

**A STUDY OF THE REASON OF THE GARBAGE PROBLEM IN SRI-LANKA AND A PROPOSAL
FOR A SYSTEM TO MANAGE WASTE THROUGH RECYCLING.**

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Abstract

Management of the generated solid waste has become a major issue in Sri-Lanka and is highly affected by the swift expansion of urbanization in the present society. Fast development of population has prompted a proportionate increment of wastage and the nature of this waste has differed enormously with the multifaceted nature of the mechanical advancements. According to the estimations presented by Pressreader.com (2018), the solid waste generated per day per capita in Sri-Lanka is 1-0.4 kg. But waste management authority states that local authorities collect only around 50% of this garbage produced. The western province itself is considered to be responsible for more than 60% of the waste generated nationwide. The recent calamity at the Meethotamulla dumping site is one of the best examples for an affliction of improper waste disposal. There are a number of recycling companies in Sri-Lanka, recycling a variety of items such as batteries electronic equipment and plastic bottles. But unfortunately major portion of public is unaware of the presence of such companies. Everyone from individual households to commercial entities should be accountable for the waste produced by them and if dealt with appropriately this waste can be a beneficial operation. The main aim of this project is to bridge the gap between the waste generators and the various befitting methods of waste disposal present and make the society knowledgeable of the little known recycling companies in Sri-Lanka through a user friendly IT solution.

Keywords: Waste management, Recycling companies, Sri-Lanka, Waste generators, Disposal

Introduction

The facilitation of Waste management depicts an intrinsic part of guaranteeing a secure and healthy atmosphere. Recycling is often thought of as one of the principle methodologies of successful waste management. Accordingly, some platforms have already been created to connect the waste generator with the recycling companies in a number of other countries and the need has emerged in Sri-Lanka to step up with regards to developing such a solution as well.

For a productive implementation of the proposed course of action the setting of waste management in Sri-Lanka ought to be examined. According to Visvanathan, C. and Trankler, J. (2003), uncontrolled and unmonitored urbanization due to rapid economic flare through industrialization of developing countries in Asia prompt the formation of severe problems related to issues in waste disposal.

Sri-Lanka is an island nation with a land area of 65.610 km² and hosts a gross population of 20 million as of 2018 based on the recent evaluations done by United Nations.

The Gross Domestic Product (GDP) rate in Sri Lanka averaged 5.88 percent from 2003 until 2017. (Tradingeconomics.com, 2018). This lively financial development which has enhanced the expectations

for everyday comforts of citizens enabling them to their revise their pattern of utilization of products has seen relative increase in the per capita waste generation.

Physical characteristics presented by waste impact the feasibility of their particular treatment option significantly. Therefore, it is important be have an understanding about the composition of waste in Sri-Lanka in order to figure out the best methodologies to dispose of this waste.

