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Semi-Automated Metallic Waste Segregation System

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Abstract: ***The important challenge faced by developing smart cities is the processing of waste materials. The increasing amount of WEEE (Waste of Electrical and Electronic Equipment) makes their disposal a difficult situation to handle. WEEE is an economical instrument as the wastes consists more of key metals which are economically valuable. Due to separation of different types of key metals available and the restoration of the key metals being difficult the disposal of WEEE becomes hassle. The aim of this paper is to separate the key metals from the waste, weigh them and credit the corresponding amount to the particular citizen who disposes the waste.***

Keywords: WEEE Disposal

I. INTRODUCTION

Due to increase in population and rapid development of urban cities the management of waste materials becomes one of the most important factors that affect the economy. Due to the lack of efficient waste removal systems it becomes a challenge for the government to keep the cities clean. Thus solving such problems involves different social, economic and technical aspects to come together. The growth of technology and the rising need for waste disposal brings in the presence of IoT and RF-ID. It is better to collect waste rather than to leave it in the dustbin as a full bin may result in dramatic consequences.

II. RELATED WORK

In [1] the authors have proposed that IoT is being used for providing efficient ways of tracking garbage truck routes. The algorithm is implemented within simulation frame work which is available as open source for future extensions.
In [2] the author explains about multiple criteria decision deciding approach for the important and convenient support tools for garbage management.
In [3] the authors have discussed about the different health outcomes due to landfills incineration wastes and nuclear installation dumps. Waste management facilities are arranged in high population residing areas which will provide direct access to human exposure measurements and supported by information on health effect bio markers.

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In [4] the author has detailed a frame work about the problems of garbage collection and this paper tells about the optimisation vehicle routes for collecting solid wastes. The author provides solution for the adaptation of real life waste collection problems.
Different implementation methods for the reduction of memory usage has been discussed.
In [5] the authors have discusses about the impacts of smart city which enhances the quality of living. This paper provides the areas of natural resources and energy and the economy of people. The paper gives an understanding of urban, geographical and demographic wastes. This provides geographical location which gives an impact on smart city strategy.
In [6] the authors have proposed about absorbing huge amount of resources and having major environmental impact. This helps members in the authority to attain cost effective methods of waste recovering. This provides an updated survey of solid waste management and has a wide bibliographic coverage and provides relationship between various problems.
In [7] author compares municipal solid waste management methods in different countries and finds the important reasons for waste disposal. It provides literature on municipal solid waste logistics and compares issues addressed in various other research agenda.
In [8] the author discusses about the tendency to demonstrate IoT integration with statistic networks, digital engineering and IoT image embedded with sensor to collect and transmit trash volume through internet.
In [9] the paper focuses on the issue of heterogeneous waste management and provides a novel approach which aims for the provision of high performance cloud based memory service.
In [10] the author proposes the importance of information and communication technology (ICT) to be an unavoidable design for solid waste management systems. The ICT is divided into four categories as spatial technologies, identification technologies, data communication technologies.
In [11] the author tells about vehicle routing difficulties from a technical view for wide range of time. This gives a survey of real life applications of road transport routing. Some ideas on future scopes and real time implementation are imposed.
In [12] the paper proposes the problem posed on the municipal budget which results in high cost and reduction in the understanding of various factors that disturbs the different levels of waste management.
In [13] the author tells about the usage of RFID technology and its implementation and also about the load cell sensor concepts for weight measurement.

In [14] the author discusses about the emergence of smart city for the increasing population and rapid urbanisation. To gel the gap in theories about smart cities the paper introduces a framework to implement the concept of smart cities.

n [15] the paper focuses on the incorporation of IoT components in the base of the infrastructure of smart cities. The potential of IoT in waste management is more robust and efficient.

III. SYSTEM ARCHITECTURE

In the proposed system, within the dust bin itself the key metals are separated, weighed and corresponding amount is given to the citizen who accesses the dustbin.

A. Hardware description

The hardware of the dustbin consists of a partition which separates the bin into two parts.

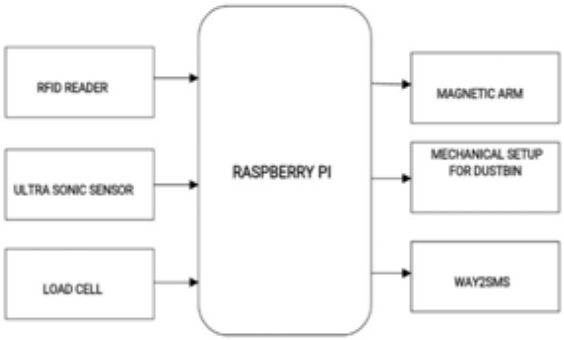

Fig 1.1 Block diagram of hardware components

Lids are available for both the parts and a mechanical magnetic arm is present to pick the metals separately. The lids are fit with motors for the back and forth movement which commences the opening and closing of the dustbin door. The up and down motion of the magnetic arm is also done with the help of the dc motor. Raspberry pi controller is used to control the actions of the bin. An ultrasonic sensor is used to check the level of the dust bin and once it is filled the level is sensed by the ultrasonic sensor and message is intimated that the "garbage is filled". The message delivery is done by a 'way to SMS' application. The hardware setup consists of load cell that would weigh the amount of the key metals put in the dustbin by the corresponding user. The RFID system is used where the dustbin opens only when the correct RFID is detected by the system.

