Habib University

Dhanani School of Science and Engineering

Engineering, Innovation and Design

(EE 391L-D1, D2)

Need Specification Document – Group 02

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1. **Need Statement**

    A way to address [the lack of ease in trading the segregated waste] in [localities of Karachi] so that [maximum recyclable waste separation can be achieved at the consumer level*].

2. **Background**

    Arwa's Mother is a typical desi mother. She likes to make the most out of everything. Similar to how she attaches the old soap to the new one and reuses the Jam bottle to store the seasonal Achaars, she stores the recyclable waste or commonly known as Kabaad until she sells it to the kabaadiwala. Though the money earned is a small amount but its useful in hard times. The trade happens once in a while, when considerable amount is stored or there is a Dawat and she needs to get rid of all the excessive mess. If it's a Dawat she has to send someone urgently out to bring the kabaadiwala or inform the chaukidaar (gate keeper) to send the kabaadiwala to her place if he sees him, a hassle and a never-ending wait with no reliability of him showing up. And if its late than 2 in the afternoon then she lost her chance completely. And so, the stored kabaad goes in the dustbin outside the house with all the other waste.

    On the other hand, Batool's Father told her how the Kabaadiwala in their locality was very distraught because of the very less kabaad he collected and requested Batool's Father if he could give the kabaadiwala the kabaad of his place.

    It seemed as if the locals wanted to sell the kabaad and the kabaadiwalas were in dire need of buying it but there was some gap in between that could not be met causing most of the recyclable waste going in the junk resulting in overflowing of the landfill sites. After doing interviews, other primary research and secondary research we saw that maximum people in Karachi segregate their waste for the kabaadiwala but still very less recyclable waste is recycled.

    Our idea aims on how the path between the locals and the kabaadiwalas plus between the kabaadiwalas and the relevant industries could be strengthened so that this existing system could be standardized and made efficient.

3. **Significance**

    Up to 87 percent of the 16,500 tons of municipal waste generated daily in Karachi is recyclable [1][2], but not even 30% of it is actually recycled. Like other developing countries, Pakistan lacks waste management infrastructure, creating serious environmental problems. Most municipal waste is either burned, dumped, or buried on vacant lots, threatening the health and welfare of the general population. [2] All major cities of Pakistan face enormous challenges on how to manage urban waste. Bureaucratic hurdles, lack of urban planning, inadequate waste management equipment, and low public awareness contribute to the problem.

    One of the major problems is the inefficient of the waste at the producer level. The separation of recyclable waste helps in processing because the major part of processing is waste segregation. The lack of segregation of the waste at the source in Karachi leads to various problems, including roadside trash, blocking of sewage and gutter lines, incineration of waste on every other corner, overflow of the landfill sites and many more.

    * Consumer level: Households of Karachi that produces waste on a daily basis

According to a study, around 80% of the people in Karachi from different financial backgrounds segregate their waste to sell the waste that can be recycled. Since decades, there exists a culture of selling the recyclable waste to a collector known as a Kabaadiwala who would then sell it to the relevant industries. However, the maximum of trash is not recycled. There can be various reasons for this problem like the lack of ease in selling the waste at the source, the collected waste not reaching the proper industries, the unawareness about what wastes can be recycled, the inefficiency of the complete chain etc.

The strengthening of this existing system can significantly lessen the burden on the waste processing at the landfill sites. Maximum waste can be recycled if delivered to the relevant industry. From the interviews conducted we found out that the industries that recycle from scrap in Karachi have a major chunk of their raw material imported from other countries. If the industries receive properly segregated waste locally their extensive cost in importing or segregating from the landfill sites can be saved. One of the interviewees agreed that if a direct connection with the households could be achieved, they would benefit significantly. Thus, our idea was to decentralize and build a D2C model to make this system efficient.

We want to standardize this complete chain by providing a digital ease to this existing system. Kabaarz is an app that connects the users to the nearest collector anytime, anywhere and at a click. In addition, it also informs the users on the type of waste that can be recycled and its market value. This will build awareness and encourage the locals to separate maximum waste for the Kabaarz.

Moreover, it also provides the collectors the information about the recycling industries. After interviewing one of the Kabaadiwala, it showed that they do not have much information about anything and they just buy the kabaad from the households and sell it to the dukaans, which are basically shops that buy the kabaad from the locals and kabaadiwalas and sell it to the industries. He said he earns very less and sometimes no money when he sells the kabaad to the dukaan. If these collectors are given information about the relevant industries they can earn more and can also be aware of the Kabaad that can be collected. Bringing the industries in the system completes the chain and eradicates the chance of breaking off of the chain.

