

Swachh Celebrations: With next Gen Robots!

by

DUST DESTROYERS

Team members

Aarush Kumar Shrivastav

Kavin Senthur S.S

Mentor

Ms. K.B Sathya

Elpro international school

School address- Shridhar Nagar Road

Pimpri-Chinchwad Link Rd

Pune

Maharashtra 411033

India

Table of contents

1. Team Presentation

2. Summary Project idea

Executive summary

Problem that this project is solving

Solving problem using our robotics solution

Benefit of our robotic solution

Real-life usage and its advantages

Why is our project and its solution is important

3. Proposed Robotics solution

Description of the robotics solution

General Aspect

How did we produce this idea?

Other Ideas Investigated

Similar ideas discussion

Difference between our idea and other ideas: Brainstorming session

Technical Aspect

Materials used

Design & Methodology used

Coding

Challenges faced and likely to face during developmental process

4. Social Impact

Impact of our solution for the society

How it is important to the society

Where our idea could be implemented?

5. Future work

6. List of Sources

1. Team Presentation: Know about the Dust Destroyers?

We (Kavin & Aarush) are from Pune which is a beautiful city located in Maharashtra. Kavin is currently studying grade 8 and his hobbies are reading books, making innovative projects using robotics and Legos, doing chemical experiments at home using his mom's kitchen materials 😊, playing badminton, chess along with doing microscopic observations. He has won 3 awards at chess tournaments specifically 2,3,5 positions. He won a medal at Jr Lego League, in the second round which took place at Navi Mumbai in the year 2018. Next is the small intro about the little cricket fan that is Aarush 😊. His hobbies are reading and playing cricket from dawn to dusk. He has been participating into various external examinations like SOF Olympiads and has international rank 1st and AIR 1 in SOF Olympiad maths IMO in 3rd class with 40 on 40 marks he also gets medals for every SOF Olympiads. He also got selected for level 2 of SOF Olympiad in both 4th and 5th class. He won prize money in ISSO Olympiad twice and once in IMO when he got international rank 1st. He is good at playing cricket as a wicket keeper and allrounder. He is inspired by Mahendra Singh Dhoni. Regarding our work split for this project was we are going to divide the tasks in a way that Kavin would do the research, programming, and the training of AI (Artificial Intelligence). Aarush is doing the technical part of the project such as creating the circuit diagram for the project and identifying the needed sensor, chip boards and other technical aspects as well as designing and prototyping along with Kavin. Our team strengths are we both have basic programming experience, creating cool robotics and artificial intelligence projects at home. Our team goal is to make the world a better place to live and leave our mother EARTH clean and green. We wish to leave the world to our future generations exactly like the previous generations had given it to us and if possible, improve it using technology.



Champs @ school campus: under the red para is Aarush (cricket mad) and near to blue para is Kavin (book worm)

2. Summary of the Project:

Executive summary: We are aware the earth is beautiful planet. We human beings share this space with millions of other species. We need to keep the blue planet clean and green; so that it enables other species to thrive and survive. As our community spaces offer us opportunity for teaching and learning. When we have community gathering such as weddings and other social occasions. we tend to enjoy with sumptuous food. In those social occasions, after the food is consumed, there were lot of left-over food, plastic/paper cups come to the trash.

As we see the wastes themselves were not a problem but mixing with other types of wastes becomes a major challenge for recycling and environment. As the mixed wastes become garbage, we lose an opportunity to generate wealth from the waste and as well as to reuse. To make use of dustbin by understanding its colour code as habit, we need to incentivise the practise of using the bins according to the bin colour. The same solution can be extended for the next level at the home, school campus and apartments in future. For this we were proposing the solution of using the tech powered bin at the marriage halls.

We are developing a prototype of tech enabled dustbin powered by Artificial Intelligence/Machine learning using the Raspberry Pi and Pi camera to do waste segregation. Raspberry camera's images will be used to identify the waste which user trying to throw in the dust bin, guide (through voice) the user with the help of LCD and speaker and opens the correct bin. As extension of the project, users can send a displayed code to a WhatsApp number which is available on the bin's screen and, earn bonus points and receive coupons for carrying monetary value.

For example- if the user has some trashes in his hands after having food, which are a paper cup and a plastic plate and leftover food. Initially the lid of the green bin will prompt people to dispose the food waste. once it detects the user have thrown, the lid of green bin will close followed by blue bin will open which is for the recyclable waste.

