

Title: Smart Waste Segregator

Team No: 13

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Contribution:

Hardware assembly

Algorithm Design

Implementation of code

Research Work

Track our Project!

https://drive.google.com/drive/folders/1x7hLta_j0PFawFG5InaCso_9vKKjk_eA?usp=sharing

Introduction

This waste segregator is a prototype which segregates waste into two parts: wet and dry waste.

But, why is waste segregation even important?

1. *Good for the pickers*

Segregation protects health. When waste pickers put their hands into the waste to clean it up, it results in cuts that further lead to infections, resulting in deterioration of a waste picker's health. It becomes our responsibility to help these waste pickers by carefully segregating the waste that is generated in our homes.

Moreover, . When we sort and store our waste separately, we retain its value and pass on the benefits of that to our pourakarmikas, sanitation workers and recyclers and others in the chain.

When we dispose mixed waste, not only is each material difficult to separate, but it also releases toxins in our air, water, and soil. The breakdown of these materials in landfills in the absence of air produces methane – a deadly greenhouse gas, that is nearly 25-30 times more potent than carbon dioxide. Toxic leachates from this stinking mess poison ground water.

2. *Composting*

Once you begin segregating waste at home, you can generate more value from waste by composting. The COVID-19 pandemic is a good time to turn to the practice of composting. This is because you will be contributing your personal CSR towards the local municipal government by managing organic solid waste yourself. Composting at home during COVID-19 takes the load off waste pickers and municipal authorities who are struggling with social distancing. The benefit you receive is free compost to use for your plants or sell to gardeners.

3. *Good for the planet*

Waste segregation is included in law because it is much easier to recycle. Effective segregation of wastes means that less waste goes to landfill which makes it cheaper and better for people and the environment. It is also important to segregate for public health. Hazardous wastes can cause long term health problems, so it is very important that they are disposed of correctly and safely and not mixed in with the normal waste coming out of your home or office.

4. *The sites are often dangerous:*

As the waste management sites include the landfills to recycling units under its aegis, these sites are highly susceptible to fungal and bacterial growth thereby leading to various diseases.

Even the debris formation will be accelerated by such bacterial growth, which makes it totally unsafe for the workers who work there. It also causes widespread pollution and releases harmful chemicals. These chemicals, when mixed with drinking water or any other consumable item pose a high amount of danger to human health.

References:

Major highlights of the new SWM rules, 2016

The new rules have mandated the source segregation of waste to channelise the waste to wealth by recovery, reuse and recycle. Waste generators would now have to segregate waste into three streams- Biodegradables, Dry (Plastic, Paper, metal, Wood, etc.) and Domestic Hazardous waste (diapers, napkins, mosquito repellents, cleaning agents etc.) before handing it over to the collector.

| WHAT THE POLICY SAYS | | |
|---|---|--|
| Primary collection Door-to-door collection of segregated waste from households, shops, offices and any other non-residential premises  | Street sweeping and roadside drain cleaning Waste picked from streets should also be segregated till door-to-door collection becomes 100% effective across the city  | mind quantity & types of waste to be disposed while adopting technology as per the pollution control board's guidelines  |
| Waste generation and segregation Cities must ensure procurement of suitable equipment — blue & green dustbins, rickshaws with separate compartments — to facilitate source segregation of dry and wet waste, and composting machines  | Secondary collection and transportation Segregated household waste should be transferred directly to the secondary collection vehicle and not dumped or kept in the open  | Management of special waste, including domestic hazardous waste Special waste shall not enter the main stream of municipal solid waste and waste generators shall also collect such waste in a separate container from MSW at the household or commercial level  |
| STATE DIVIDED INTO 14 CLUSTERS | | |
| 4 clusters, including Gurgaon, will have waste-to-energy plants | 10 clusters will have waste-to-compost plants | |

Institutional generators, market associations, event organisers and hotels and restaurants have been directly made responsible for segregation and sorting the waste and manage in partnership with local bodies. In case of an event or gathering of more than 100 persons at any licensed/ unlicensed place, the organiser will have to ensure segregation of waste at source and handing over of segregated waste to waste collector or agency, as specified by the local authority.

All hotels and restaurants will also be required to segregate biodegradable waste and set up a system of collection to ensure that such food waste is utilised for composting / bio methanation. The rules mandate that all resident welfare and market associations and gated communities with an area of above 5,000 sq. m will have to segregate waste at source into material like plastic, tin, glass, paper and others and hand over recyclable material either to authorised waste-pickers and recyclers or to the urban local body.

2.Swachh Bharat mission a step towards waste segregation

Swachh Bharat mission, a five year nationwide clean up mission. It is a systematic effort towards waste segregation, several cities and states have launched efforts directed at the municipal waste collection of segregated waste.