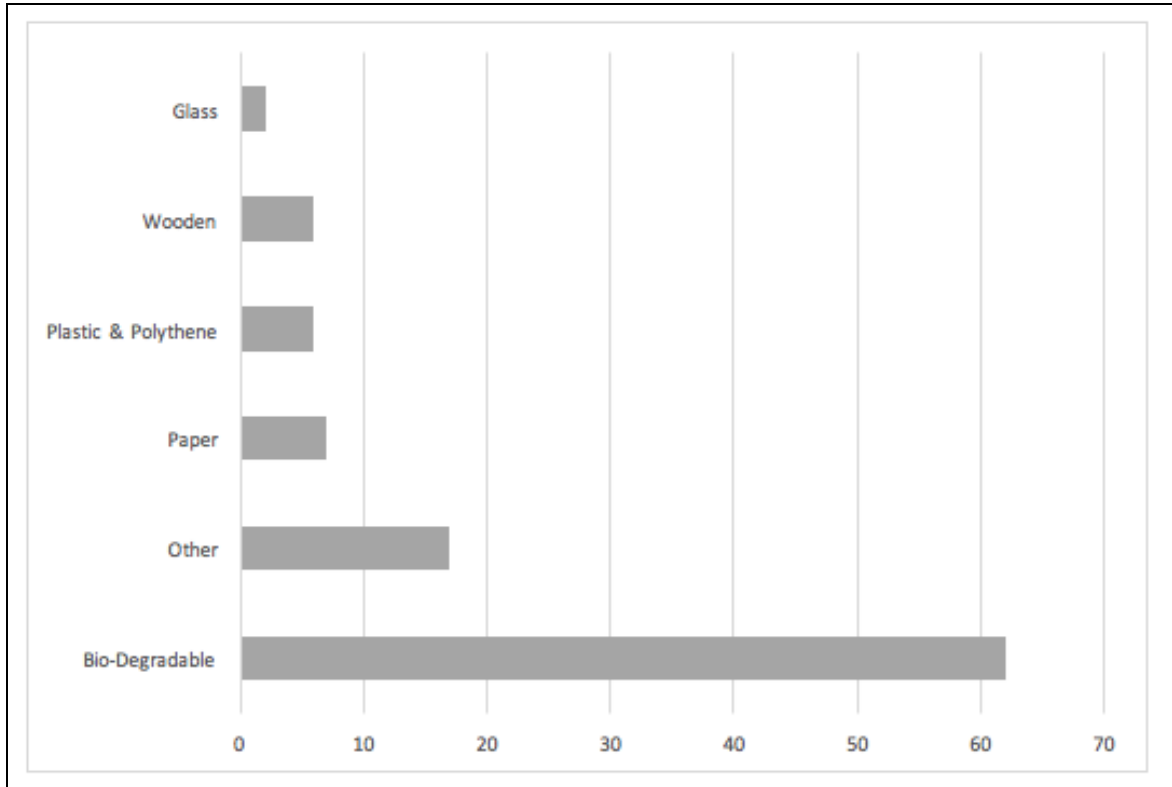


Figure 1: Average waste composition in Sri-Lanka as percentages (source: Unescap.org, 2018)

This graph depicts that even though the highest percentage is bio-degradable waste there is paper, glass and plastic waste as well as other types e.g. E-waste to a level that is surely not ignorable.

Problem Domain

In order to provide a basic overview of the purpose of this analysis, we could say that it aims to present solutions to the subsequent problems prevailing within the country at the instant.

- Improper disposal of garbage.

Throwing away of garbage to unsuitable places and adding non-degradable items to the surrounding causing environmental pollution is one of the major issues grasping the nation at present. Also there are certain items which shouldn't be reused at a domestic degree or decomposed by any regular means, but individuals are not aware of those items and this paves the way for perilous conditions in both humans and the environment caused by the toxins released in those course of actions.

- Most of these problems are created due to the lack of awareness among the general public about acquiring the maximum advantage of the recycling companies present in Sri-Lanka.

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Data about the recycling companies and licensed waste collector in Sri-Lanka are scattered over the web and there is no link between each of them. So except if somebody does a thorough search particular to those companies, it is unlikely that they come up in a casual search. There is also a chance that those precious companies might shut down in the future due to the deficit of circumstances for them to run.

Current solutions provided in Sri-Lanka in terms of waste management.

Up to now Sri-Lanka by CEA (Central Environment Authority.), Municipal councils, NGOs, waste management authorities, etc. has initiated a number of waste management programs island wide

Following could be cited as a couple of examples for those campaigns.

In 2017 Sri-Lanka's Local government ministry Launched a hotline in co-operation with provincial councils, which enabled the public to make complaints about the garbage collection in Colombo Municipal area. To address those complaints a special contingent called "National Task Force for Management of Waste" has been set up by the Ministry. This unit involves an environmental police unit and tri-forces.

Introductory comments for this scheme has been positive however as of late the rubbish accumulation has been ignored for a considerable length of time in the areas and also problems have been arisen in reach by means of the hotline and plastic not been gathered at all. (Lanka Business Online, 2018)

The surveillance officer in control would take steps to send a picture of a garbage pile and a message via social media to the relevant authority if the garbage isn't collected continuously. The main issue here there is no framework associating all the activities and enabling people to identify with service providers other than the hotline and the segregated social media messages through a third-party.

Accumulation of solid waste and disposal is presently dealt with by the health division of municipalities. The collected items only include, household waste, street sweepings and light commercial waste (Bandara, N.J. and Hettiaratchi, J.P.A., 2010).

Another example for waste management activities initiated in Sri-Lanka is the Public-private partnership for municipal solid waste management by "INSEE Ecocycle" for in co-processing "segregated non-recyclable plastic, polythene waste since 2014 in Gampaha and Kurunegala districts (Pressreader.com, 2018).