The problem which this project is solving is the inefficient segregation of waste in many places due to the use traditional single dustbins and this problem is important because of following reasons

- Waste segregation reduces the amount of waste dumped in landfills. Methane, a greenhouse gas that is 25 times more potent than carbon dioxide, is a common byproduct of landfills.
- It aids in promoting composting and recycling. It contributes to resource conservation and environmental protection since recyclable and compostable materials can be transformed into new goods, reducing the requirement for virgin materials.
- Poor waste management can result in air, water, and soil contamination, endangering both human health and the ecosystem.

Land pollution is the most noticeable pollution caused by landfills appears in the form of overfilled garbage mountains such as those in Bandhwari village near to Delhi and Deonar near to Mumbai in India. This land pollution poses a huge problem as it contaminates the groundwater and soil. Plastics which are a large part of unsegregated waste often broken down by the elements when in landfills into microplastics goes in the Foodchain. This can be dangerous to wildlife. When ingested by wildlife it can cause severe gastrointestinal issues although some animals are able to release debris without passing it fully into the digestive system, such as birds that can regurgitate, or throw up indigestible materials. Debris can also pass completely through the digestive system for many animals depending on its shape and size. If an animal is not able to regurgitate or pass marine debris through their system,

it can cause serious health problems. Sharp or rough plastic marine debris can create cuts in the digestive system, leading to infection and internal bleeding. It can also block their digestive system, making them feel full, reducing their urge to eat, and making it difficult for the animal to get the nutrients they need. Water pollution is yet another type of pollution caused by landfills in the form of leachate, a toxic mixture which is formed when rainwater passes through landfills contains heavy metals and toxic organic compounds can contaminate water bodies and groundwater. Although air pollution is the least recognized part of the pollution caused by landfills it is still significant part of the problem as landfills emits methane and carbon dioxide both of which are dangerous greenhouse gases. All these problems are caused by unsegregated wastes.

We wanted to create solution when we saw the problem in our own backyard. This took us back in time when one of us went dispose electrical waste in a dustbin with a board saying 'electrical waste' in large bold letters but all he saw in it was domestic plastic trash such as chips packets and chocolate wrappers along with food wastes and another instance we saw the waste unsegregated was when Aarush seen many dustbins full of plastic, food and paper wastes all mixed up in each and every dustbin while in theory each of those dustbins was for different types of waste.

So, we wanted to create the sense of habit among the elders and kids, with idea based on tech powered dustbin. With robotic voice of a smart dustbin can act as a strong deterrent to people who throw trash in the wrong bin either mistakenly or leisurely and serve as a guiding light to people who are not aware about how important segregation of waste and we are planning to provide an incentive or reward for the good behaviour this will make sure that people put different wastes in different bins as demonstrated by the skinner's theory of rewards and punishment.

3. Proposed Robotics Solution:

3.1. About our robotics solution for the defined problem:

Trash is a significant byproduct of weddings and community celebrations, yet many people are unaware that waste can hold valuable energy and resources. Definition of **Trash**: "Something worth little or nothing: things that are no longer useful or wanted and that have been thrown away: these events, 90% of waste comes from decoration materials, served food, and single-use items like plates and cups. Our solution aims to convert food waste into organic manure for growing eco-friendly crops or biogas for cooking, transportation, electricity generation, and other needs. Using the design thinking cycle, we have proposed a tech-based solution: an AI-powered smart waste bin designed to make waste management more efficient and hygienic. This smart dustbin utilizes AI/ML detection systems to identify distinct types of trash and guide users to the appropriate bin, employing machine learning to promote the habit of waste segregation among the citizens.

Executive summary: We are developing a smart dustbin combining AI/ML and a Raspberry Pi chipboard, integrated with actuators to address waste segregation and educate users. The dustbin features different bins based on event scale and uses a camera to identify the type of waste a user holds, guiding them to the correct bin by opening of the lids. As extension of the project, we plan to upgrade it for guiding for proper disposal, the dustbin displays a code on an LCD screen. Users send this code to a designated WhatsApp number, and upon verification, they receive points. Accumulating these points can earn user's coupon codes for monetary rewards, incentivizing proper waste disposal habits.

3.2 General aspects:

Our robotic solution is tech based - AI powered smart waste segregation dustbin with features that are designed to make waste management more efficient and hygienic with an aim to revolutionize the way to a closed waste cycle. Our smart dustbin robot is a revolutionizing dustbin that has complex AI powered detection systems that detect distinct types of trash and guide the users to the correct bin by using emerging technologies such as machine learning to achieve the goal which is to educate and guide the user to do separation and segregation of waste as the habit.

How did you produce this idea?

