

Solid Waste Management and UX: A Sustainable Experience

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Abstract: Due to Industrialization, Urbanization and the plummeted population; the generation rate of municipal solid waste in Indian cities has increased tremendously and is expected to grow substantially by 2050. Strong administration of solid waste is of grave significance to an urbanized setting which confronts a consistent growth in population, rising infrastructural requests and continual inflow of migrants. A smart city is created upon various particular components and strong administration of solid waste is one of the crucial components. “When a system is far from equilibrium, small islands of coherence have the capacity to shift the entire system”. Our project, thus, would be a sincere attempt at creating those ripples in a giant ocean to enforce some visible shifts in the current Solid Waste Management scenario. For that, we will be amalgamating Solid Waste Management with one of the latest and most powerful technologies of today i.e., UX (User Experience). UX aims at easing the human effort by introducing us to a systematic model that it follows for designing of a product or service. UX design must strive to be as inclusive as possible and so will we. Through this paper, we have collated the troubles people face during waste management and also what motivates some to manage waste appropriately. The goal is to design and develop an app that facilitates the waste management process with the aid of UX methodology.

Keywords: Solid waste management, UX, Waste.

1. Introduction

A. What is Solid Waste & Solid Waste Management?

1) Solid waste

Solid Wastes comprise of all the wastes arising from human and animal activities that are normally solid and that are discarded as useless or unwanted.

2) Solid Waste Management (Referred further as SWM)

Solid Waste Management may be defined as the discipline associated with the control of generation, storage, collection, transfer and transport, processing, and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics, and other environmental conditions, and that is also responsive to public attitudes.

In its scope, SWM includes all administrative, financial, legal, planning, and engineering functions involved in solution to all problems of solid wastes.

The solutions may involve complex interdisciplinary relationships among such fields as technology, political science,

city and regional planning, geography, economics, public health, sociology, demography, communications, and conservation, as well as engineering and material sciences.

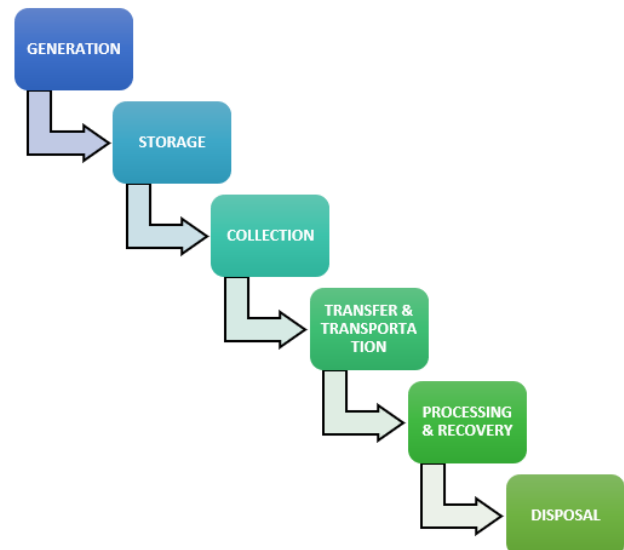


Fig. 1. SWM process flow diagram

B. Importance of SWM

We don't have to be reminded in particular about how the production of waste is inversely proportional to the waste being disposed or recycled correctly because it is an age long problem that our country specifically and even the world is facing.

In India, good domestic habits like composting at home on a regular basis or even micro-segregating is on the rise.

Dumping in landfills or open grounds is only a short-term solution for a long-term problem. As we will research more and more, we will realize how grave the situation actually is and how long does it take to manage waste in general. But we can start and create a paradigm shift in the existing system to bring a small wave of visible change.

C. What is UX (User Experience)?

Let's start with some examples for a better understanding:

1. Why do you use Google? Why does searching anything online make us think about Google? Why don't we use other search engines like Mozilla Firefox

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or Internet Explorer etc., because technically even they, just like Google, are simply search engines? Then why do prefer 'googling' something instead of the other search options?

Google is easier to use with its easy to look interface and intuitive searching capacity. It feels trustworthy and we as users rely on our experiences to choose Google.

2. Do Government websites give you a hard time getting your work done? We all have experienced it one or the other time. It is because the websites are never user friendly to start with? What makes it user friendly though?

