

# IOT Based Smart Waste Management System

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**Abstract**— Nowadays, wasting food is common among the students in colleges, hostels, and workplaces. This results in a great demand for food products in the future, which may lead to food scarcity for future generations. As food waste management is tedious process. In this paper we have mainly focused on measuring the food waste and providing rewards for the users, where it shows the real-time food waste of every individual on a screen and in a website for future reference. This research mainly focuses on monitoring the food wastage of everyone. Our model proposed over and create a parallel result to give a detailed report to the managing and the user about their amount of food excess each time. This helps to analyze and generate the list of user falls under the non-food wasting criteria and reward them for their noble act. We can do this either manually or automating the process using Internet of Things as a key tool. We use an RFID sensor to monitor the wastage of individuals. They can be opened only by using the RFID card provided by the management. Basically, we are automating the method of identifying the amount of food wastage in the areas, where we are sure that the amount of food waste can be decreased by the analysis of food wastage by every individual and awarding them with rewards and prices by the reports generated by the system.

**Keywords**—Internet of Things (IOT); Weight Sensors; Arduino; RFid sensor; Stepper Motor; Motor Driver; Cloud computing; Food waste management.

## I. INTRODUCTION

Food management is always a difficult task for the management as it involves a lot of labour work and continuous analysis of food wastage by every individual. This tedious process can be aided using the Internet of Things (IOT) [1]. It is an important application which has the potential to deliver amazing services. Food wastage not only affects the environment but also creates a negative impact on the economy of a nation and creates great demand for food products. In places like hostels, college canteens, office cafeteria the amount of food waste is extremely high because of the carelessness of the employees and students. In fact, that amount of food can feed a lot of people who could not afford their food. If food wastage is monitored individually and providing them with rewards, there is a high chance of reducing the amount of food wastage in those public areas. The solution for this problem can be achieved by using the Internet of Things, Cloud Computing [2].

Security has become the most important issue with the development of the Internet of Things. The waste management objects and objects are combined to the Internet of Things (IOT) date verification system with high productive information's,

and this information requires to be moved over the main server machine. The collected information in the main server is has been analyzed and processed according to the need of the user. In this system uses the cloud computing virtual network to store all the real time information's and analysis of data instantly. The report is generated immediately and effectively of each product in every individual for future reference [3].

It is highly secure as the IOT provides distinct IP addresses for different devices [4], So it is hard to steal data from the server [5]. Now, cloud storage is becoming a trending platform for storing and retrieving the services through the internet. Cloud computing permits the organization to start for free and charges only when we request for more services. All data captured using IOT sensors will be fed into the database for further analytics. But the process of retrieving the data from such a big data lake is exceedingly difficult and, usually the existing system is not capable of processing such volume of data [6]. In this case we use Cloud computing over big data to store the details.

This paper is organised as follows: Section 2 outlines the features of IOT, detailing its requirements; Section 3 provides a brief review of the general approaches in Food waste management system describing which ones are desired; Section 4 presents a summary of the findings of the investigation; details an experiment that shows how IOT handles the food waste management effectively ; Section 5 concludes this paper with a discussion on the IOT sensors and cloud computing for tracking the persons individually using RFID.

## II. REQUIREMENTS FOR FOOD WASTE MANAGEMENT SYSTEM

In developing the leftovers are a worrying concern. School hostels, college hostels, canteens, workplace cafeterias and ceremonies give rise to a huge amount of food wastage [7]. This wasted food causes pollution to the environment and causes many economic distresses. Modern reports show that nearly half of the food is wasted globally there is a greater number of volumes in food excess is about tones and is anticipated to keep on increasing in the upcoming years and cause harmful issues. In many developing countries the government is in combat to dispose of the food wastage in a proper way not creating any harm to the society by implementing innovative ideas and projects using advanced technologies. This food wastage is not only an issue in developing countries, but many developed countries are also affected by the issue. In many developed countries the leftover food is dumped in the open areas, which affects the environment. Also, the people in the society should

be aware of the effects of wasting food and try not to waste their food each time they are taking a meal and request others to follow the same [8].

The existing system has the capability only to measure the food wastage of a whole organization or a particular bin for a day but not for each and every individual person [9]. With that data only few measures that can be taken by the organization to reduce the food wastage. The existing system is a semi-automated process where the report should be verified manually, and rewards selection should be done manually. As mentioned early the existing system will calculate only the food wastage of a whole organization [10]. Which leads to very limited applications of data which is collected by the organization. Even with the collected data there would be less effect in creating any awareness or taking measures among the people in the organization. The existing system lacks in the data collection part and the applications with the data collected are limited. So the existing system has limited uses.

