WASTE MANAGEMENT APP: PROPOSED SOLUTION FOR AN EFFICIENT WASTE DISPOSAL.

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Abstract

Millions of metric tons a day of rubbish are thought to be produced by urban people. As a result, urban cities face a serious environmental issue with waste disposal. Government in these urban regions used Private Sector Participation (PSP) to improve trash disposal in the city in order to control the issue. Residents frequently have trouble getting in touch with these operators, thus they frequently dump their waste at unapproved locations such roadside ditches, partially constructed structures, and undeveloped properties. These disposal techniques put the city's ecology and residents' health at danger. This study examines the potential for employing an Android Application (App) to improve garbage disposal among residents of an Urban Settlement in order to ensure that residents dispose of waste properly when the need arises. This app creates a unique code for each subscriber and registers them as PSP operators' subscribers. This code is used to ask the PSP operator to dispose of waste and to compensate the operator when that request is granted. The adoption of this app ensures that an operator has a sufficient database of subscribers and gives subscribers a way to contact the PSP operator whenever they need to dispose of waste. According to the study's findings, waste management in metropolitan areas can be improved if residents have a way to contact their waste managers whenever they have a need, as opposed to waiting until the majority of the waste has been put in illegal dumpsites.

Keywords: Waste Disposal, Android Application, Private Sector Participation, Urban Settlement

Introduction

Waste is any substance or material that needs to be disposed of because it is damaged, worn out, polluted, or has otherwise lost its usability (Anifowose et al., 2011). It might be harmful and take the shape of a liquid or solid. According to Akinbola, Ojo, and Hakeem (2015), garbage can be domestic, household, medical, solid, or liquid, or industrial waste such used motor oil, ash, sewage sludge, or industrial metals. Governments work hard to manage waste effectively to protect the environment and boost its economic worth. Waste disposal is one of the most significant environmental challenges now affecting numerous countries all over the world. The amount of waste produced in African cities has increased quickly as a result of urbanization trends. The majority of countries are seeing an urban population growth that is outpacing their ability to collect and dispose of waste (Amuda et al. 2014). The issue of urban waste management, particularly waste collection and disposal, is expected to worsen as Africa's cities increase. Given how important it is, waste management is a priority for every country, including Nigeria. Waste disposal is still manual and limited in Nigeria today. The trash can be full before the scheduled garbage collection day, and the delay in garbage collection will cause the waste to overflow and smell. While an officer will clean up at a predetermined time in accordance with the schedule, this is exceedingly inefficient. Inefficient waste management would produce a lot of garbage, which would swiftly breed bacteria, viruses, and insects that may potentially infect humans. The dehumanizing effects of these circumstances in our urban lives and more advanced environments have frequently been addressed and accepted as major contributors to the decline of urban centers. (Marco Caniato et al., 2014) Despite the significant funds set aside for trash management and disposal, the rate of waste generation and disposal, particularly in big centres, is alarming. Reduced trash production, effective garbage disposal, proper recycling and reuse of abandoned objects are the primary aims of waste management. There have been several attempts, both conventional and non-conventional, such managing waste into something with economic worth and disposing of waste in landfills. The innovator created waste management with economic value to increase the value of waste so that it can benefit the community (Hamzah et al., 2013). It is challenging to change the community's attitude and behaviour patterns with regard to trash management. They must be educated about garbage disposal and management, including the advantages (Boham & Rondonuwu, 2017).

This study offers a technique for improving waste removal in urban areas that makes use of Android apps to effectively improve rubbish removal from residential areas. The Android application, employed in many urban areas

today, enables a direct link between the houses where garbage is created and the waste collectors, who are mainly private sector operators in waste management. Therefore, the goals of this investigation are

- √ To create an Android application that PSP operators could use to collect client data, and the client could use the app to request waste removal as needed.
- √ To look at the prospect of a clean and hygienic environment that could be achieved with the deployment of this App.