Creating the options on the website in a such a way that helps every type of person operating it; old, young, handicapped i.e., by providing a text to audio option and other inclusive parameters.

3. Will you buy products from someone who is reluctant in entertaining you and your customer needs or will you buy it from someone who attends all your doubts and queries regarding the product plus giving you insights on why should you choose one product over the other?

Obviously the second one. That's called having a good user experience when buying a product. Online or offline, it applies to both scenarios.

We are surrounded by UX including cooking, studying, solving big and small problems.

UX aims at easing the human effort by introducing us to a system that it follows for the designing of a product or service.

The beauty of this system is that it can be applicable in all sectors of our life and the results will never disappoint if the processes are carried out appropriately.

2. Need for Current Study

Solid Waste Management in India is already a pressing issue. If we combine it with UX design principles, it will cater to specific problems in a sustainable and fun way bringing all age groups on board.

We know that mobile phones are used extensively by everyone regardless of their age and so using that to our advantage we thought of solving a part of the waste management problem through making an app that addresses similar needs.

Need of UI/UX in SWM is very critical because the motivations, frustrations (pain points) and requirements of users are understood and designed through the same.

It is important to think about unconventional solutions to conventional problems.

3. Objectives

- To design an app prototype (low fidelity & high fidelity).
- To incentivize the users.
- To encourage community participation.
- To make waste management a fun and doable process for all demographics.

- To create a culture where waste is viewed as hidden treasure and is not mishandled anymore.

4. Methodology

Our prime Research Methodology is 'Design Thinking'.

It is an iterative, non-linear process of understanding users, challenging assumptions, redefining problems, and creating innovative solutions to prototype and test. Design Thinking allows for the user of the system to have a more structured plan for understanding innovation and to grow more as an idea, start-up, company, etc. Design thinking encompasses processes such as context analysis, problem finding and framing, ideation and solution generating, creative thinking, sketching and drawing, modelling and prototyping, testing and evaluating. 5 Key Steps involved in Design Thinking include- Empathize, Define, Ideate, Prototype & Test.

A. Empathize

To empathize is to understand someone's situation/condition by putting oneself into their shoes and trying to feel what they are feeling. To understand some 'on-priority' problems regarding waste management that our locality is facing in general and to gather the pain points from all demographics.

User research is the key step here.

1) Survey

A survey questionnaire in English and Marathi was circulated for getting these answers along with user interviews from different backgrounds.

Survey Link:

<https://docs.google.com/forms/d/e/1FAIpQLSfcEQ0fFqzyOLCAuyLz8FEj9vj4NrPkbHzkLEoK-aVYrTx0Xg/viewform>



Fig. 2. Screenshot 1 of SWM survey

Around 70 people filled the survey questionnaire. Responses ranged from a doctor to engineer to an environmentalist, lawyers, students, etc. Responses highlighted user pain points (UX issues that frustrate the user and block the user from getting what they need), it gave us an insight into where people are in their waste management process and how and from where do they learn about waste management in general.

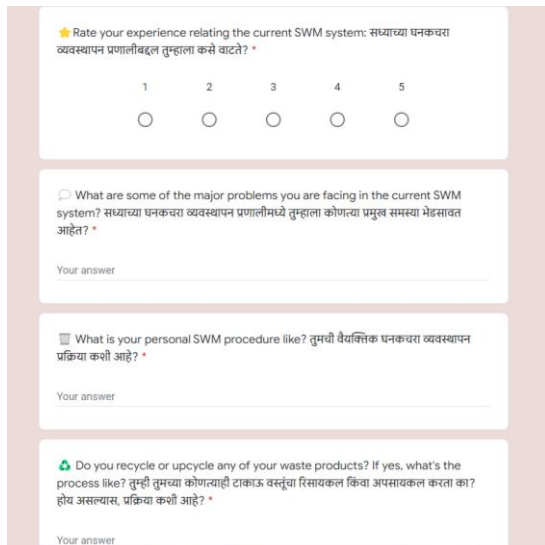


Fig. 3. Screenshot 2 of SWM survey

Few Responses included:

- “Any system is as good as its followers. When the public is not aware of their rights and benefits of a healthy environment, they would never bother to look at the SWM. SWM works under Municipal Corporation of District which is an official authority working under the government. It is not that SWM and MNCs are not efficiently doing their work because of lack of rules/regulations/protocols but the public not holding, MNCs or any SWM which is providing them services, accountable is what make them work loosely.”
- “Public participation for collection of waste at source level is necessary. Public private partnership also will play a vital role for managing municipal wastes.”