When I came for the birthday celebration at Kavin's home. We had wonderful time celebrating. after celebrations were over. It is time to leave place clean and tidy, while we started cleaning, we found the community hall where we had celebration in the society where the mixed trashes were overflowing. Then an idea came to our minds when we both went to dispose wastes in the society and we had chance to take a look at the waste segregation areas of the society, we saw that the waste segregation method of the society were very inefficient one of us looked at the dustbin which had a board on it saying 'electrical waste' in large bold letters but all he saw in it was domestic waste like chips packets and chocolate wrappers which were made out of plastic but the plastic waste dustbin was not too far from there!! we started thinking that why was plastic waste in the electrical waste dustbin?? we immediately found out that this was the caused by not only unaware people who don't have knowledge about such waste segregation topic but also leisurely people who don't want to walk such a small distance to keep our environment clean and adults and small kids doesnt have any idea about colour code and its purpose.

We thought to make people aware about these topics and found not all people were aware about this topic and too numerous for just 2 people (kavin & Aarush) to spread awareness. We both then checked more places which had an inefficient waste segregation system and found out that many more places had this same problem at that point we found out that this problem is not a small one. Root cause of the problem is absence of cleanliness literacy among people. We use the cleanliness literacy because they are not aware of the cause and effect of the trash which is thrown out and second being partial clean literate people who uses the dust bin but not knowing what colour code for the kind of trash is they want to get rid of. Absence of cleanliness literacy is due to not having the guidance & habit of proper waste disposal from the early age or from the school age.

We really wanted to know how the people were really feeling about the problem, or do they consider this a significant problem to this Mother EARTH? So, we decided to hit the ground to do survey about the problem in our locality.

Customer Survey:

Survey questions:

- After the delicious dinner at wedding halls how do you dispose the trash/leftover food?
- How was your experience about wedding hall dustbins? What you like or not like?
- Do you think that the waste segregation systems in weddings are working properly? If not, why do you think so?
- Do you think we need to fix the issues in such large social gathering places?

Sample Customer survey audios:

Customer 1	Customer 2	Customer 3	Customer 4
Customer 5	Customer 6	Customer 7	

We conducted a survey to understand the opinion and practice of the public. All the people for the survey were from Kavin's apartment as we thought that people living in apartments will be more numerous than people living in individual houses so, we decided to do it in Kavin's apartment. At first, we thought that it will be an easy task, but we could not be more wrong because most of the people did not know what the correct code for the dust bin and its purpose is. Then we hit a stunning realization that there were more people were aware about problem due to trash than we imagined. We never thought that even the people in our own backyard did not know about dustbin colour codes, but they have understood the problem of trash. This made us to rethink our entire project idea & felt the problem's importance. When we had done survey, we understood that the problem is real, and it is recognized by the public as well. The problems that we came to know where that many people understood this problem, but they did not raise their voices since they thought that this was not their problem and unaware about cleanliness literacy. The people still welcomed our Smart dustbin and supported our idea by suggesting many improvements. Some of these were improvements that we never imagined but still some were not feasible. Hence, we decided to brainstorm to find a better solution to resolve the problem along with our mentor.

What are other ideas investigated?

Brainstorming:

When we have done the research there were lots of methods of brainstorming where available. Such as following,

- SCAMPER Technique
- Hudson's Production Thinking Model
- Reverse Brainstorming
- Six Hats of Critical Thinking
- Lego Serious Play

Out of the methods listed we found that the SCAMPER technique was rightly fitting to the problem we have identified. SCAMPER method of design thinking, which emphasizes on the creative thinking. SCAMPER is method used for improvising the existing design and it is direct method in the design thinking. *SCAMPER stands for the acronym (S) substitute, (C) combine, (A) adapt, (M) modify, (P) put to another use, (E) eliminate and (R) reverse.* For the Brainstorming session we along with mentor decided to go through all phases mentioned in the technique

Substitute: The substitute technique focuses on the solution such as existing method inefficient waste segregation to be replaced with smart dust bin and other ideas which we have discussed. During this part of the discussion, we focused on making decisions to substitute current part of the waste collection at the marriage or community ceremony with our idea. Questions asked during our brainstorming is as below,

- What part of the process can be substituted without affecting the whole project?

We decided to use the collection part is better way to eliminate spillover of the wastes.

