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E-waste Management System: E-Waste Recycler (Application for Smart City)

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ABSTRACT: Electronic waste or E-waste is one of the emerging problems in developed and developing countries worldwide. Electronic waste is the fastest growing stream of waste in industrialized countries. E-waste contains many hazardous constituents that may negatively impact the environment and affect human health if not properly managed. It comprises of multitude of components with valuable materials, some containing toxic substances, that can have adverse impact on human health and the environment. If we continue to do nothing, these problems will become more serious. India's e-waste growing at 30% annually. India's production of e-waste is likely to increase by nearly three times, from the existing 18 lakh metric tons (MT) to 52 lakh MT per annum by 2020. Due to lack of appropriate infrastructural facilities and procedure for its disposal and recycling have posed significant importance for e-waste management in India. E-waste is the reduction of waste volume and the utilization of the energy content of combustible materials. In the proposed system an Android application acts as intermediary between recycling team and people, so that the process of E-waste management will be easy, reliable and beneficial for customers.

KEYWORDS: ICT, UNEP, 3R, EEE

I. INTRODUCTION

E-Waste includes used computers, laptops, fridges, mobiles, ovens, machines etc, it includes the wastage which is meant for resale, reuse recycling or disposal. Faster changes in changing media and planned obsolescence and falling prices of these technological things causes the rapid growth of electronic wastage.[9] Electrical and electronic waste is a growing problem as volumes are increasing rapidly. Rapid product innovation and replacement, especially in information and communication technologies (ICT), combined with the quick migration in various technologies has resulted in electrical & electronic products quickly reaching the end of their life. The rising levels of e-waste generation in India have been a major issue in recent years. With reference to the UN statistics, India is world's 5th largest generator of e-waste.[1] India is on second position in mobile market, and also has fifth rank in producing of electronic waste, discarding overall 18.5 lakh tonnes of E-Waste every year.[4]

United Nations Environment Programme (UNEP) estimates that E-waste is increasing by 40% per year worldwide and E-waste is the fastest-growing type of waste. Between 20 to 50 million metric tons of E-waste are generated worldwide every year, representing more than 5% of urban solid waste, particularly in some developing countries where the volume is expected to grow up to 500 percent over the next decade.

Unfortunately, most of this E-waste is handled in cruel hazardous way by informal processes. This is causing threats to the human health and environment as they are not handled in controlled conditions while storage transportation, recycling, recovery processes and lead to contamination of air, soil and water thus damaging our environment.

The Ministry of Environment, Forest and Climate Change has notified e-waste management rules, 2016.[1] The Government directive on e-waste aims to minimise e-waste by putting disposal responsibility on generators for collection and environment friendly disposal of e-waste. Rapidly growing E-Waste is causing harm to environment, so we create a system based on 3R principle to Reuse, Reduce, Recycling of it.

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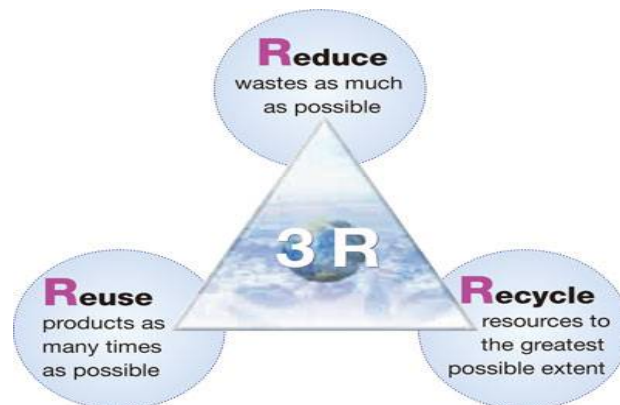


Fig1 :3R principle. [3]

Main Sources of E-Waste

1. Importers
2. Producers / Manufacturers
3. Retailers(Business/ Government/ others)
4. Traders
5. Scrap
6. Dealers
7. Recyclers[5]

Problems of E-Waste with respect to the Indian scenario

10 states that contribute to 70% of the total electronic-waste which gets generated in the country. And 65 cities generates more than 60% of the total electronic-Waste in India. Among the top ten cities generating E-Waste, Mumbai ranks first followed by Delhi, Bengaluru, Chennai, Kolkata, Hyderabad, Nagpur, Surat, Pune & Ahmedabad. Main sources of E- Waste in India are public, private means industrial and government sectors 70%. Individual house hold contributes 15% .Rest is contributed by manufacturers.[6] Rich class is using new devices like laptops, cell phones, fridge, ovens, computers and then pass it to the poor class. No proper way is available for disposal of these items.[7]