2) User Interviews

User Interviews were conducted with Environmental Consultant Dr Rajendra Saraf, Srishti’s grandfather Mr. Mukund Jainapur who is also the secretary of their building, experts in this field etc. which helped in getting insights regarding the waste management scenario.

3) Empathy Maps

Empathy Map is an easily understood chart that explains everything designers have learned about a type of user. Here, what the user says, thinks, does and feels is noted.

User Says:

“I don’t have time to segregate waste.”

“I don’t know to segregate waste.”

“Sometimes when I segregate my waste, the waste is finally mixed together in the truck.”

“I have no motivation to manage my waste in general because of casual and unfollowed rules by all.”

User Thinks:

Wants easy to follow guidelines for segregating waste.

Wants a fun process to tackle the otherwise mundane waste management.

Authorities lacking in their duty have a huge impact on

citizens’ mindset to follow or not follow something.

User Does:

From our survey, our demographic included people from middle class to upper middle-class people.

User Feels:

Nothing because it has become a deep-rooted habit.

Guilty because mistakes are knowingly committed.

Angry because the government isn’t taking this issue seriously too.

Worried but helpless & wishes to do better.

4) Personas

Persona is a fictional user whose goals and characteristics represent the needs of a larger group of users.

We created 2 personas for our project namely Krishna and Alok.



Fig. 4. Krishna’s Persona

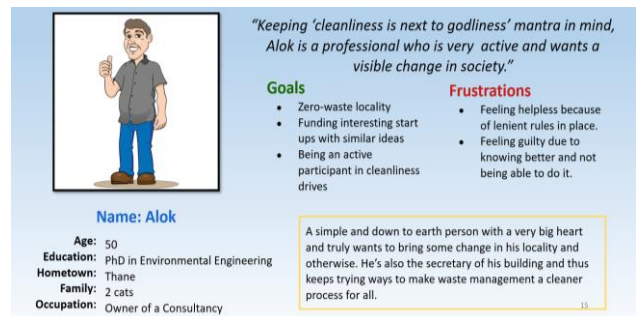


Fig. 5. Alok’s Persona

5) User Story

A user story is a fictional one-sentence story told from the persona’s point of view that inspires and informs design decisions.



Fig. 6. Krishna’s user story

6) User Journey

A user journey map helps UX designers create obstacle-free paths for users.

Persona: Krishna				
Goal: Wants to use technology to manage her waste better and wants others in her locality to do the same				
ACTION	May wake up late and miss disposing waste	Is frustrated of not knowing where to go when waste relating issues arise	Doesn't know people around her who are as enthusiastic as she is	Lacks Motivation
TASK LIST	Tasks A. Slept late due to college work B. Wanted to sleep more	Tasks A. There is no app or so for citizens to track their waste related stuff so she needs that.	Tasks A. Community participation is already very less so she finds it hard to find like minded people. B. Cannot learn new things alone.	Tasks A. No one to keep her accountable B. No reward/penalty system
FEELING ADJECTIVE	User emotions Needing rest, guilty, angry	User emotions Confused, Frustrated, Helpless	User emotions Lonely, Bored	User emotions Lazy, uninterested
IMPROVEMENT OPPORTUNITIES	Area to improve Schedule a booking according to suitability	Area to improve One stop app for these needs	Area to improve Community Building in the same app	Area to improve Receiving benefits from app as well as penalty for doing wrongdoings.

Fig. 7. Krishna’s user journey

B. Define

To define is to know our problem statement and hypothesis statement in order to understand what issues we will be tackling specifically through our app. It is to filter out our researched data into how our project requirements are.

1) Problem Statement

To design a sustainable, engaging and user-friendly solution for all age groups to achieve a zero-waste locality.

2) Hypothesis Statement

If technology, here in the form of an app, is introduced to the public and government for managing, tracking, understanding and taking initiatives in the managing waste better, then the chances of obeying and getting on board increases as an average person spends around 5-6 hours on their mobile phone.