For example, Bangalore's municipal body administered by the Karnataka high court to enforce compulsory segregation of municipal waste before collecting – a first for our country. Following this many cities in India have made segregating municipal waste mandatory.

3.Waste Regulations 2011

Under the Waste Regulations 2011, you must segregate paper, cardboard, plastic, metal and glass at source unless it is technically or economically unfeasible. Under the same regulations, you should implement the waste hierarchy; reduce, reuse, recycle, other recovery and disposal. By law, you should implement this hierarchy and segregation helps with recycling.

Process and methodology/design

1.Components:

- Arduino Uno
- IR sensor
- Capacitive Sensor (that will work as moisture sensor)
- Ultrasonic Sensor
- Servo Motor

2. Design:

This waste segregator has two sections: one for the dry waste and other for the wet waste. Each section has two moisture sensitive flaps on the top, one flap on top of each section. One of the flaps can rotate clockwise while other rotates anticlockwise. Say for one of the flaps, the rotatory blades of the servo motor are at an initial angle ϕ . Now, when it is directed by the Arduino board to rotate it rotate by 90 degrees and the flap falls open. It has been provided with two openings, one for each section, in the front to take out the garbage from each section. The doors to this opening are kind of sliders. So, to take out the garbage, one can use the sliding door to take out the garbage (as obviously the garbage would be inside garbage bags). It also has a handle on one side and wheels at the bottom to move the waste segregator from its designated place to the garbage dump area.

3. *How does this work?*

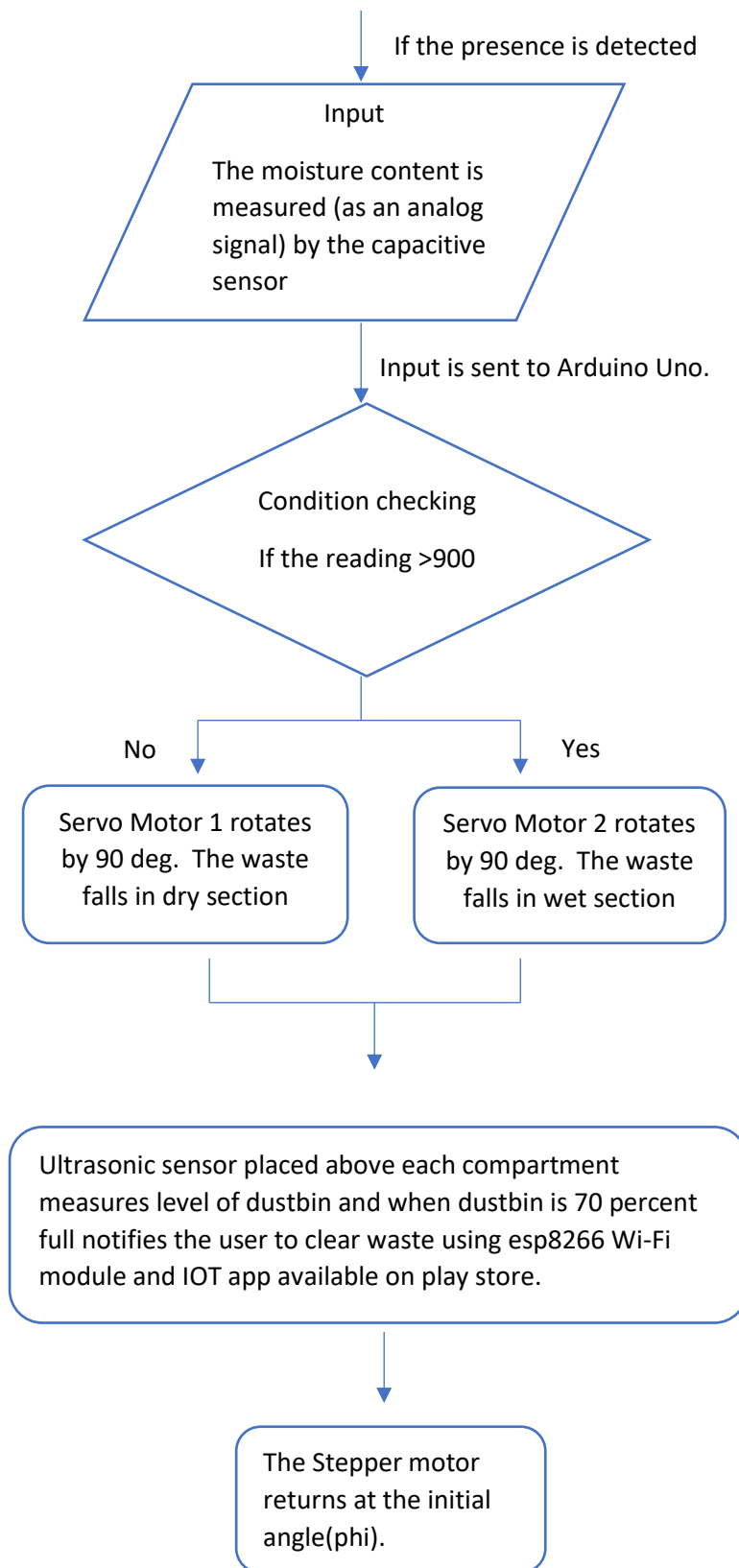
This waste segregator has two sections: one for the dry waste and other for the wet waste. The first component is the IR sensor, which detects the presence of waste thrown into the waste segregator. Then, it has two moisture sensitive flaps on the top, one flap on top of each section (dry and wet). The moisture sensor has been made by using aluminium sheet as the moisture sensors available in the market had many problems associated with them, which has been discussed in detail in the discussion section. These capacitive sensors (made from aluminium sheet) attached to it measures the moisture content in the waste and sends the output it has obtained to the Arduino uno.

