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# Application of an Integrated Mobile Persuasive Waste Management System in Enugu State.

Ekwuaju Binyelum .S., Okeke Ogochukwu .C.
*Department of Computer Science, ChukwuemekaOdumegwuOjukwu University, Uli.*

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**ABSTRACT**
The problem of solid waste collection and disposal, especially in cities, has been one of the most intractable environmental problems in Nigeria. In many cities, the volumes of solid wastes overwhelm urban administrator's capacity to plan for their collection and disposal. The existing electronic means of payment for waste management levies is not customer-centered. It is entirely administrative and deployed for administrative purposes – in partnership with the banks. There are no visible persuasive system techniques that could improve the quality of communication between waste managers and the public customers. So this paper is aimed at designing an integrated mobile persuasive waste management system that is user-friendly and at the same time serves administrative purposes. The system developed incorporated system interactivity that could improve the quality of communication between waste managers and the public customers. It also provide automated support to help users in taking decisions to change their attitudes towards waste disposal, achieve set target behavior, self-monitor themselves, reinforces and reward a user for achieving a target behavior. The applications developed enables vicinity registration, waste pick-up schedule, bill generation, bill payment monitoring, sending persuasive messages to people on the need for clean environment, creating an interactive platform and lastly, report generation. The system was developed with PHP, MySQL and JavaScript. The System Design followed the OODM methodology for componentization of the system. The result obtained from the new system shows significance in its ability to serve as a helping tool for waste agencies in managing and processing their records at a very fast rate.

**Keywords:** Waste, waste management, health, environment, information system, persuasive, information, databases, communication

## I. INTRODUCTION

The problem of solid waste collection and disposal, especially in cities, has been one of the most intractable environmental problems in Nigeria. In many cities, the volumes of solid wastes overwhelm urban administrator's capacity to plan for their collection and disposal. Urban streets and roads are practically blocked by solid wastes, contributing to the problem of flood disasters in cities like Enugu. Uchegbu (2018) reported that municipal solid waste (MSW) disposal is a great concern in developing countries, like Nigeria, because poverty, high rate of population growth, high urbanization rates, ineffectual and underfunded government projects, all combine to prevent efficient management of wastes. Thus, the problem of solid waste collection and disposal has persisted for years in the Nigerian urban areas, despite attempts by government agencies to deal with the problem. Heaps of uncollected refuse still characterize most of the urban areas. To stem the tide, the Federal Government launched the campaign on "War Against Indiscipline" (WAI) and introduced the monthly clean-up exercise held on the last Saturday of the month in 1984. The monthly clean-up exercise was enforced by the law enforcement agents. Waste was collected at designated dumps for onward collection and disposal by the refuse disposal agency. Mobile courts were established and instant prosecution of defaulters of the programme introduced. This entrenched hygiene culture on citizens. In 1985, the State Environmental Sanitation Agency (SESA) was established in each of the States. In 1988, the Federal Environmental Protection Agency (FEPA) was established by Decree No. 58 of 1988 and charged with the overall environmental protection and management in Nigeria.

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1.1 **Statement of the Problems**

1. The existing system employed is not automated.
2. The existing electronic means of payment of waste management levies is not customer-centered.
3. There are no visible persuasive system techniques.

1.2 **Aim and Objectives of the Study**

1. To design an integrated mobile persuasive waste management system that is user-friendly and at the same time serves administrative purposes.
2. To incorporate system interactivity that could improve the quality of communication between waste managers and the public customers.
3. It could also provide automated support to help users in taking decisions to change their attitudes towards waste disposal, achieve set target behavior, self- monitor themselves, reinforces and reward a user for achieving a target behavior using persuasive techniques etc.

## II. LITERATURE REVIEW

**Meaning of Waste Management**

Waste management according to Adewole,A.T.(2019) is the collection, keeping, treatment and disposal of wastes in such a way as to render it harmless to human and animal life, the ecology and the environment generally. This definition is very crucial because the import of waste management is to protect human lives in particular and the environment in general. United Nation's (UN) (2018) defines sustainable development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own need. The principle of sustainable development seeks to achieve societal and environmental equity while in pursuit of economic gain. From the point of view of sustainable development, waste can be interpreted broadly or narrowly. Broadly it might be construed as including various forms of pollution, ranging from discharges of toxins into the commons, or of emissions into the atmosphere. A narrow interpretation on the other hand, can be characterized as those byproducts of production and consumption that are the subject of specific waste control programs.