C. Ideate

To ideate is to come up with every creative solution possible to our problems and brainstorming about it to understand what all needs to be there and what doesn't. Ideating is done through brainstorming with the team, potential users and officials.

After ideating, we came up with ideas of having these functions in our apps:

- Waste Pickup
- Initiatives
- Challenges
- Rewards
- Leaderboard
- News Nation
- Information
- Violation

D. Prototype

It is like a representation of your ideas, features and options into your app in a visual way before actually developing it. This involves creating rough sketches, wireframes, low- fidelity and high-fidelity prototypes thus to produce a clickable prototype.

1) High-Fidelity Prototype Screens

Tool used: Adobe XD

Splash Screen: where the app name, logo and colour theme are revealed.

App Name: W+

Logo Meaning: W is rotated sideways to make it look similar to the Greek letter Sigma which means ‘summation’, thus focusing on waste management as a ‘summation’ of everyone’s efforts.



Fig. 8.



Waste Management

Solid Waste Management may be defined as the discipline associated with the control of generation, storage, collection, transfer and transport, processing, and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics, and other environmental conditions, and that is also responsive to public attitudes



Skip

Fig. 9.

An *Introductory Screen* to segue into our main sign-in and sign-up procedures.

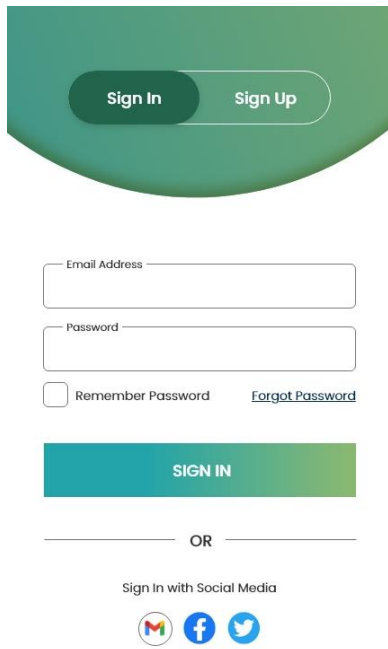


Fig. 10.

Sign-in Screen for existing users.
Sign-up option provided as a toggle on the same screen.

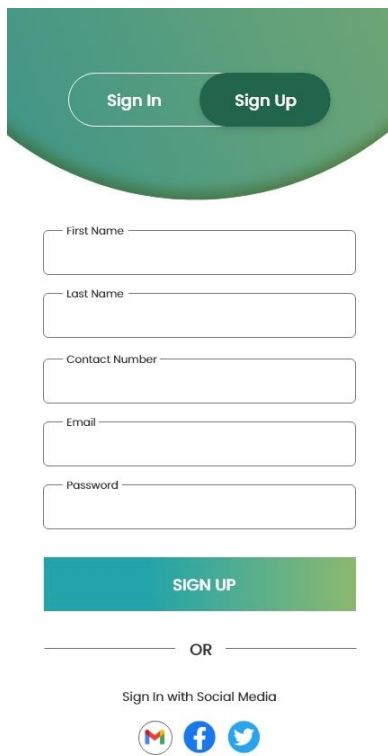


Fig. 11.

Sign-up Screen for new users.

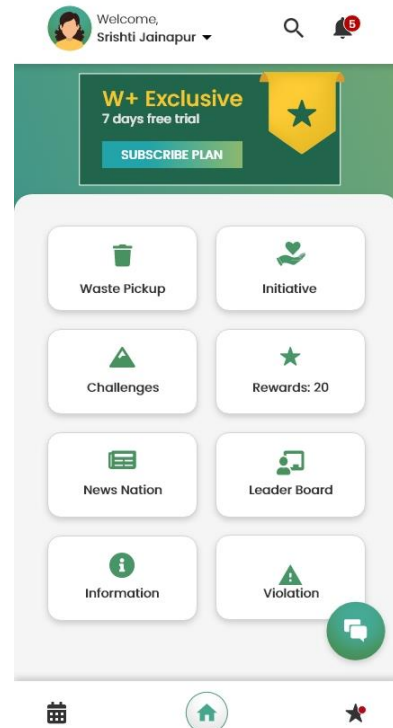


Fig. 12.

