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Waste Management Using Reward System

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Abstract
The planet has undergone tremendous stress since the beginning of the industrial revolution, the invention of plastic, boosted the manufacturing industries. Plastic is inexpensive, versatile, strong, flexible, waterproof non porous. Due to this, plastic is used on a large scale to develop and manufacture even the most basic products such as plastic covers, bottles to space equipment. The success and dominance of plastic as a goto material for varied commercial products created concerns of environmental pollution. Currently, plastic pollution is one of the major threats to the environment and wildlife. Recycling is opted as a measure to reuse and repurpose plastic. The main challenge of the scenario boils down to the collection of plastic, governments have to deal with littered plastic which proves to be difficult. This paper addresses this problem of plastic waste management and proposes a solution using IoT and introduces the concept of rewards which will motivate proper waste disposal.

Keywords: *IoT, Waste management, reward system, Smart City*

1. Introduction

The advent of the Internet marked a new era in the history of human civilization, since then the Internet has become one of the driving forces of innovation and also a basic need for commoners. The possibilities of the Internet has led to the development of the Internet of Things(IoT), where almost anything can be connected to the Internet. This enabled companies to introduce "smart" devices or gadgets that are connected to the Internet [1]. World as one knows today is coming up with new fascinating technologies that make human life easier and smarter with each passing day. Scientific advancement is remarkable, in fact, the world has witnessed immense progress in the last few decades more than the combined history of all human civilizations and there's no stopping it but there's a dark side to it as well, in the same last few decades, humans have been polluting the earth without thinking of the consequences - Global Warming, Climate Change, Unfertile dead lands, ocean pollution and more. It is forgotten that the present generation is not the last on this planet and not the only life to thrive on it.

The reasons for pollution is a lengthy list, few of them to name - fossil fuel combustion, methane emission due to livestock, overpopulation, poor waste management, plastic waste dumping, over exploitation of natural resources etc.,. Measures taken against these in the upcoming 4-5 years will undoubtedly decide the fate of the planet. One of the prevailing problems of humanity which needs immediate attention turns out to be Waste Management, more specifically plastic waste management. Waste in general is any material substance that cannot be used or doesn't add any economic value to its owner, broadly waste is categorized as wet waste and dry waste[3]. Usually, most of the wet waste and some of the dry waste is naturally biodegradable, other human strategies to manage waste are recycling, animal feeding, fermenting, landfill burning, and composting [2]. A large part of dry waste is made of plastic, and from the above strategies, recycling of plastic is the most sensible way to handle it. Even so, the collection of plastic waste proves to be a deal breaker.

This paper proposes a method for efficient collection of recyclable waste, it also discusses how the system can be used to motivate ethical disposing of recyclable plastic waste. This paper will discuss the management of plastic waste, which plays a major role in pollution. The concept of rewards is used to motivate proper disposal of plastic waste.

Paper is organised as follows, in Section 2, literature survey is discussed. Section 3 presents the proposed system, Section 4 presents the results of the model. Section 5 concludes the paper and Section 6 discusses the future enhancements for the project.

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2. Literature Survey

There have been several researches on implementing IoT solutions for waste management, In [1] a model for a smart dustbin is proposed where the dustbin is interfaced with a microcontroller equipped with IR/ultrason and weight sensors, It also suggests a website to display the information of the garbage, such as level of the garbage and the weight of the garbage. When the garbage is at threshold level, and when the dustbin is full, the information is sent to the website.

HN Saha et al. [2] points out that poor management of waste has a direct effect on the global environment, leading to various kinds of pollution and long-term health ailments, this results in indirect implications on the economy and growth potential. Hence it is necessary to propose innovative solutions for waste collection and recycling.

In [3] SA Mahajan et al. said that managing waste can be done by planning, collecting, transporting , treating, recycling and disposing of waste with monitoring and regulation. The author also suggests that the current ways of collecting waste and managing it is not efficient.

Gopal Kirshna Shyam, Sunilkumar S. Manvi and Priyanka Bharti [4] propose a smart system of efficient waste collection by authorities based on level of waste in the dustbin using IoT and Machine learning analysis of waste data, this analysis allows for optimised collection routes for workers.

In this paper we propose the concept of rewards to motivate people in adopting ethical waste disposing practices. The concept of rewards will drive people to dispose of waste in the dustbin.

