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An IoT Based Approach for Efficient Collection and Disposal of E-waste

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Abstract:

In the modern era of rapid technological advancements, electronic devices are flooding our homes and offices. The problem one face's is the safe disposal of inoperative electronic items which we call as electronic waste without causing any harm to the environment. Another crucial point is to note is that depositors aren't motivated enough to recycle their e-waste. Moreover e-waste collectors are unable to locate source of e-waste. This paper talks about an automated system that can let the depositors dispose their e-waste and in doing so get rewarded for it. As far as collectors of e-waste are concerned, an online bidding session is organized, the winner of which get to claim possession of the electronic waste that he/she won in the online bidding process. An interactive smart bin with various sensors and modules is required for this purpose. The bin must be able to lock and unlock itself upon successful authentication by the user.

Index Terms **— IoT, e- waste, cloud, sensors, android app.**

I. INTRODUCTION

Electronic waste is generated 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. CRTs for example have a very high concentration of lead and phosphors. The work proposed in this paper illustrates how depositors use android applications installed in their phone to determine the location of an empty bin and deposit their e-waste in that bin. The depositors can deposit their items in a bag containing QR codes. Each bag belonging to a particular depositor can be uniquely identified using these QR codes that will be scanned by the depositors' android application. The ultrasonic sensor placed within the bin measures fullness of the bin and then automatically creates a bidding session for the participants of the online auction. The participants of the auction are none other than e-waste collectors themselves. They use a dedicated android application for participating in the online bidding session. Only the winner of the bidding session will be able to unlock the bin. Once the bin is full not even the depositor will be able to unlock the bin.

II. RELATED WORK

There are smart bins around the world that provide a smart way to interact with their users. A good example of such a system is Renew pods. Renew pods provide news, information, and recycling bins to London's Commuters. Renew connected pods have launched at 25 location 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.

III. PROPOSED SYSTEM

Fig 1, shows how the entire system works. The users of the system are also vividly shown in the same figure. The two main users of the system are depositors and collectors. The smart bin has four important components such as the arduino board, servo motor, ultrasonic sensor and android device.

Firebase cloud services are used for authentication of users of the system. The ultrasonic sensor measures the fullness of the bin while servo motor secures the bin by locking it from inside and unlocking the bin for authorized users.

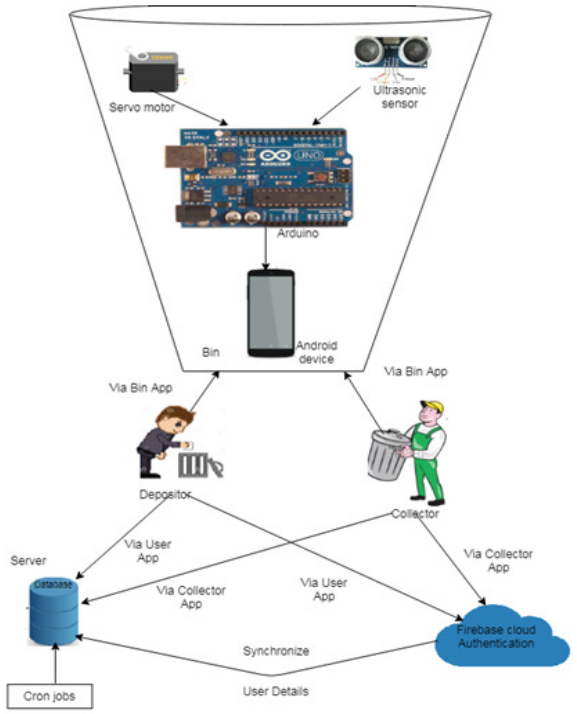

Fig 1: System Design

Figure 2, shows the system architecture of the smart bin and its various components. There are three basic categories of components for this system, which includes IoT, Frontend and Backend applications. IoT refers to the smart bin itself which has the necessary sensors and IoT modules. The front end refers to the android applications installed in the users' smartphone. These include the depositor's and collector's application. The Backend refers to the PHP files stored on the server that have the capability to fire certain SQL queries required to perform transactions on the depositor and collector tables of the database.

A. Frontend – Android applications

There are three types of android applications for this system. The depositor app, collector app and the smart bin app that needs to be installed in the android device embedded in the smart bin. Firstly the depositor application is developed with a brilliant user interface that provides the users with several options in a very presentable manner. Some of these options include displaying the location of the bins around the city, displaying the user profile information, displaying the status of the items deposited by him/her. Secondly, the collector application is developed with options that are suitable for the e-waste collectors like participating in active auctions, checking the result of auctions and also updating the weight of items that were deposited by the depositors. Thirdly the smart bin app which is a part of the bin itself (installed in the android device of the bin) provides a UI for users to login to the bin. Apart from this it is also required to collect data from the microcontroller (Arduino) and check the status of the bin. If the bin is full, it sends an HTTP request to the server to start a bidding session online.

B. Server (Backend)

The server is the store house of data required for this system to be functional. It stores the databases and the PHP files required to access data from them. The front end 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. Since relationaldatabases offer 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 Job scheduler to generate http requests automatically at specified intervals. This is especially useful for declaring results of the bidding sessions.