A committed part in waste management in Sri-Lanka is also portrayed by various NGOs'. One such example as given by Visvanathan, C. and Trankler, J. (2003), is the work carried out by "Seth Sevana" NGO encouraging 1,280 families in the area of Moratuwa to separate waste at their households and establishing small-scale composting units. The same authors also point out the engagement of Abans Environmental Services by CMC (Colombo Municipal Co-operation) to handle fifty percent of the waste collection of the city

But as stated by the Environment Foundation (Guarantee) Limited. (2017) while the general public could hand over the recyclable waste to either collection centers or recycling unit straightly, whatever that won't be prepared in that frame ought to be assembled and arranged as isolated waste with proper management techniques.

they called attention to the fact that the gap between local recyclers and waste generators should be filled by making the operation more reachable by the citizens and polythene, plastic, electronic recycling enterprises in Sri-Lanka should be encouraged

Waste management models and theories.

According to Visvanathan, C. and Trankler, J, (2003) the most well-known strategy for waste disposal in developing countries is the environmentally harmful method of open dumping. 85 percent of waste in Sri-Lanka is disposed by means of open dumping. As recommended by the author some waste disposal methods which are consistent are,

- Landfilling
- Incineration
- Composting

But also Karunarathne, Lakshi. (2015) expresses that Integrated Solid Waste Management (ISWM) is a strategy that is most reliable in leading to an environmentally sustainable evolution.

This methodology comprises of the following procedures,

- Recycling and Composting
- Waste prevention
- Disposal (landfilling and combustion)

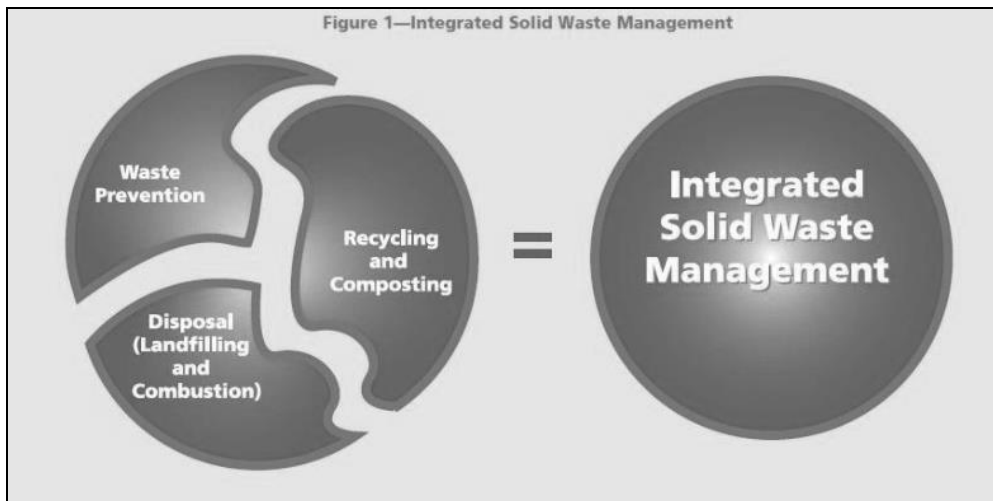


Figure 2: Integrated Solid Waste Management (source: Karunarathne, Lakshi. 2015)

This procedure permits the recognizable proof of the levels at which the most noteworthy estimations of individual and aggregate materials can be rescued. Given is an aggregation of different methods expressed by various case studies.

Composting

Composting helps to quantify the amount of garbage that has to be disposed, notably reducing the probability of pollution and volume of the residual waste for landfilling. Even though there are no large-scale commercial composting plants present in Sri Lanka, a number of local authorities (such as Weligama, Balangoda, and Bandarawela) have been successfully conducting their own mini composting plants for a certain time period (Gunaruwan, T.L. and Gunasekara, W.N., 2016).

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Landfilling

Attaining a controlled, engineered landfill with a minimum amount of environmental pollution and health risk to the community ("sanitary" landfill), can be a step to step procedure based on the financial state of affairs of the authorities. Such a step-wise advance should be aided in standards and legislation for landfill disposal (Pfammatter, R., Schertenleib, R., 1996). Bandara, N.J. and Hettiaratchi, J.P.A. (2010) points out that although a sanitary landfill had been proposed for the Greater Colombo Area, it had not been implemented owing to public opposing the siting of the facility.

