

INTRODUCTION

In the bustling urban landscape of modern cities, metro systems have emerged as lifelines of efficient and convenient public transportation. Commuting millions of passengers daily, these underground arteries promise a swift and reliable journey, alleviating the burden of traffic congestion and reducing environmental impacts. Yet, amid this promise of seamless travel, a recurrent issue continues to challenge the passengers' experience—the uneven distribution of crowd in metro cabins.

The metro system's efficiency greatly relies on its ability to accommodate a large number of passengers during peak hours, ensuring that commuters reach their destinations in a timely and comfortable manner. However, the uneven distribution of crowds across the train carriages presents a multifaceted predicament for passengers and transit authorities alike.

When metro cabins experience uneven crowding, certain compartments become excessively packed while others remain comparatively empty. This spatial disparity leads to a host of problems that negatively impact the commuting experience. For passengers, it can result in discomfort, inconvenience, and even safety hazards.

To overcome this problem, we came up with COMFORTRO. Our idea involves displaying passengers count in each cabin and displaying them at metro stations. This provides an additional freedom to the passengers to choose the cabin he wants to board in.

DESIGN THINKING

Design thinking: Design thinking is a method of creative problem solving. It draws upon logic, imagination, intuition and Systematic reasoning to explore possibilities of what could be and to create desired outcomes that benefit end user having empathy as a key filter. In contrast to traditional problem solving which is a linear process of identifying a problem and then brainstorming solutions, it works only if it is iterative.

Phases of design thinking:



- **Empathize:** research your users' needs.
- **Define:** state your users' needs and problems.
- **Ideate:** challenge assumptions and create ideas.
- **Prototype:** start to create solutions.
- **Test:** try your solutions out.

EMPATHY

Empathize: Research your user's needs.

Empathize is the first stage of the Design Thinking process. Design teams conduct research to get personal grasps of their user's needs. They set aside assumptions to obtain insights into the user's world by observing and consulting with users.

Empathize-Ask WHAT HOW WHY

- Tools to help you better observe.
- Especially good for analyzing photos.
- What you should do for a specific observation.

Empathize Tools:

- Observe
- Immerse
- Engage

Observe: Observe users in their environment.

Immerse: Immerse yourself in the task/environment of the user.

Engage: Engage in a conversation to understand the users better (look out for non-verbal users).

Empathy:

We Empathized many metro users in our college ,neighborhood

We listened to their stories patiently, asked them many questions regarding their problems. Some also suggested their answers.

We come across every problem and noted their common problem.

The problems are:

- Uneven distribution of crowd in cabins
- Late arrivals of metro
- Inconvenience caused during boarding or leaving the metro cabin
- Men entering women cabins

DEFINE



The second stage of typical Design Thinking process is called the Define phase. It involves collating data from the observation stage (First stage called Empathize) to the design problems and challenges.

- Re-visit unknowns to align new knowledge.
- Distil research findings into artefacts.
- Start to tell a story.
- Generate problem statements collaboratively.
- Record everything

Define:

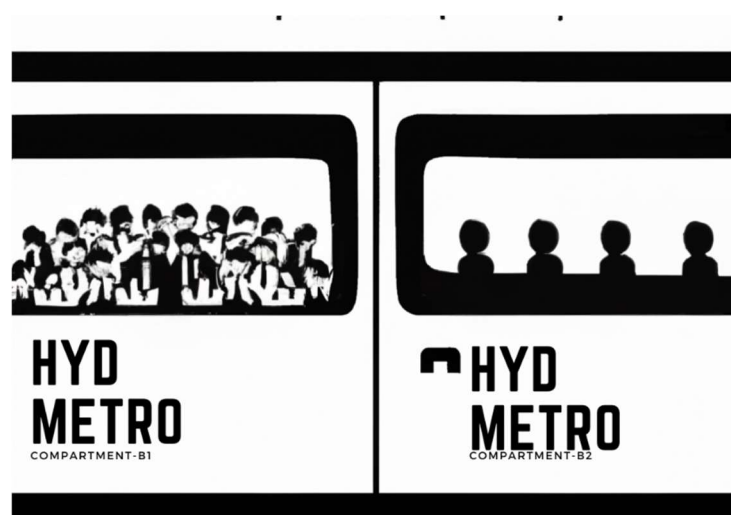
We noted every problem faced by the passengers in empathy stage. We combined all problems and get to know the basic problem of the passengers.

