Smart Waste Management – An Inclusive approach to support Swachh Bharat Abhiyan

• **Noor Fatima**   • **Anjali Rai**   • **Ayesha Zubair**
• **Manisha Prasad**

Abstract: In modern times, tackling waste and switching to environmental sustainability has become a major and challenging issue, as well. One of the most pressing challenges in dealing with waste and transition to a round economy is the increasing complexity of products. In an effort to make them more efficient, their recovery and reuse are neglected and thus become an environmental challenge.

This (Kadus et al.,2020) paper is based on the concept of Automation used in the waste management system under the Hygiene and Sanitation domain. Garbage dumping on roads and public spaces is a common concept in all developing countries and this in particular ultimately affects the environment and creates a number of unsanitary conditions.

To address these issues, we propose an IoT-based Smart Dustbin and a waste management Portal. Smart Dustbin is simply a standard bin integrated with some hardware components such as NODEMCU, Ultrasonic sensors etc. Which helps authorities to track bin in real-time.

The web app works as an E-kabadiwala where we can sell our solid waste and will also provide us with a variety of information about recycling activities that we can do at home and produce our new recycled product.

Keywords: NODEMCU, Ultrasonic sensors, GPS and GSM module, IoT, Arduino.

Noor Fatima
BCA III year, Session: 2019 – 2022,
Patna Women's College (Autonomous),
Patna University, Patna, Bihar, India

Anjali Rai
BCA III year, Session: 2019 – 2022,
Patna Women's College (Autonomous),
Patna University, Patna, Bihar, India

Ayesha Zubair
BCA III year, Session: 2019 – 2022,
Patna Women's College (Autonomous),
Patna University, Patna, Bihar, India

Manisha Prasad
Head, Department of Computer Science
Patna Women's College (Autonomous),
Bailey Road, Patna–800 001, Bihar, India
E-mail :manisha.bca@patnawomenscollege.in

Introduction:

The world is in the process of being upgraded, there is one major problem that we have to deal with is garbage.

A major (Kumar et al., 2020) challenge in urban areas is solid waste management not only in India but in many countries around the world.

Waste management is a major challenge in both small and large cities in India. This is due to population growth and the rapid increase in solid waste disposal and the burden on the municipal budget. This waste poses a threat to human health and the environment if it is not stored properly, collected and disposed off properly. To address these issues, we propose an Iot based Smart Dustbin and an online Portal — Swachh

Bharat Abhiyan's ingenious approach. This smart Dustbin is built using hardware components like NODE MCU (ESP8266), Ultrasonic sensor etc. This compact component makes the job easier to dispose off solid waste. The sensors used will detect levels of waste in the bin and assist the municipality or authorized dealer to dispose off the bin where necessary.

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The online waste management site acts as an E-kabadiwala where we can buy and sell solid waste easily and efficiently. We will also receive regular updates and information on recycling and much more.

Objectives:

The present study was focused on the following objective:

- To identify the current waste management practice/s in the city and analyse the challenges faced by residents of Patna in proper waste disposal.

- To find the possible ways of enhancing the overall effectiveness of the waste disposal management framework through IoT solutions.

- To develop a waste management portal that analyses the amount of waste generated, provides information and help the residents in proper disposal of waste.

Methodology:

The study was divided into various phases:

Phase 1: Identification of Pain Point/Problem Identification

In this phase we tried to identify the pain point in waste management from point of view of a citizen. For which Information for study was collected by both primary and secondary sources. Primary data was collected from residents of city of Patna and secondary data was collected from various books, magazines, journals and websites. And a study was done about the existing waste management system in Patna and its limitations.

- **Data Collection :** The primary data was

collected to fulfil the objective set forth in the study. For collection of data, a structured questionnaire and formal interviews was used.

- **Area of study :** Residents of various areas of city of Patna with varied age group.

Phase 2: Design and development of a waste management solution.

In this phase we designed and developed a waste management solution to help citizens in waste management.

Through this research project we proposed two solutions for waste management: -

- **IoT based smart dustbins :** This is a normal dustbin with an elevation that alerts the municipality once the dustbin gets filled.