4. **Existing Solutions Survey**

The existing solutions are not appropriately maintained throughout the chain. A general method followed in Pakistan is that when people take the recyclable waste out, usually in bulk, to give to teen-dabbay wala, in exchange for a bit of money, this is then taken to go-down where they store and sell it to warehouses. These warehouses sell it to industries. The recycling industries process the waste into raw material for manufacturing, e.g., metal sheets, plastic granule, paper etc. It is then traded to the manufacturing companies which produces end products to be used again by the locals.

The strength of this existing system is that it motivates segregation at the source level, which is contrary to our belief that there was no or very less separation of recyclable waste in households. This system comprises of a complete chain incorporating different employees with the locals getting an incentive to discard their waste. The system however, has certain loopholes. According to the survey we did in class, kabaadiwala are not available in every area of Karachi with the same frequency. There is a high frequency in low and middle income areas like Shadman Town, Gulshan-e-Iqbal, Nazimabad but in low frequency in places like DHA and Clifton. Thus causing a lack of

ease to reach out to these kabaadiwala. People can contact them by calling at some places, but the circle is very small. Some people are unaware of the waste that can be recycled and some not bothered because calling the kabaadiwala is a hassle. For the industries, the waste from the households is not significantly enough, so they have to either pick up from landfill sites and separate it on their own or have to import scrap internationally, causing them high costs.

A way to reduce waste is not only recycling but reusing too. Usually, people give away their books, notes, bottles and containers, clothing, etcetera. These are recyclable yet can be reused. It is sold out to other people by Kabadiwala and thrown in mixed waste also. Which, again, is inefficient. Even if the mixed waste is collected in a smart bin with an IoT sensor, e.g., made by Sensa Networks*, it will not be used for segregation. In addition, it is costly to incorporate in a complete city of a developing (not developed) country like Pakistan. Moreover, it goes to the landfills through middle dumping points inside the city. From the landfill sites**, either the recycling industries have to segregate waste by themselves or through a separating solution. Veolia and Zypher waste solutions allow this to separate waste coming in trucks; however, this project needs significant investment and piece of land to provide space for segregation on a large scale.

Another existing solution is an Indian website which has a similar idea of taking recycling material from home and delivering it to the relevant industries. Its strength is its similar D2C model, which eases the process for the end consumers and industrialists. However, the middle man is the service providers themselves. Their employees collect the waste from the locals living in Indore, Nagpur, Lucknow, Bhopal and Raipur. While on the other hand, we are trying not to destroy the existing chain or change the nature of employment, but allowing these stakeholders to integrate in the system at different stages with their choice. Moreover, their model had just a calling option with no tracking or choice of a rider while in our system each of our collector will have a trust quotient corresponding to the number of people who have vouched for the reliability of that particular collector. Consequently, this will ensure security of our customers, an initial customer base and ease in adaptability of the users. To ensure minimum pickup time, our service will be providing the customers with the nearest collector as well as providing the collectors with the shortest path to reach the customer using GPS tracking and optimized algorithms.

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*Sensa Networks provide smarts bins centralized system that allows self-dumping from bins when they are completely filled and detected by sensors.
**There is a landfill regulation, that allows industries to take the waste and process it.

