

BIX: Final Report

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Abstract

In creating a product that would assist the community, BIX, a trash robot, strives to alleviate waste pollution in the city, otherwise known as, litter. Making up 65 percent of California's pollution, litter not only brings environmental problems but health problems as well. In many locations of the world, you may see clean areas, while others are very polluted. Living in the US, most people are fortunate because they have clean air to breathe and nice neighborhoods. However, that doesn't come without costs; for example, a large majority of people don't have the money to live in an area where there is a clean and safe environment, which leads them to worry about safety. This is where most of the litter in the US is located, in run-down or big cities such as San Francisco and Los Angeles. This is because no one cares about pollution, it has become a social norm that places are left dirty because it has always been dirty. Compared to other countries, such as China, the weather is very depressing; it's filled with pollutants, invading the air, lands, and oceans. To add on, people contract diseases from litter-based areas. However, this is a very broad comparison, since China is not in the area code that we belong to; it only serves as a reminder of what our state- or country- should avoid to be like.

Keywords: Litter, Waste, BIX, Environmental, pollution, Big Cities, Weather, Litter-based Diseases

Introduction

With an increasing amount of trash being littered in places it shouldn't be, the lack of accountability from the city and the people has negatively impacted communities from all around. It has become more difficult to clean up after people, especially for community service organizations. Which is what BIX, the company robot, would help to accomplish. During the initial planning stage of BIX, we chose a topic that resonated with a lot of people. We had to do a lot of research on what litter was, so that it could roll over into the next phase of BIX, which is the ideation stage, sketching a robot that was efficient and productive. This led to the prototype where the design came into play, which ultimately led to the testing phase.

BIX - Empathize

Throughout the surveys and interviews, many respondents had stories about litter and how it has affected their lives from the streets to their overall daily feeling (see Appendix A.1). Along with the respondents, there has been an impact of litter, not just for community members, but for the environment as well (see Appendix A.2). With the respondent's input of the issues surrounding litter, our service in creating a robot would help assist and manage the amount of litter being trashed.

BIX - Define

During the research for BIX, this survey found that many of the respondents prefer having a cleaner neighborhood, and using BIX could help the community. (Oberoi, 2022) "It is estimated that 24% of global deaths and 28% of deaths among children under five are due to preventable environment-related causes," (Turner C, 2021). This is a very high proportion of children who had their lives taken away because of a preventable issue. "It is estimated that nearly 100,000 children under 5 years of age in the Americas die each year from physical, biological, and chemical hazards in the environment," (Turner C). With a cleaner neighborhood, this risk is minimized to an extent where people can feel comfortable and not intimidated by the litter. In this survey, many people were intimidated by the amount of litter in the streets of cities (Oberoi, 2022).

BIX - Ideate

There were 4 proposals, a drone (see Appendix C.1), a big robot (see Appendix D.1), a Roomba-based design (see Appendix E.1), and finally a carrier robot (see Appendix F.1). The

benefits for a drone is that it would be able to pick up trash in hard to get places, transport trash to a dumpster, and it was cheap to assemble. This robot would be able to carry a large amount of trash, have a long-lasting battery, and it would help clean cities. For a Roomba-like design, it would have a suction to pick up trash, it is sleek and compact, and you could control where it goes. Lastly, the carrier robot would be effective because it has a compact nature. It would be able to carry lots of trash, and it is the most efficient of the four. The proposal that is fit for this project would be the carrier bot. Although there were some cons, the pros outweigh them. This is because every design had its unique features, but putting them all together would make the best out of all worlds. For example, BIX was meant to be mass-produced to help serve the community by being compact and having the capacity to carry large amounts of trash. On top of that, it is easy to maintain and transport the robot because of its compact and small nature.