A lot of studies has been done to find a way for an effective waste management. In their study, Chaudhari and Bhole (2018) described an Integrated Platform for Waste Management in which smart bins are fitted with a network of sensors that send real-time data about the bin's fill level. Route optimization can be done based on the condition of the bin, which improves the efficiency of fuel and collecting time. The vast amount of data gathered can also be utilized to learn more about the waste produced by different cities. A fill level-based smart bin was suggested by Atayero et al. in 2019. Garbage bins are placed in strategic locations across the city, and ultrasonic sensors within each bin track how full it is with solid waste. The sensor data is sent to an IoT cloud platform called ThingSpeak over a Wireless Fidelity (Wi-Fi) communication channel. The program is set up to alert local authorities and interested parties of the necessary action by delivering the correct warning message (in the form of a tweet) at different filling rates.

The study by Wang & CAO (2014) examined the use of IOT in residential waste management with an emphasis on waste traceability, dynamic trajectory tracking, and parameter monitoring, all of which will enable better waste management procedures. In order to identify trash sources and track monitors, the study describes the use of RFID, GIS, GPS, and sensor networks. In addition to highlighting some of the technological challenges they faced, the researchers were able to make some advancements. These challenges included low power consumption, low cost, the downsizing of wireless sensors, and the synchronization of technical standards.

According to a 2012 study by Gomes, Brito, Mendes, Cabral, and Tavares, wireless sensor networks can be used to manage trash. In the paper, a wireless embedded solution is suggested for checking the garbage level in recycling bins. In their studies, the researchers found that the suggested platform worked well as a low-cost, low-power wireless monitoring system.

Zigbee and GSM (global service module) communication technology, as well as a few carefully selected sensors, were used by Pranjal Lokhande and M.D. Pawar (2016) to track the state of trash cans in real-time. The three tiers of the paper are lower, medium, and higher. The middle layer will be used for collection, the lowest tier for the sensor installation, and the control center for data transmission. The upper layer's specifics will be stored for further use. The bin level is collected using an energy method in the first layer process.

Sani Abba and Chinaka Ihechukwu Light proposed the design and use of an Internet of Things (IoT) based Arduino microcontroller with ultrasonic sensors to measure the amount of trash in a trash can and periodically display situational information on an LCD screen, such as "full," "half-filled," or "empty," and occasionally send content level information to a central web server system to display the amount of trash in the cans. The Arduino IDE and embedded programming language are used to program the Uno microcontroller. This procedure aids in both controlling and activating the trash can automatically. The web page analyzes and visualizes the trash waste levels, time, and location in real-time viewing and shows a bar chart using the distances measured from the trash cans as input.

A smart bin created by Prof. Rajashri Nikam (2019) is based on a tiny Arduino uno-based controller board that is connected to a GSM modem. A dustbin's garbage level will be determined using an ultrasonic sensor that is placed on top of the bin. The cap is set at 70% of the total amount of trash collected for dustbins. The remaining distance from the threshold height will be displayed when a trash is filled thanks to programming done on Arduino. The GSM modem will always notify the authority until all litter in the trash bin has been removed when the ultrasonic level limit sensor detects the appropriate level of waste. Depending on the area, the system will notify the proper employees and dispatch a trash truck to pick up any garbage. The technology will reconstruct updated routes and establish paths using GPS (Global Positioning System). This information will be provided by the system on the driver's mobile app.

Methodology

Several methods and strategies were employed to design, create, and launch the demand for a full mobile application that will improve garbage disposal in an urban community. The study employs the Descriptive Analysis method to describe the possibility of utilizing the application to create a cleaner and healthier environment and Android Version X to develop the Android application, Gradle Plugin 7.0 to compile and Build Plugin 4.5 to execute and create the entire app.

Design

A structural component of the mobile application is the software component. The Waste Management App's software is divided into four (4) elements, as shown in Fig. 1. The connections of the components are labelled with arrowheads to indicate their relationships.

