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Smart waste management using IoT

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ABSTRACT

Many times, in the current situation we see that the trash cans or Dustbins are put in the public squares of the city that are overflowing every day due to a rise in the waste. It produces unhygienic conditions for people and produces an unpleasant smell in the local environment, which leads to the spread of certain deadly diseases and human disease. With a rapid growth in population, sanitation problems with regard to waste management are tremendously deteriorating. With rapid population growth, sanitation-related problems with regard to garbage management are extremely degrading. "Smart Waste Management using IoT" is the latest, evolving solution to avoid this problem. Public dustbins will be supported in the proposed system with embedded devices that helps to track the amount of garbage in the garbage bins in real time. Analysing the constant data collected would help municipal and government authorities develop smart waste management strategies with the help of reports produced by various systems.

Keywords— *Internet of Things (IoT), Sensors, Smart Bin, Solar Panel*

1. INTRODUCTION

Devices connected to the Internet which can be controlled from the internet are commonly known as the Internet of Things (IoT). The Internet of Things or IoT is a term in which objects surrounding it are linked without user interaction through wired and wireless networks. The artifacts in the field of IoT communicate and share information to provide users with advanced intelligent services.

Along with networking network innovations such as Wi-Fi and LTE, the IoT has gained substantial academic interests thanks to recent developments in various sensors and connectivity modules. Owing to the characteristics and advantages of IoT facilities, managing waste has become an important topic in academia, business, and government as key fields for IoT applications. An unpredictable and unlawful release of waste, a nonappearance of waste removal and the board frameworks, and wasteful waste administration strategies have caused genuine natural issues and have brought about impressive expenses for squander removal. The field of research covers both the technical aspects as well as the real-world aspects such as the application that would be the technological aspect developed on the technical platform and the smart dustbin that would involve hardware from a real world.

The Smart dust bins are connected to the internet in our system to get the smart dustbins details in real time. There has been a rapid population growth in recent years which has led to more waste disposal. So, it is important to have a good waste management system to avoid spreading any deadly diseases. Managing the smart bins by tracking its status and taking the decision accordingly. The local corporations are still gathering this waste to eventually drain it into recycling areas and landfills. However, due to lack of capital, inefficient groundwork, some waste is not collected which poses a serious health danger to the environment around. Proper intervals for cleaning may provide a solution to this problem. But manually keeping track of the bin's status is a really difficult job. There are several dustbins all over the city or the Campus.

Using Arduino-based platform, these dustbins are interfaced with the ultrasonic sensors. Where the ultrasonic sensor detects the trash level in the dustbin and sends the signals to Arduino, the same signal is encoded and sent to the receiving municipal companies. The data is collected, analysed and stored in the database, which shows the Garbage status in the dustbin and sent to the email of authorized person. The concerned authority gets alert about the dustbin being full and illuminates the individual whoever is liable for gathering trash from the specific territories. The waste vehicles gather the trash from the totally full dustbin and dump it. Also, to save energy, we are using solar panels instead of regular batteries. In this project, the bin's paramount value is set at 80 percent of the bin's size,

because if a person decides to dump garbage before the municipal truck arrives, he can dump it so he doesn't have to wait before the truck empties the bin. It will also provide the supervisor with a regular daily update on the staff.

2. LITERATURE SURVEY

In this paper "IoT Based Smart Garbage and Waste Collection Bin ", a system for tracking and handling of the waste of the garbage. IR sensors and ARM microcontroller are advantageous and has enhanced the process. In this paper "Design of a Monitoring System for Waste Management Using IoT", devices are given with an UID to transfer and communicate with one another. The Ultrasonic sensor and Gas sensor are used to find the amount of trash and also collect the information of the gas present in the bin. In this paper "Smart Waste Collection Monitoring and Alert System via IoT", the message is being sent using Arduino UNO. The sensors collect the data of the level of dustbin filled. This data is being displayed using Arduino IDE.