BIX - Prototype

After going through multiple phases of testing and picking the right prototype for the job, it came down to two things stemming from the planning stages of BIX (the robot) and the structure of the BIX prototype. A robotic-like mechanism that allows it to gather up trash and distribute it to the back is what came of many discussions. Although BIX isn't as minimalized as it was expected to be, it still performs the job well and efficiently. Initially, BIX leaned more towards resembling a futuristic design. However, the idea was far too complicated and ambitious. Thus, resulting in a more practical contraption with obtainable components (see Figure H.1).

This mock-up helped identify which materials would be efficiently used and which materials wouldn't be used- using insufficient materials would be bad for the environment. As for the financial planning, each robot would take at least \$1500 to make, alone. To make up for those costs, the robot is set at a starting price of \$1750 per robot (see Appendix J). Each month, the price will increase by 15 percent for the first year; by the end of that year, the total estimated revenue would be \$253,764. As for the expenses, there would be a total of \$354,450 in the startup year (this includes warehouses, legalities, offices, etc). To add on, there would need to be an investment of \$50,000, initially to start the business up (see Appendix J).

Materials that are eco-friendly and resourceful were very important in choosing because using plastic and other harmful waste would be counterintuitive, since plastic is a nondisposable material. Other materials would be thrown in places like trash bins, which overflow. This causes the trash to be swept away into the sewers, which end up in the oceans. If it doesn't end up in the ocean, it would be at surrounding parks and streets. Using materials like cardboard, foam, and aluminum were excellent choices for this prototype because BIX's mission is "empower and encourage a greener and cleaner environment".

BIX - Test

Throughout this process, feedback from the interviewees remained to be positive, with also bringing awareness to the negatives that need to be worked on. To start, five different people were interviewed and each gave similar positive feedback, however, there were a variety of negatives.

From the different interviewees, they were all presented with the same questions (see Figure I.1). Our interviewee(s) was also pretty adamant about how this idea is good and hoped that this product will help keep their areas clean. Despite receiving positive feedback, there were also questions and concerns about this product, BIX. For example, one of the most common concerns and complaints about BIX was battery life and the structure (see Figure I.3). Through multiple stages of development, BIX's battery life might be a problem because with having a compact design, there would be areas where we need to cut back to make sure everything fits. Although the battery life might not last as long as people would want it to, BIX would be able to last for one year without problems with the battery. It uses an automotive battery, which is the same battery used in vehicles. The structure of BIX is a common concern for all the interviewees (see Figure I.3). However, with numerous testing, the structure of BIX should be able to withstand about 20-30 lbs without it breaking. Although everything can't be perfect and many companies can't account for it, there will be compensation, such as a replacement for the robot in exchange for the broken one. This way, there will be an analysis run on the broken one which would help to improve the robot, BIX.

Striving to initiate the interviewee's comments and concerns, the BIX robot will undergo further testing to hopefully unveil it to the public soon to help promote a healthier environment.

With looking into many of the problems that BIX has, there must be something that can be fixed to make this a better and great product. Feedback from our future customers and community is very important to create a great product and with that feedback, ideas can change and with many changes creates a better product (see Figure I.2, I.3, and I.4).

Final Value Proposition

Along with purchasing our product, there will be an increase in the productivity surrounding littered areas. For the communities who actively participate in beautifying the city, an investment in our product will help in collecting small to medium-sized litter, especially the ones that are more dangerous and difficult to collect. In ambition, we hope that our product will decrease the amount of litter, as well as, spread awareness of how an organized community should look.

Conclusion

During this project, each group member had something to learn. Whether that'd be about an obstacle or about each other. We learned that each of us had similar leadership styles, but very different concepts of initiating it. We learned how difficult it is to organize meetings that would fit in each other's schedules, but we also discovered how to work around that and each contribute to the project. We all stuck till the end, despite losing a team member, and each walked away having an idea of what and how business projects are created and presented. To conclude, we managed to break through stressful situations and each learned something new about what kind of person we are, as well as, what we can do to improve in future business endeavors.

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Appendix A

Figure A.1

Classified Project - City Pollution Survey Question 1 Results

Q1) Where do you think litter is most found?