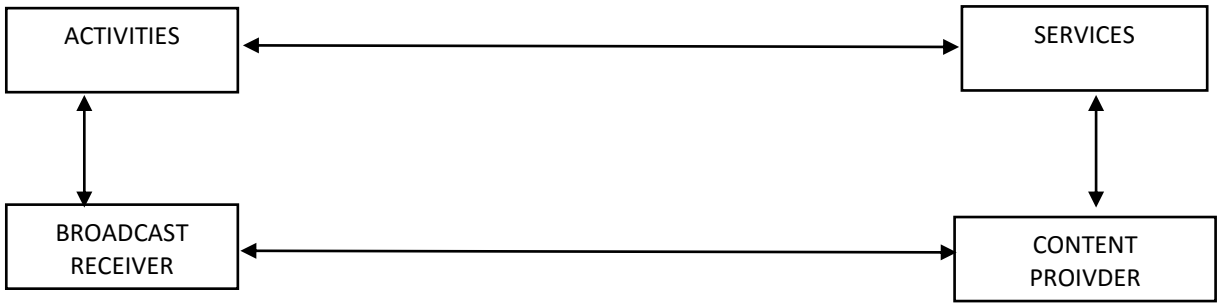


Figure 1:Components of the Android Application

Activities: The activities show the possible operations that the app could perform. Both functional and non-functional needs constitute the foundation of these operations. Non-functional needs are those that improve how well the app works, whereas functional needs are those that the app absolutely must fulfill.

Services: These are the specified advantages that users of the application may receive. These advantages, as they are characterized in this application, include flexibility in trash disposal and durability in offering a way to improve connections between service provider and user.

Broadcast Receiver: A component that listens to operational intents and events within an application is called a broadcast receiver. The app's operations and system events are entirely under the supervision of the broadcast receiver. More protection from an attacker is needed for the broadcast receiver.

Content Provider: The data in the central repository are managed by the Content Provider. They protect the data and offer a way to specify data security.

The software design component serves as a framework or endpoint in the software development process, ensuring that the mobile application satisfies all necessary functional and non-functional requirements.

Software Class Diagram

The class diagram in the figure below represents the structural elements of the mobile application. It displays the actions and communications carried out between each class in the mobile application. Figures 2 and 3 depict the class diagram, which lists the classes, properties, and functions of the user (subscriber) and administrator (admin) in the waste management application.

User (Subscriber) Class Diagram

Figure 2's User class diagram illustrates the connections between the objects, classes, their properties, and how they function (or methods). The user model contains 6 main classes, each with their own special operations and attributes (public or private). The class explains how the app implements the fundamental functions of its users in the user interface for mobile applications. In the user model, relationships between classes are mostly aggregated.

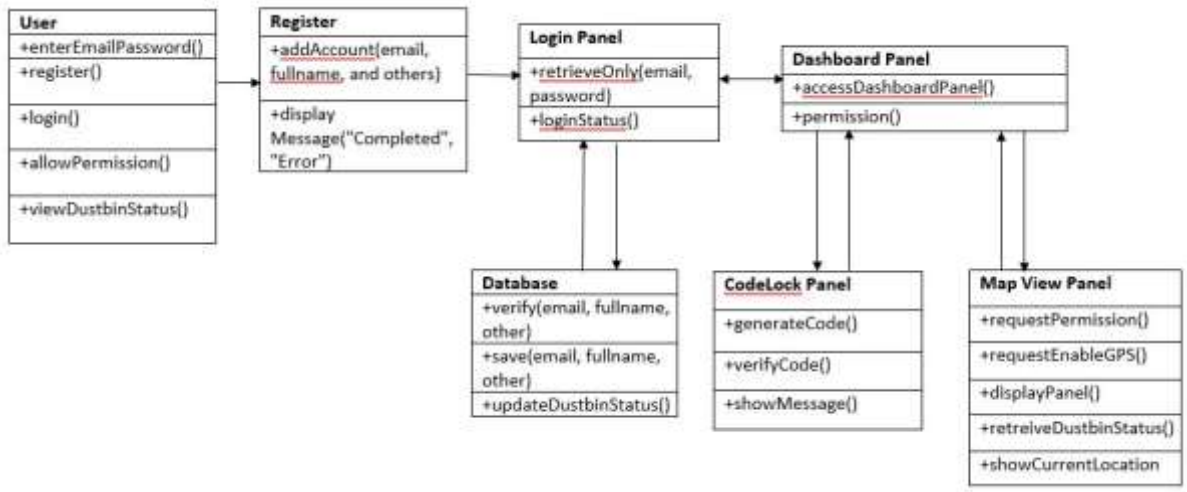


Figure 2: User Class Diagram for Different Class of Operation in the Waste Management App