I) RFID reader

Radio frequency Identification Reader (RFID) is used to get information from an RFID tag which is used to identify individual objects. The RFID reader consists of receiver where information is transferred from transmitter which is present in RFID tag

B. Software description

The main software part of this waste management system consists of the programming of Raspberry pi. The coding is done by Python programming language. Python language is chosen as it is simple and easy to customise our code. Python code is done using python idle in OS Rasbian which is a linux based platform. The coding is done for the movement of the mechanical setup which on placing the RFID makes the magnetic arm to move in up, down, left and right directions. The ultrasonic sensor senses the height of the garbage in the dustbin and when it reaches the preset value it sends a message indication that the garbage is filled and it requries to be disposed.

IV. PROPOSED SYSTEM

In the existing system, if the dustbin gets filled an intimation may be sent to the municipality or to the server of the waste disposal department of the government. And also in the existing system, the user may access the dustbin using RFID and the government can receive information about the status of the dustbin through the internet by the use of IoT. Now the improvements of the proposed system than that of the existing system are as follows:

1] In the proposed system we have included a partition which separates the bin into two parts. The major inclusion is a mechanical magnetic arm which separates key metals from the other non-degradable wastes. The magnetic arm gets into the dustbin as soon as one side of the bin opens and picks up the key metals and then puts it separately into the bin which is in the next partition of the bin.

2] In this proposed system the next inclusion is a load cell which would weigh the amount of the key metals and then the amount corresponding to the weight of the metals is credited to the account of the particular person accessing the dustbin.

3] In this system the amount to be given for each kilogram of metal is present in the python code. Thus for the total weight of the metals disposed will be calculated immediately and message intimation will be provided for the user.

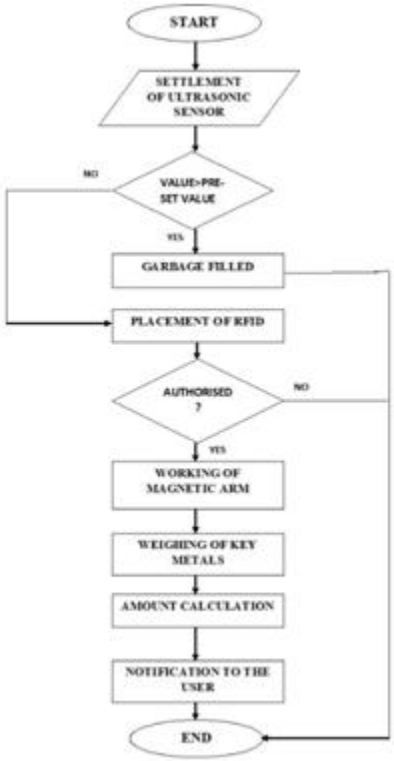

Fig 1.2 Flowchart of the proposed system

When RFID is placed the program mentioned in Fig 1.3 runs which sets the mechanical setup into action. As the first process, the ultrasonic sensor senses the garbage level and if it is full sends notification to the municipality.

If the ultrasonic sensor value falls below the predefined value then RFID is placed. If RFID value is authorised the GPIO pin 25 is set and the right side partition of bin opens. Then the delay of 5 seconds is given by enabling the pin 20 after which magnetic arm moves towards right and by enabling pin 19 the magnetic arm moves down and picks the metal.

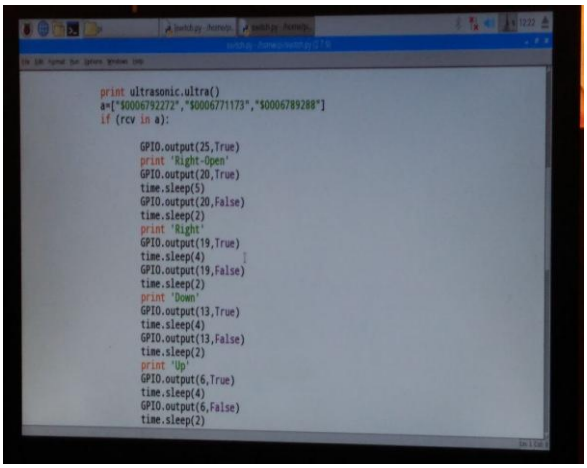

Fig 1.3 Program for mechanical setup

Then pin 6 is set which moves the magnetic arm upwards and enabling pin 26 makes the arm to move towards the left. Once the arm moves towards the left, the right side partition of the bin closes. Enabling pin 12, opens the left side partition of the bin. Enabling pin 13 pushes the magnetic arm down and it drops the metal picked from the side right partition of the bin.