- **Web Application for waste management :** This web application acts like **E-kabadiwala** where you can sell your solid waste and it educates about various recycling activities that we can perform at our homes.

Literature Survey:

To understand the issues related to waste management system, the related recent works for waste management system using IoT were studied and analysed.

Prof. J.S.Chitode in July 2014 made a sincere attempt to provide a comprehensive review of the generation, characteristics, collection, and transportation. (Khan et al., 2020). This project focuses on solid waste monitoring and a management system has been successfully implemented with the integration of communication technologies such as Zigbee, GSM, and the truck monitoring system.

Problem Definition:

Through our research, we got to know that the existing waste management solution in Patna had some limitations, the existing system cannot manage waste efficiently. Citizens were not satisfied with the existing waste management solution and the major problems they face were foul smells, flies, rats, etc.

As seen many times the dust bins are overflowing and the concerned person does not get the information

over time and due to the unsanitary conditions that form in the environment, at the same time the bad smell is spread due to waste, bad appearance of the city opening the way for air pollution and other dangerous diseases.

The traditional way of tracking garbage in garbage cans ,it is a complex process and consumes lots of human effort, time, and expense beyond which we can easily avoided by our proposed solution.

Flaws in the existing system:

- Time consuming and less effective
- No real-time monitoring.
- High Cost
- Unhygienic Condition

A survey on the study of Waste Management practice/s in Patna: Present Status and Measures for Improvement.: The present study focuses on awareness of proper waste management practices among people of Patna which includes proper collection, transport, treatment, sorting of waste using different types of bins and disposal of waste.

In our study we recorded responses given by75 residents from various localities of Patna. The respondents were asked to answer the e-questionnaires consisting personal details and problems faced and changes expected in proper waste management or disposal near their area. New recycling practices and information were also gathered. The questionnaire was self-administered, structured, and prepared in English language.

Proposed Solution:

We propose two solutions to overcome the flaws or loop holes found in the existing waste management solution.

- Our first solution is IoT based smart dustbin, which can monitor the level of waste and inform the concerned authorities.
- Second solution is a web portal to automate and extend the rate of recycling.

1. IoT based Smart Dustbin

IoT based smart dustbin is a normal dustbin with some smart features. These smart bins can be monitored

24x7.The whole setup consists of Node MCU as the primary controller which is the main processing unit and is connected to the internet working on the principles of the Internet of Things.
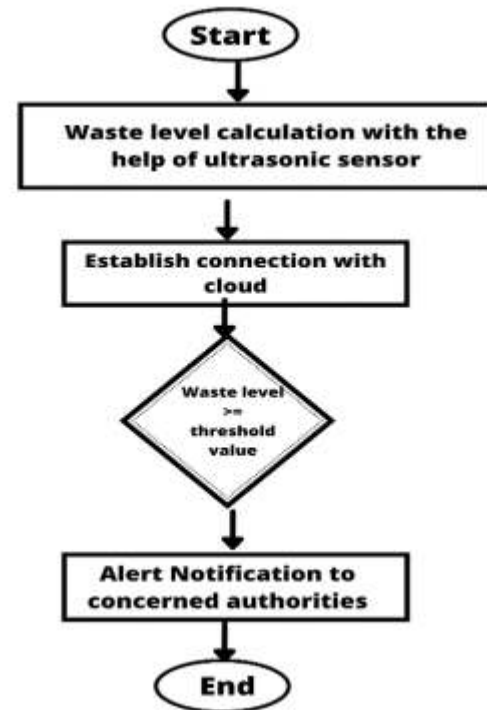

Fig. 1. Flow Diagram

Along with this the bin consists of ultrasonic sensor, which monitors the level of waste in the bin. The ultrasonic sensor was placed at back of lid of the bin. Ultrasonic sensor emits the sound wave towards bottom of the garbage.

Fig. 2. Bin Diagram

Hardware Components:

1. Node MCU(ESP 8266): It acts as the main microcontroller of the system .It is a Wi-Fi module hence it helps our system to connect to internet or wi-fi.

Fig. 3. Node MCU

2. Ultrasonic Sensor:The Ultrasonic Sensor was used to measure the distance with high accuracy and stable readings. It can measure distance from 2cm to 400cm or from 1 inch to 13 feet. In our solution ultrasonic sensor is used to measure the level of waste in the bin..