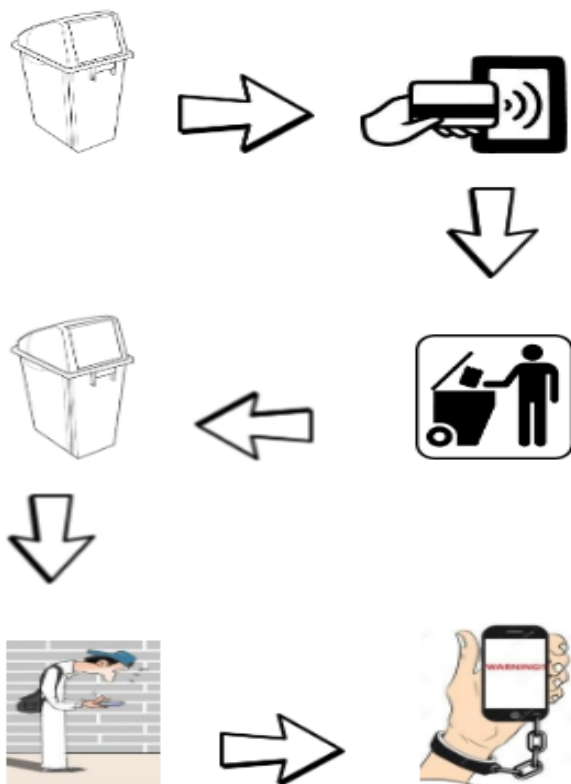


Fig 1: Overview of the proposed method

Our project comes up with a solution to monitor the food wastage of each and every individual. With that data of every individual's food wastage, the organization can come up with some new schemes to reduce the food wastage. Mobile devices, smart devices and sensors have created great waves in the field of food processing all around the world. Food Industries have many advantages by the development of Internet of Things technologies [12]. Figure 1 gives the overview of the proposed method. Each user has to scan their RFID to open the bin to

pour the food waste inside the bin, RFID is used to monitor the food wastage of every individual as every RFID has its unique number. Load cell measures the amount of food wastage of each and every individual in the office premise and is displayed immediately on the screen fixed outside the bin for every time and then the amount of wastage is fed into the database. In the database all the records of every individual are gathered, and an analysis report is generated and the final report is shared to the display of the management website. Then finally management can take necessary measures based on the reports generated by the system. Figure 2 shows the data flow diagram of the proposed method which gains power supply and the arduino controls the entire hardware components like motor, load cell, RFID sensor, LCD display, WIFI module and the motor driver. Then the WIFI module connected to the arduino sends the data gained to the server [11].

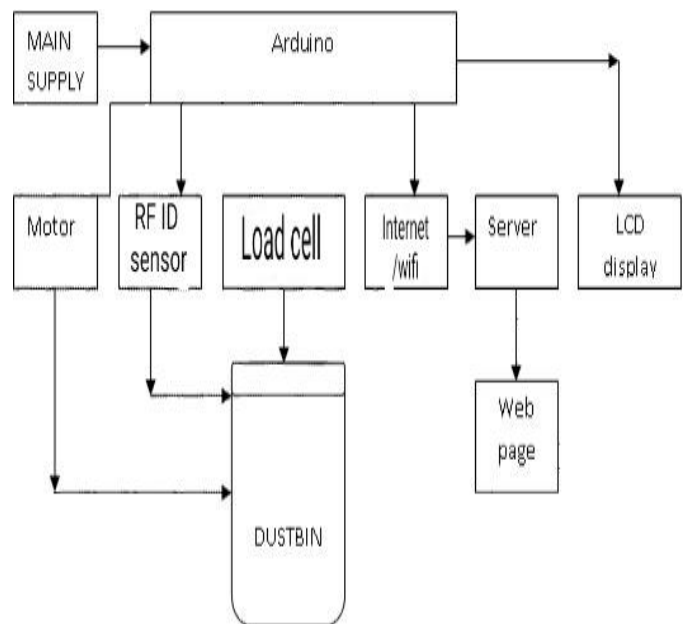


Fig 2: Data flow diagram of the proposed System

### III. REVIEW OF THE APPROACHES

The main research focused on

#### User Interface

It consists of RFID and LED displays. A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity, and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration [13]. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. User interacts with the product using an RFID scanner fixed to the bin with the RFID provided to them by the management to open the

bin[3]. Once the user scans the RFID card in the scanner, the LCD display shows the student or employee ID of the particular card. Then the LCD display shows the information to the user to dump the waste into the bin. After the bin gets opened and the user has to pour the waste inside the bin. LCD displays show the amount of waste that is thrown in the bin by the particular user at that particular time.

