative impact both environmentally and economically[Ankidawa Buba Apagu [2012]]. With this knowledge and with the information gained from several interactions with rag-pickers, garbage depot owners and with the conclusions from the survey of almost 200 residents we decided to work on processing of biodegradable waste at domestic level providing them with a solution which tries to overcome challenges faced by the people and at the same time creating an atmosphere of awareness, competition.

The objective is to introduce smart-bin playing dual role of a dustbin and bio-waste processing bin. The data collected from various in-built sensors will be send to cloud. Data from various users will be compiled to create a database. The users will be given points for their consistency with managing their waste using our bin. The app feature will be used to display the user's personal data- points, progress report, etc and the leader-board based on points. The user to achieve certain targets will receive a cashback. This app feature will create awareness and also publicize our product-the smart-bin

Market Research/Literature Survey

Biodegradable Composting is divided primarily into aerobic and anaerobic. In anaerobic decomposition occurs in limited or no supply of oxygen. The drawbacks are strong odour and phytotoxicity, low temperature process hence leaves pathogens and weed-seeds intact, and long conversion time. The drawbacks often offset merits like less nutrients lost and little attention[Misra R.V [2003]]. Aerobic decomposition is a high temperature process with little risk of phytotoxicity and higher conversion time.
Aerobic composting is divided into several techniques-Indian Indore method, Indian Coimbatore method, North Dakota State University hot composting, Chinese rural composting, Ecuador on-farm, Berkeley rapid composting, etc. Out of these, we have chosen Berkeley rapid Composting method owing to its fast speed of conversion and little or no additives. This method can compost in 2 or 3 weeks. The conditions under given method are as follows:

- Material size-$1.25 - 3.75cm$
- Moisture conditions- around **50%** initially and **30%** at the end
- Aeration and daily turning forms the crux of this process
- C:N ratio- **25:1- 30:1** initially. 10:1-15:1 at the end
- Temperature- **20-40 degree Celsius** initially(called mesophilic stage), **50-70 degree Celsius** during the later stage called as thermophilic stage

We combine this method with a modified version of Rotating Drums method[Misra R.V [2003]] to facilitate turning and aeration

Software and Hardware Requirements

Software Requirements

- Arduino IDE
- Google Firebase Cloud
- Android App Developer
- Flutter Framework

Hardware Requirements

- Node MCU
- Soil Moisture Sensor
- Temperature Sensor DS18B20
- MQ2 Gas Sensor
- Voltage Booster
- Structural Requirements
  - Pipes
  - Plastic Bins
  - Elbows (2 way and 3 way)
  - Air Vents
  - Drain Pipes
  - Miscellaneous

Implementation

The entire project is divided into two parts- Software and Hardware. The Hardware part consists of a Smart-Bin to process the biodegradable waste. The Bin will have inbuilt sensors to sense temperature, moisture content, humidity, pH of generated compost and weight measurement sensor. With this knowledge of various parameters we can analyze the complete composting process. Each stage in composting is characterized by specific range of values of these parameters. The ranges are given according to the method followed (Berkeley Rapid Composting Method). The entire setup can be powered by Arduino output voltage pins and thus require a minimal of 5-12V voltage which can be supplied using DC source like a battery.

