



DEVELOPMENT AND TRYOUT OF IOT BASED E-WASTE MANAGEMENT SYSTEM

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Abstract:

In this hi-tech and modern era of scientific progressions, electronic equipment's and devices are drowning our day today lives. Due to exhaustive use of electronic devices, the problem one face's is the safe dumping of defective electronic items without instigating any harm to the society and environment. The basic issue observed in E-waste management is that depositors aren't encouraged adequate to recycle their electronic waste and electronic waste amassers are unable to detect source of e-waste. In this paper researchers tried to talk about an IoT based system that can help the depositors gets monitory benefit after dispose of their e-waste. With the help of an online bidding module developed for e-waste collector's selection, e-waste collector will be finalized. A collaborative smart bin having embedded system to lock and unlock itself upon successful authentication by the user with several sensors is required for this purpose.

Keywords: Smart bin, Servo motor, IoT, Arduino, Cron jobscheduler

I. INTRODUCTION

The Internet of Things (IoT) or the Internet of Everything (IoE), consists of all the web-enabled devices that collect, send and act on data they acquire from their surrounding environments using embedded sensors, processors and communication hardware. These devices, often called "connected" or "smart" devices, can sometimes



Fig. 1: IoT Working Principle



talk to other related devices, a process called machine-to-machine (M2M) communication, and act on the information they get from one another. Humans can interact with the gadgets to set them up, give them instructions or access the data, but the devices do most of the work on their own without human intervention. Their existence has been made possible by all the tiny mobile components that are available these days, as well as the always- online nature of our home and business networks.

Technological challenges of IoT

At present IoT is faced with many challenges, such as:

- Scalability
- Technological Standardization
- Inter-operability
- Discovery
- Software complexity
- Data volumes and interpretation
- Power Supply
- Interaction and short range communication
- Wireless communication
- Fault tolerance

When an electronic product has reached the end of its working time period after which it is nothing more than trash that accumulates heavy metals and toxic chemicals into the environment. Such as CRTs which produces very high concentration of lead and phosphors. The proposed work in this research paper exemplifies how depositors use android applications installed in their phone to determine the location of an empty bin and deposit their e-waste in that empty bin. They can deposit their items in a bag containing Bar codes or QR codes. Each garbage bag belonging to a particular depositor can be easily and uniquely identified using these codes that will be scanned



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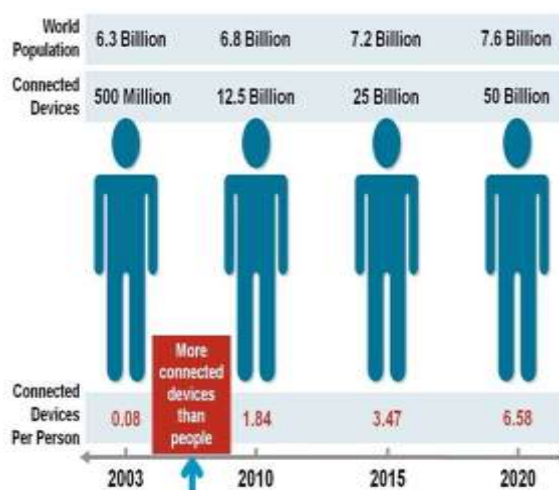


by the depositors' android App. To measure the fullness of the bin will be measured by ultrasonic sensor placed within the bin and then automatically creates a bidding session for the e-waste collectors of the online auction. They use a specialized android application for participating in the online bidding session. Once the bidding session finishes, winner of the bidding session will be provided with secret key to unlock the bin. Once the bin is full with e-waste, not even the depositor will be able to unlock the bin.

II. RELATED REVIEW

One of the well-known example of using smart bins around the world that provide a smart way to interact with their users is Renew pods which provide news, information, and recycling bins to London's Commuters. These pods have launched at 25 locations in the city of London. Renew has recently deployed 25 of its futuristic on street pods

throughout the city. In development for more than six years, the Renew unit has as dual functionality apart from serving as a recycling depository; the pods are also a connected hub with LCD's on both the front and back offering passers- by the latest on financial headlines and world news. According to survey conducted by EnviroStat it is observed that more connected devices than world's population.