3. Proposed system

A systematic methodology is adopted in building the project. Rewarding any user who disposes recyclable waste is the main aspect of this project.

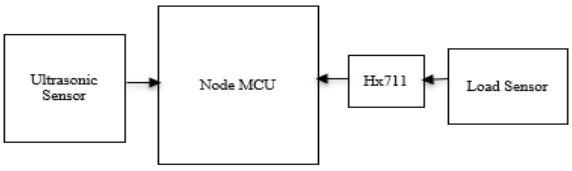

Figure 1: Block Diagram of the waste system hardware

Figure 1 shows the basic components of the trash bin. Each trash bin is given a unique id which is encoded as QR code. The Trash bins also have a dedicated microcontroller (NodeMCU) to manage the sensors on board (Load Sensor, Ultrasonic Level Sensor) and synchronise the data with the server. Figure 2 illustrates the complete system architecture, the trash bin updates any changes in the weight to the server, the user establishes a session with the trash bin by scanning the QR code.

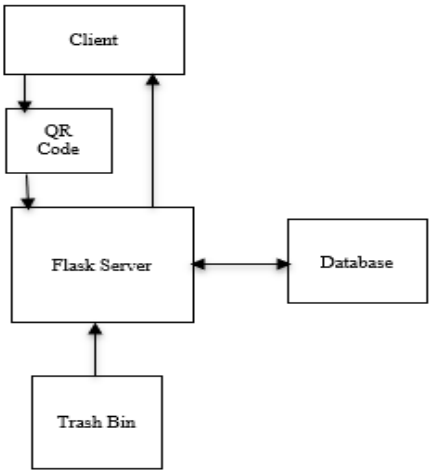

Figure 2: Block Diagram of the waste system

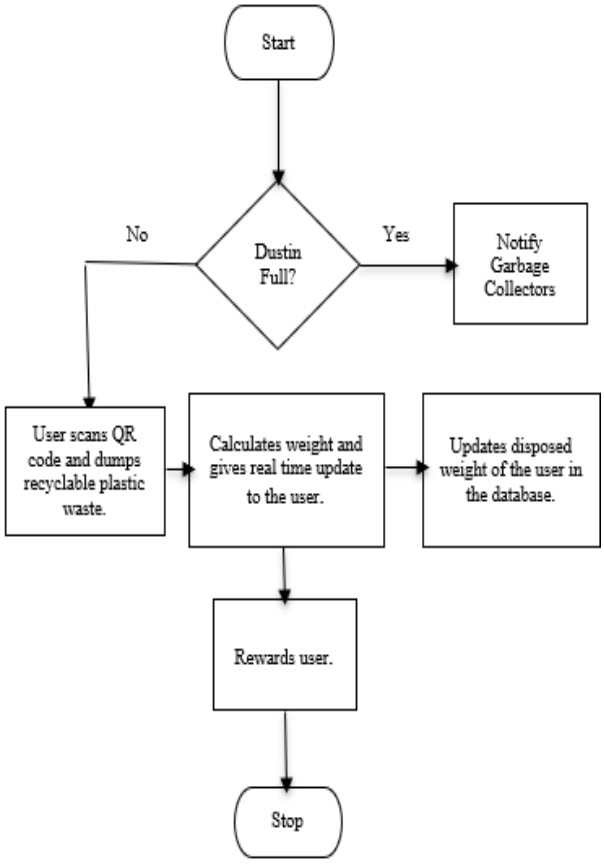

Figure 3: Flow chart of the project

The above flow chart indicates the entire flow of the system.

Figure 3 depicts the flow control, the user, using the client application scans the QR code on the trash bin, a session is set for a limited time between the user and the trash bin, plastic is disposed within the session expiry time, the weight of the plastic disposed is updated to the user in real-time and reward points are awarded based on the weight.

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The Flask Server handles incoming data from the Trash Bin and updates the database.. The server also handles user management functions and reward calculation.

The reward is computed as, assuming 2 points is awarded for each 100g of plastic disposed:

$$rewardPoint = (disposedWeight \div 100) \times 2 \quad (1)$$

3.1. Specifications

1) Load Sensor: Load Sensor is used to detect the weight of the garbage in the bin. The measured weight is sent to the microcontroller(NodeMCU).The load sensor that is being used can measure according to kitchen scale.