Sustainable development is an implied development without destruction, it is the judicious use of non-renewable resources for the present and future generations, which are non-renewable resources, which must be used at a judicious rate, neither too fast nor too slow and to ensure that the natural wealth that they represent is converted into long-term wealth as they are used Adewole A.T. (2019).

In Nigeria, we succinctly put it as sustainable development without jeopardizing future development, meaning that in our efforts to explore and exploit the natural resources to serve us, there is an obvious paradox evident in the need to ensure economic development, while protecting the environment. It is important to note that there must be a balance between levels of development and the stock of natural resources, that is, development must be at a level that can be sustained without prejudice to the natural environment or to future generations.

**Persuasive Technology**

The Preface of the Proceedings in First International Conference on Persuasive Technology, by Ijsselsteijn et al,.(2016) provides a definition of exactly what Persuasive Technology is, they opined that persuasive technology is the general class of technology that has the explicit purpose of changing human attitudes and behaviors. Persuasive technologies apply principles of social psychology in influencing people; principles of credibility, trust, reciprocity, authority and the like. Social psychologists have spent a great deal of effort over many years in trying to understand how attitude and behavior change comes about, focusing on the effectiveness of human persuaders, and the persuasive power of messages delivered through non-interactive mass-media, such as newspapers or television.

**Mobile Persuasive Technology**

Until recently, most software applications and technologies were developed without much thought to how they influenced their users. This perspective is changing. Today, industry experts and academics are embracing a purposeful approach to persuasive design. In an industry context, designing for persuasion is becoming essential for success. In academic settings, the study of persuasive technology illuminates the principles that influence and motivate people in different aspects of their lives Oinas-Kukkonen, H. &Harjumaa. H(2018). Persuasive technology is rapidly growing into a major discipline, sometimes referred to as captology or the study of computers as persuasive technologies Oinas-Kukkonen, H. &Harjumaa. H(2018). Captology includes the design, research, and analysis of interactive computing products (computers, mobile phones, websites, wireless technologies, mobile

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applications, video games, etc.) created for the purpose of changing people's attitudes or behaviours. While a precise definition of persuasion is not agreed upon, for the purpose of this discussion, Persuasion is a non coercive attempt to change attitudes or behaviours'Fogg, B(2019). Behavioural change technology is an object of study within persuasive technology Oinas-Kukkonen, H. &Harjumaa. H(2018).