Waste prevention

Additionally, called source reduction, presents the concept of keeping waste from being created. Less bundling, planning items to last more, and reusing items and materials are few examples for the processes followed in waste prevention initiative. Waste prevention helps reduce handling, treatment, and disposal costs (USEPA, 2002)

Recycling

An example for government joining with commercial business entities to carry out waste management procedures is the co-operation of fourteen private sector companies (e.g. Mobitel, Telecom, Etisalat, Abans, Virtusa, Metropolitan) with the CEA to launch an e-waste a management program. "Geo-cycle" and "Green Link" play the role of service provider, collecting e-waste in Sri-Lanka (De Silva, D.D.R., 2017). The importance of recycling activities is emphasized in the reduction of the volume of waste, in the recovering of resources and the economic benefits of recycling are being recognized.

Factors which influence citizen participation in waste management by connecting with recycling company initiatives.

Similar to the circumstances of many of the developing nations, local authorities in Sri Lanka haven't yet succeeded in providing the necessary levels of waste management services. At present, only part of the waste stream is collected by local authorities. (Menikpura, S.N.M., Gheewala, S.H. and Bonnet, S., 2012). As communicated by Ranasinghe, P. (2017) in connection to the shocking calamity of Meethotmaulla, the lack of ability of the relevant authorities to take proper actions in tending to the affair of Solid Waste Management (SWM) at hand with more practical arrangements is mostly a result of the erosion in the political culture of Sri Lanka which is supposedly the dragging force of the power of issues in the country.

This would dishearten citizens to further take part in activities of government and cause them loose the trust they have placed in the local authorities.

More frequently, well-off residents use part of their income to avoid direct involvement to the environmental issues at a nearby to their domiciles, and the issues are moved away from their neighborhood to somewhere else.

Municipal authorities are obligated to assign their lacking monetary assets to the zones of higher tax generation where more affluent locals with higher political power reside (Zurbrugg, C., 2002). This results in open dump sites being created near individuals who are less capable of protesting to them or taking necessary actions to prevent such activities taking place.

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The social obligations of individuals are critical in waste management. As per to UNEP-IETC (1996) Watchfulness and peer pressure of citizens is then also essential to observing strong waste administration exercises.

The absence of inspiration of people through any prizes or advantages could lead low-level of co-activity or enthusiasm from the general public. Such views are expressed by Minn, Z., Srisontisuk, S., Laohasiriwong, W. (2010) that there is no inspiration for individuals to assume their normal part.

On the off-chance that specific people are perceived through media like daily paper for their commitment towards a proficient waste administration in the arrangement, at that point this could draw in new clients while spurring existing clients of the IT solution.

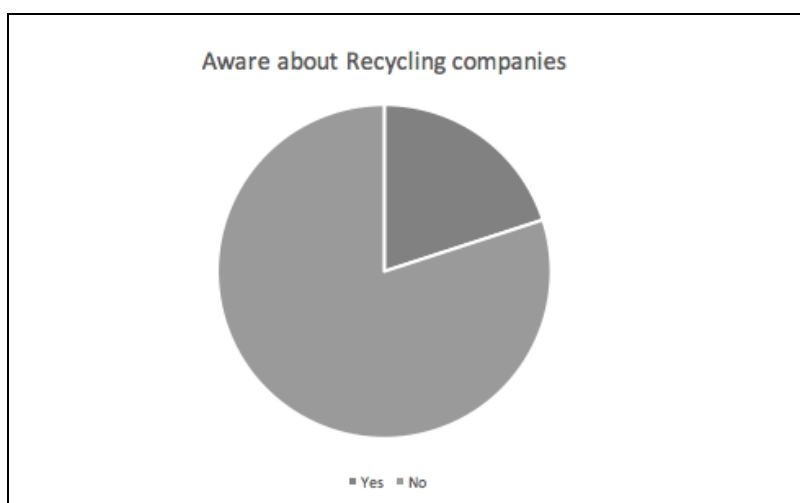
“The Tragedy of the Commons” is a situation wherein shared-resource system individual users act in an independent manner contrary to the overall benefit of every user. Considering a scenario where one individual feels that since everyone else will be properly disposing of garbage, it is fine that if he neglects it and yet if each and every individual thinks this way, collectively there will be a whole nation disregarding proper garbage disposal and then it would lead to a major issue.