5. Stakeholders Assessment

	Stakeholder Name, Role	Stakeholder Description	Power/Interest Class	Primary Benefits	Primary Detriments	Net Impact
		Stakeholders in Waste Recycling in Karachi (Clean Stream)				
A	Households	Primary user, separate and store the saleable waste components to itinerant waste buyers	1	Gets monetary incentives as well easy waste disposal	Takes effort, insufficient cashback	Mostly positive as incentivezed for doing a routine work, getting paid for throwing trash
B	Domestic Servants	Primary user, in high income areas they separate and store the saleable waste components to itinerant buyers	2	Gets monetary incentive	Takes effort, insufficient cashback	Mostly positive as incentivezed for doing a routine work, getting paid for throwing trash
C	Itinerant Waste Buyers	Middle user, they purchase the waste from the household and other sources to middler dealers	1	Gets monetary incentive, its good for business	Difficult to collect useable waste	Positive, better source of income, they will have access to more waste pick up places hence better income
D	Middle Dealers	Middle user, they are purchase materials from itinerant buyers and sell it to the main dealers, they also clean and process some materials to reduce transport cost and add value	2	Gets monetary incentive, its good for business	Difficult to collect useable waste and process it	Positive, better source of income because more waste will be provided by people to them, they will get it easily.
E	Main Dealers	Middle user, deal in single type of waste in bulk from middle dealers and sell it to the recycling industries	1	Gets monetary incentive, its good for business	Difficult to collect useable waste and process it	Negative, ware houses may not be need because the middle dealers might directly take the waste to recycling industries as they will have all the details available
F	Recycling Industries (High Level Industries for eg Metal Scrape)	End user, converts waste materials to saleable products.	3	Improves business	Difficult to process and collect waste	Mostly positive as incentivezed for doing a routine work, they will get waste easily instead of importing it or spending money to get it from waste dump and landfill sites
		Stakeholders in Waste Recycling in Karachi (Dirty Stream)				
G	Sweepers	Middle user, collects waste from households and separate and sell components	1	Gets monetary incentive, its good for business	Difficult to collect useable waste	Positive, better source of income, getting paid for doing routine work of picking waste and providing it to middle dealers or recycling industries
H	Street Pickers/Local Govt Departments/ KMC	Middle user, collects waste from streets and local dump sites	2	Gets monetary incentive, its good for business	Difficult to collect useable waste	Positive, better source of income because more waste will be provided by people to them, they will get it easily instead of collecting from dump sites
I	Middle Dealers	Middle user, purchases waste from sweepers and street pickers, process it and sell it to recycling industries.	1	Gets monetary incentive, its good for business	Difficult to collect useable waste and process it	Negative, ware houses may not be need because the middle dealers might directly take the waste to recycling industries as they will have all the details available
J	Recycling Industries (Low Level Industries for eg Paper and Cardboard)	End user, converts waste materials to saleable products.	3	Improves business	Difficult to process and collect waste	Mostly positive as incentivezed for doing a routine work, they will get waste easily instead of importing it or spending money to get it from waste dump and landfill sites

Table 5.1: Stakeholders Details

6. Features

Must have features:

1) List of types of waste that can be recycled:
   Our application must offer different types of waste that could be recycled; the initial list comprises paper, metal, glass, plastic, and organic waste. These are the most commonly produced waste items in any household.
2) Customer Support:
   There should be a 24/7 customer support team available to help the users with any problem experienced by the user; these problems can range from booking issues to payment frauds, etc.
3) Waste Pick up Tracking system:
   A live tracking system tells and shows you how far the pickup personnel are from your location through a map when you book a waste pickup.
4) Payments:
   Every type of waste has an associated value written with it. The amount is given to the person who is giving their waste. The amount is based on 1 kg of weight of trash produced.
5) Intuitive Design:
   The app is user-friendly; there is no need for a demo or walkthrough; users can easily use it with intuition and navigate it.
6) Rating system:
   Once the waste pick-up is done, the users can rate the waste pick-up person and provide feedback that helps develop a profile for the personnel and helps other people.
7) Past recycling history:

There is a log system that keeps track of all the waste pick-up sessions that have ever taken place. The details include everything from date, time, amount, and type of waste picked up to the details of the person who picked up the trash.

8) <u>Dual Language Interface:</u>
The app can be used with either an English or Urdu interface because it will make it easier for people from less literate backgrounds to understand and use it easily.

9) <u>Integration with Google Maps:</u>
Google maps can be used with the tracking system to see how far is the pickup personnel and select pick-up point from the maps.

10) <u>Information about the industries:</u>
The collectors should be given the information about the recycling industries including their address, number type of waste they buy etc. So that the collector can easily reach out to the industries and trade the waste.

<u>Nice to have features:</u>

1) <u>On-call waste pick up:</u>
If someone finds difficulty using the app, they can use the call feature for the company to book a waste pick-up.

2) <u>Reminder system:</u>
A notification system that reminds the users to recycle their waste on a specific period basis.

3) <u>Wallet system:</u>
Users can either opt for taking hard cash or deposit it into the app wallet, which can be redeemed later at any point.

4) <u>Waste management statistics:</u>
Graphs and stats regarding waste management history, waste produced, recycled etc.

5) <u>External wallet transfer options:</u>
The in-app wallet can be integrated with bank apps to transfer money quickly.