#### *Weight Management:*

This module consists of a load cell. A load cell is a force transducer. It converts a force such as tension, compression, pressure, or torque into an electrical signal that can be measured and standardized. As the force applied to the load cell increases, the electrical signal changes proportionally.

Load Cell acts as a weight sensor which will sense the weight of food wastage poured inside the bin by the user and send the weight to the arduino board so the LED can display the weight that is thrown in the bin by the user at that particular time. The weight measured is sent to the server using the wifi module installed and stored in the database. We are using MySQL database for data updates.

#### *Hardware Management*

This module consists of a motor driver, motor, and arduino. A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback.

It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. In this the motor driver is used to control the rotation direction and speed of the motor. The arduino controls the functions of all the hardware in the product. The motor is responsible for the open and close functions of the bin when the user scans their RFID.

#### *Database Management*

This module consists of a GSM or WIFI module that sends the data captured by the sensors and the record of the users to the server for further tasks [4]. The GSM or WIFI module is used to upload the weight of the waste to the server which has the database [7]. We are using MySQL for the database. HTML can embed programs written in a scripting language such as JavaScript, which affects the behavior and content of web pages. Inclusion of CSS defines the look and layout of content.

#### *Website Management*

This module consists of user login and admin login. The user can login and review their record [9]. The admin can login and view the record of each and every user. The admin will be having access to add new users with their details like Roll No, Address, contact information. So, based on the requirements the database can be improved.

### IV. ANALYSIS

An analysis graph Figure 3 is collected for the amount of food wasted in different parts across the globe for one year. The

graph also shows the amount of food wastage by the consumer and the employees involved in production to retailing [10].

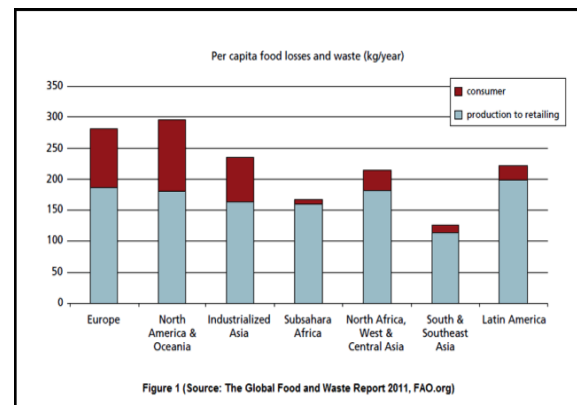


Fig 3: Bar graph shows global food waste report

#### *Card Identification*

It consists of RFID and LCD displays. User interacts with the product using an RFID scanner to open the bin. LCD shows the amount of waste that is thrown in the bin. The user has to scan the RFID card provided by the management. The bin gets to an open state and has a duration of a few seconds.

So that the user can throw the food wastage and the bin gets closed. In this process, the motor driver is used to control the rotation direction and speed of the motor. The Arduino controls all the hardware in the product.

#### *Weight Measurement*

This weight Measurement process consists of a load cell. Load Cell acts as a weight sensor which will sense the weight and send the weight to the Arduino board so that the LCD can display the weight that is thrown in the bin. In this system the weight management plays a major role. Some grace weight will be set to each user so that the necessary wastage like chilies, bones, can be reduced while storing the data.

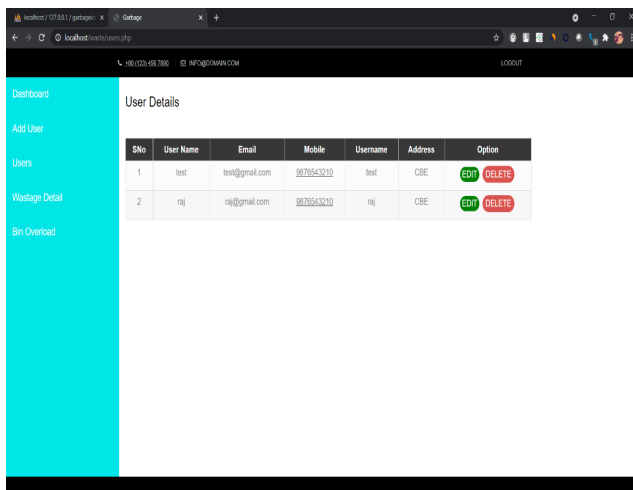
#### *Record Maintenance*

It consists of a GSM module and the record of the users. , The GSM module is used to upload the weight of the waste to the server which has the database. This module consists of user login and admin login. The user can login and review their record. The admin can login and view the record of each user.

#### *Website Interface*

There will be two different logins. Admin Login and User Login. In Admin login we can create new users and monitor the wastage dumped by each user. And there will be an overload column which shows the data of users who has wasted more food. So that the management can take actions accordingly.

