

A FRAMEWORK FOR E-WASTE MANAGEMENT

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Abstract: The proposed system aims to be an effective and sustainable means of addressing the environmental problems caused by e-waste and to manage them in a better way. The existing management practices related to e-waste in India are reasonably poor and have the potential to risk both human health and environment. This includes used electronics which can be reusable, resalable, recyclable or disposable. A platform is created s towards assessing the present situation of e-waste management globally, considering the present regulations and guidelines. The developed web portal act as a platform for linking end users with recycling agencies in order to ensure proper disposal of E-waste. The end users will register E-waste products into the website. The agencies can view the product details. The quotation is sent by the agency to the user. Information regarding the electronic waste is gathered from the companies/organization and further analysis is done. It generates the report based on the analysis done on the E-waste. The statistical view of the generated report is shared among the agencies and the government organization. The analysed report is referred by the government and further steps for the management of e-waste is undertaken. This is designed to serve as a knowledge based on e-waste recycling with the focus on the needs of the developing countries

I. Introduction

Electrical and Electronic Equipment [EEE] contain valuable as well as hazardous materials. If these hazardous materials are not disposed in a proper manner, it may cause serious damage to the environment and public health. The average lifespan of electric and electronic equipment is becoming shorter, while the amount of related waste is rapidly increasing. E-waste has become one of the fastest growing areas of the international waste stream compared to other streams. The main E-waste sources are imports, public and private sector discards (over 70%), retailers and manufacturers, secondary market of old PCs; and individual Households[8]. E-waste is not hazardous if it has a safe storage or recycled by scientific methods. Some of the electronic waste product are Mobile Phones, Computers, Servers, Telecom, TV, Calculators, Audio, Scanners, Printers, Air Conditioner, Cartridges, Mother board, Alarm, Sensor, CD etc. There are new practices being adopted globally that will lead to the sustainable management of E-waste. Any substance which is of no longer in use, probably of any defect or end of life time, and those cannot be further repaired are termed as waste materials. The statistics of various countries E-Waste resources are:

[i] USA discards 30 million computers each year and 100 million phones are disposed of in Europe each year [5][9]

[ii] The Environmental Protection Agency estimates that only 15-20% of e-waste is recycled, the rest of these electronics go directly into landfills and incinerators [6]

[iii] An estimated 50 million tons of E-waste are produced each year in India. [7] [8]

[iv] China already produces about 2.3 million tons according to the 2010 estimate domestically. [6] [10].

WHAT IS E-WASTE?

Electronic waste, e-waste, e-scrap, or Waste Electrical and Electronic Equipment describe discarded electrical or electronic devices. The electronic industry is the world's largest and fastest growing manufacturing industry. During the last decade, it has assumed that role of providing a forceful leverage of the socio-economic and technological growth of a developing society "E-waste can be classified as any electrical powered appliance that has reached its end-of-life". Old electronic equipment that has outlived their useful life is categorized as e-waste. On an average, in India, in case of mobile phones the useful life goes up to 2 years. In case of PCs, it may go up to 5 years. The life of these equipment is extended due to reasons such as upgrade, repair and reuse, donation to charity, etc.

SIGNIFICANCE OF E-WASTE

E-Waste has raised concerns because many components in these products are toxic and do not biodegrade easily. Based on the survey conducted, the E-waste is disposed unsafely in the developing countries leading to an environmental and health problem. The two broad divisions on which studies are made every year is the limited information about the quality of E-waste materials exported-imported between the countries and the presence of hazardous substances. While the study[2] of Matsudo, Terazno, Stevel and Macaule is based on the former one; Reported by the Silicon Valley Toxics Coalition (SVTC) and Basek Action Network are based on the later. Matsuto studied the domestic attempts of recycling the used home electric appliances, focusing on the Home Appliance Recycling Law which states that , it is the responsibility of producers to collect and recycle the dead appliance. [2]

While global demand for these modern gadgets is increasing, policy to handle the increased volumes of electronic waste has not been handled correctly. Most people are unaware of the potential negative impact of the rapidly increasing use of electronic appliances. A major driver of the growing e-Waste problem is the short lifespan of most electronic products. The Information technology (IT) industry has been one of the major drivers of change in the economy in the last few years. These industries have contributed significantly to the digital revolution being experienced by the world. Studies so far revealed that e-waste generation in India has reached 1.7 billion tonnes in the year 2015-2016 and the fifth largest producer of E-waste. The study reveals that the US accounts for the highest share of india's E-waste imports, followed by china and the EU. While the US has a share of around 42%, china has around 30% and Europe, 18% [11].