Now, this Arduino Uno will read the output value sent by the capacitive sensor as its input and decide whether the waste is dry or wet based on the code fed into it. Now, it will direct the motor servers, associated with the section to which the waste belongs, to rotate. Structure wise, two motor servers have been used, one for each section. Each flap is attached to a motor server. So, whenever the motor server rotates, the flap also rotates. Now, when the Arduino uno directs the motor sensor to rotate and the associated flap also rotates. Now, when the flap rotates, the waste goes to the corresponding section.

In addition to segregating the waste, it will also be able to ping the user when it gets full. For this purpose, it has an ultrasonic sensor attached to each section which will measure the distance from it to the nearest object in the respective section and if it comes out to be over a certain limit set by the programmer, it will ping the user. Now, the user can take the trash out when he gets a notification.

Algorithm

IR sensor detects its presence



Results and discussion:

While working out this project, we faced many **problems**:

1. The moisture sensor available in the market would also sensor the atmospheric moisture. Thus, this waste segregator would fail at places with high level of humidity.
2. The moisture sensor attached to the flap could not measure moisture content of the waste if it were not dropped directly on top of it!

Solution: We replaced this moisture sensor by a capacitive sensor made from aluminium foil. It could measure moisture content of all the waste irrespective of the place where the waste was thrown. It was neither too sensitive nor less sensitive. It not only overcome our problem of atmospheric moisture but also overruled the possibility of wear and tear of the moisture sensor purchased from the market.

Moreover, it also helped us reduce the cost of this waste segregator. And since we are making this on a household level, we must make sure that it falls in the budget of a common man.

How does it operate?

One of the aluminium foil flaps is connected to 5V pin on Arduino while the other flap is connected to the analogue pin of Arduino. Now, the waste acts as the switch for the circuit. As soon as the waste is thrown, it touches both the flaps (as the flaps have slope, the waste thrown is bound to go near the middle and touches both). So, it connects the 2 flaps, and a closed loop is formed. Now, since water or wet waste have dielectric constant higher than insulator (plastic), the capacitance, which is directly proportional to the dielectric constant, increases and hence charge Q , which is equal to CV (where V is the potential between the two flaps), increases. As a result, the value of analogue signal increases for wet waste. While the dry waste, which acts like an insulator results in lower analogue signal. Hence, our capacitive sensor gives higher reading for wet waste, indicating more amount of moisture content, and a lower reading for dry waste, indicating low amount of moisture content in it.

Conclusion:

We have successfully assembled this waste segregator, from software to hardware, from circuit simulation on tinkercad to running code on the Arduino board, and finally from 3D prototype on free cad to a proper working model.

This project has many benefits. First, it will reduce waste generation at the source as a part of segregated dry waste can be sent for recycling which would not have been possible if dry and wet waste were mixed while the wet waste can be dealt with by composting. Thus, it will also encourage the habit of composting among locals.