In this paper, "Solid Waste Collection as a Service using IoT Solution for Smart Cities", the data collected at Thing Speak is automatically stored in csv file and then further it is processed using python or R for analysis purpose. In this paper "IoT Based Smart Waste Management System: India prospective", this technique uses the GPRS to track the location of the dustbin. The sensors transmit the information and this is displayed on the website.

3. SYSTEM ARCHITECTURE

3.1 Ultrasonic sensor

The level of garbage filled in the dustbin is measured by ultrasonic sensors. The level of waste in the bin is determined by the distance between the sensor and the garbage. The electrical signal is converted into a 40 khz ultrasonic sound pulses by the one that acts as a transmitter. Trig pin triggers the ultrasonic sound pulses. Echo pin generates a pulse on receiving the reflected signal. The length of the pulse is corresponding to the time it took for the transmitted sign to be detected. GND should be connected to the ground of Arduino. Max range and min range is 4m and 2cm and measuring angle is 15 degree.

Fig. 1: HC-SR04 Ultrasonic Sensor

3.2 Weight sensor: hx711 load cell amplifier

This needs to be used to weigh the dustbin. A load cell is a transducer that makes an electrical sign whose magnitude is directly relative to the power being measured. The electrical sign yield will be commonly in the request for a couple of millivolts and will require enhancement before it very well may be utilized. The HX711 load cell speaker must be utilized to get quantifiable information out from a load cell.

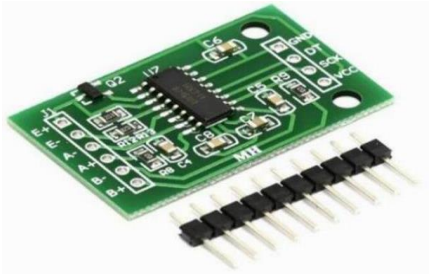

Fig. 2: Weight sensor: hx711 load cell amplifier

3.3 Arduino UNO

The information collected by the sensor will be processed by the micro-controller. For this purpose, the Arduino UNO is being used.

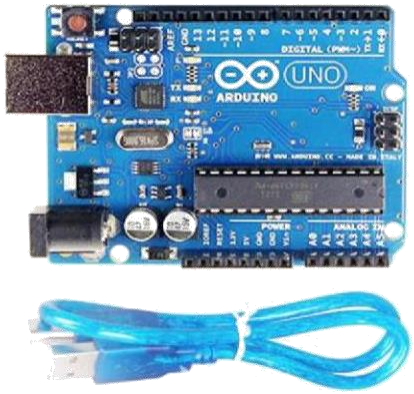

Fig. 3: Arduino UNO

3.4 Diode

The diode is defined as a two-terminal electronic device that only leads current one direction (in so far as it works within a fixed voltage level). The ideal diode would have minimal resistance in one form, and constant interference in the opposite direction. Thus, the solar energy captured from the solar panel is deposited in the rechargeable battery. We are only utilizing the diode to ensure that the energy in the rechargeable battery does not transfer back to the solar panel, because the diode provides only one form of charging.

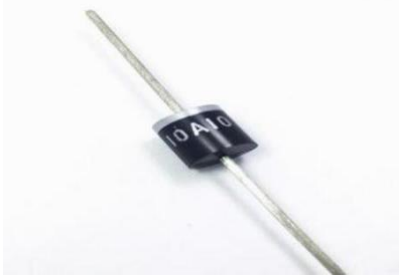

Fig. 4: Diode

3.5 Jumper and USB cables

These are used to connect the components to one another.

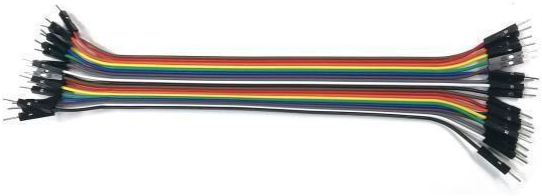

Fig. 5: Jumper and USB cables

3.6 Power Source-Solar panel

The Solar Panel is a collection of photovoltaic cells placed in the installation structure. Photovoltaic cells use heat from the sun as a source of energy and generate electricity. Solar panel modules use sunlight (photons) to generate electricity through the photovoltaic effects.