The fig.1, shows the statistical view of the e-waste generated during the year 2011 and 2015 in India.

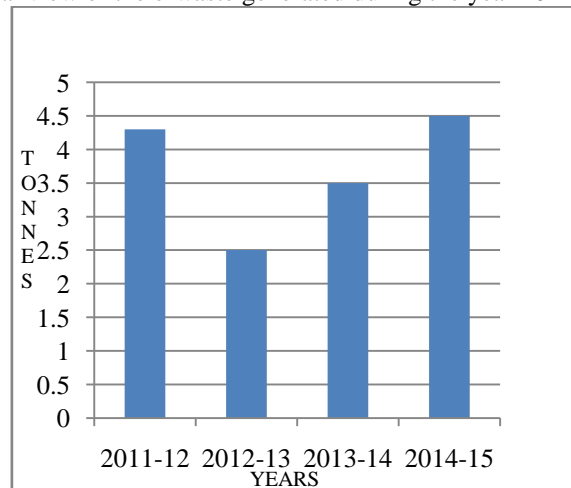


fig.1 E-WASTE generated during the year 2011-15 in India

II. Recent Study

While the world is advancing in technology day by day, developing countries like India are facing the problem of E-waste. Developed countries dispose their E-waste in India and in other Asian countries because of availability of cheap labour and resource where they are disposed of or recycled without taking the issue of health and environment into account. Problem faced by developing countries towards E-waste management are- The involvement of uneducated and untrained workers, most of the E-waste is recycled through informal recycling sectors. Existing laws do not supervise informal recycling sector which covers most of the recycling process in India and doesn't take the rehabilitation of the workers. Instead of focusing on health and environmental issues , people focus on profit making process. According to UN report India was the 5th biggest generator of E-waste in 2014 with 1.7 million tonnes of discarded electronic and electrical equipments[3]; It is estimated that E-waste in India is going to rise with 500% in 2020. India has surely emerged as the second largest mobile market with 1.03 billion subscribers, but also the fifth largest producer of e-waste in the world, discarding roughly 18.5 lakh[3] metric tonnes of electronic waste each year, with telecom equipment alone accounting for 12 per cent of the e-waste.

The Ministry of Environment, Forest and Climate Change (MoEFCC) has notified e-waste management rules, 2016. These rules have time covered under Extended Producers' Responsibility (EPR) of electronic producers. It has prescribed a waste collection target of 30% e-waste generated under EPR for the first two years (till 2016) and it will progressively go up to 70% in the seventh year of the rule. These rules also have prescribed stringent financial penalties for non-compliance. Debate continues over the distinction between "commodity" and "waste" electronics definitions. Some exporters are accused of deliberately leaving difficult-

to-recycle, obsolete, or non-repairable equipment mixed in loads of working equipment. Protectionists may broaden the definition of "waste" electronics in order to protect domestic markets from working secondary equipment. The high value of the computer recycling subset of electronic waste can help pay the cost of transportation for a larger number of worthless pieces than can be achieved with display devices, which have less scrap value. In a 2011 report[4], "Ghana E-Waste Country Assessment", found that of 215,000 tons of electronics imported to Ghana, 30% were brand new and 70% were used. Of the used product, the study concluded that 15% was not reused and was scrapped or discarded. In the existing system, Legal framework and proper collection system is missing.

III. Proposed System

The efforts towards E-waste management is highly increasing in developing countries but the proper handling model or system not yet been developed. There is no unique or ideal model for e-waste management in developing countries, which has its own specific environmental, technological, social, economic and cultural conditions. The existing system does not have any proper communication regarding the E-waste products with the recycling agencies. The E-waste management and monitoring is not systematic. The aim would be to reduce the generation of e-waste through smart manufacturing and maintenance, reuse till functioning of electronic equipment by someone else and recycle those components that cannot be repaired.