6) <u>Referral system:</u>
Users can refer the app to their friends and other family members and get a reward every time some uses their referral to sign up or promo code to get a bonus on cashback.

7) <u>Picture of trash that is to be picked up:</u>
Take a picture of the waste that is to be recycled and send it to the person coming to pick it up so that they are prepared and have an idea of what type of waste they are dealing with.

8) <u>Bonus incentives and Industrial Marketing:</u>
With the help of the feature of waste management statistics we can keep a trach of the frequency of each local and then offer discounts and coupons from the industries which are a part of this system. This would help both the users and industries in marketing.

Musts & Nice to Haves			Stakeholder Name or Role									
Category	#	Statement	Households	Domestic Servants	Itinerant Waste Buyers	Middle Dealers	Main Dealers	Recycling Industries (High Level)	Sweepers	Street Pickers	Middle Dealers	Recycling Industries (Low Level)
MUST	1	Different types of waste for recycling	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MUST	2	Customer Support	✓	✓	✓	✓	✓	✓	✗	✗	✗	✓
MUST	3	Waste Pickup Tracking System	✓	✗	✓	✓	✓	✓	✗	✗	✗	✓
MUST	4	Payment System	✓	✓	✓	✓	✓	✓	✗	✗	✗	✓
MUST	5	Intuitive Design	✓	✓	✓	✓	✓	✓	✗	✗	✗	✓
MUST	6	Rating System	✓	✓	✓	✓	✓	✓	✗	✗	✗	✓
MUST	7	Past Recycling History	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗
MUST	8	Dual Language Interface	✓	✓	✓	✓	✓	✓	✗	✗	✗	✓
MUST	9	Integration with Google Maps	✗	✗	✓	✓	✓	✓	✗	✗	✗	✓
MUST	10	Information about the Industries	✗	✗	✗	✗	✓	✓	✗	✗	✓	✓
Nice to Have	11	On call waste pick up	✓	✓	✓	✓	✓	✓	✗	✗	✓	✓
Nice to Have	12	Reminder System	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗
Nice to Have	13	Wallet System	✓	✗	✓	✓	✓	✓	✗	✗	✓	✓
Nice to Have	14	Waste Management Statistics	✓	✗	✗	✗	✗	✓	✗	✗	✗	✓
Nice to Have	15	External Wallet Transfer Options	✓	✗	✗	✓	✓	✓	✗	✗	✓	✓
Nice to Have	16	Referral System	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓
Nice to Have	17	Picture of trash that is to be picked up	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗
Nice to Have	18	Bonus incentives and Industrial Marketing	✗	✗	✗	✓	✓	✓	✗	✗	✓	✓

Table 6.1: Musts & Nice to Haves with Stakeholders for Assessment

Assign weight to row relative to column	Prioritizing nice to have features								Score
	On call waste pick up	Reminder System	Wallet System	Waste Management Statistics	External Wallet Transfer Options	Referral System	Picture of trash that is to be picked up	Bonus incentives and Industrial Marketing	
On call waste pick up	-	1	1	1	1	1	1	1	7
Reminder System	0	-	0	0	0	0	0	0	0
Wallet System	0	1	-	1	1	1	1	1	6
Waste Management Statistics	0	1	0	-	1	1	1	1	5
External Wallet Transfer Options	0	1	0	0	-	1	1	1	4
Referral System	0	1	0	0	0	-	0	0	1
Picture of trash that is to be picked up	0	1	0	0	0	1	-	0	2
Bonus incentives and Industrial Marketing	0	1	0	0	0	1	1	-	3

Table 6.2: Prioritizing Nice-to-have features using a Priority Matrix

7. Concept

We started with the idea of redesigning the existing waste management system in Karachi. The initial plans we worked on started with transforming the waste collection system to improve the waste management and segregation system. By narrowing down to recycling products, we discovered a chain of the waste recycling process; if it was to be converted in a decentralized network and integrated with mobile application technology, we could achieve our goal. This resulted from the primary and secondary research conducted on the topic.

The first idea was to create smart bins that automatically separate the waste and make it easier to separate and recycle. The container opens through a QR code scanned via phone of the user/thrower. On each throw, the person gets points. The waste collectors from waste bins will also get a bonus on the higher amount of waste. Eventually, this idea was discarded as the questions were not answered - who will fund rewards, points and maintenance.