Home Screen of W+
Options mentioned in the 'Ideate' phase are included here.
Another feature is 'W+ Exclusive' that will be an upgrade from 'W+ Regular' and will include personalized, advanced and special offers for its users.
A 7 days free trial is provided to get a feel of the same.

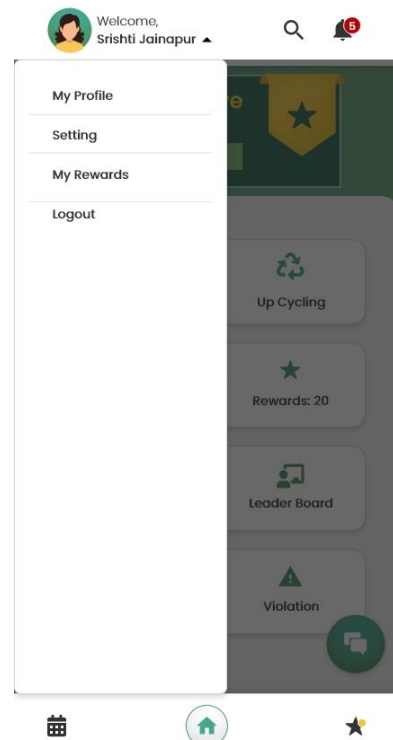


Fig. 13.

Dropdown seen after clicking the profile icon.

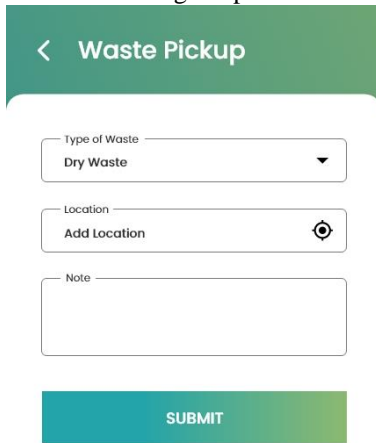


Fig. 14.

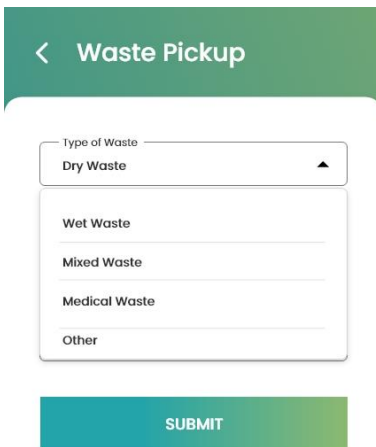


Fig. 15.

First Option on the Home Screen, 'Waste Pickup' is designed as above.

Here, the user can schedule a waste pick up by selecting the 'type of solid waste' they want to be picked.

Then the user will enter their 'location' for the waste picker to come there along with any additional specifications

mentioned in the 'notes' section.

This is the dropdown of the 'type of solid waste' option where Dry Waste, Wet Waste, Mixed Waste, Medical Waste and other wastes can be chosen.

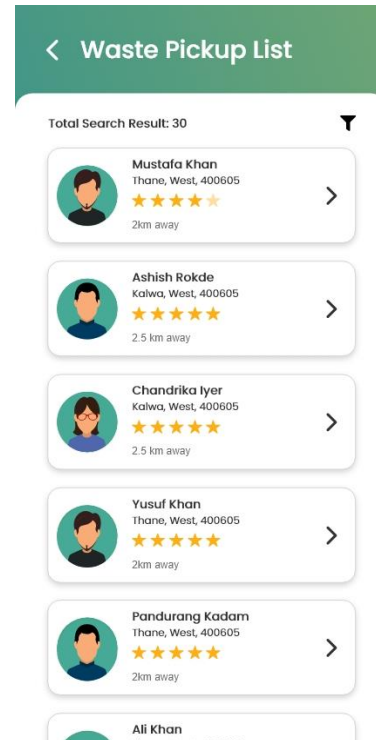


Fig. 16.

A list of various waste pickers will be displayed.

Waste pickers can be filtered based on the users' location, user ratings etc.