- Who or what can be substituted without affecting the waste collection?
We arrived that the element in waste collection is the dust bin. which could be replaced by other method which is efficient and help in inculcating the habit of using it often can help the user hooked to the habit.
- What part of the process can be replaced with better alternatives of waste collection?
Efficient waste collection with aided /guided trash would be better alternative along with incentive for using the dustbin.
- What will happen when we replace part of the waste collection with smart collection?
We are trying to form the habit. Once the habit is formed, it will reinforce the user to use the dustbin continuously.
- Where else could you sell the product?
Our project target customers were community halls. But can be extended to other places in the public such as society with improvisation.
- Could we use another alternative of waste collection?
We can use the other alternative for the existing dust bin. As it does not educate the people and guide the people. New proposed smart bin will be able to guide the people and help forming habit among the masses. As we can have option to even teach literate people by the robotic voice through the local language as well.
- Can we substitute the current device for a better one?
Yes, our solution to the problem is to make the existing device as smart.
- Can we replace the process with a simpler one?
Yes... the process is the same. It is made smarter with guidance of the automated voice and the opening of the lid of bin along with incentivising the user.

Combine: Combine is method of the merging two process into one. Here we are trying to make the collection of waste into smart process. Following were the questions and answers we arrived at our brainstorming session.

- Can we merge two steps of the process?
- Can we apply two processes at the same time?
- Can our company combine resources with another partner in the market?
- Can we mix two or more components together?
- Can we combine X and Y technologies?

Adapt: Adapt refers to a brainstorming discussion that aims to adjust or tweak dust bin for better collection system. This adjustment can range from minor changes to radical changes in the collection and guiding method. Adaptation is one of the most efficient techniques for solving problem.

Following questions were discussed during this stage.

- What would we need to change to reach better collection of trash?
- What else could be done for the segregation of the trash?
- How can we improve the existing process of trash collection and segregation?

- How can we adjust the existing waste collection and segregation?
- How can we make the process of waste collection be more flexible?

Modify, minify, or magnify: Modified technique refers to changing the waste collection in a way that unleashes more innovative capabilities or solves problem of the irregular waste separation. This change is more than just an adjustment as it focuses on the overall process. For example, it can change our perspective of how to look at the problem of waste collection. The questions asked under this could be:

- How will modifying the process of waste collection improve results?
- What if we had a better process of separating the waste?
- If the collection locations were different, what would the waste separation process look like?
- Can we change the waste collection so that it works more efficiently?

Put to another use: the technique concerns how to put the current simple dustbin or process of collection of waste at functions. how to use the existing product to solve problems. For example, this technique can be used to learn how to shift an existing waste collection process to another segment such as community event or user type such as in public places.

- What are the benefits of the smart bins if used elsewhere?
- What if we target another segmentation such as public places for the current smart bin?
- Can we add a specific step into the process to replace another?
- What are other ways can we use it?
- Can we recycle the waste for another use?

Eliminate or elaborate: As the name implies, this technique aims to identify the parts of the collection that can be eliminated to improve the process/product. It also helps to explore the unnecessary parts of the project. Questions can be asked as follows.

- What would happen if we removed this individual use dust bin?
- How can we achieve the same output without an individual use dust bin?

Reverse: the reverse or rearrange technique aims to explore the innovative potential when changing the order of the segregation Reversing the segregation of it can help solve problems The questions in this part include:

- What would happen if we reversed the process of segregation?
- How can we rearrange the current process for better output?
- What if we consider it backwards?
- Can we interchange elements of the collection bins?

Did you find similar ideas available?

The following ideas, which are already in the market, and we studied its functionalities, were discussed below. The current products operate based on user leg or hand movements near the lid. However, they do not prompt or guide people on correctly disposing of trash according to the colour code.

One project, featured on the mentioned website, presents a simple smart bin with some features like ours. It uses an Ultrasonic sensor HC-SR04 to detect objects in front. The sensor sends signals to an Arduino Uno, which then activates a Servomotor to open the bin lid, allowing trash to pass through.

While this project is more economical, it lacks intelligence. We believe our dustbin will become more economical due to rapid technological advancements in artificial intelligence and board manufacturing technology. Technically, our bin uses a Raspberry Pi instead of an Arduino, as it can better incorporate artificial intelligence due to its higher computing power, as mentioned on the website. Another significant difference is that this dustbin does not use artificial intelligence to guide users to the correct bin. There are many projects like this.