Effects of E-waste on human health and environment

E-waste is highly complex to handle because of its composition. It is made up of multiple components some of which contain toxic substances that have an adverse impact on human health and environment if not handled properly that is if improper recycling and disposal methods are deployed. So there is a need for appropriate technology for handling and disposal of these chemicals. Basel Convention characterizes e-waste as hazardous when they contain and are contaminated with mercury, lead, cadmium, polychlorinated biphenyl etc. Lead affect kidneys, reproductive systems, nervous connections. May cause blood and brain disorders, sometimes may be fatal. Barium can affect heart muscle. Chromium can damage liver, kidneys and may cause asthmatic bronchitis and lung cancer.[2]

II. PROBLEMS FACED WITH EXISTING SYSTEM

The existing system has one way of collecting waste. It is offline which is done by government for eg. Waste material with all solid and liquid waste. The waste is then sent to garbage factories for further processing. From the overall wastage of Electrical and electronic equipment (EEE) material deployment and recycling of the wastage is less than 30%. Major need of the people is to make the E-Waste management process easy.

Limitations of the existing system is that maximum management of E-waste product is done offline so people suffers from inconvenience for eg. Many times people are not present at their homes when municipal corporation

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comes for E-waste collection because of miscommunication between the customers and the collection team and the work could not happen. Some online systems(website) are available but because of lack of awareness among people, they do not make use of it up to expected level.

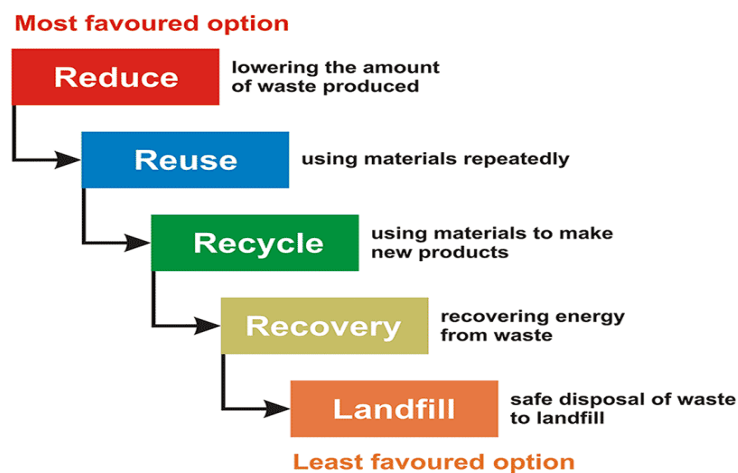


Fig2 :Waste Management Hierarchy[8]

III. PROPOSED SOLUTION

If an E-Waste is recycled properly it gives best economic values but because of the lack of the management it is not recycled according to different categories of the wastage.[10]So our aim is to develop an Android application this will act as an intermediary between customers and the recycling team for E-Waste collection. Process of online collection of an E-Waste from people, so that it can be recycled and reused by others(here NGO),which will help in reducing the generating rate of E-waste, and also achieve proper disposal of it so that we can keep environment green and healthy. we collectively refer as “E-Waste Management System”.

In this proposed system as we recycling and reusing the products and giving these product to NGOs for their well being, by doing this it contribute to our society Basically the proposed system is supposed to work in the area of Pune.According to THE INDIAN EXPRESS on 19th of December 2017 2.5 tonnes of E-waste is collected in one of offline collection drive conducted at Pimpri-Chinchwad Municipal Corporation PCMC in just 10 hours. Electronic Waste comprising of 900 kg of cell phone chargers and USB chords about 1000 cell phones including latest models of iphone, 17LCD screen, TVs a total of 50 CPUs and UPS and 21 monitors was collected within 10 hours of a pilot drive conducted in the jurisdiction of Pimpri-Chinchwad Municipal Corporation(PCMC). At the end of the day volunteers weighted in with more than 2.5 tonnes of collected waste. The search found the items as small as a button cell used in wristwatches to refrigerators, washing machines, air conditioners, microwave ovens, televisions, coolers, heaters, CPUs, Computer monitors, keyboard, pendrives, UPS etc.

The proposed system is basically a platform for providing an organized way of e-waste collection and management for more convenience. The main purpose of online E-waste collection system is to provide another way for the customer to giving the E-Waste material.

IV. GOALS AND OBJECTIVES

Objective:

1. The major purpose of proposed system is to build an android application to guide the customers to plan their e-waste material including material collection, transportation and treatment of E-waste in

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their city

2. To create an application to provide anytime service for customers.
3. This mobile application will be intermediary between people and recycling team and helpful for NGOs
4. Create social awareness among people.
5. To keep environment green and healthy.