2) Ultrasonic sensor: Here it is used to detect the level of plastic waste in the trash bin.The sensor uses distance to measure the level. The distance between the sensor and the garbage level computes the level of waste.

The sensor gets the distance by emitting ultrasonic waves and computes the time taken for the waves to send and receive. 40Hz is the working frequency of an ultrasonic sensor.

3) NodeMCU: NodeMCU is a micro controller unit with ESP8266 Chip for Wifi capabilities. It is handy for rapid prototyping of IoT projects which need wireless connection or interfacing with Wifi. It is used to collect and send weight data from the waste bin to the server in this project.

3.2. Modules

1) Weight Calculation: The weight of the waste is calculated using load sensors connected to the hx711 which is connected to the nodemcu.

2) QR Code: The QR code plays an important part in the system by giving each trash bin a unique identity. The user needs to scan the QR code before depositing waste in the bin.

3) Server: A Python-Flask Server, used to handle all the incoming requests from trash bins and the clients. The weight updation and reward calculation is also handled by this server.

4) Reward Calculation: The criteria for reward calculation is based on the deployment scenario. For the purpose of this project reward calculation is done using (1).

5) Database Connection: An online database is used to store user and waste related data. In this model, mongoDb is used to serve this purpose.

6) User Interface: An android application is made for the user to interact with the reward points and mainly scan the QR code present on the trash bin.

4. Results and Discussion

4.1. Initial Connection

The dustbin is deployed and a connection is established with the server. The client application scans the QR code and a time limited session is established to dump the waste.

4.2. Weight Calculation

The weight changes in the dustbin is continuously monitored by the NodeMCU using hx711 load amplifier. Amount of disposed weight is calculated as,

$$disposedWeight = updateWeight - currentWeight$$

4.3 Reward Assignment

When the waste was disposed within the session expiry, the client is rewarded based on the amount of plastic weight of dumped.

4.4 Average plastic Waste Collected

Figure 4 depicts the trend of average plastic waste disposed (in grams) by each individual every week for a period of 12 weeks. Figure 12 shows a significant increase in the amount of plastic disposed every week.

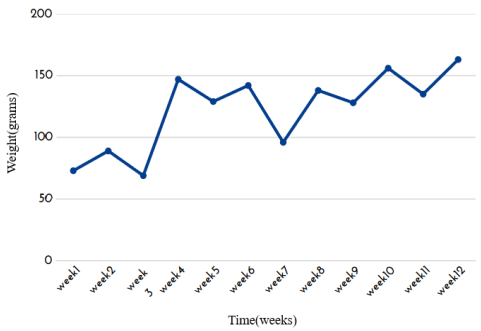

Figure 4: Weight of the waste disposed of by a single user

Figure 5 depicts the linear increase of average waste collected in kilograms by the trash bins over a period of 12 weeks.

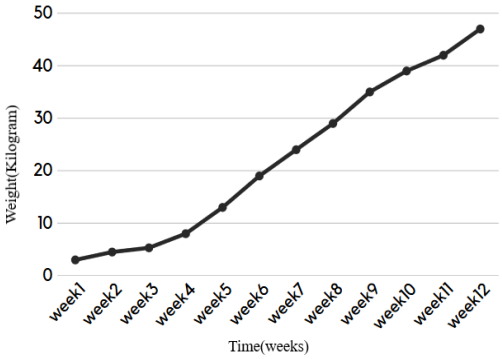

Figure 5: Weight of the waste disposed of by all users

5. Conclusion

There are many innovative solutions for the problem of waste management. These solutions tend to be at their

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best only when the plastic is properly disposed of. The proposed concept of rewards motivate people to be conscious of ethical plastic usage and disposal. Thus enabling municipalities to manage the disposed waste efficiently. The rewards could be customized based on the deployment scenario.

6. Future Work

Future scope includes the possibility of extending the system with a blockchain ledger to track the waste from its source to its recycling destination, as done in many supply chain solutions. The data from this can be presented to the users as interesting statistics such as how is the plastic recycled? where is it recycled? what is it recycled as? This ensures proper usage of dustbins and trash bins to dispose of plastic waste, and also reduces public littering.

7. Acknowledgment

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