III. PROPOSED SYSTEM

The users of proposed system are basically of two types namely depositors and collectors. The proposed smart bin has four basic components like arduino board, servo motor, ultrasonic sensor and android device. Arduino boards are able to read



inputs and turn it into an output such as publishing something online. With the help of Firebase cloud services or Google cloud services of users of the system were authenticated. With the help of ultrasonic sensor the status of bin will be measured while with the use of servo motor the bin will be secured by locking it from inside and protect bin from authorized users.

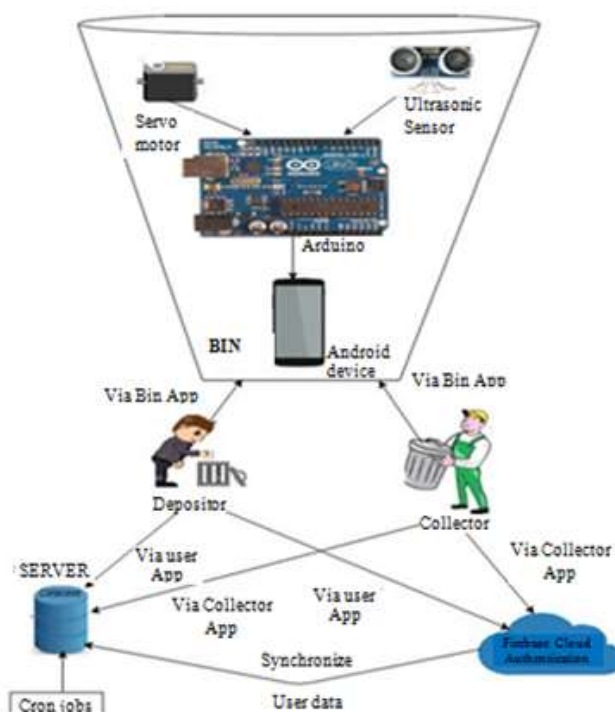
Figure 2, shows the overall system architecture of IoT based e-waste management system. It involves three basic categories of components, which includes IoT, Frontend Application and Backend database applications. Where, IoT refers to the smart bin itself which includes necessary sensors and IoT modules. The android applications installed in the users' smartphone are Frontend application, such as depositor's and collector's application. The Backend database application refers to the PHP files stored on the server that have the capability to trigger certain SQL queries required to perform transactions on the depositor and collector tables of the database.

A. Frontend – Android applications

The proposed system uses three types of android applications. The e-waste depositor app, e-waste collector app and the smart bin app that needs to be hosted in the android device entrenched in the smart bin.

1. Firstly, the depositor application is developed with an intense user interface that provides the users with number of options in a very presentable way. Such as displaying the location of the bins around the

Fig 2: System Design





city, displaying the user profile information, displaying the status of the items deposited by him/her.

2. Secondly, the collector application is developed with options that are only suitable for the e-waste collectors such as participating in auctions, checking the result of auctions and updating the weight of items he deposited in a bin.
3. Thirdly the smart bin app which is a part of the bin itself provides a user interface for users to login to the bin. Also it will collect data from the microcontroller (of Arduino) and check the status of the bin. Once the bin is full, it sends an HTTP request to backend server to trigger a bidding session online.

B. Backend database application server

It stores the databases and the PHP files required to access data from them. The frontend makes http requests to the backend, and the server responds with the appropriate response. Some of the tables stored in the database are user_info tables, collector_info, bin_info table, bidding table. As to avail benefit of relational databases like concurrency control, it is quite easy to perform bidding sessions online even if multiple bidders place their bid at the same time. The server also has a Cron scheduler to acceptor generate http requests automatically at specified intervals and schedule them. This feature plays a vital role for declaring results of the bidding sessions.