The amount of knowledge perceived by individuals also affects the way they respond towards the waste management. So it should be ensured that each and every individual is well aware of proper disposal methods for particular items as well as the harmful effects of failing to carry on these ethical procedures particular to the item.

Factors which influence the collaboration of the recycling companies with the proposed initiatives.

The other primary stakeholder party affected by the presented solution is the recycling companies. Therefore, in order to ensure the maximization of the involvement of recycling companies we should deliberate on the factors that would affect their decisions leading to the collaboration with the solution presented.

According to most of the case studies, the lack of recognition received by the recycling companies’ and license waste collectors at Sri-Lanka puts them at a major disadvantage. Even based on the surveys conducted among 50 people, only 20% were aware of the existence of recycling companies, while none of them have made use of them.



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Figure 3: Awareness of Recycling companies

This emphasizes the fact that recycling companies need to receive much more recognition from the society for their betterment as well as to improve the living conditions of the country.

Another affecting factor is the activities carried on by scavengers. Those informal waste collectors are not an uncommon occurrence in most of the areas of Sri-Lanka, and most people who gladly get rid of their waste burdens without pausing to give a second thought about how they are processed. Those waste collectors may directly sell them to recycling enterprises, which wouldn't present a problem, but also some might decompose them or sell them to unauthorized decomposers who might try to recycle them in harmful manners. This not only leads to problematic environmental conditions but also reduce the opportunity for the recycling companies interact with the public. If the recycling companies were to be more well known, then the waste picker activates could be more formalized and have them directly report to the companies.

Identifying the issues

Before we move onto describing the solution this section identifies the problems that needs to be addressed by the solution.

Although recycling companies exist there are several reasons that prevent the garbage generators from utilizing their services, some of them are the lack of awareness about the recycling companies and the lack of ways to contact the suitable recycling companies. It should be highlighted that a major reason that prevents the general public from accessing the recycling companies is the unavailability of an efficient system that allows coordination with the recycling companies.

On the other hand, we could also consider the reasons why the recycling companies do not directly collect garbage at a domestic level. The scale of garbage produced at the household level would not generate profit that would exceed the cost of the journey made to collect this debris and the cost of recycling the material. Also, there is no definite manner to identify and confirm the locations and times of waste pickup. This points of the absence of a system for them to connect with the generators of trash. Considering the garbage collector to be a middleman between the company and generator, it won't also be profitable for them to collect garbage from a single home, nor would they have a proper contact point.

Proposed Solution

By considering all the factors presented above, the following solution could be presented as a stepping stone for an effective waste management system through the promotion of recycling.

The focal point of this undertaking will be on building the citizens' understanding about proper garbage disposal and veer off from the traditional approaches of waste disposal to connect with local recycling companies.

The solution will host various methods of waste disposal ranging from household decomposition, recycling at domestic level to connecting with recycling companies. On the other hand, this application also permits the recycling companies to carry out a cost-benefit analysis of the waste collection requests they receive.

One of the crucial reasons of the project is to advance the promotion of recycling companies and authorized waste collectors in Sri-Lanka and to maximize profit generation of the said companies.

