Recognizing & Automating the Barriers of Plastic Waste Management – Collection and Segregation

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Abstract - *Plastic disposal and recycling are some of the most challenging aspects today. The different types of plastics developed these days and the addition of various additives to them to make them look more attractive and durable and thereby increase their demand in the market has made recycling of plastic very difficult. This paper discusses the various barriers that appear in plastic waste treatment and proposes a method for proper collection and segregation of plastic products via an Android application. The project proposed in this paper has both economical and social impact. With a proper collection of plastic waste based on different plastic codes, plastic will not end up landing in oceans and landfills which in turn will reduce environmental pollution.*

*Key Words***:** Plastic waste, Recycling, Collection, Android Development, Segregation

1. INTRODUCTION

Plastic products demand has incremented immensely over the past few years be it in food packaging products, toys or appendages due to its shiny appearance, durability and low price. But this plastic is ephemeral and the utilization is not environmentally amicable. The disposal of this plastic is one of the major areas to be taken into consideration today and this can be achieved by congruous accumulation and segregation of this plastic.

Collection and segregation of this plastic properly, based on plastic codes make it easy to analyze which plastic can be recycled and reused in future. Due to improper collection and segregation plastic ends up in landfills and oceans [1]. Plastic is either directly dumped in landfills or is burnt before dumping which causes pollution. Also, dumping in oceans creates a problem for aquatic life. This paper discusses a method by which proper collection and segregation of plastic based on plastic code can be initiated through the use of the Android application. Also, the paper raises points like the harmful effects of plastic, various barriers that appear in plastic recycling and different types of plastic and their usage.

2. PLASTIC IN PRODUCTS

In today's era, plastic has become a crucial part of our lives. Due to the handy and low-priced properties of plastic, it is used in various fields ranging from industries to households and so on. Statistically, it is true that the demand for plastic has increased with the growing need for humans. There are many types of plastic that are used in various industrial products. In beverages and sand packaging foods, Polyethylene terephthalate (PET) is used which can affect potential human carcinogen. In fibers and textiles Polyester (PES) is used and can cause respiratory tract, eye irritation and acute skin rashes [2]. In cutlery, throwaway cups, CD, packing foam, food containers and plastic tableware, Polystyrene (PS) is used which causes inflammation to the throat, dizziness and unconsciousness [3]. In flooring, shower containers, plumbing pipes, films, window frames, Polyvinyl Chloride (PVC) is used and can cause loss of vision, skin diseases, chronic bronchitis, liver dysfunction, deafness and often lead to cancer [4]. In milk bottles, detergent containers, insulating moulding, pipes and tubes, High- density polyethylene (HDPE) is used and can cause changes in human cells structure due to estrogenic chemicals release [5]. In traffic light, riot shields, construction materials, eyeglasses, compact discs, security windows and lenses, Polycarbonate (PC) is used and can cause insulin resistance changes, alteration in brain function and liver function due to leaching of bisphenol-A [6].

3. HARMFUL EFFECTS OF PLASTIC

Plastic waste is an ecumenical quandary, but with regional variability. Plastic has numerous advantages such as resistivity, stretchability, cheaper rates, lightweight and reusability to some extent [7]. But the main concern is that plastic is discarded just after its use. Due to the materialistic properties of plastic, it can sustain in the environment for a longer time and can cause a hazardous effect. The random throwing of plastic sometimes can get consumed by the animals wandering in streets or yards which can deteriorate their health. Not only the persistency of plastic in the environment is dangerous, but also during the manufacturing of plastic, the industries release an immensely colossal amount of perilous gases in the atmosphere such as carbon dioxide (CO_2), hydrogen cyanide

(HCN), carbon monoxide (CO) and so on [7]. The availability of such gases in the atmosphere has an adverse effect on human and animal health. Also, when plastic is recycled or broke down, methane gas is relinquished, releasing greenhouse gases and thus significantly contributing to global warming [8].

Another problem that arises due to the disposal of plastic is its decomposition in landfills. The current way of dumping plastic waste implicatively insinuates an unchangeable loss with respect to precious raw materials and energy. The insufficient burning of different types of plastic during the thermal utilization process emits hazardous chemical gases such as carbon monoxide, dioxins etc. Sometimes plastic is also dumped inside the sea or oceans, due to various environmental anomalies it moves to the surface of the sea and can cause severe hazard to surface feeding and sea feeding creatures [9].

4. CHALLENGES DETECTED

In Today's technologically led and industrialized world, Plastic has become an essential part of everybody's lifestyle. It has managed to penetrate and blend into people's lives so well that it seems impossible to pull it off. According to the report submitted by the central pollution control board (CPCB) India, the nation dumps roughly about 26k tons of plastic waste every day. The figure estimates show that per annum about 9.4 million tonnes of plastic waste is generated, out of which approximately 5.6 million tonnes are recycled annually (which accounts for 15,600 tonnes of waste every day). Thus, the figures show that 3.8 million tonnes per annum of plastic waste are left uncollected or littered, [10] which can be mounted to 9,400 tonnes of waste per day [11]. Further, Plastic being a non-biodegradable product, researches show that it persists in the environment for as long as 4500 years. Plastic production is estimated to escalate at the rate of approximately 3.8% every year till 2030 worldwide [12].