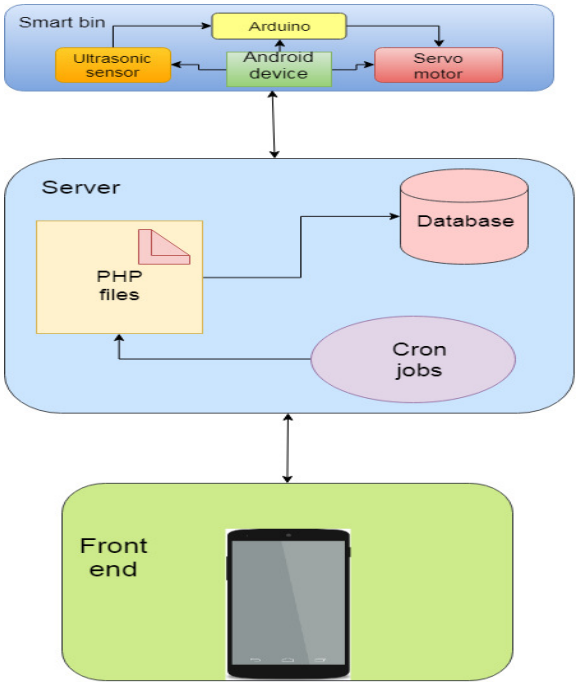

Fig 2: System Architecture

C. SMART BIN (IOT COMPONENTS)

The smart bin is a collection of four other sub-components, like ultrasonic sensor, android device, servo motor and microcontroller (Arduino). The purpose of the ultrasonic sensor is to measure the fullness of the bin. The ultrasonic sensor 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 actually filled or not. If the bin is full, then an HTTP request is made to the server to create an online bidding session.

Once the bin is filled, it can be opened only by the winner of the bidding session. This is where the servo motor comes into the picture. It is capable of locking and unlocking the bin upon successful authentication by its users.

IV. IMPLEMENTATION

In this paper we propose a solution that is backed up by implementation. This system provides a solution to problem of managing e-waste in homes and offices by rewarding depositors with monetary incentives. Collectors will have an organized way of collecting the e-waste from the filled bins by competing in an online bidding process. By means of technologies like IoT, Application development (Android), Backend (using PHP, SQL), we can achieve the mentioned objectives.

A. Depositor Android Application

Depositors can login to their application .The application has the following options: to determine the location of bins in different localities, know their reward points, determine the status of their deposited items, scan the QR codes of the bags in which they deposit their items.

B. Smart-bin

As mentioned above the smart-bin is composed of several IoT components as well as an Android device which has an android application for authentication depositors and collectors and also creating bidding sessions based on the status of the bin (full or empty).

C. E-waste collector Android Application

Collector can use his/her application for reasons like: checking availability of active auctions, checking results of concluded auctions and updating the weights of items belonging to the depositors.

Fig 3 Depositor Android Application

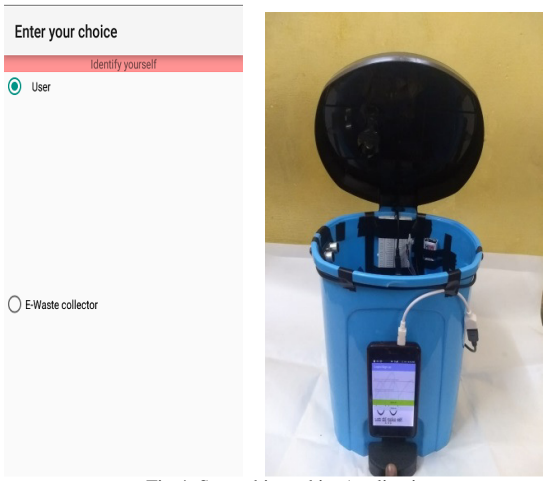

Fig 4: Smart-bin and its Application

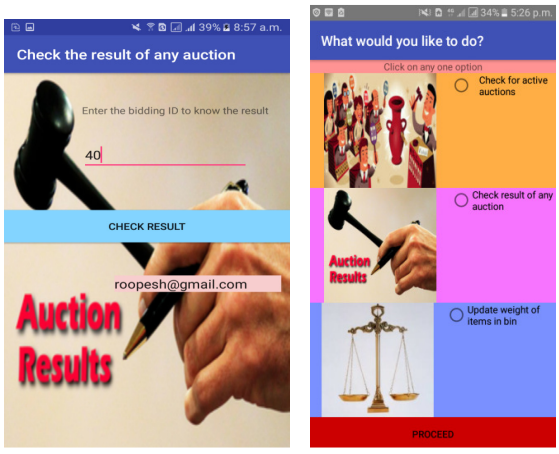

Fig 5: E-waste collector Android Application

V. CONCLUSION AND FUTURE ENHANCEMENTS

In this paper we propose a solution that is backed up by implementation. This system provides a solution to the problem of managing e-waste in homes and offices by rewarding depositors with monetary incentives. Collectors will have an organized way of collecting the e-waste from the filled bins by competing in an online bidding process. By means of technologies like IoT, Application development (Android), Backend (using PHP, SQL), we can achieve the above mentioned objectives.

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