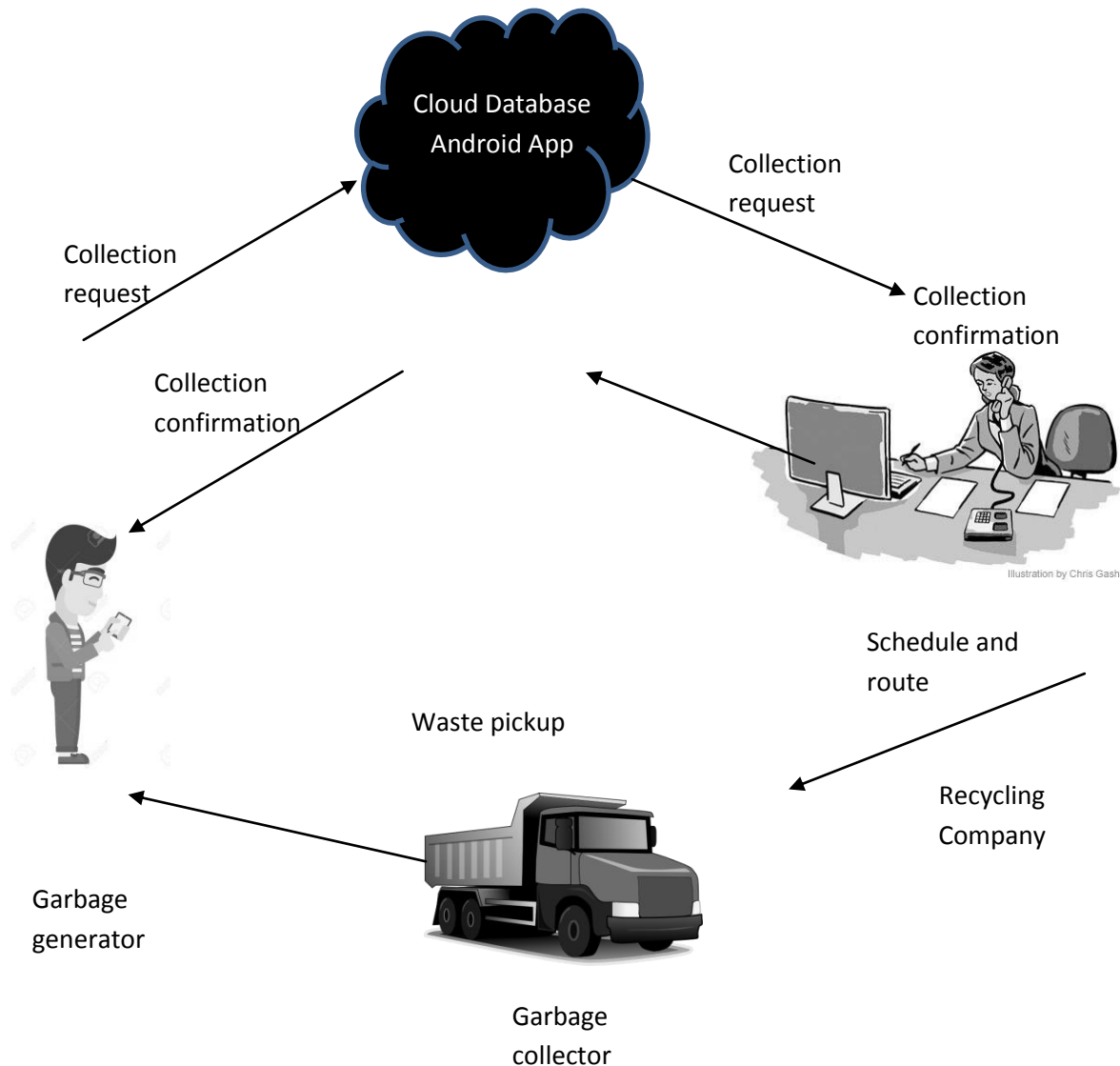


Figure 4: Main process of the proposed solution

There will be three main actors in the proposed system. The garbage generator, garbage collectors (employed by the recycling company or a middle party which collects the garbage from the generator and deliver them to the recycling company) and the garbage recyclers (recycling company). The garbage generators are the civilians who generate various types of waste as a by-product of their daily activities, this also includes commercial business entities and manufacturing companies which produce industrial level reusable waste.

The garbage collectors are the recycling companies, who collect the garbage or an individual a collector who acts as a middle party coordinating between the waste generators and the companies

The recycling company carries out initial analysis and request processing when the garbage collection request is received and recycle the trash into some meaningful reusable product or as a raw material after the collection of the garbage.

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Each one of those actors will have a different role and a different set of problems they intend to solve. For example, the garbage generator wants to quickly dispose of the refuse. With garbage, their primary motive won't be profit, but it would be to get rid of the waste before the next health inspection occurs or getting the litter or the unsanitary items removed from their surrounding environment as soon as possible.

Recycling companies want to make a profit out of the waste if they are private companies. The waste collection and disposal initiatives of Municipal councils are of course non-profit. The recycling companies feel the need to minimize their operational cost and use the optimal path in-order to make every journey for garbage collection a profitable one. So within a single journey, they want to collect the maximum amount of detritus.