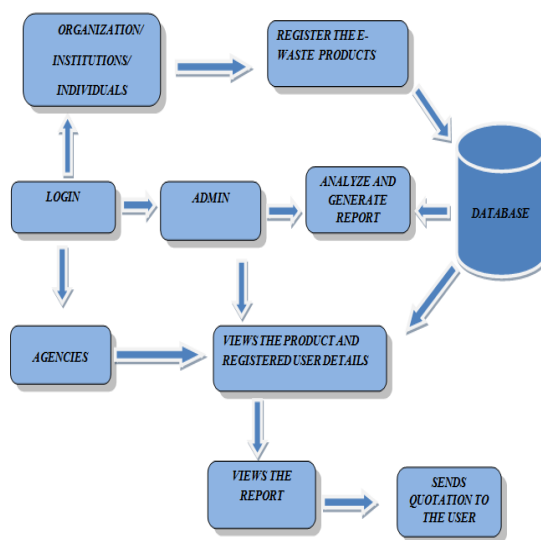


fig.2 Architecture Diagram

In the proposed system, a web portal is created that acts as an intermediate between user(IT corporate, recycling agencies, education institutions) and the recycling agencies. In the portal, all the corporate companies would register in the website with basic details. The users signup into the page or register with their details into the website. The information regarding the organisations is stored in the database. When the user login into the page, product icons(desktop, laptop, scanner, etc...) will be displayed along with the description of the product. The user can select the product which he wants to register. The e-waste products description are clearly mentioned by the organisations/user in the form generated. The information regarding each products are separately stored in the database. When admin login to the page, the user/organization who have registered the e-waste products will be displayed. The admin can view the details provided by the user/organization from the database. The admin categorizes the products as 1).RECYCLABLE2).REUSABLE 3).REDUCE (Scrap products). The report gives the detailed description about the products that includes, i)Amount of E-waste products ii)Description of the product iii)Product which can be recycled iv) Company details. The Statistical analysis of the report is viewed by the recycling agencies and further referred by the government officials. This system aims to manage the e-waste and recycling process. If the recycling agencies wish to take the products, they can send quotation to the organisation regarding the products, a report is generated by the admin. To deal with the increasing volume of waste electronic and electrical equipment, a recovery system is set so that the private users could return waste electronics to end-users and distributors for free. The product is set with code for tracking the product information. The factors associated with the product can be recorded on the product code.

IV. Implementation

The software and tools used for the development of this model are HTML, CSS, BOOTSTRAP, JAVASCRIPT, PHP, and XAAMP SERVER.

LOGIN AND SIGNUP MODULE

In the developed system, a web portal is created which act as an intermediate for the user/organizations who give away their e-waste products and the recycling agencies. fig.3 is the Home page of the web model developed that gives the description about the website. fig.4 is the signup page that is designed separately for the organization, user (residence/institutions) and recycling agencies.

REGISTRATION MODULE

Later the organizations/user register their products providing all the details asked in the registration form which is available when the product icon is selected. The products included in the list are desktop, laptop, keyboard, hard disk, pen drive, mouse, AC, Routers, Mobile phones, and so on. Fig.5 Product registration page that includes the following parameters: Brand (Hp, Dell, Lenovo), Make (India, China, Japan), RAM capacity (4GB, 8GB, 12GB, 16GB, etc..c), Quantity, Size and Product Id. The above details are the basic information gathered from the users. It varies from product to product. For example: Mouse, Keyboard, Routers includes the parameter- Type which can be wired or wireless. The mobile phones include the parameter- OS version. Once the user is registered into the website, then the user can submit the products any number of times. The same products can also be registered again.

AGENT MODULE

When the agent logs in, the list of registered users/organization are viewed along with the product description. If the agencies are interested in the products, they can view into the organization/user details. A tabulated report which gives individual product details is provided to agencies. fig.6 gives the details of product and user/organization details separately. The agent can contact users/organizations for further details.

REPORT MODULE

The admin views the registered user/organization and the recycling agencies. The admin can view the product details along with date and time. An analysis is done from the information provided by the users/organization regarding the products. Based on the analysis, a report is generated by the admin. fig.7 and 8 illustrates the view of the report. The analysed report is further viewed in different ways either as Table view or Chart view. The report is shared among the recycling agencies and government officials.