This operation helps in separating the metals from the whole dustbin and keeps it separately. Inside the left side partition of the bin the load cell is placed where it weighs the quantity of the metal put by the user. The amount for each gram of the metal is present in the python module and according to that the total amount for the metal weight is calculated. The calculated amount will be credited to the user bank account and the notification through a message is sent to the user. IoT is used to display these transaction information to the municipality.

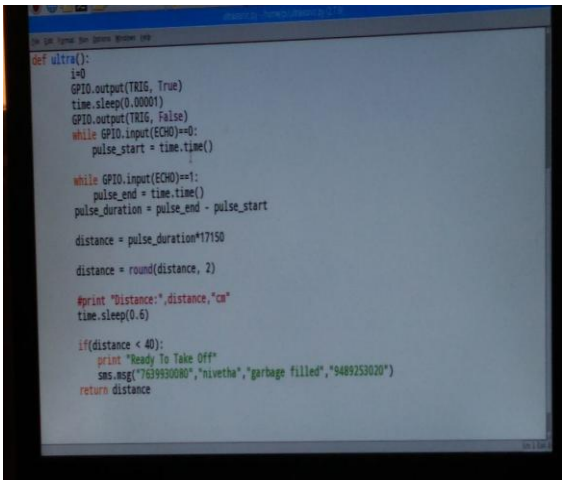

Fig 1.4 Program for Ultrasonic Sensor

The above figure mentions the program for ultrasonic sensor. The ultrasonic sensor sends ultrasonic waves from the input trigger pin and it reaches the target object and reflects back. Here, the target object is the level of the dustbin and once it reaches the maximum mentioned height it reflects back the ultrasonic wave to the echo pin. The pulse duration determines the level of the waste in the bin. The pulse timing, level of waste, is determined by starting and ending time of pulse to the person. The maximum height of the dustbin is present in the program and once the ultrasonic sensor senses this maximum level, intimation is given that the bin is full with garbage. When the dustbin is full and intimation is given, any other person cannot access the dustbin unless the bin is cleared.

V. RESULTS

The result of the proposed system is that the key metals are separated from the other non-degradable wastes, they are weighed and corresponding amount is credited to the user. The major part of the proposed system is the separation of metals and calculating the amount worth for the metal. Once the amount has been calculated the next major part is the sending of the relevant information to the user and to the government. The final result is the obtaining of information through SMS. This intimation through message can be done with the help of any way to SMS application.

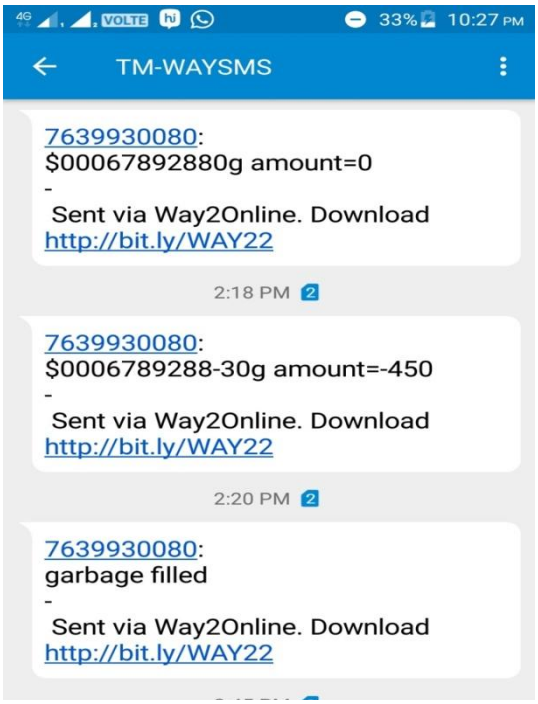

Fig 1.5 SMS intimation of amount

The above figure shows the message intimation regarding the amount that would be credited to the individual. The SMS notification consists of the RFID identification number, the weight of the garbage being put by the user and the corresponding amount which will be credited to the person.

VI. CONCLUSION AND FUTURE SCOPE

Thus in this paper, we have discussed the method to separate key metals from other wastes and the way by which the value of the metals can be reatined. The way by which IoT can be used to display the information regarding the level of garbage and the amount that will be available for the metal wastes have also been discussed.

The use of ultrasonic sensor for the sensing of garbage level has been discussed. The use of raspberrry pi pins for performing the various actions of the mechanical magnetic arm has also been discussed.

The system propsed here is adaptable for extending to future use. As future scope the mechanisms for the separation of plastic materials can be included which can be done with the help of sensors that would separately pick and seggregate plastic wastes and they can be sent for recycling process which makes the exixsting process of plastic separation easier. Another improvment of the existing system can be the separation of paper which can be done by the usage of unique friction screens that would separate paper by attracting them and separting them into different bin.

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