Fig. 4. Ultrasonic Sensor

2. Waste Management Portal (GREEN TRASH)

We proposed a transparent and trustworthy platform for trading resources and knowledge as well as providing access to a community of experts. The approach of this web app "GREEN TRASH" is to automate and extend the rate of recycling procedure with tech-support and to establish a connection among the people and organizations dealing in waste-to-product conversion.

The residents will be able to know about various recycling techniques and waste collection points near their locality where they can sell and buy recyclable materials. In turn they can make some money with the waste they are going to sell.

Fig. 5. Screenshot 1

Fig. 6. Screenshot 2

The web application act as E-kabadiwala where we can sell our solid wastes and it will also provide us various information regarding recycling activities that we can perform at homes and can produce our own new recycled product.

This app includes a domain of users where they can get themselves registered, Choose whether they want to buy or sell the waste. Select its type and know about the various organizations or collection points concerned with that type of waste. The waste type and its reusability are finally analyzed and the selling or purchase gets confirmed if the waste is worth selling and vice versa. Further with help of transportation the waste will be sent to its destination and then converted to reusable material.
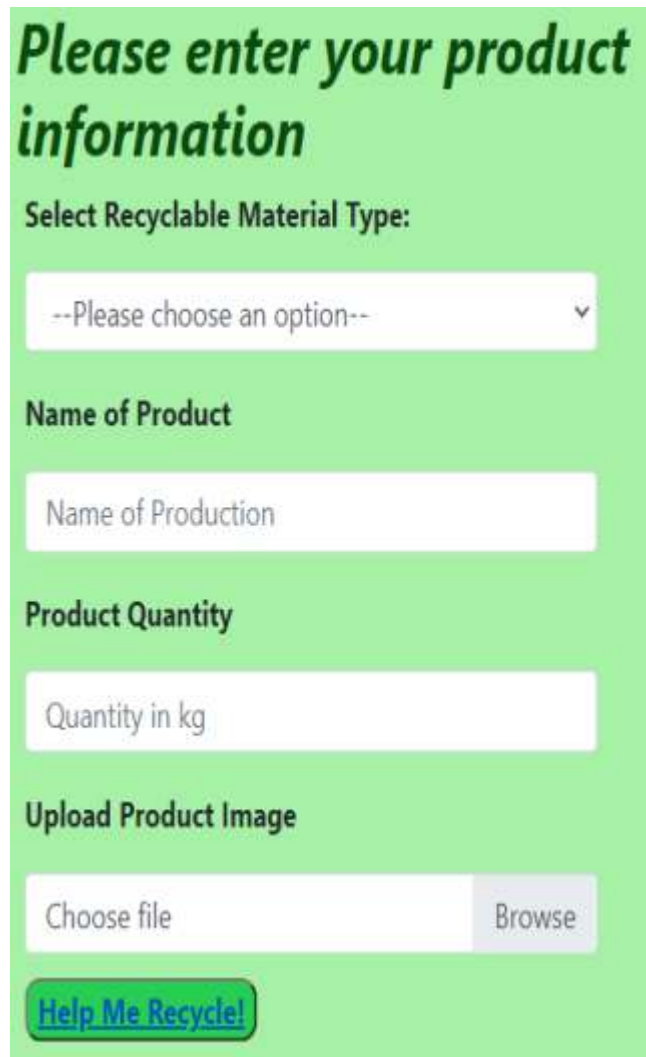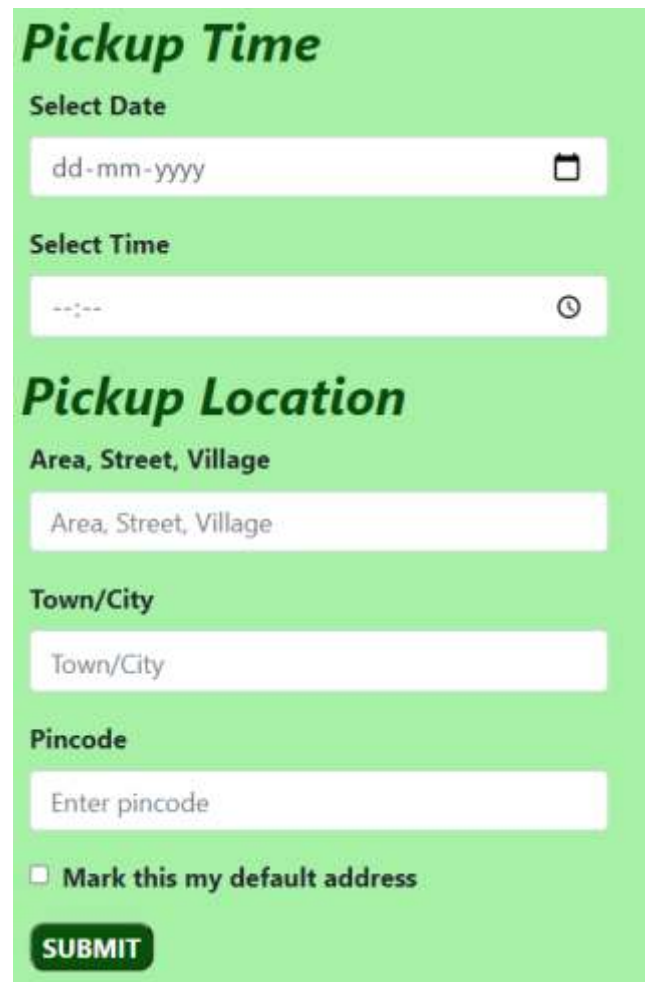