Another intriguing project, detailed on the mentioned website, is a Raspberry Pi-powered smart bin aimed at efficient waste management in urban areas. This system includes distributed dustbins, a central system, and a dashboard connected through IoT (Internet of Things). The dustbins are equipped with Raspberry Pi, LEDs (Light Emitting Diode), ultrasonic sensors, infrared sensors, and servo motors. The central system collects data from the dustbins, processes it, and provides monitoring and analytics. The dashboard shows the status of the deployed dustbins. The proposed system uses MQTT and REST protocols for data transmission. While this system addresses inefficient and untimely waste collection, it has limitations, such as the lack of location data for the dustbins and unreliable network connectivity in non-urban areas, as mentioned on the website. The key difference is that this system does not guide users unfamiliar with colour codes to the correct bin using machine learning or other tools.

This project captures an image of the object by pressing a push button, placing the garbage in front of the camera. A green LED indicates the image capture. The image is then pre-processed using the OpenCV library, and a neural network detects the object. A blob created from the image is passed through the neural network for prediction. Based on the waste type, the motor rotates in a specific direction: clockwise for biodegradable waste and anti-clockwise for non-biodegradable waste. An ultrasonic sensor indicates if the dustbin is full, with a red LED lighting up when full. The differences between this project and ours include the use of a push button to activate the camera, which we avoided to reduce disease transmission risks. Additionally, this project uses LEDs to indicate a full bin, which could be ignored, leading to overfilled bins. Our dustbin, on the other hand, sends notifications to organizers for quick bin replacement. Furthermore, this project does not reward users with points for waste disposal, lacking an incentive for correct waste sorting. Despite its similarities to ours, this project did not offer these additional features.

These were some of the projects sharing similar ideas to ours. We chose these three projects because they share many of our aspects and aims, although they are less ambitious and designed for typical use rather than specific events like weddings and other occasions.

3.3 Technical aspects:

The materials we plan to use in this project are –

Hardware Requirement:

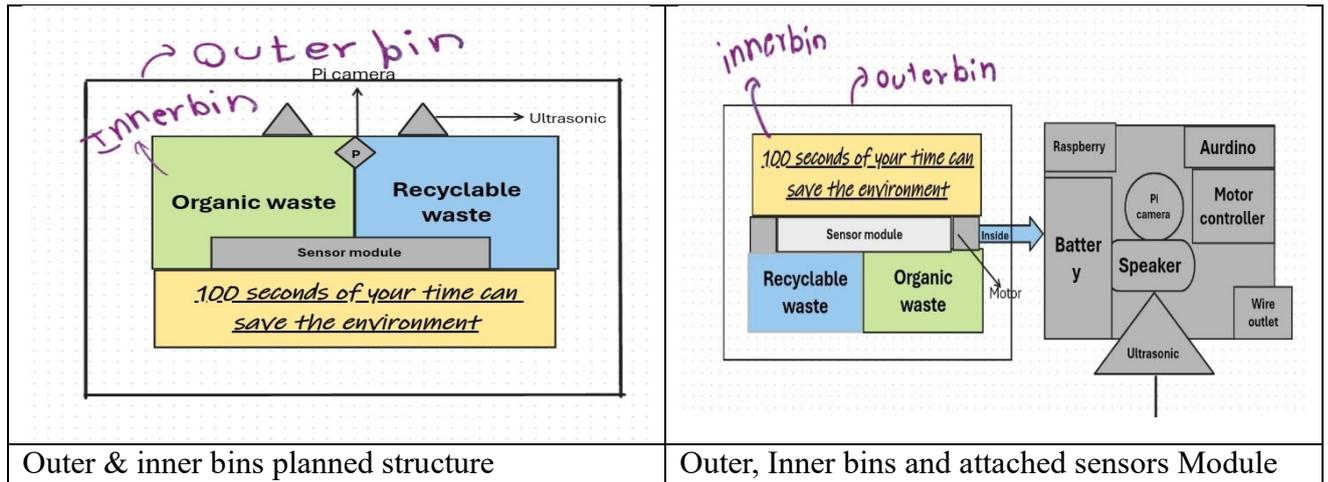
- Raspberry Pi module, Pi camera
- Battery holder case & AA rechargeable
- Lego WEDO bricks, servo motors
- Speaker
- Connecting wires
- LCD screen

Software Requirement:

- Teachable machine tool, Scratch
- Python

Design:

The design of our smart dustbin module consists of two distinct colour (Blue – paper & plastic waste, Green – Food Waste) coded bins and each of them have a label on it mentioning the type of dustbin it is.



Also, there will be a camera or dashcam looking at the user and the trash the user is holding on the top of the module. Structure of the dustbin module is discussed below:

The outer dustbin cart: This part of the module has 2 inner bins and the sensor block inside it. It has a door on its backside which has a lock in it. The lock ensures that the electronic components are not stolen from the inside of the outer part of the dustbin. It has a lid that opens with the help of a DC motor. The lid of this part of the dustbin has an ultrasonic sensor on its top which senses the distance from the lid of that part of the dustbin to the trash so in this way it can sense that how much place is left in the dustbin and which bin needs immediate replacement. The lock on the outer part of the dustbin can be opened with the help of its key and can be easily pulled out and emptied.