The first idea was the revamp the waste collection trucks in Karachi because almost all of the waste collection trucks in Karachi have no covering. When they pick up the waste and take it to the dumping site, they already spread and drop a lot of the waste material on the way. We wanted to develop a covering mechanism that can be easily retrofitted unto the existing waste collection trucks. The cost incurred in the implementation of this solution is a minimum. Given the limited funds available for the waste management department, many problems need to be resolved.

Building on these ideas with the help of secondary and primary research, we found that 80% of the people already separate their waste for recycling and give it to a Kabari wala or a local waste recycling shop where the waste is collected and weighted and then depending on the weight of the waste money is given to the people. This is the basis of our idea; we intend to innovate this process.

The process starts with users segregating waste in these homes; the debris is divided into one that can be recycled and one that cannot be recycled. According to an industrialist from Scrap Industries, the recycled waste is either taken to a recycle shop in the area, or a rehri wala person comes home. The waste is weighed and then collected while the people get money. The recycling shop or rehri wala then takes the trash to a warehouse where all the recycling shops and retro walas bring the waste, and it is divided and grouped as per the type of waste for the recycling industries to take it from paying them. These recycling industries have three sources of acquiring recyclable waste; the first source is explained above. The second source is the landfill sites where mainly metal waste is collected, but it's a complex process because trash is mixed. Hence, it is the least preferred source. The last reference is to import waste from abroad rather than collecting it locally and then recycling it.

We are devising a mobile application that can simplify the existing process. There are three users of the mobile app; the first set of users are the general public who will provide the trash which can be recycled, the second set of users are the intermediaries who collect waste from the crowd and take it to the warehouse from where the third set of users which are the recycling industries obtain it.

Starting with the first set of users, the mobile app's general public interface will ask them to make a user account that will require them to select the type of waste they have and then book a waste pickup session. The intermediaries, who are the second set of users, will get the place's location from where to pick up the trash, and then he will head to them to perform the routine task of checking and weighing the waste and then paying the users money. He will then take it to the industries and contact them using his app version. The drives will pay him similarly to how he spent the general public to get the waste. We will create a decentralized D2C network and increase the waste recycling process. The stakeholders of this process will benefit from it, and the process will become smoother and more efficient. Overall, all of these things will collectively lead to better waste management.

Costing
The tables show the prices and waste going to the recycling industries in 2001. Assuming the prices are increased (e.g. from 1994 and 2001) but the trend is same, we can see that at each level dealers keep their margin but it is very less in Rs/kg. 200tonnes/day was generated mainly as industrial or commercial waste as given in "Estimated Quantities ofWaste Processed by Large Industries" and it then goes to the manufacturing industries. However, waste generated at homes going to these recycling industries is very negligible as compared to what they are getting from other sources. It is not because the waste is less but the waste is actually not reaching properly to the point where it has to go i.e. for recycling.

Prices Paid (Rs/kg) for Major Separated Materials at Various Stages in the Recycling Chain of Cleaner Materials [3]

Materials	Middle dealers pay to IWBs (Rs/ kg)	Main dealers pay to middle dealers	Main dealers sells at
Urdu Newspapers	5.50	6.0	6.30
English Newspapers	9.00	10.00	11.00
Ferrous Cans (cooking oil etc.)	5.50	6.00	6.30
Ferrous Metals (pipes, fittings etc.)	7.50	8.00	8.30
Bottles (cold drinks, medicine etc.)	-		
Glass (window glass, broken bottles etc.)	1.0	1.50	2.00
Plastics (soft)	10.0	12.0	13.50
Plastics (hard)			
Paper, Magazines etc.	3.50	4.0	5.0
Bread (food waste)	-	5.50	
Aluminium (foil, cold drink cans etc.)	-		
Copper (wire)	65	70	80
Copper (old utensils)	45	50	58

Waste material (typical sources)	Prices in Rs per Kg (1994)	Prices in Rs per Kg (2001)	Remarks
Urdu Newspaper	2.00	5.00	An increase of 150 per cent in 7 years.
English Newspaper	2.50	8.00	A three times increase.
Ferrous Cans (cooking oil etc.)	5.00	6.00	Number of metal industry in the non-formal sector is marginal.