- In the more populated parts of the city
- The ground
- places with a lot of ppl
- Parks and beaches as they are busy areas with large gaps between trash cans.
- Nearby on a freeway or in a rural area of a city.
- I think litter is mostly found under bridges in cities and in the sewers.
- Highways (where pedestrians can't access) and the ocean.
- Sidewalks and alleyways
- Creeks, sides of streets
- Litter can be found on the major roadways and walkways
- City corners, alleys and just random streets
- Parks, parking lots, street
- Random streets or alleys
- Probably near highways people feel safe in a car to litter.
- malls
- in the streets/areas with lots of water

Figure A.2

Classified Project - City Pollution Survey Question 2 Results

Q2) Think big with me for a second, what do you think it would look like if the city was litter-free?

- Clean, like the opposite of SF
- All of us would be driving around in teslas, no more swear shops, and the air would be fresh.
- beautiful... absolutely spectacular. I can imagine it now; crystal skies, pure, untainted lakes, fluffy clouds and healthy green hills as far as the eye can see. oh, it would be just like a dream... the prettiest world.. i ever seen..

- It would make public spaces such as parks much more inviting places for communities to gather and connect.
- Cities would be more clean and less disease prevention.
- That would suck. Imo littering and dirty streets are part of California culture.
- It would look shiny and clean and would also be free from bugs
- The city would be prettier but not much of a change. Trash is easy to faze out.
- The city would look more appealing and nice
- It would look cleaner and more fresh
- With a lack of litter the city may still be polluted depending on how the waste is disposed of, if it's being burned then the pollution may get worse.
- Clean and nice
- It would be amazing not to see trash on the ground and ruin the view
- The city would be safer. With less trash around, there would be less rats and cockroaches, both of which carry diseases.
- I think it would be a more enjoyable area presentable and people would want to buy a home more in that area
- cleaner

Figure A.3

Classified Project - City Pollution Survey Question 3 Results

Q3) Do you have any experience(s) with city pollution?

- Yes, littering is a ever present problem in many big cities and tourist towns
- Yes and No, in SF most of the litter is caused by the homeless and encampment there
- I've had a few experiences with city pollution in SF
- Yes, I did community service and found lots of trash in rivers/creek in my neighborhood
- Yes with several homeless encampment made of litter of waste
- Riverside, CA is heavily polluted, making the air quality worse
- Yes, in my area there is a lot of litter

Figure A.4***Classified Project - City Pollution Survey Question 4 Results***

Q4) Why do you think people litter?

- People are lazy and don't want to put in the effort.
- A mixture of laziness and lack of adequate waste disposal facilities such as trash cans.
- Because they don't care. They think the whole world is a garbage can or someone would clean up after them.
- Because there may not be a trash can close by.
- Laziness, poor decisions, and disrespect toward issues.
- It is more convenient for people to litter than going through the trouble of finding a trash can.
- Convenience, lack of disposal areas, and poorly designed disposal areas.
- Cuz they dont care or they weren't raised correctly.

Appendix B**Figure B.1*****Recorded Interview Summary Question 1***

Q1) How do you define city pollution?

Throughout this interview, interviewee one brought up the main points of trash being a part of pollution in the city, which also ties into car and factory pollution. Interviewee two brought up the fact that one specific street, McKee road is scattered with trash, which makes it dangerous. Interviewee two stated that it was dangerous for her and her dog to walk along. Interviewee three, which included a group of people, all came to a conclusion that city pollution includes gas pollution, water pollution, and garbage in the oceans.

Figure B.2***Recorded Interview Summary Question 2***

Q2) Why do you think people would litter?

The interviewees came up with similar conclusions of the problem stemming from peoples' homes- picking up bad habits from home-, an influx of the homeless population, people ignoring the consequences of littering, and how they are educated.

Figure B.3***Recorded Interview Summary Question 3***

Q3) What do you think you can do to help a city be litter-free?

The interviewees all suggested that they would clean up after themselves and be a set example, hold their peers accountable for their trash, have more conveniently placed trash bins for people, and have more community clean up days.