The inner dustbin: It is the part of the dustbin that holds the trash, and it is located inside the outer cart. Each individual bins have its own lids to open and close. If the suitable trash is identified by the Pi camera and the trained machine learning model will pass the message to the controller to give the suitable instruction to open that lid (Blue and green bin) using the servo motors attached to it.

Sensor module: This box has a small open slit from which the raspberry pi camera can see out of it, the task of this raspberry pi camera is to capture what trash its user wishes to throw in it. The raspberry Pi camera will capture the picture and send the captured image to the raspberry Pi controller module. The raspberry pi controller module will then use the trained machine learning model to find out what materials the garbage is made from in this case paper or plastic or food waste accordingly the lid would be opened with the servo motors connected with the lid.

We have used the raspberry pi which will work as brain for the project. Raspberry pi is single board computer with 1GB RAM and BCM 43488 RAM and CSI interface for connecting the PI Camera module. Apart from this SD card acts as local drive. We have used the raspberry pi to connect with the power source to 2.5A. The dust bin camera senses the trash in the hand and provides the signal to the stepper motor which in turn controls the dust bin lid. Pi Camera module used to detect the type of trash which is thrown. We have used the Python library such as OpenCV and Tensor flow for the capturing and training the machine. Using Pi camera, the module will capture and detect the images of the trash which is brought near dustbin and Tensor flow which is trained will take the decision and Tensor flow which is trained will take the decision based on the training.

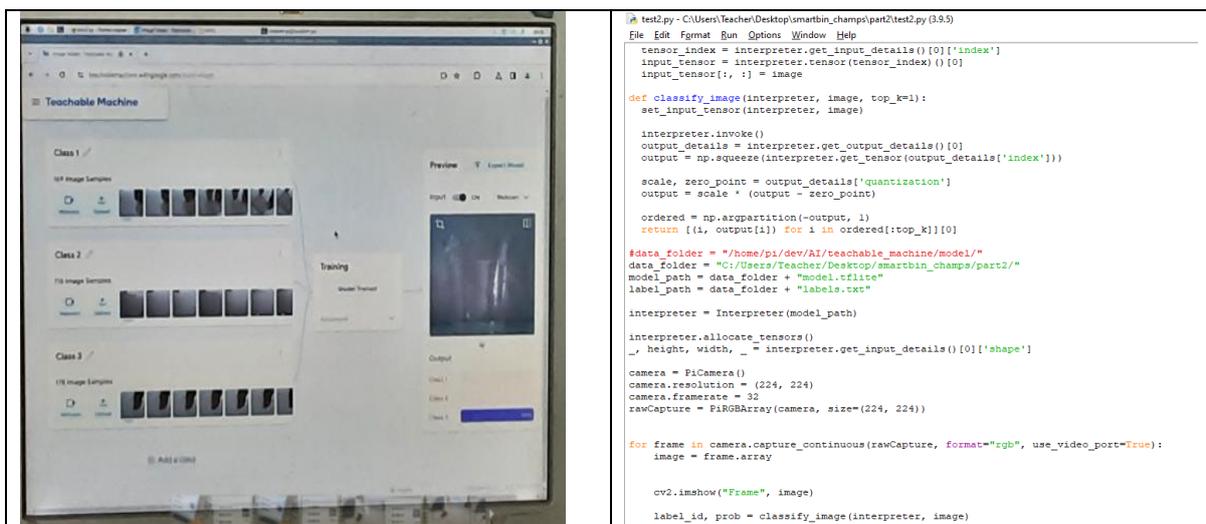
Methodology:

We plan to develop it step by step in 5 stages –

- Stage 1: We will develop the base model with the help of LEGO bricks to construct bins, stepper motor for activate the lids of the bins, Raspberry pi and pi camera to capture the object image.
- Stage 2: Using Teachable machine tool, ML (Machine Learning) model would be trained to classify the non-recyclable waste, recyclable waste, food waste. The captured image (using PI camera) would be used as the test data, and it is used to activate the lid among other lids of the bin using machine learning technique and stepper motor connected with Raspberry pi controller.
- Stage 3: We will add a speaker to our project so that the user could be guided to the correct dustbin. This feature is for people who are not aware of dustbin colour codes.
- Stage 4: Addition of a banner saying, ***“100 seconds of you time can save the environment”***. This is to make people who leisurely throw trash in the wrong bin think.
- Stage 5: Addition of an Ultrasonic sensor to assess the level of trash in the dustbin. Thereby preventing it from overflowing and causing unsightly scene at the sight of wedding hall. Sending the push notification for the function manager and in charge team about which bin is getting filled soon and which one needs quick replacement.