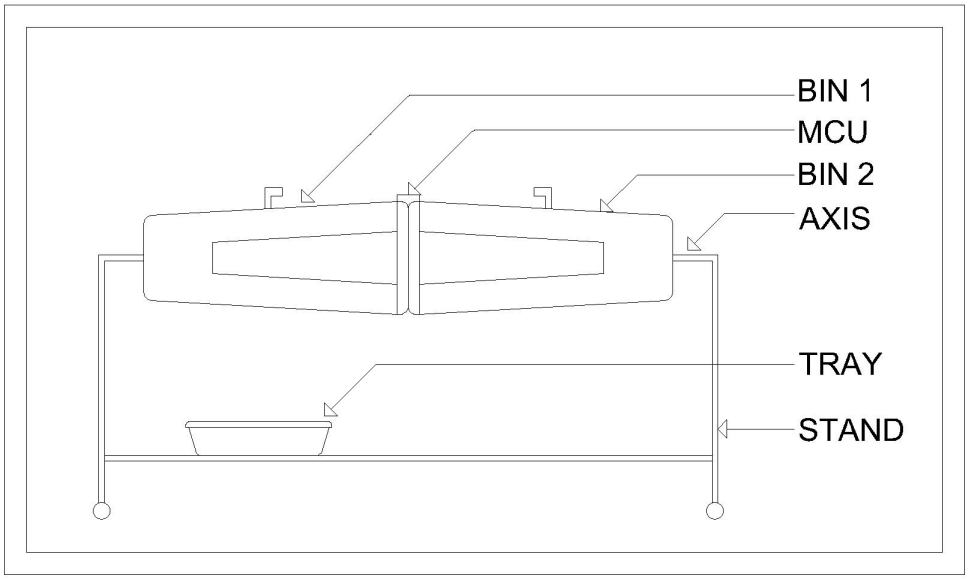

Figure 1: FIg 1: Smart Bin Structure

The complete model has two bins on a single setup. Since the composting takes 15-20 days these bins can be used one after another. An average household of 4 members generates not more than 1kg waste every day (researched by measuring individual wet waste of the team members' household, friends and family). Thus two 15 kg bins can we used sufficiently one after the other.

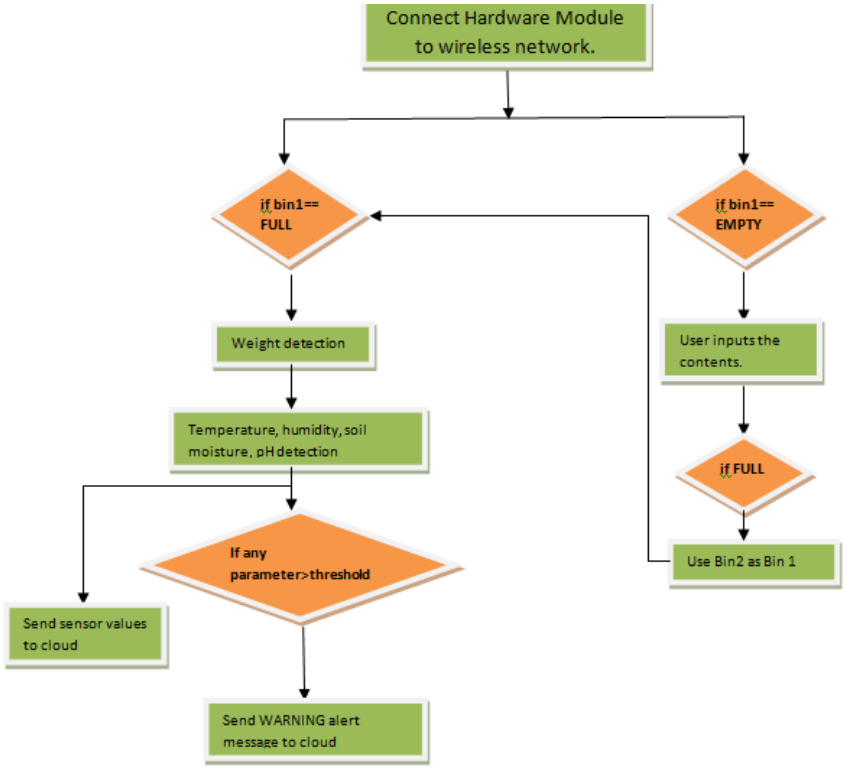

Figure 2: Fig 2:Hardware Module Flowchart

The user will input waste in a bin. The increase in weight will be sensed by load cells. When the bin will be filled to its capacity the user will be notified in the App to use another bin. User will thus use another bin-bin2 for waste disposal. Meanwhile, analysis of Bin1 parameters will start. The moisture content, temperature values, humidity, pH should vary in accordance with Berkeley Composting method. This will be a parameter to ensure the genuineness in the process. The corresponding data will be sent to cloud database every day. The bins will have a rotating structure. User will have to manually just give the bin a spin everyday to ensure aeration and ventilation. This concludes the hardware aspect.