Appendix C**Figure C.1*****BIX Project Idea #1 - Drones***

Small drones that flies and has a hook that picks up trash and moves to a marked bin

- Can have a swarm of small robots that can clear large areas.
- Can be used to pick up trash in harder to reach areas.
- Easier to clean up as you would only need to clean from one bin.

Figure C.2***BIX Project Idea #1 - Drones Pros***

Pros

- Cheaper
- minimalized
- easy to transport

Figure C.3***BIX Project Idea #1 - Drones Cons***

Cons

- Easy to break,
- cannot pick large objects up
- drop trash on people
- crash into walls/people
- battery life

Appendix D

Figure D.1

BIX Project Idea #2 - Big Robot

Big robot on the ground that has its own bin that will be collected.

- Big robot uses an arm mechanism to grab larger pieces of trash off the floor.
- Big robot that suctions litter off the floor and separates each trash item into different compartments of robot
- Big robot has recording devices, audio and video, attached inside it
- Can be used as a bin for everyone to throw their trash into instead of littering.

Can be in the way of people

Figure D.2

BIX Project Idea #2 - Big Robot Pros and Cons

Pros of Robot

- Can pick up larger objects resistant to damage
- can filter through more trash
- have more space for trash

Figure D.3

BIX Project Idea #2 - Big Robot Cons

Cons of Robot

- Production cost,
- Maintenance cost
- Can be an obstruction
- difficult to transport

Appendix E

Figure E.1

BIX Project Idea #3 - R.Bix

“Roomba” like machine

- Has to be suitable outdoors (Can't suck up everything off the floor like rocks)

- Useful in more urban areas
- Can be used as a trash bin for people to throw trash in
- Has sensors that recognize people
- Can be in the way of people

Figure E.2

BIX Project Idea #3 - R.Bix Pros

Pros

- The cheapest option out of the three
- Maintainable
- Routine clean ups

Figure E.3

BIX Project Idea #3 - R.Bix Con

Cons

- Low storage
- Small battery
- Fixed cleaning location

Appendix F

Figure F.1

BIX Project Idea #4 - C.Bix (Carrier Bot)

- Useful for outdoor place like on a college campuses or city
- Can be used as a trash can for people to throw their trash
- Has an camera to detect people in its way
- Has a bionic arm to pick up trash
- Has a chip to track its location
- Has a face with programmable eyes to intimidate people to not litter

Figure F.2

BIX Project Idea #4 - C.Bix (Carrier Bot) Pros

Pros

- Small robot that carries trash
- Abundant amount of small robot
- 2nd cheapest alternative