3.7 Rechargeable Battery

A rechargeable battery, is a type of electrical battery that can be charged, discharged, and energized many times rather than a dispensable or essential battery, which is provided completely energized and disposed of after use. In this project, without sun-oriented vitality the power will be provided from these batteries.

Fig. 6: Rechargeable battery

4. IMPLEMENTATION AND METHODOLOGY

This project is a revolutionary device that measures waste bins level and alerts about the amount of garbage present via an email. The system uses Arduino UNO and ultrasonic sensor that help us to detect the level of garbage by comparing it to the depth of the bin which is placed over the bin. The bin also contains a weight sensor to make sure that the bin is not filled by any object that makes the ultrasonic sensor believe that the bin is full. The system makes use of an inbuilt Wi-Fi module for sending data. The system is powered by solar panels. These solar panels are in turn connected to a rechargeable battery that can be used in the absence of solar energy. A Diode is being used to make sure the energy stored in the battery doesn't flow back to the panel. The required power needed by the Arduino UNO is provided by the solar panel and a rechargeable battery in the absence of solar energy. Once the ultrasonic sensors detect that the bin is full, the weight sensors are checked and if the weight is less as compared to the threshold weight set the output comes to be false in this case no message is sent or no authority is indicated, but if the weight sensors output also comes to be true then a message is sent through an email to the municipal co-operation where the authorized authority then informs the person who is responsible for the collection of garbage. An integrated Wi-Fi module is present in the Arduino which in turn is placed in the bin which collects the information from the sensors and indicates when the mail has to be sent. The mail is sent by a software called Mailgun. The data gets stored in the mailgun server; thus this data can be retrieved.

With a rechargeable battery-based power supply, the proposed system is more efficient because there is no need for any external energy resources hence reducing all the chemical and electrical wastes that could have been done if we chose nonchargeable batteries. Data transfers and facilities can be performed smoothly at any time and place in IoT which is a broad application domain. There would be a requirement of the laptop with all the software required, to carry out the proper waste disposal.

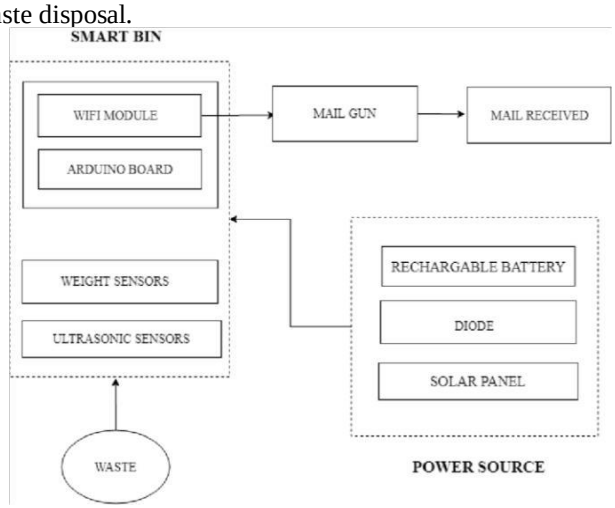

Fig. 7: Methodology

5. CONCLUSION

There is an immediate need for a waste management system which can tackle the problem of garbage disposal as population increases. Since the old methods are not useful in today's day and age, by the use of IOT in the waste management system these issues can be settled. The given system will make sure that the garbage is collected on time every day without any delay. The system will provide real time accurate reports and monitor the garbage level through sensors and Wi-Fi module which will increase the system's efficiency and reduce the overall cost of garbage collection. This system uses solar panels to power the system which is a cheap alternative.

Ultrasonic level sensor (threshold value=70%)	Weight sensor	Output
<70%	<3.5kg	Waits for the bin to be filled
>70%	>3.5kg	Message is sent
>70%	<3.5kg	Waits for the bin to be filled

Maximum capacity of the dustbin = 5KG

6. REFERENCES

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