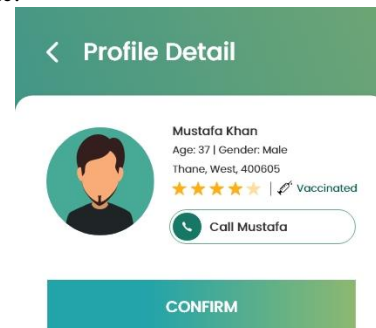
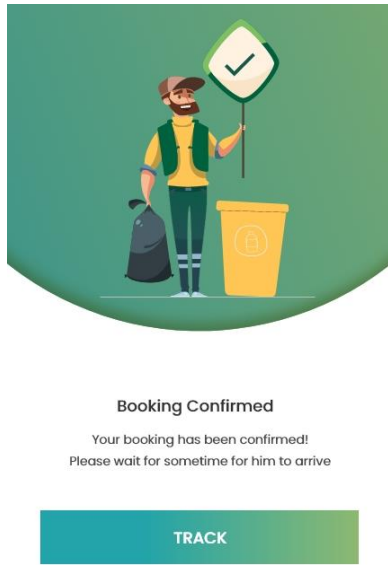


Fig. 17.

Once a waste picker is chosen, their profile details, ratings along with vaccination status and contacting options are provided.



Home

Fig. 18.

Screen displaying that the user’s booking is confirmed. Now the user can track their booked waste picker.



Fig. 19.

Tracking Screen for the user to track their waste picker.

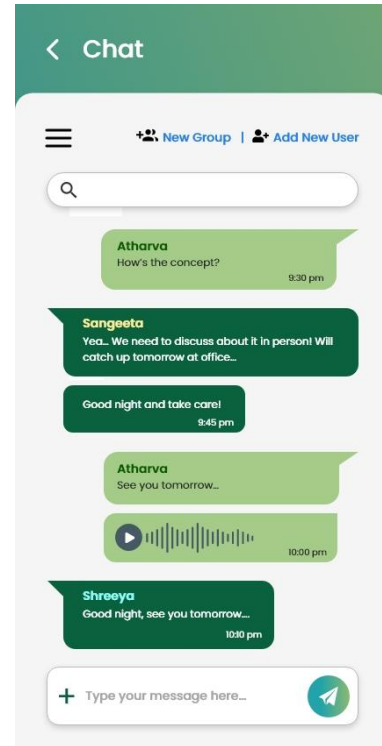


Fig. 20.

Chatting option shown on the Home Screen. The user can chat individually and in groups, thus leading to community formation and participation.

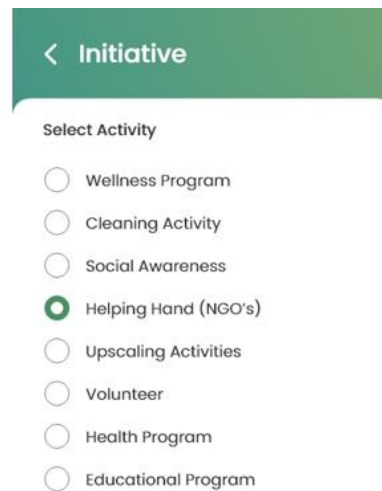


Fig. 21.

Second Option on the Home Screen, 'Initiative' is designed as above.

All options under the Initiative feature are mentioned. This can be a great tool for everyone who wants to do their part in waste management better and take it to a new level.

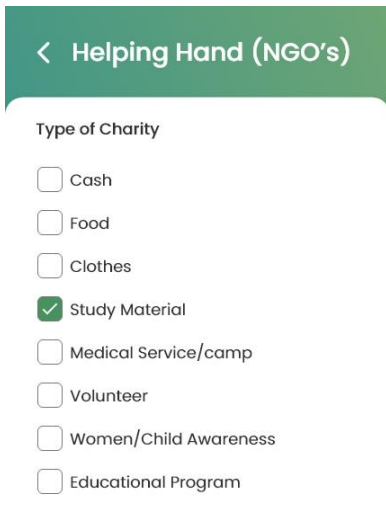


Fig. 22.

List of options displayed after selecting one of the options from the Initiative list.

Here, as the 'Helping Hand' option is chosen, a list of options relating the same appears.