India currently ranks at the 15th position globally among the biggest plastic pollution causing nations which implies nearly 11 kg per capita plastic consumption. With the growing consumer needs and plastic being the most efficient and cost-effective solution for varied industries, the rate is expected to rise "to 22 million tonnes per year by 2020 from 13.4 million in 2015" [13].

"Fig 1" shows the plastic waste generation in different states of the nation indicating state wise share in terms of the large amount of waste being generated. Plastics are extensively used in manufacturing a variety of products ranging from beverage and food containers, household products (utensils, bags, toothbrushes and many more) and the packaging industry, to several fibers and textiles as well. The use of Plastic has increased tremendously and today it has become a considerable part of municipal solid waste. Hence, there exists a dire need for proper plastic waste treatment techniques.

Fig. 1. State/UT wise plastic waste generation

Source: CPCB Annual report 2018-19 on implementation of plastic waste management rules. [14]

The primary requirement for any of these methods to yield successful results lies in proper collection and segregation techniques. According to a study carried out by the government of India, the practice widely being followed in India for the collection of plastic waste is via municipal and privately hired vehicles. The process involves people collecting waste (biodegradable and plastic waste -all mixed together) in bins at their residence or organizations which is accumulated on a daily basis. The waste loaded into vehicles or hand-held by a group of people finally ends up in landfills [15]. Apart from this some of the industrial plastic waste collection schemes involve:

- Kerbside collection of plastic solid waste is one of the most widely prevalent methods. It involves people participating in a way that they are requested to separately collect plastic and metal waste from the other organic waste. This is then collected on a regular basis by municipal or municipally-contracted workers [16].

- Bring point collection methods/Drop-off involves assigning different containers for different types of waste, say organics, paper and plastic. Containers are generally placed near the residential areas but throughout the community, such as parking lots, schools, or other such public spaces. People are expected to discard their wastes at these locations. Since, the method requires people to showcase their responsibility towards the environment and technique, the method experiences low or unforeseeable throughput [17].

- Buy-back containers. The method is quite alike to the drop-off collection systems, except for the fact that it attracts higher mass attraction because of the economic incentive it offers. Citizens are expected to collect their waste in a segregated manner which is then bought – back based on the market value of waste generated. e.g., PET bottles. The system is widely operated by private companies and infrastructure set-up usually in public spaces such as supermarkets [18].

- Deposit programmes directed at reducing pollution seeded by plastic waste and thus encouraging the citizens to give back their reusable containers. The program involves people making an additional monetary deposit whenever they buy any plastic product. The same is refunded to the person in full or partial amount when they bring waste back to the seller. The so-called reverse vending machines have begun being set-up in India and many of them can be seen on the streets of Delhi [19, 20].

According to a report relinquished by Grant Thornton in 2019, the current plastic management systems are inefficacious in dealing with the tonnes of plastic waste being engendered on a circadian substratum [21]. Accumulation and Segregation are the initial steps and one of the most crucial checkpoints as a different kind of plastic calls for a different treatment process. People often end up integrating all kinds in the same bins, which often leads to tainting of accumulated plastic. This further result in incremented expenditure on recycling or any other treatment process

Fig -2: 'Application Design-Home Screen'

5. PROPOSED PROCESS

The plastic treatment processes are astronomically immense tasks as it involves a great setup, hence it is essential to categorize the waste at the source itself. Research shows that the overall efficiency of the waste management system is incremented by 76 per cent when the sorting is done at the source itself [22]. Sorting plastic at the source has addictive benefits of ease of conveyance and making it available for the correct plastic treatment process. Withal, since the current plastic waste accumulation and segregation techniques have proved ineffective, an android application solution is proposed for the same task.

India is becoming a digital country, and people are making an effort to transmute everything to digital. Hence, an Android Application is proposed to digitize the method of plastic amassment and segregation as well. The platform offers widespread reach as it can connect to the masses. Concurrently, incorporating the supplemental feature of paying back to its users by the expedient of e-coupons, the application holds the great facility to magnetize astronomically immense-scale attention. Further, it spreads cognizance among the users regarding the variants of plastic waste and their ways of recycling.

Fig -3: 'Encashed coupons Screen'

6. APPLICATION DESCRIPTION

The application is developed on Android Studio, which allows a portable work environment by providing an integrated development environment (IDE) for the Android's operating system, predicated on IntelliJ CONCEPTION software and outlined for Android development [23]. Android is an open-source and Linux-predicated operating system for mobile contrivances such as Smartphone's and tablet computers.

On opening the application, the utilizer is redirected to an Authentication screen, which offers a simple and secure authenticate operation. The application fortifies various accommodation domains such as google, yahoo, perspective, and so on. The platform additionally sanctions the users to view the interface without engendering an account. "Fig. 2" The Home Screen is a consummate user-friendly interface that edifies the utilizer about differing kinds of plastic and the products of each type circumventing us. In order to make a give-away request, people can integrate a particular kind of plastic in their Trash bin and can arrange for a pick-up or drop schedule that suits them best. "Fig. 3" As they do that the respective e-coupons are integrated into their account

which can be redeemed as and when required. Further, is out of the scope of this paper and would be presented in other work.

7. CONCLUSIONS

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