Coding for the solution:

Finished work:



Training ML model for classification & its labels are 1. Paper waste 2. none 3.plastic waste.	Python programming to capture the real-time image using pi-camera and classify it using the trained TM model.
--	---

Work in progress:

Using the classified result above we need to write the code to open the lid using the corresponding motor. Post that we need to guide the customers using the voice assistant to dispose the thrash in the correct bin and make it as habit.

Challenges likely to face during developmental process:

The problems which we faced and likely to face during the development process of our project are:

1. Accuracy of the machine learning model depends on the number of training data that we feed in the model during training stage. Here we tried to train using 50 images of the plastic cups and paper cups. But still the machine learning model's accuracy was less and sometimes the model miss classify the data. We are trying to learn how to get the data from internet to train the model using automation process. Still, we are trying to figure it out.
2. Second problem that we anticipate was there is a high possibility that the components inside our dustbin are stolen and the strong security mechanism to safeguard.
3. Third problem that might come across is people who are not throwing their garbage in the right bins due to attitude because if our robot opens one bin for only one piece of garbage, people throwing all the garbage they have in hand into the first opened bin defeats our goal.
4. Fourth problem that we anticipate was in case people brings the plate with plastic, paper, and food waste mixed then we need to think about the improvised solution to tackle this problem.

4. Social Impact & Innovation:

Describe the impact of your solution for society:

Our robotic solution would revolutionize the way the public imagines dustbins. Our robotic solution will slow down or even reverse the growth of landfills and complex waste segregation systems which include many different expensive sensors will not be needed. The **wedding halls will become a powerhouse** due the amount of recycling of food waste for generation of electricity. This could mean that an average three-day Indian wedding could generate about 27 kilowatt hours. Over the 3 days of celebrations upwards of 800 kilos of food waste would be generated. This amount of food waste would be reused for the power generation by turning into biogas and used material can be used as bio fertilizer. Our project would also evoke a habit of segregation of waste among the public since we are planning to incentivise the public for the use of the dustbin with segregation. This would help the segregation of waste for channelizing into other useful by products such as recycling of plastics, reusing of papers and generation of electric power from through the process reuse without additional process from the collection end. We predict that our dustbin could generate a lot funds, while also making the environment cleaner. The adaptation of this dustbin would be extremely fast due to its usefulness and ability to replace the existing bins without any issue. These properties of our dustbin make it very appealing to both companies and the consumers.

Who will it help? How important is it?

This project would be helped by rental firms that rent our dustbins to small scale and medium as well bigger size wedding halls. This is due the fact that these firms could sell the wastes collected to recycling plants and receive monetary funds. Food wastes can be used for the biogas generation without any other segregation in between and plastics can be recycled. It will be more useful to preserve our mother EARTH, greener and most liveable place.

Importance of separation of waste:

The importance of waste segregation cannot be overstated. By segregating waste, we can ensure that recyclable and non-recyclable materials are disposed of properly. This also ensure avoiding the trash formation. This protects our environment and helps to reduce the amount of waste that ends up in landfills.

The importance of separation and segregation of wastes includes:

- **Environmental preservation:** Proper waste segregation enables efficient waste management systems to divert recyclable materials from landfills and encourage recycling processes.
- **Reducing landfill waste:** By separating waste into distinct categories, we avoid formation of trash by which we lower greenhouse gas emissions and preserve natural resources.
- **Public health:** Effective segregation of wastes is important for public health.

So, in short our dustbin

Importance of Waste Segregation in India

India produces a lot of waste each day, and the volume is only getting more as country is marching from developing to developed. India produces more than 619 million metric tons of municipal solid trash in 2020–21. Only 64% of this was gathered and treated, with the remainder going uncollected or untreated.

Where our solution could be used?

Our smart Bin would be used in community functions such as weddings and birthday celebrations. The celebration organizers and the company that is responsible for renting out the dustbins would benefit from our Smart Bin because they would receive monetary fund for the disposed wastes from recycling plants.