Ferrous Metals (pipes, fittings etc.)	6.00	7.00	-do-
Bottles (cold drinks, medicine etc.)	1.00	2.00	A 100 per cent increase
Glass (window glass, broken bottles etc.)	0.25	0.50	A 100 per cent increase
Plastics (soft)	6.00	8.00	Plastic quantities are increasing.
Plastics (hard)	8.00	10.00	Plastic quantities are increasing.
Paper, Magazines etc.	1.00	3.00	An increase of 3 times.
Bread (food waste)	1.00	4.00	A four times increase
Aluminium (foil, cold drink cans etc.)	30.00	NA	
Copper (old utensils)	20.00	40.00	

Estimated Quantities of Waste Processed by Large Recycling Industry in Karachi

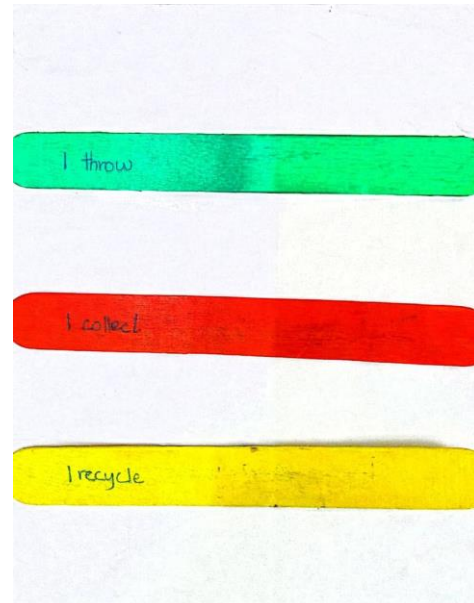| Raw Material	Product	Quantities Processed/ day	Remarks
Glass	Bottles, marbles and other glass products	50 tonnes/ day	There were 17 registered glass industries in the province of Sindh in 1995-96.
Plastics	Shoes, slippers and other plastic products.	10 tonnes/ day	There are approximately 20 units in Karachi, each processing 0.5 to 1.0 tonne/ day.
Paper	Paper board, cardboard and other products.	10 tonnes/ day	A total of 26 registered industries operated in the province of Sindh in 1995-96..
Poultry waste and other animal waste	Animal Feed	25 tonnes/ day	A total of 16 industries operating. 5 of them process more than 5 tonnes per day.
Bones	Export for gelatine and Fertiliser	50 tonnes/ day	This bone is collected by 20 - 25 contractors from butcher's shops. It is exported for gelatine and fertiliser manufacturing.
Ferrous Metals	Compaction and making bales for further transport to Punjab	An estimated of 50 tonnes/ day.	A total of 41 registered industry operate in the province of Sindh. All of them do not process ferrous metals.
	Total	An estimated 200 tonnes/ day	

8. Prototype and Testing

<u>Initial Paper Prototype:</u>

FINDING KABARIWALAS
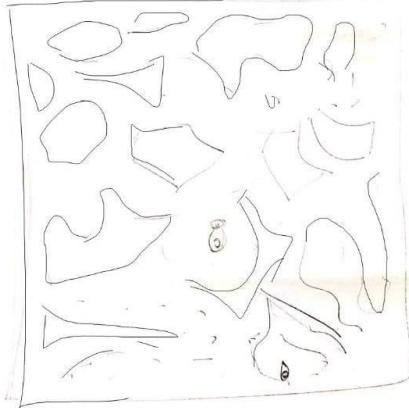
Kabariwala 1   Rs xyz   ✓ ✗
Kabariwala 2   Rs xyz   ✓ ✗
Kabariwala 3   Rs xyz   ✓ ✗