Goals:

1. To provide anytime anyplace service for the customer
2. To reuse electronic waste material by recycling or deploy
3. To decrease the electronic waste material from household
4. To obtain statistic information about the problem effect by the e-waste material
5. To provide awareness about electrical and electronics material using for household

V. PROPOSED SYSTEM ARCHITECTURE

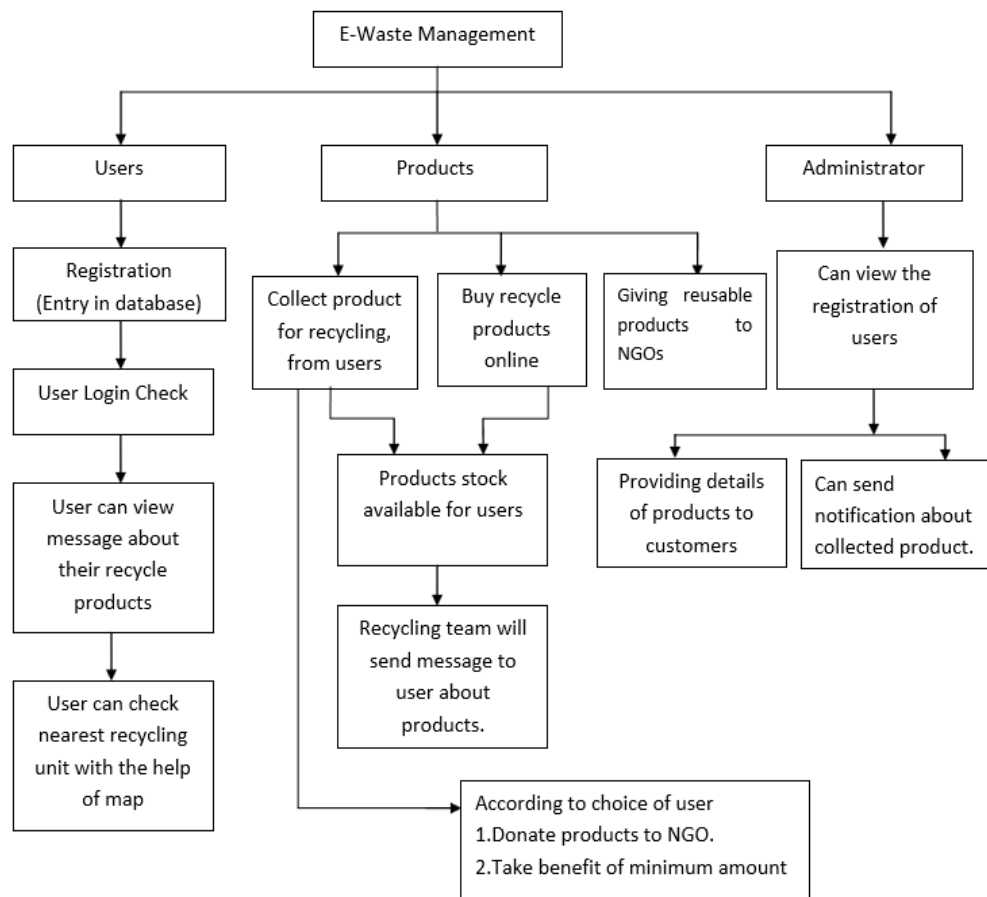


Fig 3: System architecture

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VI. RELEVANT MATHEMATICS ASSOCIATED WITH THE SYSTEM

$S = \{s, e, X, Y, F, DD, NDD, \text{Success}, \text{Failure}, \text{MEM}_{\text{shared}}, \text{CPU}_{\text{corecnt}}, F_{\text{me}}, F_{\text{freind}}\}$

$s \in S$

where

$s = \{s, e, X, Y, F, DD, NDD, \text{Success}, \text{Failure}\}$

$S = \text{Start State}$

- It is the initial condition of the e-waste management system application
- Initially the system will be constant
- Home page will be displayed which contains different tabs such as 'Home', 'About us', 'Admin', 'User', 'Product categories' etc.

$E = \text{Fexit-}$

- This will be finishing state of the e-waste management system application
- When user will complete its work of selling or purchasing the recycled product it will take exit from the application

$X = \{x1, x2, x3, x4, x5\}$

- x is the set of input parameters which will be given to the e-waste management system application
 - o $x1$ = user information (personal details)
 - o $x2$ = contact details
 - o $x3$ = product details
 - o $x4$ = payment details
 - o $x5$ = collection details

$Y = \{y1, y2\}$

- y contains the set of output values after x input data applied

Where,

- o $y1 = \text{Success}$
- o $y2 = \text{failure}$

- o $y1 = \text{Success}$

- This means that the system has successfully performed the users task
- The tests of the users may new user creation
- Or user has created a profile and user has sold some product
- Or user has created a profile and user is buying some product from the user