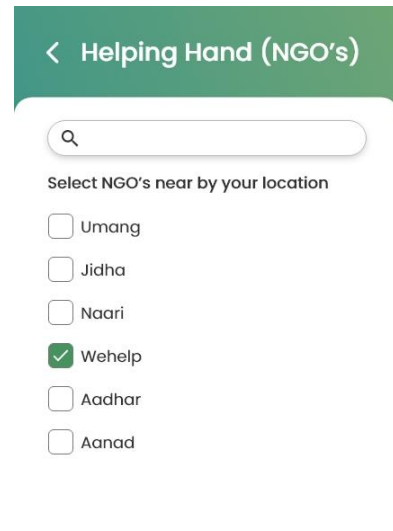


Fig. 24.

User can choose the organization they want to help based on their location.

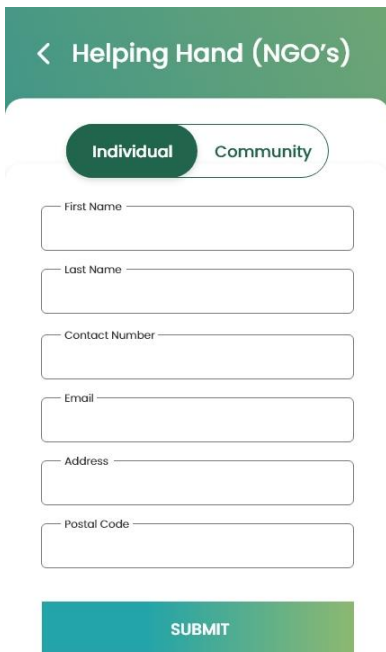


Fig. 23.

Further, contributions can be made individually or as a community, both options are provided.

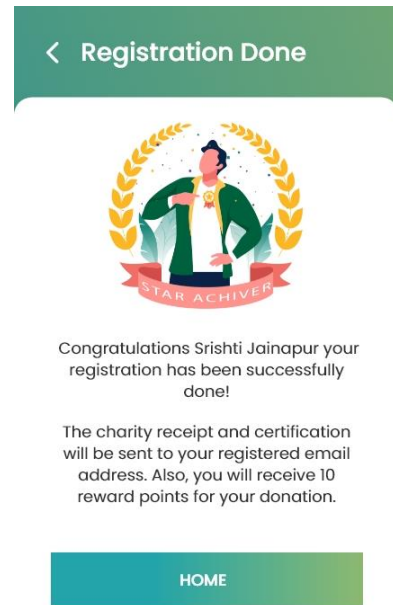


Fig. 25.

Once you are done, a screen like this will appear congratulating you on taking an initiative and the user will be rewarded with certain stars for the same!

2) *Low-Fidelity Prototype: Paper Sketches of Screens*

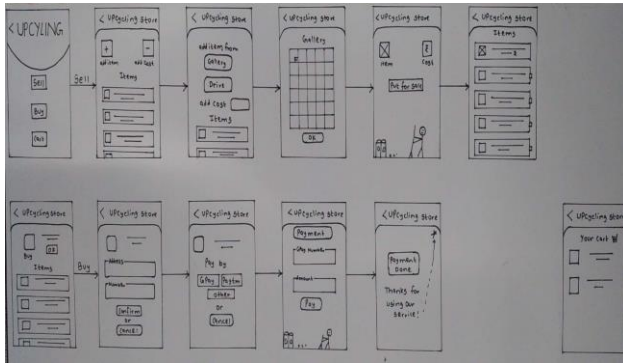


Fig. 26. Upcycling

This flow shows the 'Upcycling' option on the Home Screen. Here, we will give the user an opportunity to *buy, sell* and *donate* upcycled items for the greater good.

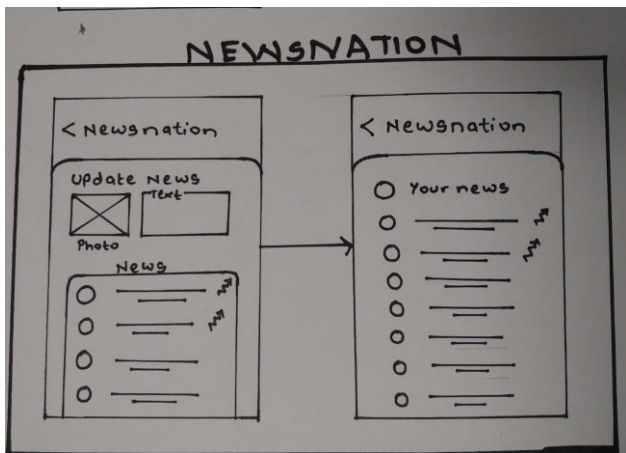


Fig. 27. Newsnation

'Newsnation' option on the Home Screen will let users read trending news relating solid wastes and its management on a whole and also allow users to make their own news where they can post the good and bad events and incidences happening in and around their locality.