5. Advantages of this product:

This project will reduce the costs of recycling and reusing wastes since further segregation is not needed. This cost reduction would aid in compensating for the inflated costs of the smart Bin. So, our project segregates waste at lower levels rather than letting the waste overwhelm the waste segregation at large facilities which leads the waste to be dumped. Many people who are not aware of dustbin colour codes would be educated and most people who leisurely throw wastes in the wrong bin would be fined. The amount of recycled waste would drastically increase and many types of wastes in a single bin

would become outdated and our Smart bins would become the present. When coupled with an efficient garbage transportation system then we believe that the world could potentially become a closed system where any external resource would not be required expect special resources since most of the waste would be recycled and reused if the public embraces our smart Bin. This could slow down the rate of land fill growth and potentially stop it. Over filled dustbins will become the thing of the past and smart AI used talking dustbins will become normal. This would clear up large garbage mountains which are formed because of decades of dumping.

A person will use it in Marriage halls as it gives them money to throw garbage in the correct place in the wedding hall and the way in which anyone could use it is first throwing the garbage in dustbin and the sending the special code which they just got on the led which is on the dustbin and that same code is sent to the manager of this dustbin and the user will have to send it to the WhatsApp number which will be given on a banner near the dustbin and that WhatsApp number will be accessed by the manager of our dustbin and then the manager will simply check if the code which the user sent and the code which he got is the same and then he will go to the app and send the amount of points according to the amount of trash they put in the dustbin and then later those points can be converted to actual currency after the user reaches some amount of points for example when a user gets 5000 points he will get 1000 rupees online and as an average Indian person attends 50-150 weddings in his life and can get 50 points every time

6. Future Work:

The Raspberry pi will give the command to the LCD screen to display a code which the user can send a message in WhatsApp to receive a fixed amount of money. Then with the help of machine learning the dustbin will identify the name of the trash item in the user's hand and send an order for the speaker to tell the name of the trash to be put in the correct bin. At the same time, it will issue command to the motor to start rotating and open the lid of the dustbin in which the first type of trash will go. For example, if someone comes near the dustbin and has one paper cup and a chocolate wrapper which is made from plastic. Here the raspberry Pi controller module will give the command to the LCD to display a code to receive money. Then the speaker will say paper cup so that the user understands that the paper cup must be thrown in the dustbin that just opened which was the green dustbin or the dustbin which had all the bio-degradable waste inside it. This accomplishes two tasks which are doing efficient separation of waste and spreading awareness about how important segregation and separation of waste is. But the differences in the project in these three places is the size and the people who are going to manage them like if the dustbins are used in homes the people who are going to manage and empty then are going to be the people who live in that house but if the dustbin is used in streets and public places the people who are going to manage and empty the dustbins are going to be the people who are employed by the government and the dustbin which will be used in homes will be a lot smaller than the dustbins which are used on the streets and public places and the dustbins used in weddings must be very large to accommodate huge amounts of wastes caused by weddings. The number of dustbins is also dependent on the scale of the wedding. We also plan to replace the AI part of the mechanism with a code that searches the images that are captured by using google lens, but we found the code extremely hard this requires internet access which might not be available in remote areas and villages so, we left this to future work. The advantage of this idea is that it has access to thousands of images which are available in google lens for every searched image.

6. List of sources:

1. *Waste Segregation: Process and Importance | Earth Reminder*
2. <https://ifttt.com/explore/arduino-vs-raspberry-pi#:~:text=Arduino's%20microcontroller%20is%20perfectly%20suited,the%20Raspberry%20Pi%20stands%20out.>
3. <https://www.linkedin.com/pulse/scamper-technique-critical-innovative-thinking-dr-zahra-al-rawahi/>
4. <https://waste-management-world.com/resource-use/the-integration-of-smart-waste-management-systems-promises-profound-transformations-in-urban-areas/>
5. <https://www.designorate.com/a-guide-to-the-scamper-technique-for-creative-thinking/>
6. <https://marinedebris.noaa.gov/why-marine-debris-problem/ingestion>
7. <https://waste-management-world.com/resource-use/innovative-ideas-for-the-waste-management-industry/>
8. [https://waste-management-world.com/resource-use/the-integration-of-smart-waste-management-systems-promises-profound-transformations-in-urban-areas/.](https://waste-management-world.com/resource-use/the-integration-of-smart-waste-management-systems-promises-profound-transformations-in-urban-areas/)
9. *What Is Waste Segregation, and Why Is It Important? (greenatlanta.com)*
10. <https://growpurpose.com/green-library/waste-segregation-in-india-an-overview-of-techniques-and-technologies/>
11. https://en.wikipedia.org/wiki/Waste_sorting