In the user login each user can login with their password and check on their food wastages. The implementation of project hardware along with the user details , wastage details and Overload details web page is shown in the figures.



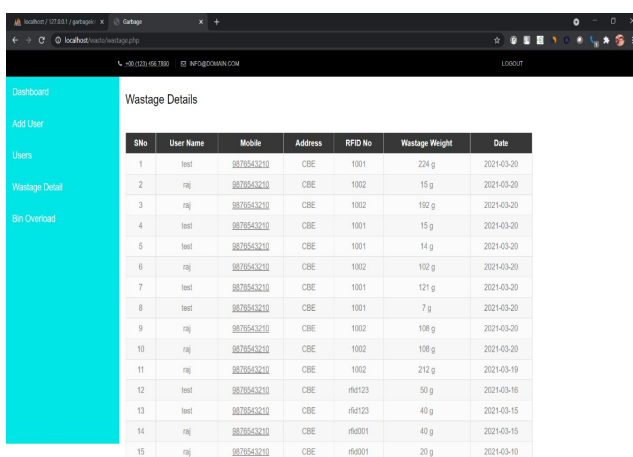
The screenshot shows a web application interface with a sidebar menu on the left containing 'Dashboard', 'Add User', 'Users', 'Wastage Detail', and 'Bin Overload'. The main content area is titled 'User Details' and contains a table with the following data:

SNo	User Name	Email	Mobile	Username	Address	Option
1	test	test@gmail.com	9876543210	test	CBE	EDIT DELETE
2	raj	raj@gmail.com	9876543210	raj	CBE	EDIT DELETE

Fig 4: User details



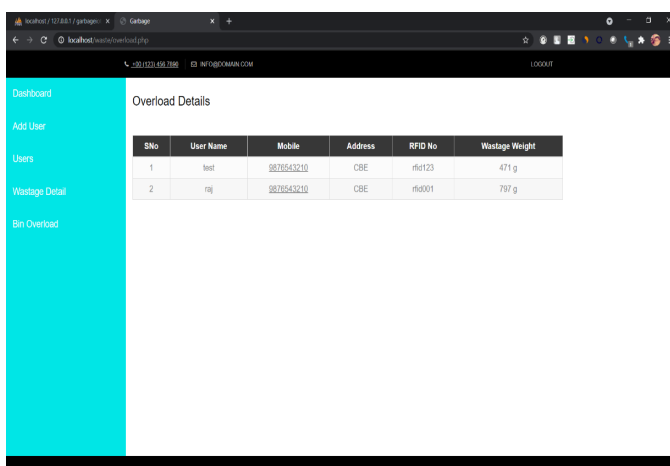
Fig 7: Project hardware and webpage



The screenshot shows the 'Wastage Details' page of the web application. It contains a table with the following data:

SNo	User Name	Mobile	Address	RFID No	Wastage Weight	Date
1	test	9876543210	CBE	1001	224 g	2021-03-20
2	raj	9876543210	CBE	1002	15 g	2021-03-20
3	raj	9876543210	CBE	1002	192 g	2021-03-20
4	test	9876543210	CBE	1001	15 g	2021-03-20
5	test	9876543210	CBE	1001	14 g	2021-03-20
6	raj	9876543210	CBE	1002	102 g	2021-03-20
7	test	9876543210	CBE	1001	121 g	2021-03-20
8	test	9876543210	CBE	1001	7 g	2021-03-20
9	raj	9876543210	CBE	1002	108 g	2021-03-20
10	raj	9876543210	CBE	1002	108 g	2021-03-20
11	raj	9876543210	CBE	1002	212 g	2021-03-19
12	test	9876543210	CBE	rfid123	50 g	2021-03-16
13	test	9876543210	CBE	rfid123	40 g	2021-03-15
14	raj	9876543210	CBE	rfid001	40 g	2021-03-15
15	raj	9876543210	CBE	rfid001	20 g	2021-03-10

Fig 5: Wastage details



The screenshot shows the 'Overload Details' page of the web application. It contains a table with the following data:

SNo	User Name	Mobile	Address	RFID No	Wastage Weight
1	test	9876543210	CBE	rfid123	471 g
2	raj	9876543210	CBE	rfid001	787 g

Fig 6: Overload details

## V. CONCLUSION

By this paper we can encourage people to take necessary amounts of food so that the wastage of food can be reduced. In our proposal, with the help of cloud computing and IOT sensors we are implementing only in premises where an RFID card is provided, this will help us in saving the cost as well as the for creating the individual records of the management, and this will create a larger impact on the individual food excess at the working surroundings, In our proposed upcoming enhancements, it will cover more areas like restaurants hotels, schools, colleges, tech parks, party spaces etc.

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