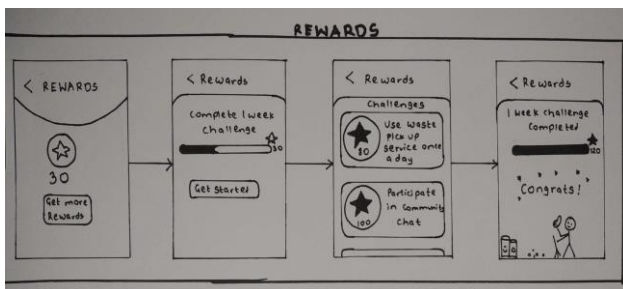


Fig. 28. Rewards

An interesting 'Rewards' option on the Home Screen is to reward the user for doing their part correctly and receiving credit for the same.

For this, Challenges will be available in the 'Challenges' option on the Home Screen where *Daily* challenges and *Weekly*

challenges will be available so that users can collect maximum stars and avail redeemable coupons or other benefits from the same.

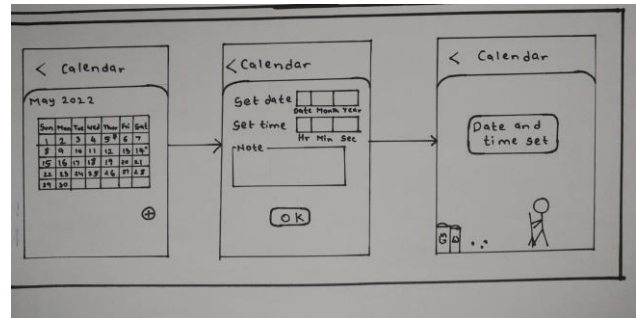


Fig. 29. Calendar

'Calendar' is an option that will help the user mark and set important dates, alarms etc.

If a community plans on organizing an event, then that date will be automatically set to the users' calendar so that no one forgets any critical meetups.

E. Test

To test the prototype is to let people use our prototype and get early feedback from them and make necessary changes.

Here, changes were made after taking in inputs on the naming of certain options, colour theme, usability, etc.

5. Future Scope

- Developing the app.
- Proposing our app to the Government of India through various programs like the 'Swachh Bharat Abhiyan' etc.
- Making it a nation-wide phenomenon.

6. Results

- High-Fidelity & Low-Fidelity Prototypes were created in Adobe XD and in the form of paper sketches respectively catering to user needs.
- Testing was done on few users where live reaction and feedback was obtained and changes in the prototype were made accordingly.
- It was understood that combining trending technologies with such a conventional topic like waste management made it easier for the public to take necessary actions immediately.
- Encouraging community participation made our app name 'W+' which is a 'summation of everyone's efforts' stand valid.
- Current options and features will keep being there and more scenarios and flows will be included in the future scope so as to meet even more advanced user needs and requirements.

7. Conclusion

- The above efforts are aimed at improved health and well-being due to appropriate and efficient waste management.

- The usage of our app will aid in building a better future for ourselves and for the upcoming generations.
- Critical attributes like duty, responsibility and awareness in users are required to be imbibed through outreach programs like Newsnation, Information section etc.
- By striking a balance between incentivizing and fining the users, it is expected to improve the outcome of Solid Waste Management.
- Enhancement of Community Participation and meeting like-minded people to create a synergy among users which will lead to better management of solid waste.

Recognition and Award

On 21/02/2022, the team led by Srishti Jainapur, alongside Vijayalaxmi Ahirwar, Sameeksha Pandit and Maithili Bambardekar won the 3rd position & a cash prize of Rs. 10, 000 in the ‘Smart City Hackathon & Startup Pitch Fest’ held by Thane Municipal Corporation & Thane Smart City Ltd.

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