Garbage collector and even the waste recyclers of the company are the people whose livelihood is the wages obtained from the collection and recycling of the waste material. Therefore, they possess an aim to make the maximum profit out of each gram of refuse.

Going into in-depth details about the proposed solution we can state that it is developed in the form of an android mobile application and a website. The mobile application will be mainly for the ease of the use of the garbage generators and if they do not want to keep an application downloaded to their mobile phones they can refer to the website. The mobile app will also aid the garbage collectors to check their schedules and optimal routes. On the other hand, a website would be useful in the operations of the recycling companies. The solution will be featured as an application and a website based on minimalistic designs which are easy to navigate and understand the flow of attributes. The system will cater to the needs of each one of those people and will address their concerns in a unique manner

To ascertain whether the garbage contains any non-recyclable items image identification software will be used with Artificial intelligence capabilities. Such software will detect the particular type of garbage that is present. For example, the software is expected to identify plastic bottles. Software with such capabilities can be found in API (application programming interface) like www.einstein.ai

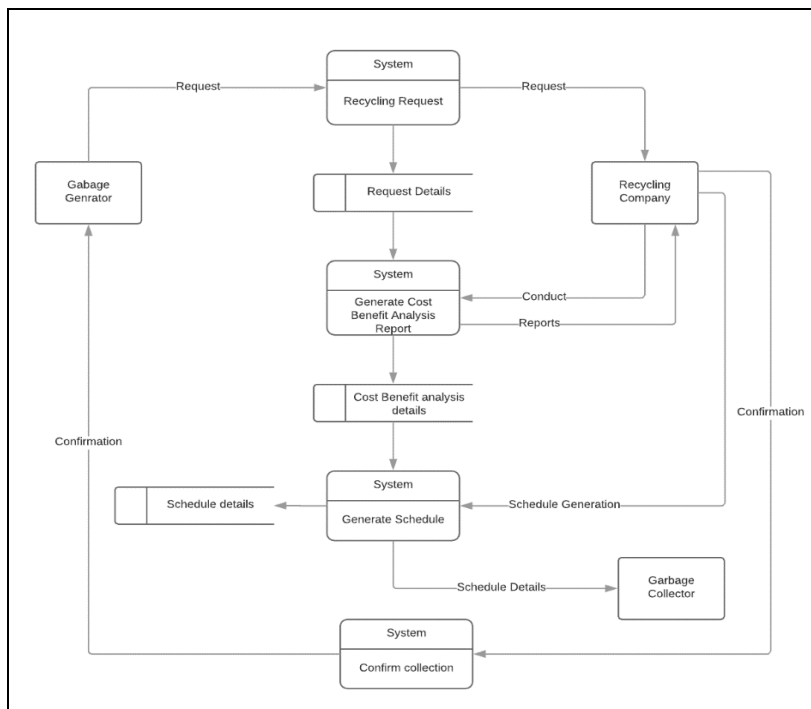


Figure 5: Data Flow diagram of the main process of the system

System flow

The proposed solution allows the garbage generator and recycler and garbage collector to register in the system. With their location traceable through a GPS in their phones. Once the garbage generator senses that there is enough garbage to be disposed he is able to take a picture of the system which is analyzed by the system to determine the kind of garbage that is present. The garbage generator is also able to enter the details. This system then signals a garbage collector who is in close proximity. This could be a stationed vehicle or a vehicle that is on the moving and is in the vicinity. The collector then comes picks up the garbage and then gives it to his nearest recycler again recommended by the system. The garbage collector is able to pick the recycler depending on the amount they pay for each KG of garbage. The collector then supplies the garbage to the recycler and gets his payment.

The payment can be made immediately or through the system where against the garbage collector account is credited with the amount that is due for the garbage that he provided. In the event that collector and recycler are the same then this option can be made redundant. The garbage generator also gains some points in the proposed system where it can be used as nominal monthly or annual payment by the garbage recycler.

Conclusion

In this study, we looked at the Garbage issue that is affecting Sri Lanka adversely. We proposed a solution that connects the garbage generator, garbage recycler and garbage collector. The proposed system satisfies each person's concerns and contributes to a cleaner Sri Lanka.

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