1. Person 1 : Paper : 5 mins   ✓ ✗
2. Person 2 : Metal : 10 mins   ✓ ✗
3. Person 3 : Glass : 15 min   ✓ ✗
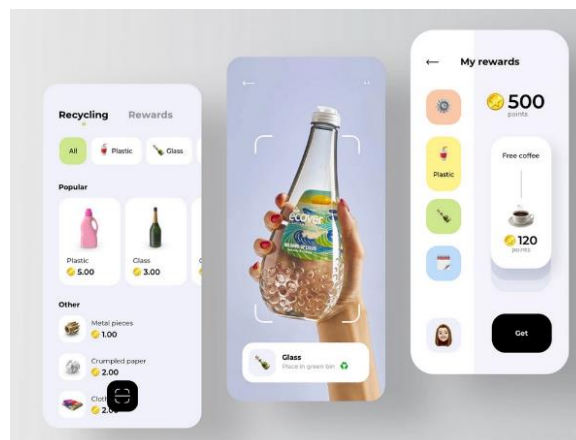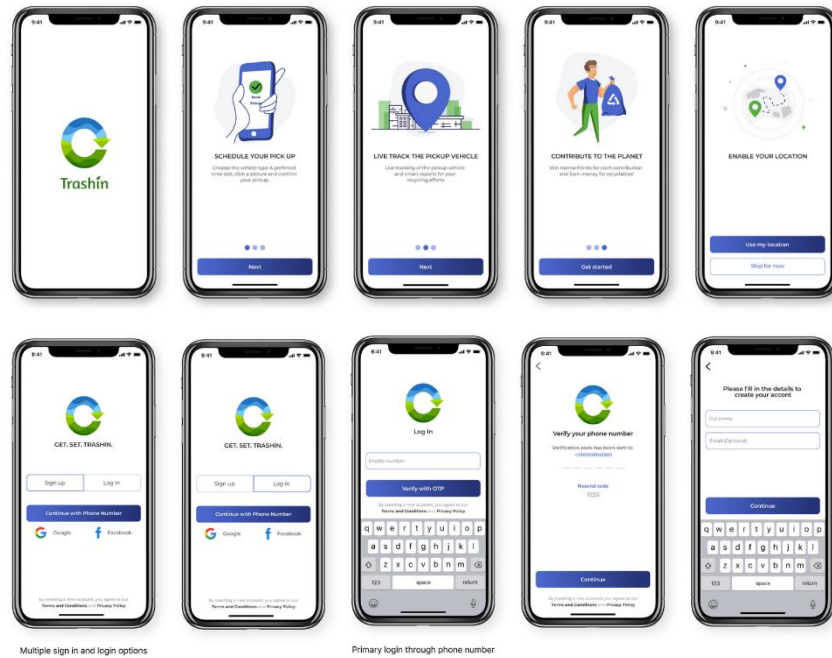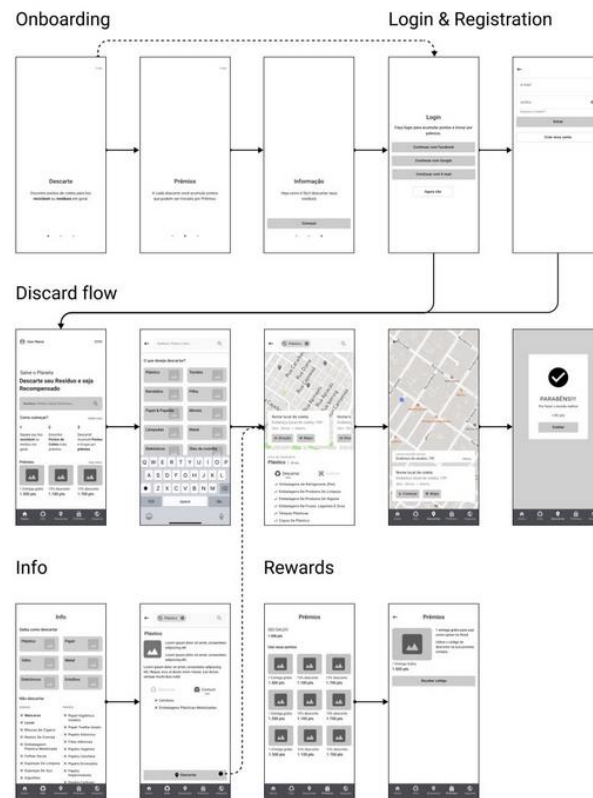4. Person 4 : Plastic : 20 min   ✓ ✗

Collect ...

1. Paper
2. metal
3. glass
4. Plastic (soft)
5. Plastic (hard)
6. Food waste.

Final Proposed Prototype:

Multiple sign in and login options　　　　　Primary login through phone number

Wireframe:

Since we are developing a mobile application, there are three different sets of users who are going to use the application. For each set of users there is going to be a different user interface and experience, currently in the prototype proposed above we are focusing on the general public so the designs are based on their user interface and experience. The application with start off with signing up and creating an account after which the person will select the general public interface option where there will be different types of waste options along with the cashbacks they provide on rupees per kilogram of amount. Once the type of waste is selected the nearest collector will assigned to come and collect the waste and provide the cash back, upon successful dealing the user can provide the collector rating and feedback. There will be an inbuilt live tracking system which tells the user the estimated time of arrival of the collector.

9. References

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4. https://medium.com/@viniciusmagalhes/recycling-app-ux-ui-case-study-40ebc0c703be
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