Fig. 7. Screenshot 3

Fig. 8. Screenshot 4

This platform also provides residents the information about recycling, recyclable products and will keep updated with the latest information around. This app will help us recycle things more easily and in a proper way which leads to environmental sustain ability. 'GREEN TRASH' can prove to be a great tool for the residents as well as the dealers.

Observations from Survey: Following are the observations we got through our survey conducted on 75 respondents belonging to various age group.

OBSERVATION ABOUT WASTE GENERATION, DISPOSAL AND COLLECTION

1. According to 80% of respondents found that major waste generated from their house are plastic, paper and food waste.
2. Around 60% of the respondents use plastic bucket for storing waste in their house

3. Around 60% dispose their waste in public bins (Municipality bins),13% on road side and 15% in open space.

OBSERVATION ABOUT STATE OF PUBLIC BINS

1. According to majority of respondents, public bins in their localities are not in good state.
2. According to 70% main problem in public bins are waste laying outside, odour, flies and rats etc.
3. 75% of the respondents are not satisfied with existing waste management solution offered by municipality only 25% are satisfied with the existing service.
4. According to majority the main reason of dissatisfaction from the existing system is improper collection and unreliability in service.

OBSERVATION ABOUT WILLINGNESS TO ADOPT SMART WASTE MANAGEMENT SOLUTION

1. 90% of the respondents are willing to use a web portal for solid waste management.
2. 60% of the respondents are willing to pay extra amount to municipality to implement IoT based smart dustbin.

Conclusion:

In present time, addressing the waste and shifting to environmental sustainability has become a major(Kadus*et al.,* 2020) topic and challenging as well. Improper disposal and maintenance of waste create issues in public health and environment pollution. This research paper attempts to provide two practical solutions for better management of waste i.e., IOT based smart dustbin and waste management portal GREEN TRASH.Smart Dustbin is just a normal bin where everyone can dispose wastes. It is integrated with some hardware components such as Arduino, NODEMCU, Ultrasonic sensors, etc. These sensors are placed in waste bin to measure fill levels and to notify city collection services when bins are ready to be emptied. Over time, historical data collected by sensors can be used to identify fill patterns, optimize driver routes and schedules, and reduce operational costs. The approach of the web app "GREEN TRASH" is to automate and extend the rate of recycling procedure with tech-support and to establish a connection among the people and organizations dealing in waste-to-product conversion. This app will help us recycle things more easily and in a proper way which leads to environmental sustain ability. 'GREEN TRASH' can prove to be a great tool for the residents as well as the dealers. The proposed solutions will definitely help to overcomeissues related to waste management(Kadus*et al.,*2020**)**and keep the environment clean and healthy

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