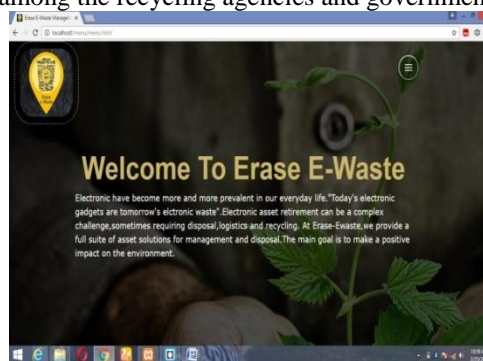


fig.3 Home Page

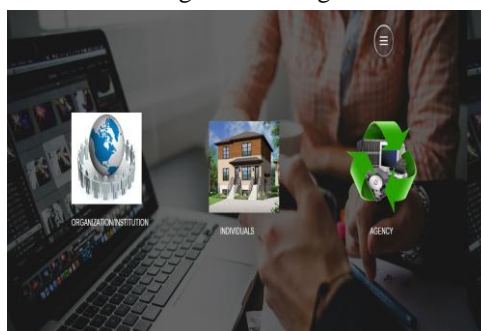


fig.4 Signup Page

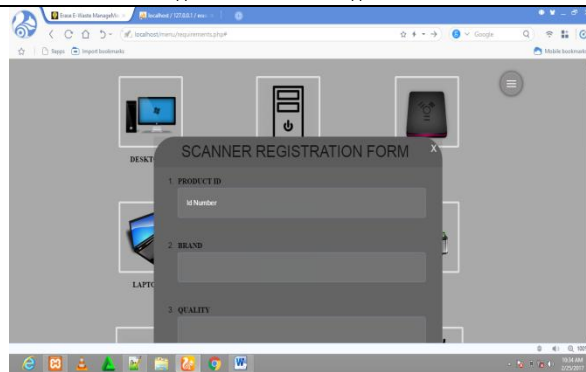


fig.5 Product registration Page

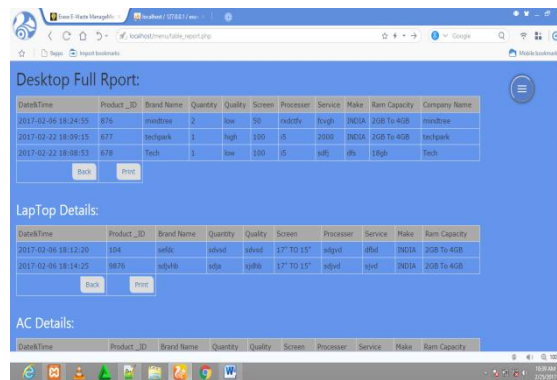


fig.6 Admin page

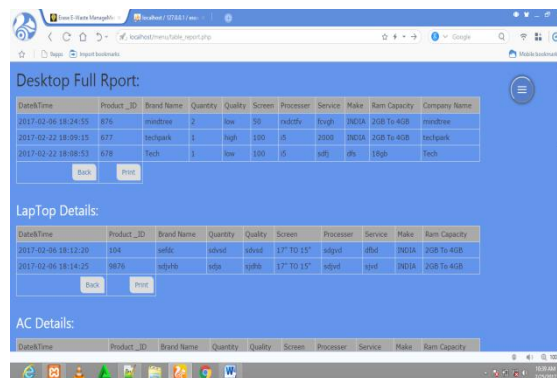


fig.7 Report Page (Table view)

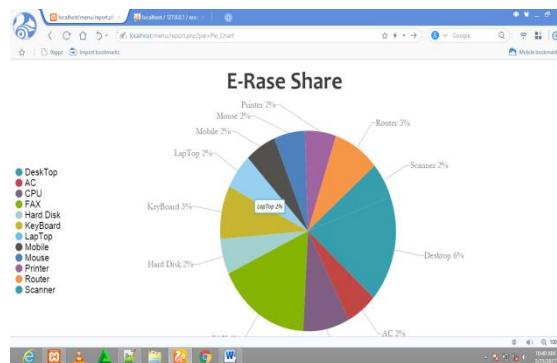


fig.8 Report Page (Chart view)

V. Conclusion

Among many, E-waste is one of the most deadly waste which has increased exponentially in very short span of time and if not regulated wisely may proved to be dangerous not only to human but entire species living on earth. Based on the report, Statistical (Graphical) analysis is done. The analysis can be made on individual organization or as a whole. The Statistical view could be in various forms based on the organization name, products..etc. The analysis report generated is shared among the government agencies. The report helps the government in eliminating the e-waste generated in India. Each individual has to cooperate with the government in order to keep the environment clean and green. Strict rules and regulations should be implemented regarding E-waste. This report is shared among the government to know the statistics of E-waste in our country and also helps in taking necessary steps to reduce them. This concept of sustainable development should be adopted to enhance our country to be a developed one in later years.

VI. References

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