To get a more knowledge about the passenger's problems. We visited them again and empathized them. Surprisingly we noticed the same problems again .

Our team started telling their stories based on what they observed in empathy stage.

Everyone in our team gave their thoughts and their problem statements. And we selected a suited problem statement basedon the problems we noted.

Problem Statement: Uneven Distribution of crowd in metro cabin



Ideation

Ideation is a process, where designers generate ideas in sessions.

Ideation phase of design thinking :-

Step1:- Define the problem.

Step2:- Choose the problem.

Step3:- Set the limits.

Step4:- Select Ideation techniques

Step5:- Rank the ideas.

Step6:- Choose the ideas that will move to the proto tying stage.

In this stage we did individual ideation such as rapid fire and brain writing and group ideation such as speed mind mapping , reverse thinking. We have also listed out the worst possible ways that ensure integrity and to get the best possible solutions

Rapid Fire:

- On a piece of cardstock , sketch 8 different ideas to address your statement.
- If you get stuck , try applying some constraints.

Brain Writing:

- Each person has 3 minutes to jot down ideas.
- After the 3 minutes is up, pass your paper to the person to your right
- That person has 3 minutes to add their own ideas and flesh out ones already on the page
- repeat this process until everyone gets their original paper back

Speed Mind Mapping :

- Write your opportunity in the middle of the page
- Use 3 levels of brainstorming to come up with new ideas
- Levels 1-preliminary ideas- 1minute
- Levels 2-expand on ideas -3minutes
- Levels 3-add some details – 3minutes
- To refine ideas, ask yourself “how “ or “ what would this look like “
- It’s ok if you don’t do all 3 levels for each branch!

Reverse Thinking :

- List the worst possible ways that you ensure heading integrity
- Examine how you could reverse these bad ideas to create the best possible solutions

Industry Swap:

- Brainstorming new ideas as a group
- create the template { shown on the left} on a whiteboard on largechart paper
- Choose a company (not in the automotive industry) that is known forhaving high customer satisfaction
- Apple , Starbucks , IKEA , and Amazon are good ones!
- Brainstorm ways that another company would tackle yourproblem
- Think of how similar solution could be applied for GM

Ideation:

After noticing every problem we noted in Empathy stage, our team came up with the problem statement as UNEVEN DISTRIBUTION OF CROWD IN METRO CABINS

Based on the problem statement, we started doing Ideation stage.

Rapid Fire:

On a piece of cardstock we sketched 8 different ideas to address our problem statement.

Brain Writing:

We took a paper and passed the paper to every member in our team. Every one has 3 minutes to write their ideas based on the problem statement. We started passing the paper to the person right to the next, whenever a member's 3 minutes is completed.

After the completion of the time we got many ideas and we even got some same ideas from our members..

By the completion of ideation stage, we selected a best idea that displaying passengers count in each cabin at metro stations

PROTOTYPE

Illustration of the Prototype phase of the design process showing a pencil, wireframes on paper, and a ruler. The fourth phase of design thinking, where you identify the best possible solution. Prototype flow has six steps. A prototyping model starts with requirement analysis. So we have gathered all the requirements of the model.

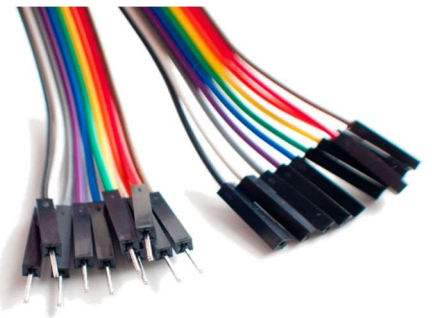
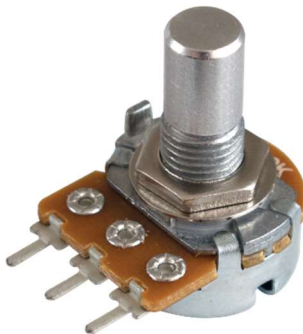
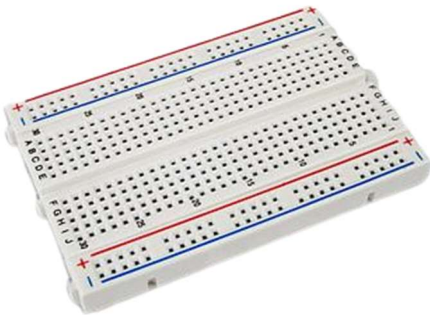
- To proceed further we made a quick design of the model. However, it is not a complete design it gives a brief idea of the model to the user. This helped us in developing the prototype.
- In the third step, we actually designed a prototype i.e. a small working model.
- We represented our model to our faculty as well as other teams, to suggest strengths and weakness of the working model.
- We have also made some changes to our prototype according to the user's feedbacks and suggestions.
- After fulfilling all the user needs we have developed a final prototype.