Figure 3: Fig 3: Data Flow

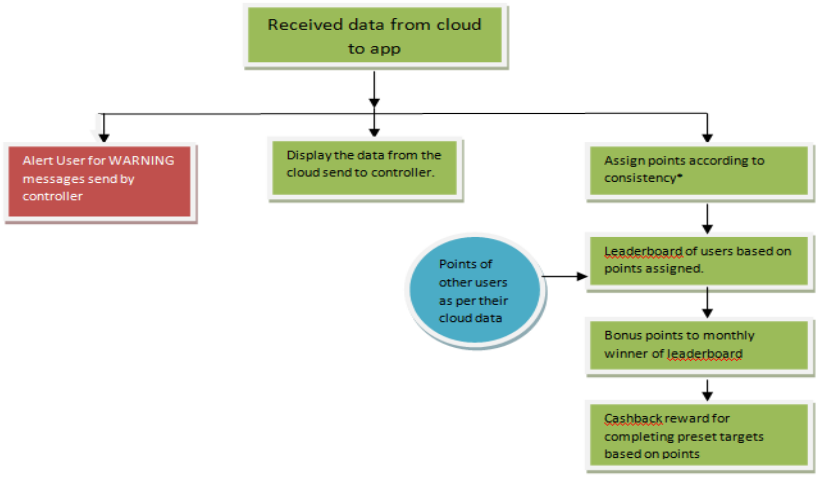

Figure 4: Fig 4: Software Flowchart

In the software part the sensor data sent everyday to cloud will be analyzed. The values will be verified with Berkeley parameters. Composting will be shown successful only if the parameters vary in accordance with each subsequent days. This data will be visible to user on the Smart-Bin software application. Alerts such as temperature or weight crossing certain threshold will be displayed on this application. The user will be assigned points after each successful composting. A leader-board will be created of this process. The leader of each month will receive certain amount of cash which will be electronically transferred. This cash flow will be ensured by following method: A fixed amount after purchase of the bin from every user will be kept aside.
Let's say 500/− is kept aside.
If 10 users are considered then
500x10=5000/-
will be kept aside. However each month will have one winner so a portion of this amount will be transferred to the winner. Single winner each month, minimal interest received from this amount, further sale of bins will ensure that this amount isn't depleted. Moreover the received prize in form of cash will in turn encourage more and more people for composting their bio-waste. It will also cause publicity of the Smart-Bins. Thus awareness and business

will go hand in hand by creation of such competitive environment.

Cost Estimation

Sr.no	Component	Quantity	Cost in rupees
1.	NodeMcu	1	320
2.	Soil Moisture sensor	2	260
3.	Temperature sensor	2	400
4.	Gas MQ2	2	300
5.	Voltage Booster	1	140
6.	Bins and Trays	2	600
7.	PVC pipes 10 foot each	3	330
8.	Valves, Elbows for joins	--	250
9.	Miscellaneous	--	500
Total Estimated Cost			**3000/-**

Feasibility

Currently, the products existing in the market either do not offer much automation at small scale level or are very expensive. The large scale level products are not feasible for domestic use. It is observed that a person may willingly buy an electronic gadget worth thousands but will not consider buying products like these. This happens due to lack of awareness about the gravity of the issue. The waste segregation should be a habit imbibed in people[News Articles]. The solution offered by us a reasonably priced Smart-Bin with its reward based application; addresses these issues. Encouraging more and more people to treat their waste through such innovative techniques is our take on moving a step forward towards zero-garbage and bin-less neighborhoods[News Articles] and maybe an inch closer to a sustainable living

References

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