- o $y2 = \text{Failure}$

- This means that the system has not performed the task successfully
- I.e. Some error has occurred
- For e.g. user account creation failed
- Or for user logging in will not be done
- System crashes because of the crowd on the application/website

$DD = \text{Deterministic data}$

$DD = \{\text{product list, collection details}\}$

- Deterministic data contains the data which can be determined
- The list of product which are going to take or they want to give their e-waste for free

$NDD = \text{Non-Deterministic data}$

$NDD = \{\text{user personal information, contact details}\}$

- The user personal information like name, address can be non-deterministic information and also the information like address of the user, mobile number of the user

$\text{Success} = \{y1\}$

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- Data successfully classified
 - Product sold successfully
 - Product bought successfully
- Failure= {y2}
- Data not successfully classified
 - Incorrect data entries
 - Mandatory data fields are not filled

Venn Diagram:

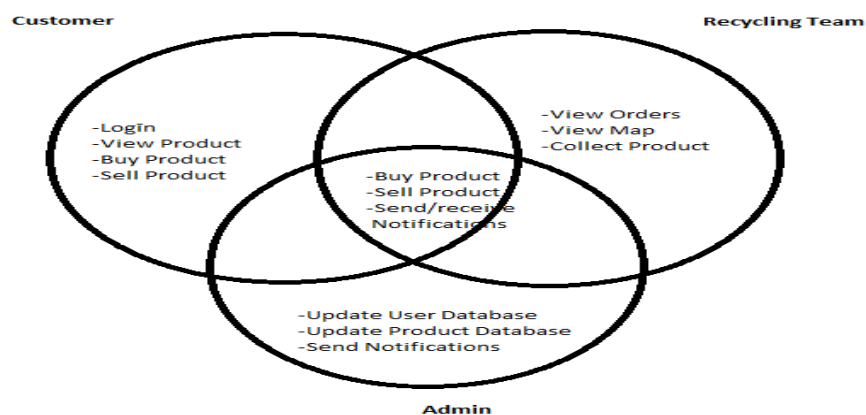


Fig. 4: Venn Diagram of Proposed System

Venn Diagram With Mapping:

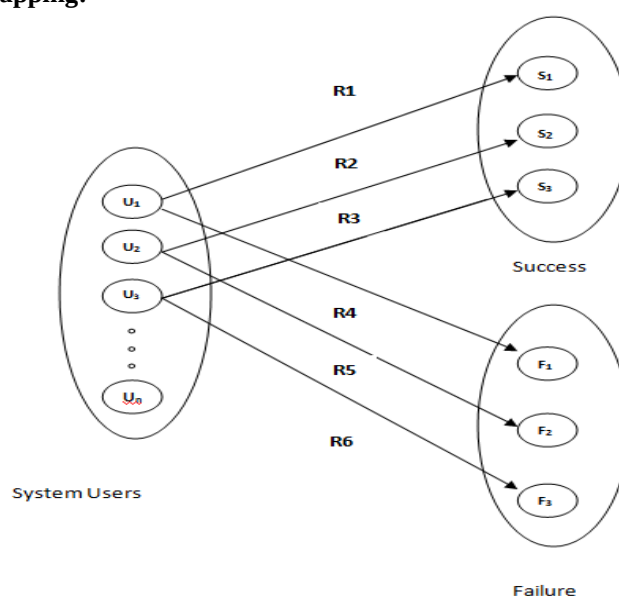


Fig. 5 : Venn Diagram with Mapping

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Where,

$U_1, U_2, U_3, \dots, U_n$ are users of system

S1, S2, S3 are successful functions and R1, R2, R3 are successful possible conditions

R1- Successful Login and Logout

R2 - Successful Login, Buy/Sell request is completed

R3 – Successful collection of E-waste is done by recycling team and notifications are provided on time

F1, F2, F3 are failure functions R4, R5, R6 are successful possible conditions

R4- Unsuccessful login of user because of wrong credentials matched

R5- Unsuccessful buy/sell request because of incomplete fields in the request page

- Mobile number is not equal to 10 digits

- Incorrect data Entries

R6- Unsuccessful collection of E-Waste because of incorrect address information filled in the request

VII. CONCLUSION

The proposed system will help the user by collecting the E-waste. Recycling team will reach to the customer location. System focuses on timely collection and delivery of E-waste material and ensures that collection is done in given time, by sending notification after every required action performed. The system guarantees buying and selling at lowest cost. E-waste is the fastest-growing part of municipal solid waste. By using this proper disposal process people can help to keep environment green and healthy. Also people can help to NGOs by donating their products. By deploying this application, online E-Waste collection, recycling and reusing process will be more efficient. System is also very useful for helping society.

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