Prototype:

After selecting the best idea in Ideation stage. We started working on preparing prototype

Components Used:

- Breadboard.
- LCD display.
- Arduino Uno.
- IR Modules.
- 10k ohm Potentiometers.
- Connecting wires.



Software used for coding:

Arduino ide

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment.

The program or code written in the Arduino IDE is often called as sketching. We need to connect the Genuino and Arduino board with the IDE to upload the sketch written in the Arduino IDE software. The sketch is saved with the extension '.ino.'

Source Code:

```
#include<LiquidCrystal.h>

LiquidCrystal lcd(2,3,7,6,5,4);

#define in 8
#define out 9
#define led 10
int count=0;
void setup()
{
    lcd.begin(16,2);
    delay(2000);
    pinMode(in, INPUT);
    pinMode(out, INPUT);
    pinMode(led, OUTPUT);
    lcd.clear();
    lcd.print("Persons In Cabin:");
    lcd.setCursor(0,1);
    lcd.print(count);
}

void loop()
{
    int in_value = digitalRead(in);
    int out_value = digitalRead(out);
    if(in_value == LOW)
    {
        count++;
        lcd.clear();
```

```
lcd.print("Persons In Cabin");  
  lcd.setCursor(0,1);  
  lcd.print(count);  
  delay(1000);  
}
```

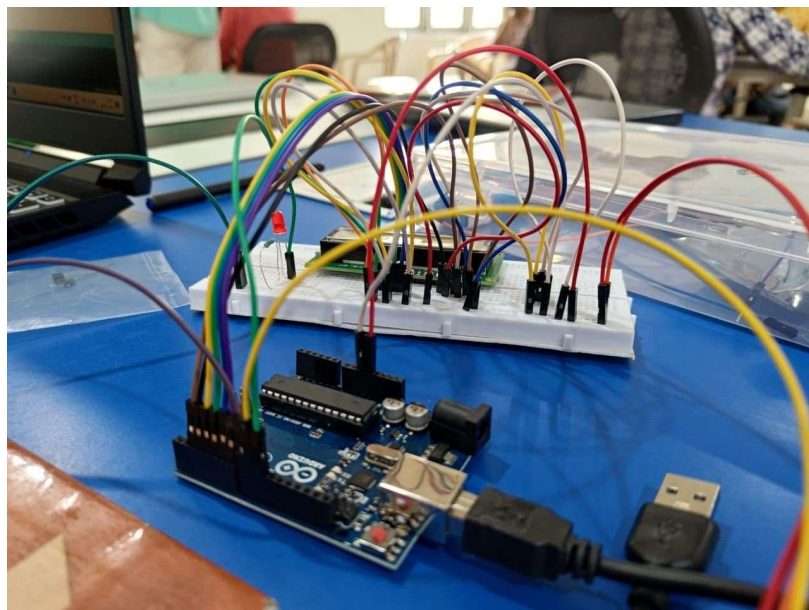
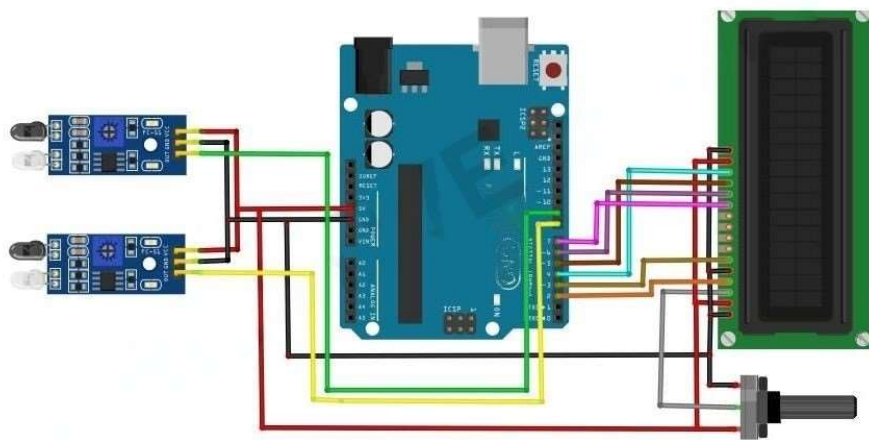
```
if(out_value == LOW)  
{  
  if(Count>0)  
  {  
    count--;  
    lcd.clear();  
    lcd.print("Person In Room:");  
    lcd.setCursor(0,1);  
    lcd.print(count);  
    delay(1000);  
  }  
}
```

```
if(count==0)  
{  
  lcd.clear();  
  digitalWrite(led, LOW);  
  lcd.clear();  
  delay(200);  
}
```

```
else  
{
```

```
digitalWrite(led, HIGH);  
}  
}
```