C. IOT Components: Smart Bin

As discussed above, the smart bin has four subcomponents, like ultrasonic sensor, android device, servo motor and Arduino microcontroller. The ultrasonic sensor will measure the fullness of the bin and accordingly sends many values of the distance between adjacent sides of the bin to the microcontroller. The microcontroller analyzes these values and decides whether the bin is empty or not. If the bin is not empty, then an HTTP request is made to the server to trigger an online bidding session. Once the bin is filled, the bin will be locked using servo motor which has capability of locking



and unlocking the bin upon successful authentication by its users. Smart bin can be opened only by the winner of the bidding session.

IV. IMPLEMENTATION

With this paper researcher want to propose a model solution that is backed up by logical implementation. This system will provide a solution to problem of managing e-waste in domestic as well as industrial uses and offices by satisfying depositors with monetary incentives. E-waste collectors will have an organized way of collecting the e-waste from the filled bins by competing in an online bidding process. In this way both depositor and collector will get benefited subsequently by means of technologies like IoT, Application development (Android), Backend (using PHP, SQL).

A. Depositor Android Application

With the App, depositors can login to perform different activities like:

- determine the location of bins, know their reward points,
- determine the status of their deposited items,
- Scan the QR or Bar codes of the bags in which they deposit their items.

B. Smart-bin

Smart-bin is composed of several IoT components as well as an Android application for authentication depositors and collectors. It also triggers bidding sessions based on the status of the bin (i.e. full or empty). Once the bin gets full it gets locked by servo

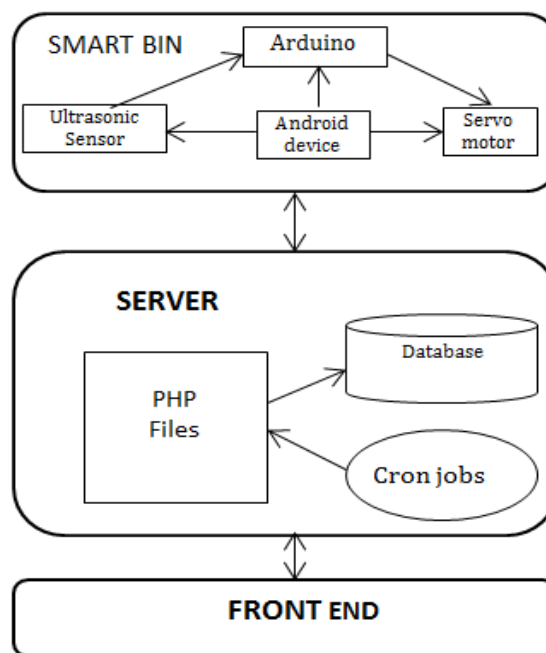


Fig. No. 3: System Architecture



motor which is capable of authentication depositors and collectors and also creating bidding sessions based on the status of the bin.

C. E-waste collector Android Application

Collector can use his/her application for number of reasons like

- checking availability of active auctions,
- checking results of concluded auctions
- updating the weights of items belonging to the depositors and
- Locking and unlocking the bin upon successful authentication by its users.

V. CONCLUSION AND FUTURE ENHANCEMENTS

The ultimate goal of IoT applications in e-waste management is producing leaner operations and delivering higher quality services to citizens. A growing collection of interlinked autonomous systems are managing everyday urban operations and improving both citizen experiences and our carbon footprint. Ultimately, however, we need deeper coordination between public sectors-through a mix of regulation and incentives-and private sectors-through a willingness to engage with regional, state, and federal agencies to use IoT applications in e-waste management to build a better and more sustainable future.

In this paper, researcher proposes a solution that is backed up by implementation. This system will prove helpful to the problem of managing e-waste in all electronic equipment manufacturers, users and offices by rewarding depositors with remarkable monetary incentives. This system will also prove helpful for e-waste collectors to earn business by using organized way of collecting the e-waste from the filled bins by competing in an online bidding process. We can achieve the above mentioned objectives by means of technologies like IoT, Application development, Backend application.



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