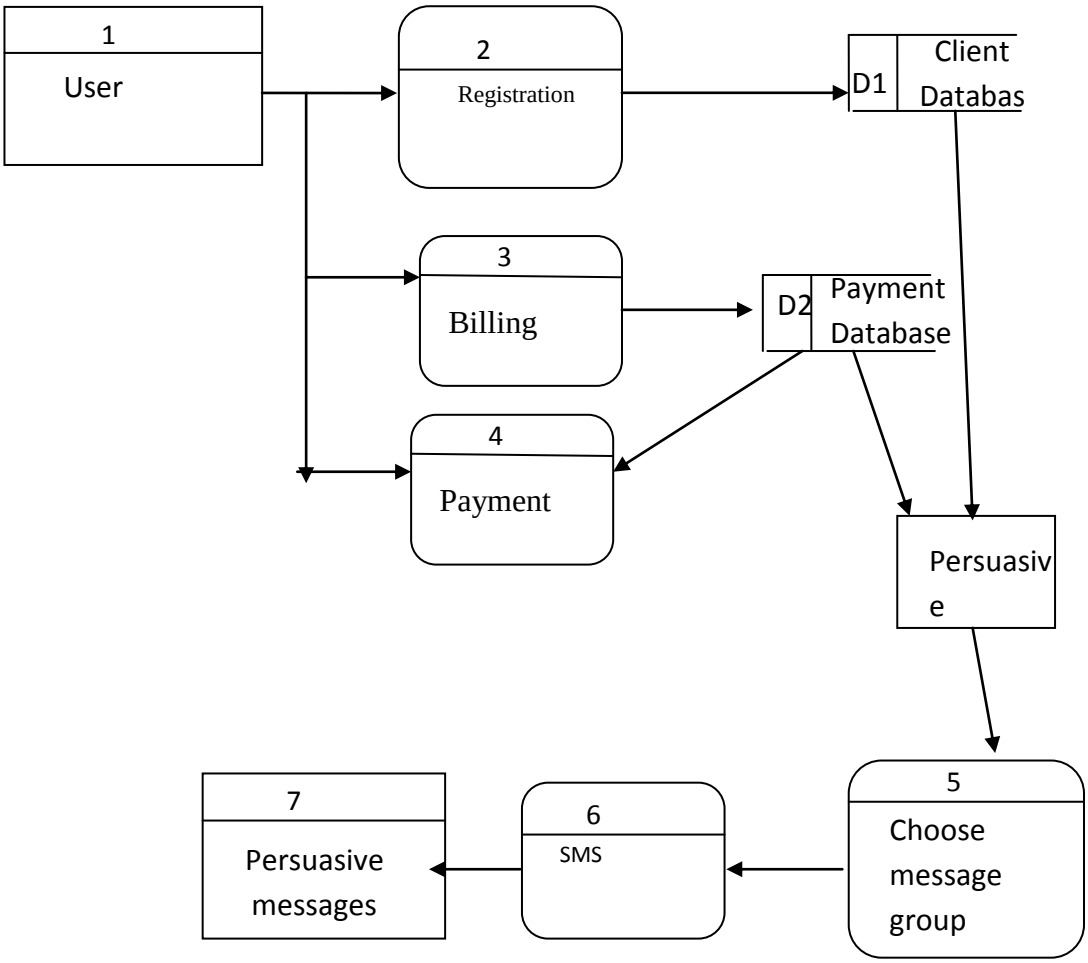
## III. PROPOSED SYSTEM

The proposed system will not only help the state waste management agency to manage their operations, but will also be interactive and user-friendly; having the capacity to motivate the public to change their attitude and behavior towards waste management, promote clean and sustainable environment in the communities as well as foster long-term and enduring change in citizens.

Other advantages include:

1) It will provide an integrated mobile persuasive waste management system that is user-friendly and at the same time serves administrative purposes.
2) To incorporate system interactivity that could improve the quality of communication between waste managers and the public customers.
3) It could also provide automated support to help users in taking decisions to change their attitudes towards waste disposal, achieve set target behavior, self- monitor themselves, reinforces and reward a user for achieving a target behavior using persuasive techniques etc.

**Data Flow Diagram (DFD) of the Proposed System**




## IV. METHODOLOGY ADOPTED

Object-oriented analysis and design methodology (OOADM) was adopted in this research work and it is a set of standards for system analysis and application design. It uses a formal methodical approach to the analysis and design of