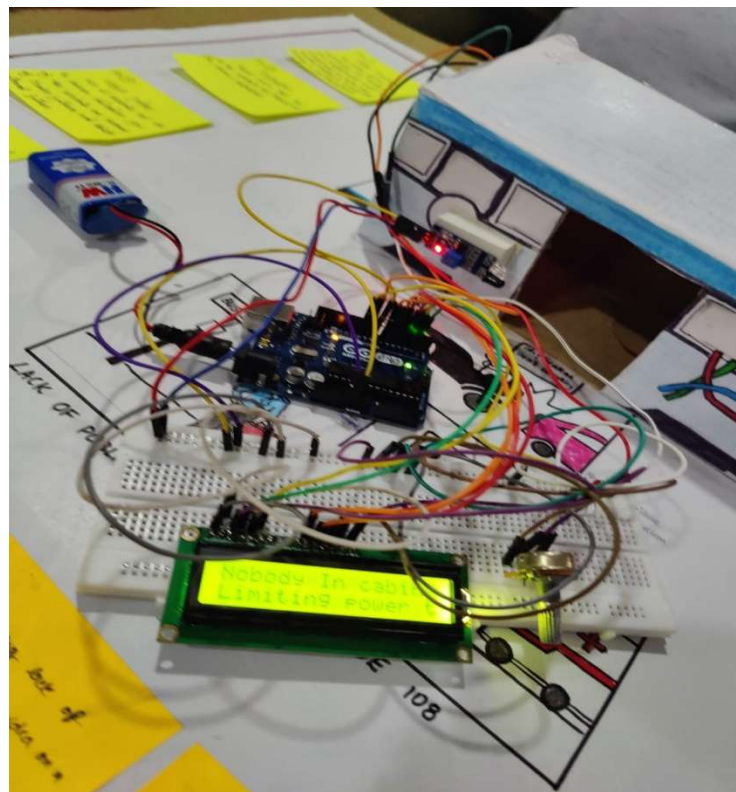
CIRCUIT DIAGRAM:



TEST

The final stage of design thinking is test. Once our final prototype is ready, it is thoroughly tested to see whether it is working or not. After completion of our prototype we tried to test it.

It worked fine. Whenever a person entered the metro the count increased and decreased when the person left the cabin.



CONCLUSION

Through meticulous research, collaboration, and innovative thinking, our project has culminated in one of the best solutions to address the longstanding problem of uneven crowd distribution in metro cabins. By offering a comprehensive approach that combines technological advancements and inclusive design, our solution is poised to revolutionize the commuter experience, creating a more efficient, equitable, and enjoyable metro journey for all.

REFERENCE:

- <https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process>
- <https://www.youtube.com/watch?v=6vj1Kh5JhP0&t=101s>
- <https://www.youtube.com/watch?v=PTFx9ZJYo58>