Figure F.3

BIX Project Idea #4 - C.Bix (Carrier Bot) Cons

Cons

- Small trash can
- Battery life
- Cannot pick up large trash

Appendix G

Figure G.1

BIX Prototype - BIX Front View

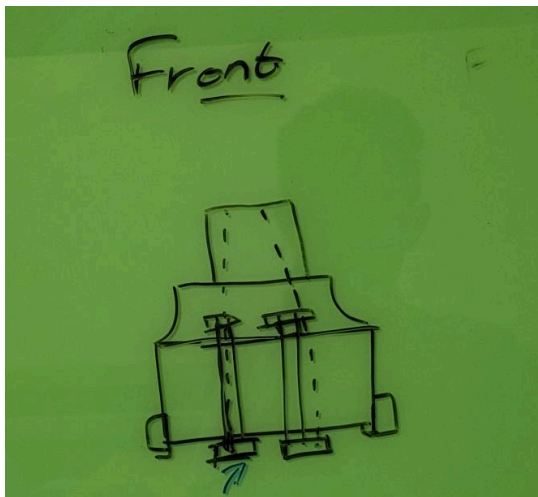


Figure G.2

BIX Prototype - BIX Side View

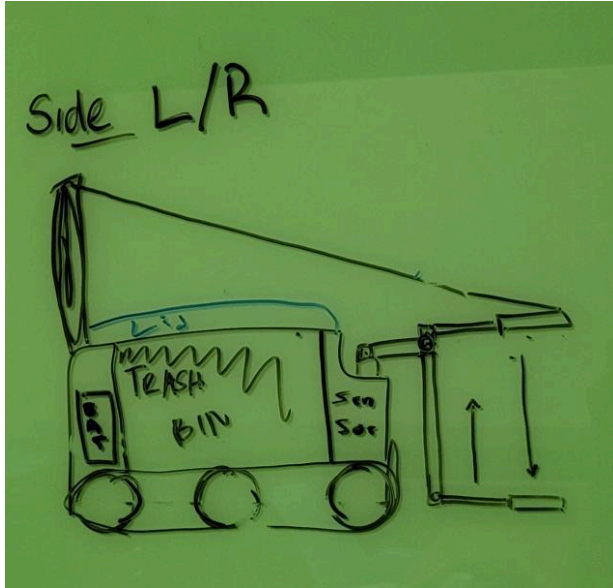
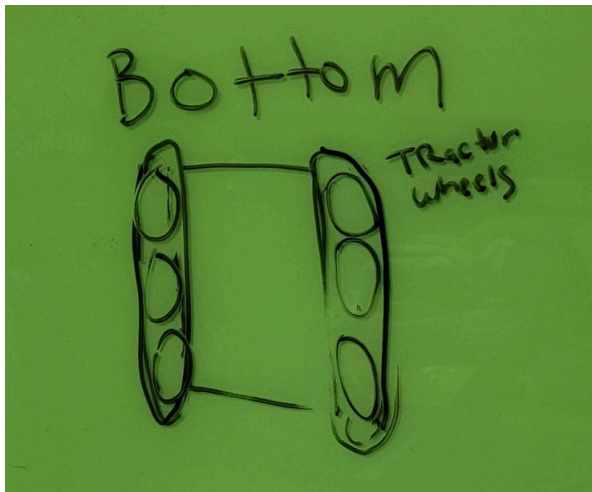


Figure G.3

BIX Prototype - BIX Bottom View



Appendix H

Figure H.1

BIX Prototype - BIX Materials

- Tray - Plastic
- Tractor Wheels - Cardboard
- Wheels - Foam
- Pulling Mechanism - String
- Crane Arm - Foam
- Body - Cardboard Box
- Swivel - Foam
- Battery - Cardboard
- Sensor Foam

Appendix I

Figure I.1

Interview Question 1) & Answers

How would you feel participating in beautifying the community with an assistive robot that would help pick up trash for you?

Interviewee #1: I think it would be good for robots to pick up trash. But I feel that people might just throw trash on the ground and have the robot pick it up for them.

Interviewee #2: That would be a good idea... I'd feel like that would help more centralized areas, like the mall centers or marketplaces.

Interviewee #3: It would be good to have a robot pick up trash that people might drop or to clean up the surrounding area

Interviewee #4: I think it would be a good idea, but I have doubts of how effective it would be.

Interviewee #5: I don't know how I would feel about a tiny robot picking up trash because teens or any kids could harass the robot from doing its jobs and it would just be a sitting duck and able to do anything

Figure I.2

Interview Question 2) & Answers

Let's say that you are participating in community service, would you think that this robot would be efficient or would slow down the process?

Interviewee #1: Personally, for me. I think that this robot would slow down the process but could be effective in cleaning trash because I would be able to clean trash up faster, but this robot would be able to do long term. Let's say, 16 hours a day could work, while someone is only willing to do it for 4-8 hours.

Interviewee #2: Growing up I did a lot of community service and know what to do and how everything is organized and I feel like yes it would slow down the process. But it could be useful in how long it could work for.

Interviewee #3: Yes, it would slow down the process, but it could be effective. It all really depends on how big the battery is because if it is small, it won't be able to do much for a long time, if it has a big battery it could for maybe 8-16 hours a day

Interviewee #4: If I was participating... I'd say that your product would probably slow down the process, just because of the limited time... and maybe the robot doesn't work as fast as we do. Plus, there's most likely a large amount of trash that needs to be collected.