Administrator (Admin) Class Diagram

Relationships between classes in this class diagram can either be characterized as inheritance (or generalization) or dependency. As opposed to the user model, Aggregation. Eight main classes, each with distinct operations and properties (public or private), are shown in the Admin class diagram above. The class explains how the app's admin basic functionality is implemented in the mobile application interface.

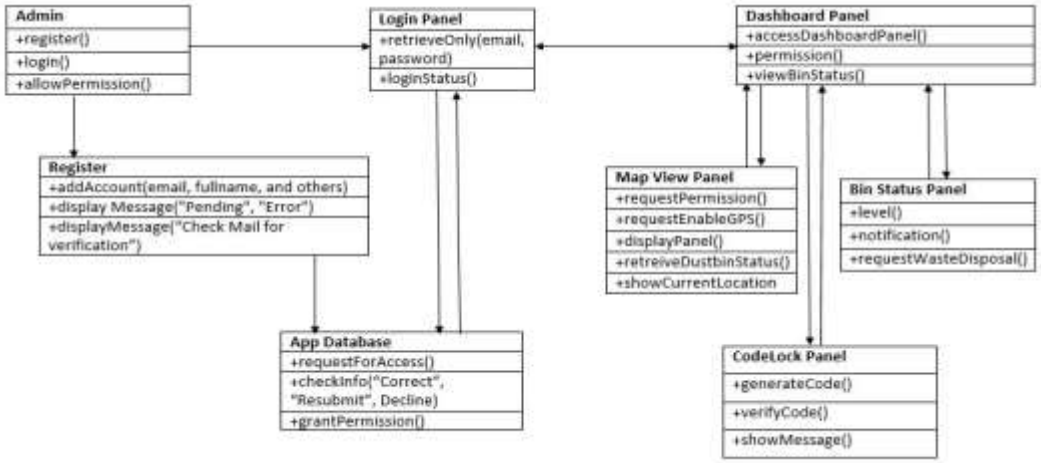


Figure 3:Admin Class Diagram of the Different Class of Operation in the Waste Management App

The Waste Management App Test

The test was conducted to see if the mobile application's features had been created in accordance with expectations. The Android app can be used to log in, register, access the dashboard, lock a code, and forget a password, among other things. The functionality developed in response to the need worked as planned once the program was activated. If the program is installed on an Android device that doesn't fulfill the minimal requirements, the program will halt and show an error message. These specifications call for the smartphone to have an Android version of 6.0 or higher, as well as a minimum of 1GB of RAM and 4GB of storage.