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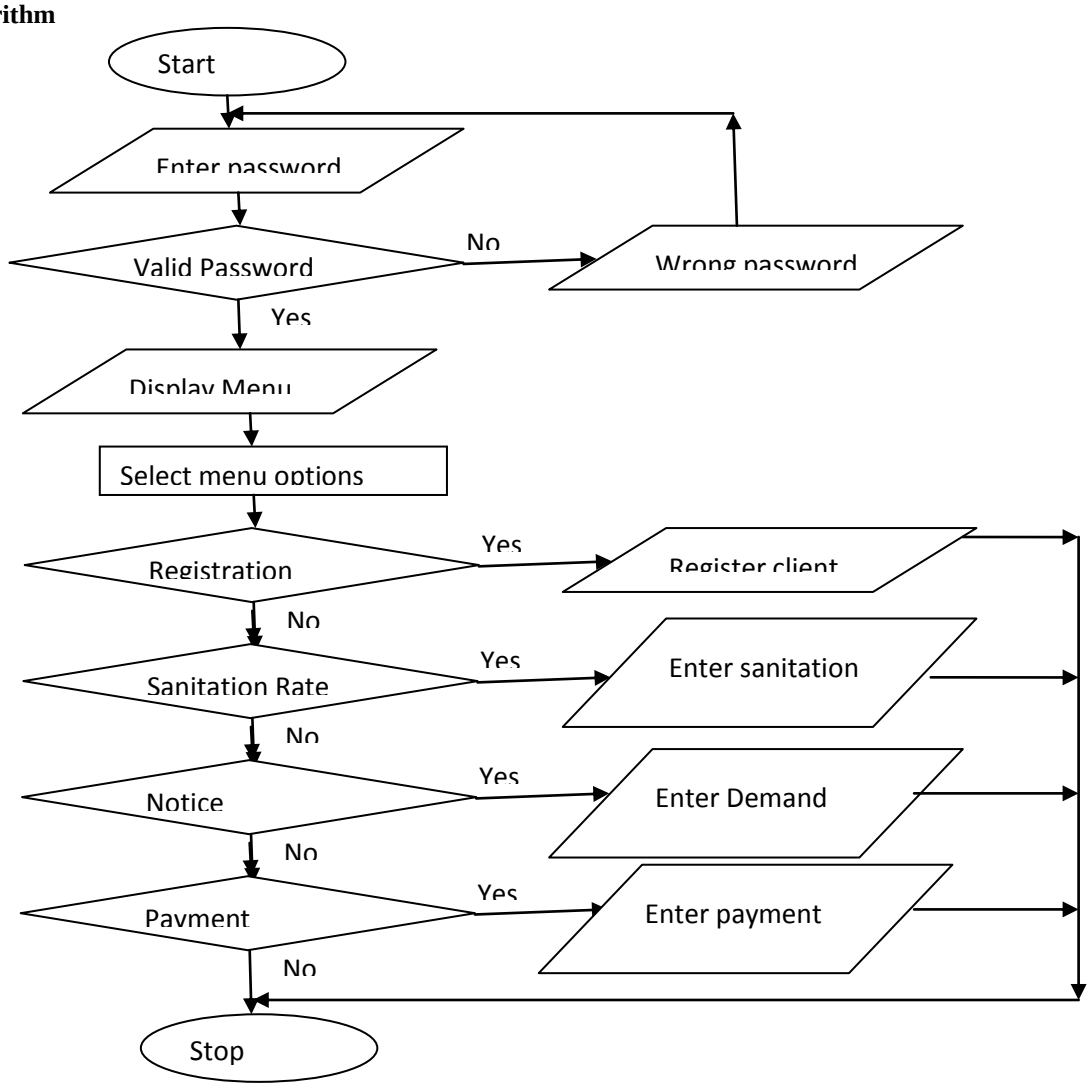
information system. Object-oriented design (OOD) elaborates the analysis models to produce implementation specifications. The main difference between object-oriented analysis and other forms of analysis is that by the object-oriented approach we organize requirements around objects, which integrate both behaviors (processes) and states (data) modeled after real world objects that the system interacts with. In other or traditional analysis methodologies, the two aspects: processes and data are considered separately. For example, data may be modeled by ER diagrams, and behaviors by flow charts or structure charts. The primary tasks in object-oriented analysis (OOA) are:

- Find the objects
- Organize the objects
- Describe how the objects interact
- Define the behavior of the objects
- Define the internals of the objects

Common models used in OOA are use cases and object models. Use cases describe scenarios for standard domain functions that the system must accomplish. Object models describe the names, class relations (e.g. Circle is a subclass of Shape), operations, and properties of the main objects.

**System Implementation and Results**

**4.0 Algorithm**



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**Test Result**

| Module | Expected Test Result | Actual Test Result |
|---|---|---|
| Home Page | Expected to see the page containing links to other modules | The home page displayed platform and contains all the links to the various modules in the system |
| Log In Form | Expected to see the Log In command button so that one can log in. | When clicked on log in, a form appeared where you can enter your username and password. |
| New registration form | When clicked on the system, it is expected to display the form for entering new customer details | When clicked on the button, the system displays the customer registration form. |
| Demand Notice | In this module, it is expected to be used to issue demand notice to customer | When you go to this module, the demand notice was issued to customers |

## V. CONCLUSIONS

This project has been able to achieve the set objectives. The web based computer human persuasive waste manager despite the limited time has been fully automated with desired results. The application has three principal actors Administrators, Waste Admin, Supervisors and the customers. Customers can register details online, request for refuse collections, view payment history and be able to pay online using credit card or any web pay points. Among other things the customer can do, they can view and monitor waste status collections. The supervisors can approve or reject waste billing, view various reports and deploy waste bins. Various reports can be generated on the application using various parameters while the system developed gives room for scalability. The database system is such that it fully integrates with the business workflow making generation of ad-hoc reports from the database archives possible.

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