Interviewee #5: It depends on how big the robot is and to be honest I wouldn't know until I see how the prototype works.

Figure I.3

Interview Question 3) & Answers

Do you have any concerns with this idea/project?

Interviewee #1: I have a worry about how this robot may not have enough energy to do certain tasks.

Interviewee #2: I worry about the structure of the robot because kids could harass the robot and the robot would be destroyed and ruined.

Interviewee #3: Two worries I have are about the mechanism being unstable and the battery because the design of the robot is good. But with a small frame, i fear there might not be enough

juice for the robot to last a long time

Interviewee #4: A worry that every member in my community may have an issue with is the amount of robots cleaning up trash. I fear that if there is a lot of robot cleaning in certain area, it may scare the community.

Interviewee #5: One question that I do have is with the design of the robot and how its structure will stand.

Figure I.4

Interview Question 4) & Answers

(If you agree with our product), what are some ways we could improve?

Interviewee #1: One thing this group could improve on is describing how the elevator and tray mechanism works. I kinda got confused when looking at the drawing and didn't know what it meant

Interviewee #2: Some way this product can be improved is how they present their material because they didn't show where each material goes. They just showcase what the final product will look like

Interviewee #3: What they could improve on is if they plan to sell this invention to the government, they would need to create a document that is easily understandable

Interviewee #4: Growing up, I always wanted a cool robot to pick up trash. It would be a cool invention. Looking at the document, I see nothing that I would change because it is cool

Interviewee #5:

Figure I.5

Interview Question 5) & Answers

Would you buy this product for personal uses or to sponsor a community service?

Interviewee #1: I'm not really sure because I would need to see how it would work.

Interviewee #2: No

Interviewee #3: Yes

Interviewee #4: Yes

Interviewee #5: No

Appendix J

Figure J.1

Financial Planning

Financial Report - Total Revenue

Expense														
Fixed Costs														0
Setup Costs	20000	0	0	0	0	0	0	0	0	0	0	0	0	20000
Rent	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	12000
Utility	200	100	200	300	200	150	200	150	150	250	250	300	300	2450
Salary	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	192000
Overhead	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	57600
Office Supplies	250	250	250	250	250	250	250	250	250	250	250	250	250	3000
Accounting	200	200	200	200	200	200	200	200	200	200	200	200	200	2400
Legal	600	600	600	600	600	600	600	600	600	600	600	600	600	7200

Financial Report - Expense Costs

Expense														
Fixed Costs														0
Setup Costs	20000	0	0	0	0	0	0	0	0	0	0	0	0	20000
Rent	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	12000
Utility	200	100	200	300	200	150	200	150	150	250	250	300	300	2450
Salary	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	192000
Overhead	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	57600
Office Supplies	250	250	250	250	250	250	250	250	250	250	250	250	250	3000
Accounting	200	200	200	200	200	200	200	200	200	200	200	200	200	2400
Legal	600	600	600	600	600	600	600	600	600	600	600	600	600	7200

Financial Report - Variable Costs & Total Expenses

Variable Costs														0
Marketing	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	36000
Travel	100	100	100	100	100	100	100	100	100	100	100	100	100	1200
Lodging	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Entertainment	50	50	50	50	50	50	50	50	50	50	50	50	50	600
Consultant	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	24000
Total Expense	48200	28100	28200	28300	28200	28150	28200	28150	28150	28250	28250	28300	28300	358450

Financial Report - Cash Flow & Net Profit

Cash Flow														
Cash Infusion	50000													
Net Profit	(46950.00)	1437.50	1653.13	1901.09	2186.26	2514.20	2891.33	3325.02	3823.78	4397.35	5056.95	5815.49	6625.08	36252.08
Cash On Hand	3050.00	4487.50	6140.63	8041.72	10227.98	12742.17	15633.50	18958.52	22782.30	27179.65	32236.59	38052.08		