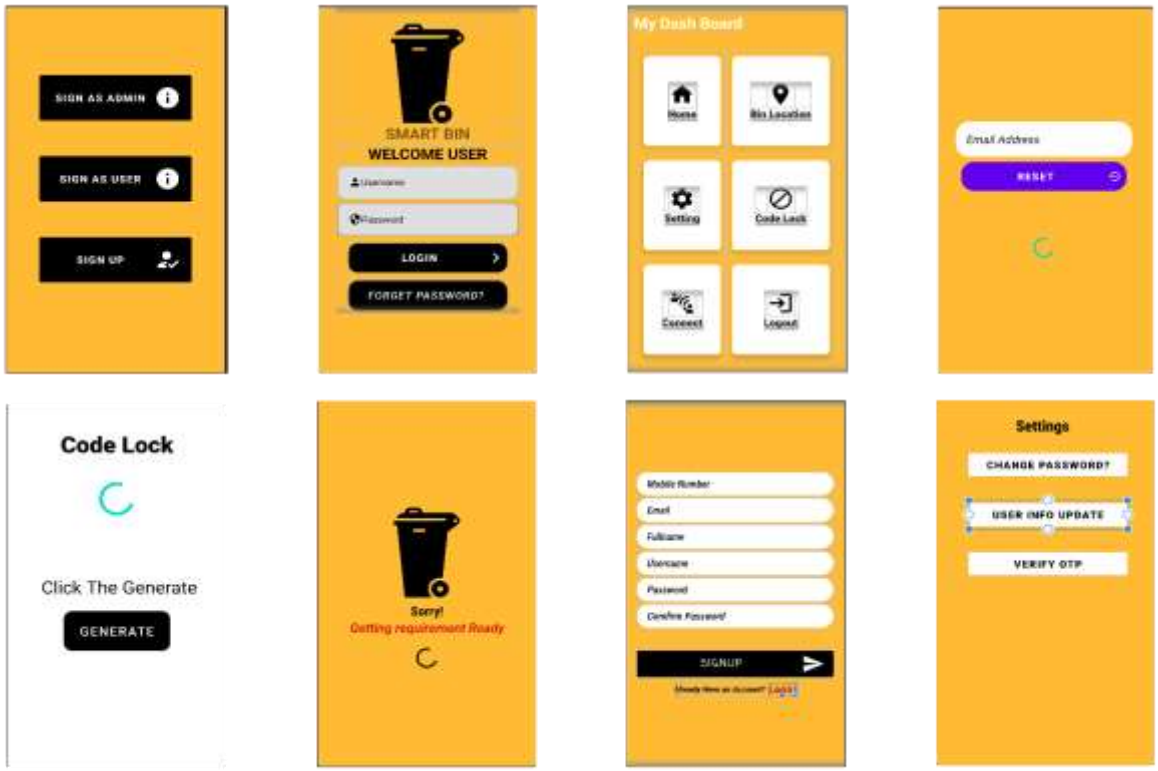
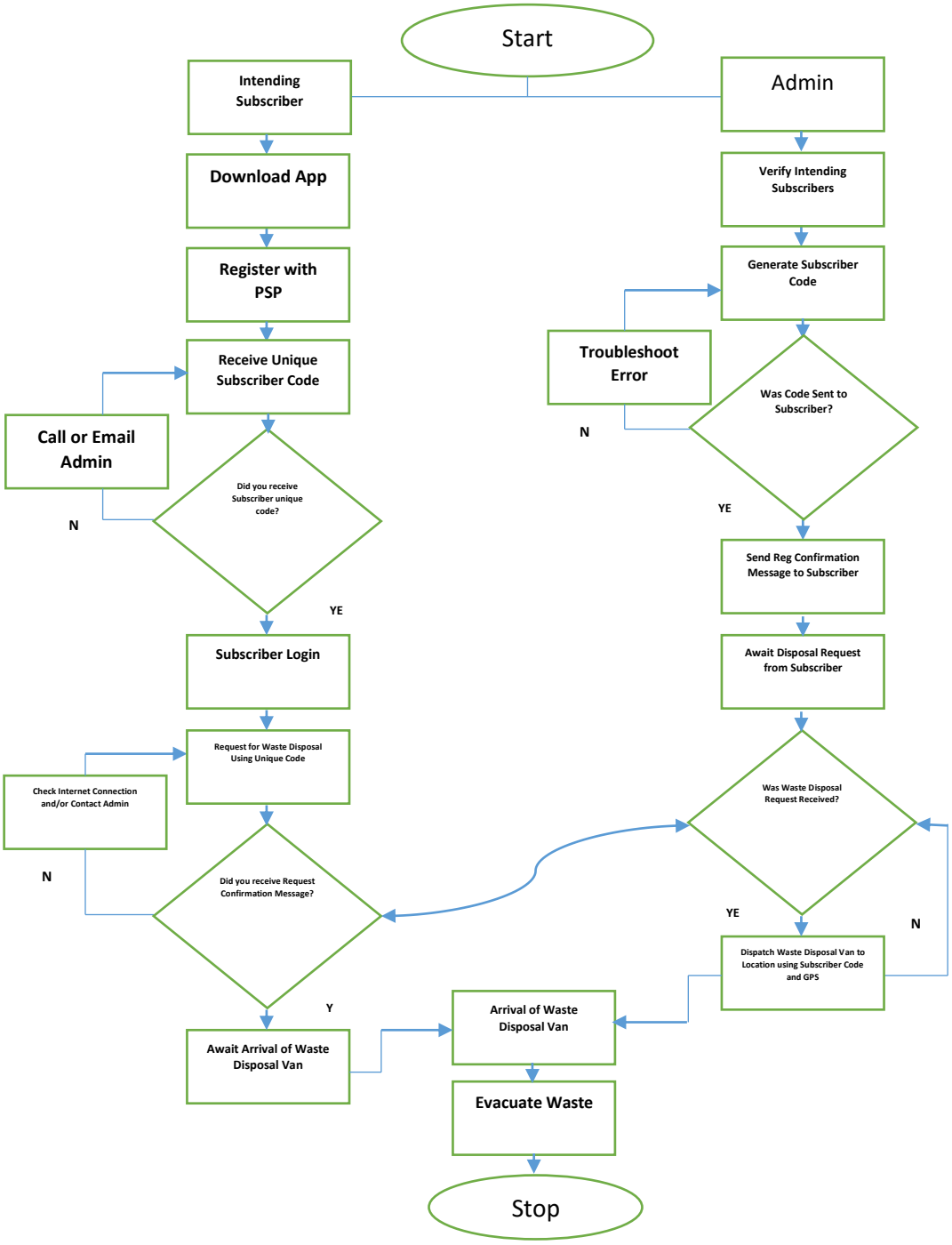


Figure 4: The Waste Management App Interface

The App Working Operation

The first step for intending subscribers is to download the App and sign up for a PSP operator's waste disposal operation. A Subscriber Unique Code (SUC) is given to the subscriber by the operator after registration. This code is connected to the subscriber's financial information, requests for garbage disposal, and address via GPS. The subscriber receives a confirmation message from the operator to confirm registration on their site when download and registration are accomplished. The operator receives a request from the subscriber utilizing the SUC when the subscriber needs garbage disposal. The subscriber receives a received confirmation message after the operation receives the request, and then they wait for the garbage van to arrive so that the waste can be evacuated. Call or email to the admin of the operator are ways to fix any issues or unconfirmed requests.

The operator's administrator verifies all prospective subscribers, generates SUC after confirming subscriber information, and sends a message to the new subscriber to confirm the registration. After the subscriber has been verified, the administrator awaits any subscriber-generated requests or orders for waste disposal. A confirmation message is sent once a request is made, and a message is also sent to a waiting waste removal van. The waste van finds the subscriber's address using the SUC and GPS and travels there to collect waste.



The prospect of using the waste management app.

The main issue facing urban settlement dwellers is how to dispose of their daily trash because it is frequently impossible to contact PSP operators directly in locations where the service is offered. As a result, trash ends dumped on roadsides and in illegal landfills at strange hours of the day. The intermediary in revenue collection makes it challenging for PSP operators in waste management to access their cash, which are typically very sparingly

Figure 5: Flow Chart Showing the Working Operation of the Waste Management Android Application

disbursed. This difficulty results in the operators having rickety rubbish vans or no vans at all to do the required service.

By deploying the app, operators will receive their payments directly, cutting out the middleman in revenue collection. As a result, the money can be used to upgrade the services provided as needed. There won't be a need to deposit waste at roadside and illegal dump sites because members will always have direct access to their waste collection. The introduction of the waste disposal app will ensure that the streets of many big cities are free of the waste hay saw that litters them, making the environment cleaner and more hygienic.

Conclusion

The design and creation of an Android mobile app for waste disposal in metropolitan areas were discussed in this study. Although the mobile application was created for Android, it might be enhanced to support iOS. The main goal of the app is to facilitate rubbish disposal among urban dwellers who struggle to get in touch with their waste managers when they need to. Additionally, it enables the waste management to communicate directly with their subscribers. For a much better and cleaner environment in emerging countries, the usage and promotion of appropriate waste disposal procedures has become essential. The possibility of employing this app to create a cleaner environment that is hygienic and healthful for all residents is discussed in the paper's conclusion

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