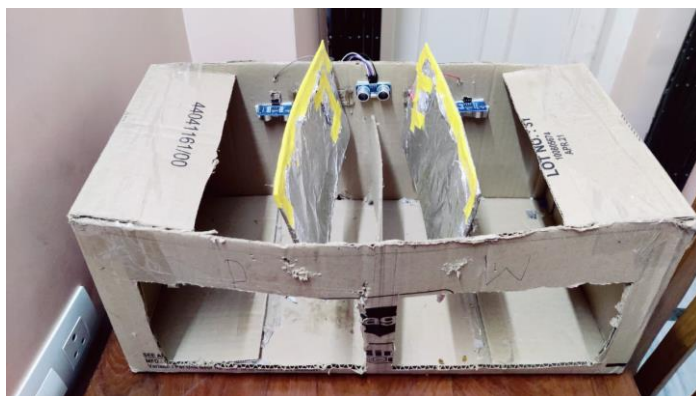
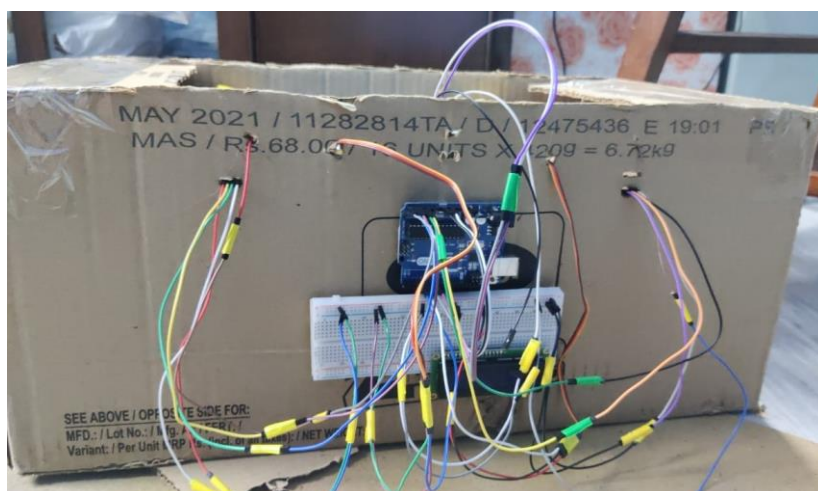
Second, Lesser the waste generation, lesser will be the environmental pollution, which will add to aesthetic value of the city/country.

Third, the rag pickers will be less prone to diseases as their job would be less dangerous than it was before. And it is not that they will lose their job. This waste management is only possible when the segregated waste is taken through different channels to their respective location. Any crossover would bring us back to the same situation. Hence, we need manpower who will monitor this waste segregation from point of source to the point of disposal and thereafter. This will also improve their quality of living.

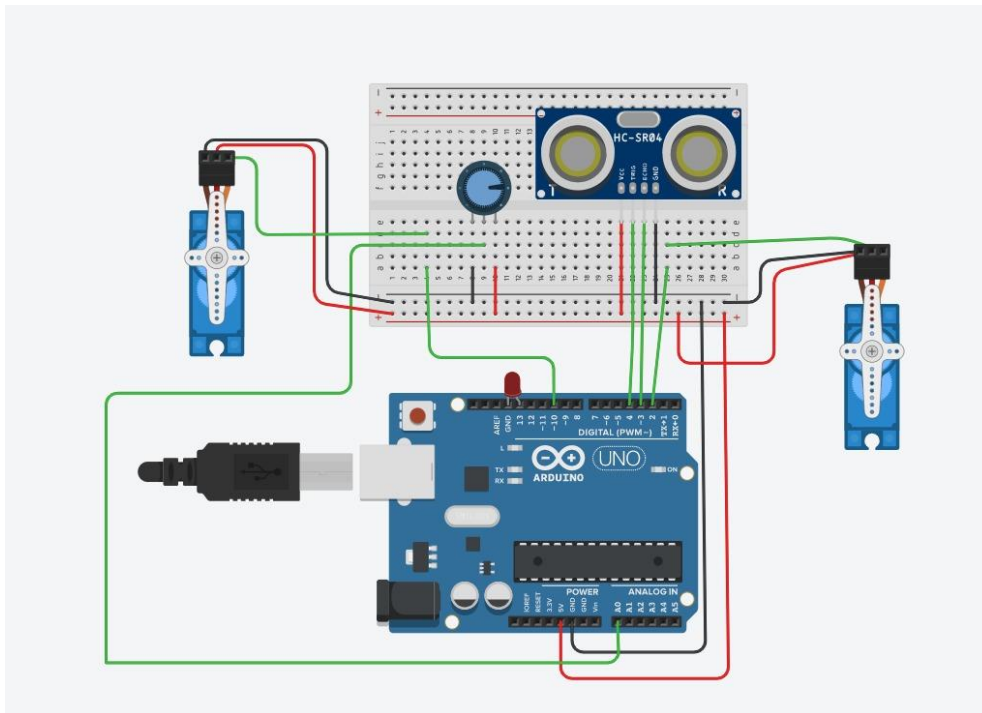
After its success at household level, it might be possible to extend this project at municipal level. At last, it will help us achieve a greater goal of better quality of life and sustainable development.

Appendix:

The working model:



Circuit Simulation :



Free cad prototype:

