COMP 1649

Human Computer Interaction and Design

3,072 Words

Tejesh Ramesh Bawa
001173097-8

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1. Introduction

The aim of this report is to document the research and design implementations that are undertaken during the development of a new interactive prototype for leisure motorbike riders. This report covers literature research on the design, a discussion of the conceptual design for the product, application of the design principles, the design implementations for the mid-fidelity prototype while also understanding the incorporation of Human Computer Interaction (HCI) Theory. Furthermore, it will provide a detailed plan for an empirical research study and discussions for any future implementation.

2. Background Literature

2.1 HCI Research

There are many different types of touchscreen mobile phones, with different screen sizes and accessibility due to their rapid development. This poses quite a problem for UX designers to understand how users interact with the application. A study conducted by (Perry and Hourcade, 2008) evaluates one handed thumb tapping interactions. This study revealed that users actually prefer their non-dominant hand when their dominant hand is occupied like when handling their motorbikes. This suggest that preference of which hand to use will defer from people to people.

Furthermore, (Perry and Hourcade, 2008) explains that the target position on the screen perceived to be easiest and preferred in terms of comfort were the middle of the screen, but it turned out to be areas of the lowest accuracy. However, target positions at the edge of screens were not preferred but had ten percent higher points compared to the middle. This prototype will require target positions to be placed where people get higher accuracy to satisfy people whether they are on or off the motorbike.

“Visual distractions by secondary in-car tasks are a major contributing factor in traffic incidents,” states (Grahn and Kujala, 2020). He explained that these negative effects can be solved by building a better user interface design and subtask boundaries. These UI designs need to be visually and cognitively low demanding for the riders. This suggests that by adding something like voice over functionality can help to mitigate the riders’ visual distractions while riding a motorbike. The research further emphasizes that tasks should be broken down into smaller task, like instead of typing only pressing a button would suffice.

(Brügger, Richter and Fabrikant, 2019) describes that the current navigation systems mainly focus on providing information, which is useful for navigation performance, mainly focusing on efficiency. By implementing the navigation systems this way, it generally consumes the navigator’s attention, and this could be quite dangerous for the rider and their surroundings when they do not have adequate spatial knowledge and attention when actually riding a motorbike. It is further explained that there should be a balance between spatial knowledge acquisition and the navigation performance. It will be important to understand the influence of human navigation behaviour in conjunction to different types of navigation system behaviour when designing the app accompanied by real world scenarios.

(Fernando et al., n.d.) explains that motorbikes have now become essential, where people use it to avoid traffic and get to their destination quicker. However, there is an increasing number of accidents, which can put the rider’s life in jeopardy. Their solutions to this problem were to add safety system which involves accident detection on the navigation page, accident alerting and allowing the system to notify the registered emergency number and speed detection to track the motorbike speed and alerting when exceeding speeding limits.

2.2 HCI Theory

"Memory and cognitive load are affected by interactions in the world," states (Mazza, 2017). His interviews suggested that people consciously support memory and aim to lower cognitive load. This supports Sweller's claims on cognitive load theory that impacts learning and performance. This theory emphasizes the importance of reducing the cognitive load and prioritize an intuitive interface for the motorbike rider when navigating through the system, especially when the rider is on the road.

(Fu, 2011) explains the different types of interaction design principles that designers need to adhere too. They mainly focus on the Structure Design, Interactive Design and Visual Design. The structure design focuses on the unified interface system, meaning that the interface structure should have the same tone and structure throughout the system without being changed and be unique at the same time. The interface design aims to make the app more usable to the users, where the core design embodies the human factors. Visual design is based on the pages, colours, fonts and so on. They discovered that the interface should feel comfortable and attractive to the user by not making use of more than 5 colours and exclude red and green, and the font size should be proportional to the size of rest of the page of the interface. This implies that the interaction design principle will prioritize user design by maintaining consistency and providing feedback to the riders.

(Pascoe, Ryan and Morse, 2000) explains that using a system while moving fall into 2 categories of mode of interaction. The first that was labelled was Minimal Attention User Interface (MAUI), which minimizes the user's attention. The second was labelled as Context Awareness, where the application will aid the user based on its knowledge of the environment. This will include the wide range of interaction modes to cater the rider's preferences and accessibility.

(Tidwell, 2011) offers a wide range of common design patterns used when developing a mobile application. his findings can be set to be theoretical foundation to this project, by offering tested and proven solutions for creating effective and user-friendly interfaces. This will help establish design patterns to solve common challenges when developing the design interaction which will allow the rider a familiar and intuitive experience.

3. Product Design

3.1 Conceptual Design

The conceptual design for an iterative product for the leisure motorbike riders will be designed to have a user-centric approach, prioritize safety, enjoyment, and simplicity. The design interface will provide a seamless and intuitive experience for riders, whether they are on or off the motorbike. The conceptual design is heavily influenced by the literature research to ensure that the app aligns with the researched principles of design.

One of the main design features that will be implemented is having target positions towards the edge of the screens, especially during navigation. As researched, this will allow for comfort and accuracy. This placement option is important because when the rider is on the motorbike riding, during that time the navigation on the map should be clear and not have many target positions which can divert the rider's attention away from the map. Also, the target positions should have

adequate size to increase the accuracy of the rider. The music system will incorporate the target positions such as the play/pause button to be big enough to increase accuracy of the rider.

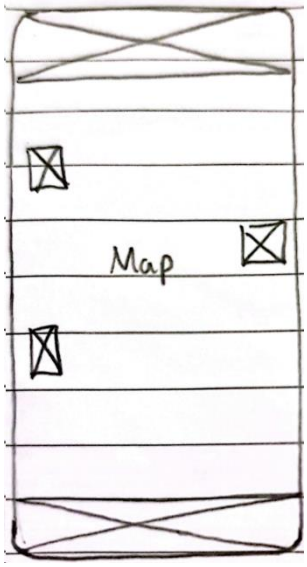


Figure 1: Image of how the target positions will be placed.

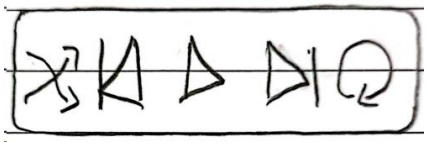


Figure 2: Image of how the music system will be structured and placed.

The research also pointed out to reduce cognitive load and support memory. This will be achieved by not displaying too many target positions on one page, especially on the navigation page. The perception of the app is to use eye-friendly colours, which are pleasant to the eye, when indoor or outdoor. Also, making use of real word objects such as icons as the motorbike symbol, or accident symbol, this will help the rider easily recognize what specific icons are meant for. These functionalities will make the rider feel more comfortable and not add cognitive load to recognize functions to make it an intuitive process.

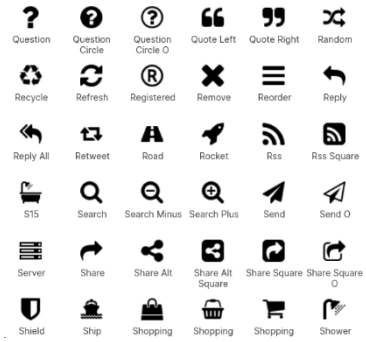


Figure 4: Image of the icon from Axure.

The design will also allow for the rider to have spatial knowledge by having the ability to connect the map navigation to real world navigation, by adding features such as viewing traffic or accidents on the road ahead of their destination. This will allow the rider to be more vigilant. The design will incorporate a speed detection, accident, and traffic detection, which will allow the rider to know without being distracted. The features will also consist of voice overs for direction, in order for the rider to not lose focus of the road.

The design will help users recognize, diagnose, and recover from error, which is important. Whereby allowing the rider to understand the error and solve it with a clear message. Furthermore, the design will implement the same colour scheme and fonts throughout all the pages to avoid user confusion. Finally, the rider will be given adequate control and freedom within the system, such as navigation through the system, logging out, play/pause music and quitting the navigation panel.

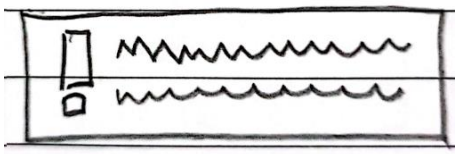


Figure 3: Image of the error drop message.

3.2 Prototype Wireframes

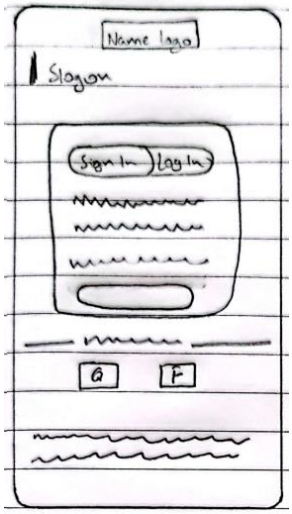


Figure 4: Login and Signup Page

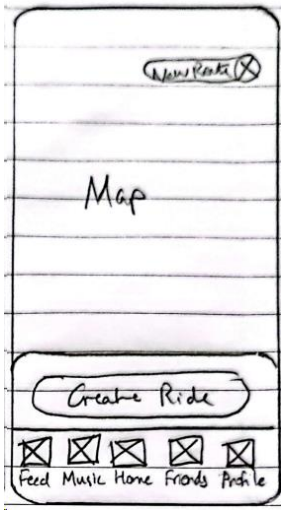


Figure 5: Home Page

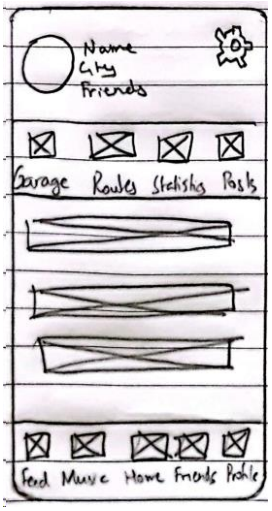


Figure 6: Profile Page

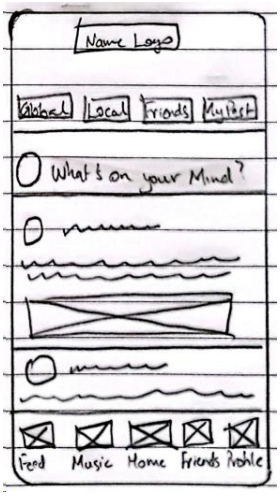


Figure 7: Feed Page

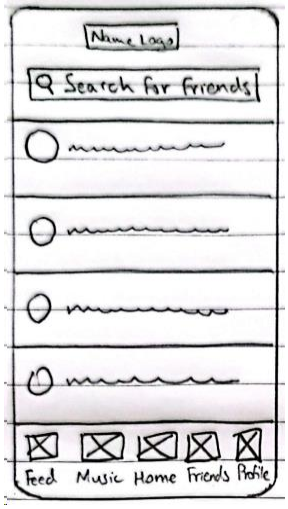


Figure 8: Friends Page

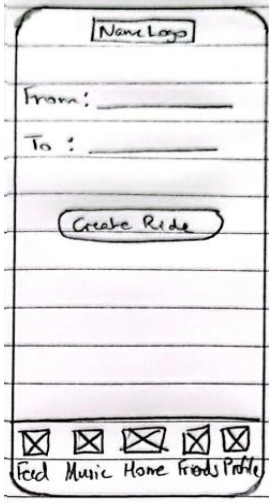


Figure 9: Create a Ride Page

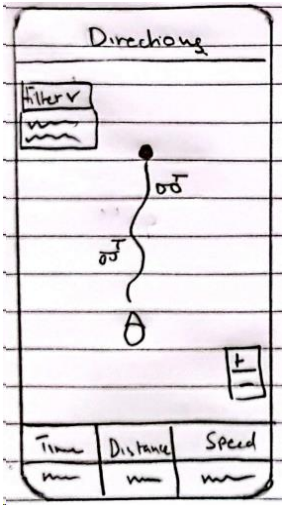


Figure 10: Route Page

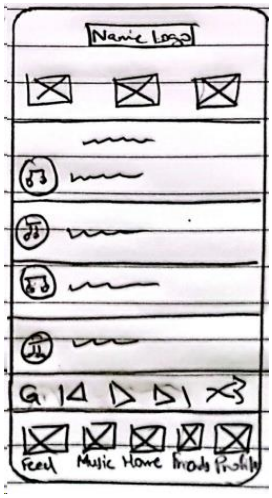


Figure 11: Music Page

3.3 Design Principles

3.3.1 Visibility

The visibility principle emphasizes on making the system status and option clearly visible to the user. On the navigation page, the route map will prominently display the contrast from the route road and surrounding areas. Clear large fonts will be used for directions as well as an option for voice over directions to ensure that the rider can quickly glance and understand the route.

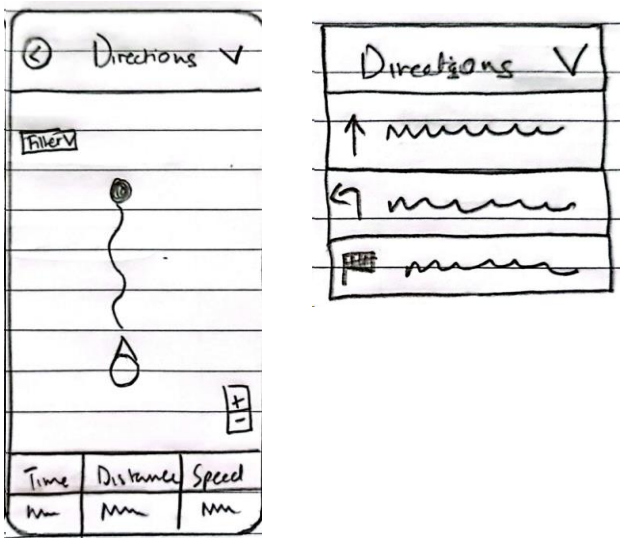


Figure 12: Appropriate change made to the route page to adhere to the requirement.

3.3.2 Feedback

Feedback is an important principle which helps user understanding and a sense of satisfaction when navigating through the system. There are constant error messages in plain icon and language throughout the system, especially the login and signup phase. These error messages will allow the users to understand and correct the error. The design has also included when the routes have been cancelled or completed.

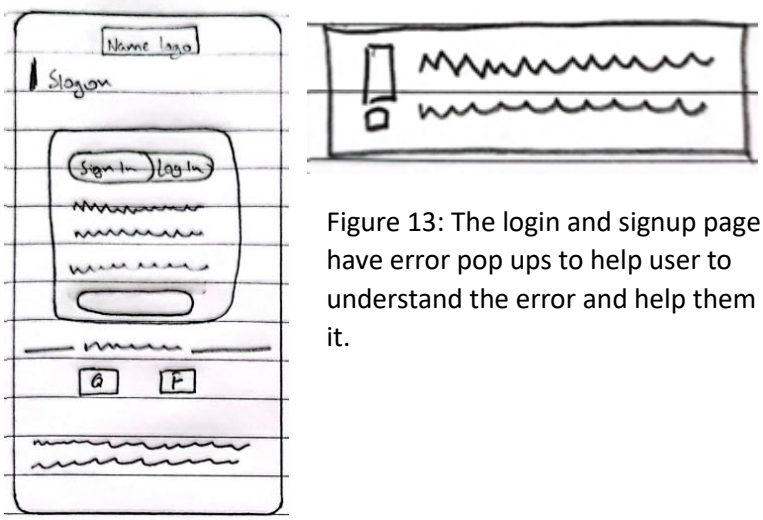


Figure 13: The login and signup page will have error pop ups to help user to understand the error and help them correct it.

3.3.3 Constraints

The constraints principle helps by limiting the actions taken by users to reduce the chances of error. This is performed in the music page where the play/pause is a large central button with the next/previous buttons smaller but with comparable ratio to the play/pause button. During the ride some of the features will be disabled such as navigating through the system, where the rider will

have to either complete the ride or cancel the ride. This will ensure that the rider can quickly and accurately perform the desired actions without confusion.

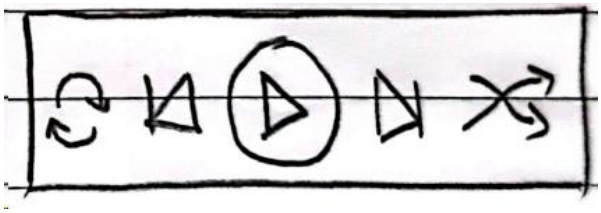


Figure 14: This showcases the layout of the buttons on the music system.

3.3.4 Consistency

The consistency of the design creates a familiar and intuitive experience for the user. The interface design between pages will have consistent iconography and colour schemes. Also, actions such as setting destinations, browsing, or playing music and tracking rides should be similar to other apps to build a sense of familiarity and intuitive. This will ensure that the rider can easily transfer their knowledge from other apps or different part of this app to enhance the overall usability and enjoyment.

3.3.5 Affordance

The affordance principle focuses on all possible actions which can be taken by the users. This can include the interactive elements such as buttons to navigate throughout the system. The design will include appealing icons where the rider can feel familiar with the icons. It can be implemented at the menu bar where the icons wills be displayed as well as name, which make it easier for the rider to distinguish different icon. This will provide the rider a clear and natural method of interaction.

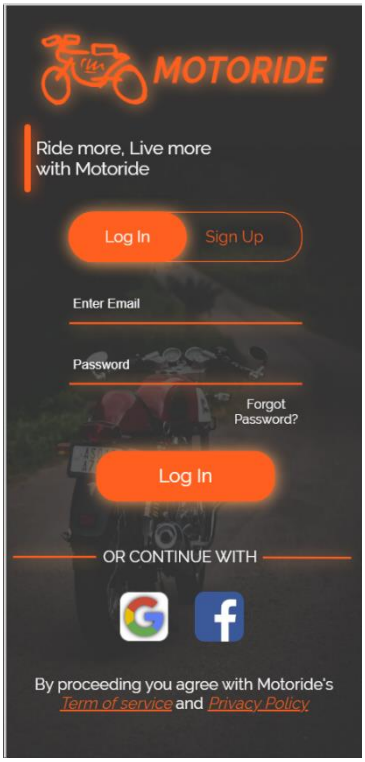
Figure 15: This showcases the layout menu buttons.

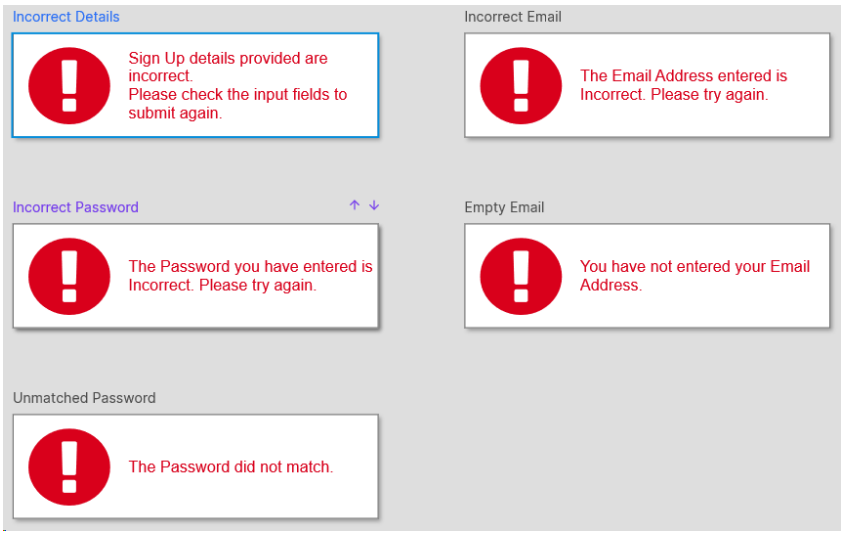
4. Prototype

The prototype will have the same consistency with the colour scheme, typography, and icon menu. The colour scheme used in this prototype is dark to bright contrast. The background is a dark greyish colour (#333333) and the rest is either white or neon orange (#FF5F1F). This added dept to the contrast which helped in preventing glare from the sun when the rider is riding the motorbike. The typography used was Raleway font. This don't is a sans-serif font which give the prototype a more modern feel.

4.1 Signup and Login Page

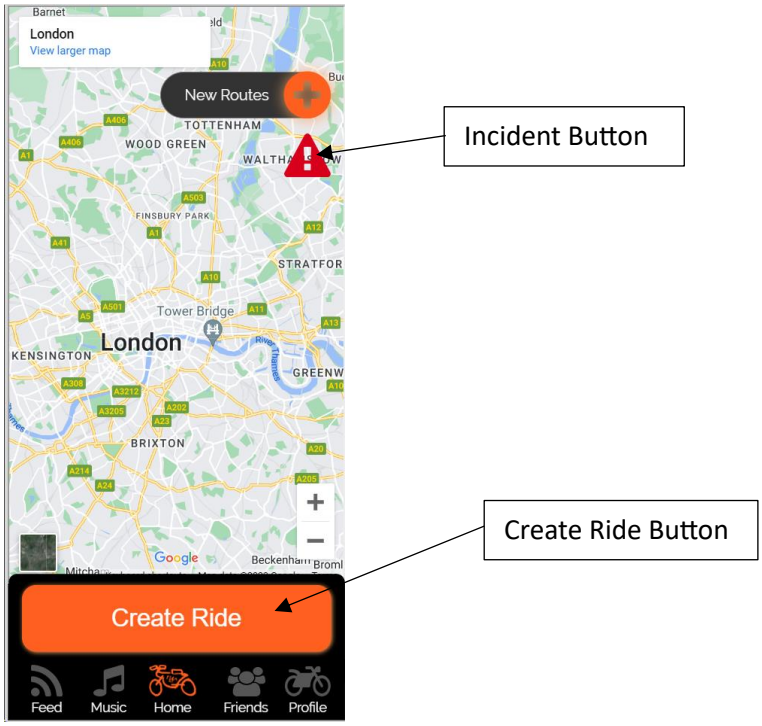
This page has the basic Signup and Login features. This page also has error pop-up messages which helps the user, to identify their mistake and correct it when signing up or logging in.





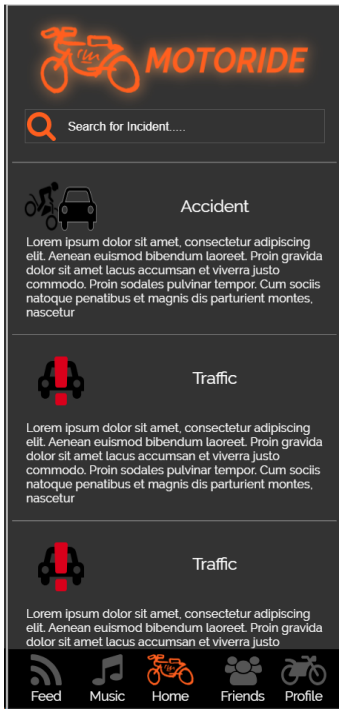
4.2 Home Page

The home page consists of a map of the city that the rider is currently residing in. The page includes a menu bar at the bottom of the page when will be present throughout the prototype, there is a create a ride button where the rider and make their route. There is an additional button included, which is the incident button at the edge of the screen, and it takes the user to the accidents page.



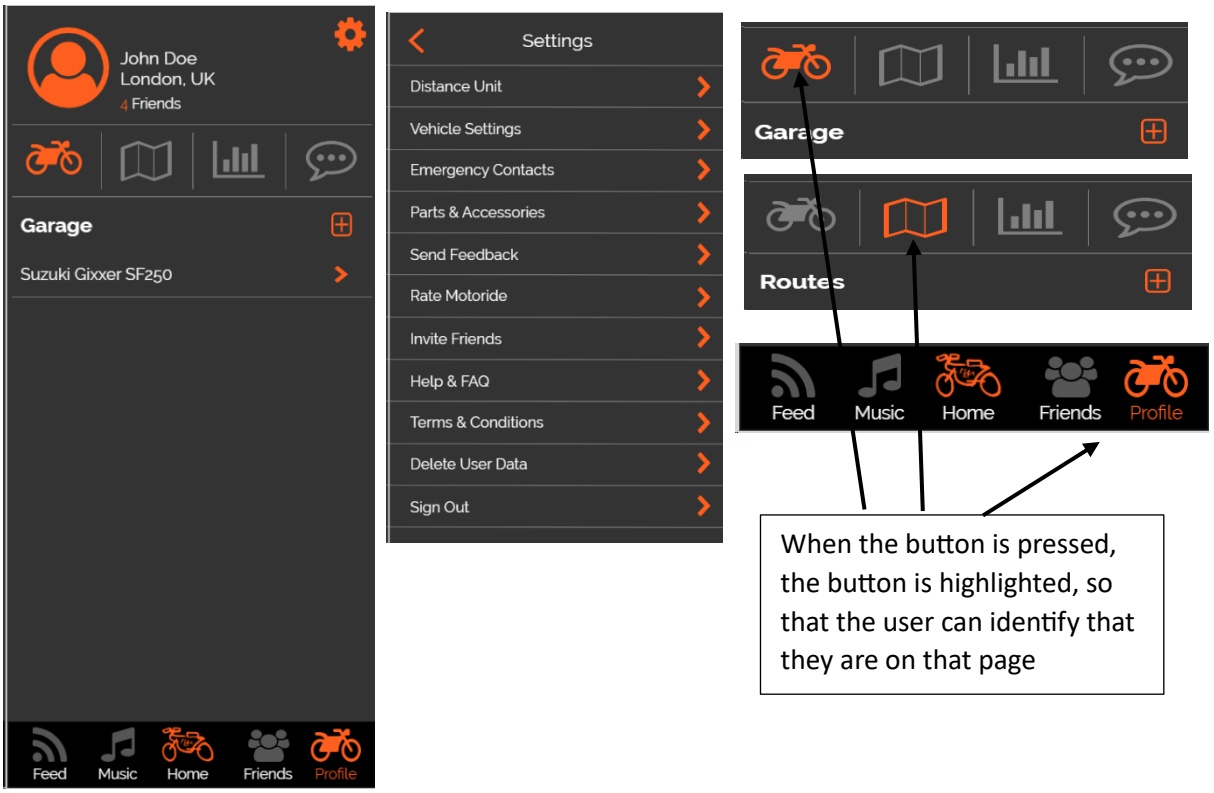
4.3 Incident Page

This page was previously not included during the development of the prototype, however, after considering the requirement, this page has been added. This is because, the user can view accidents that have happened around them.



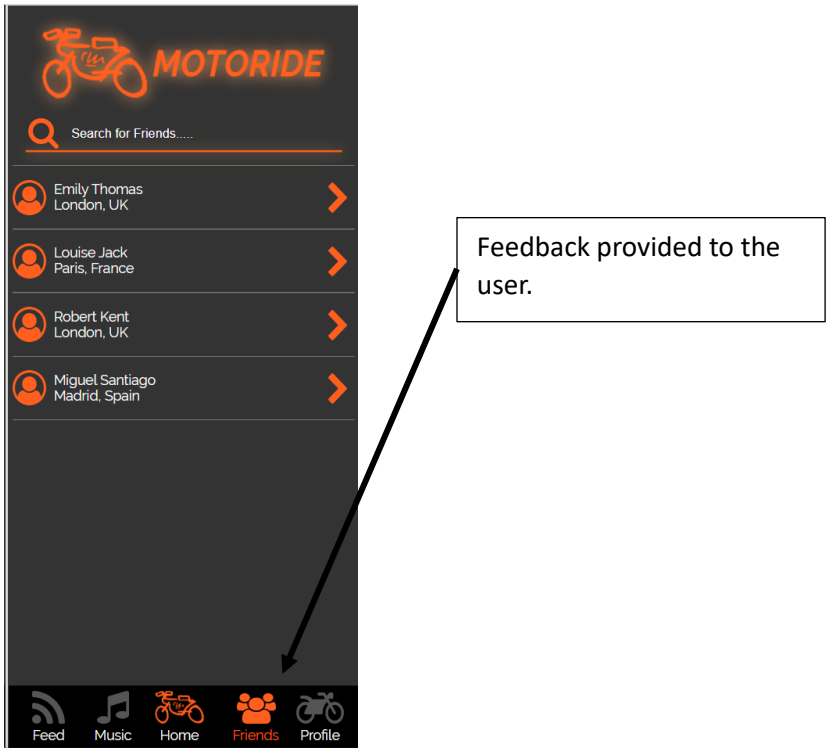
4.4 Profile Page

This page the generic profile pages, which shows the settings, the user's personal information.



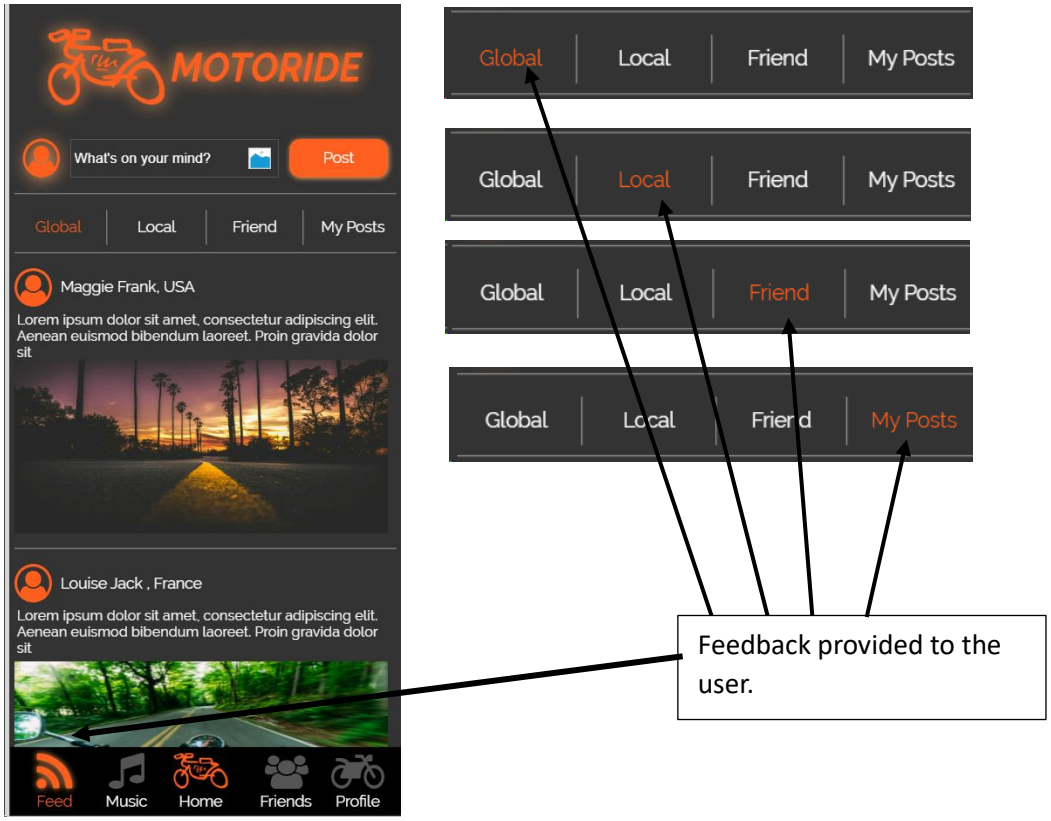
4.5 Friends Page

In this page the user can search or view their friends.



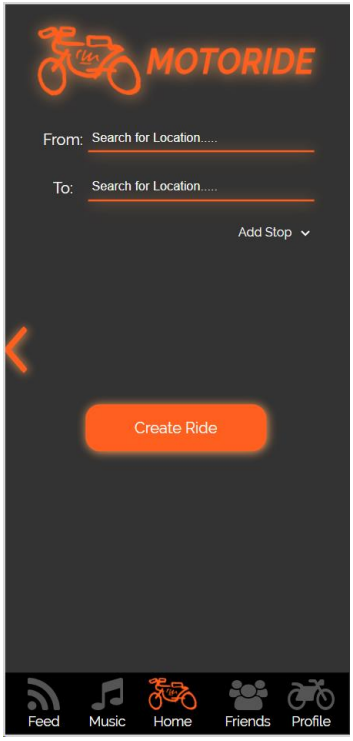
4.6 Feed Page

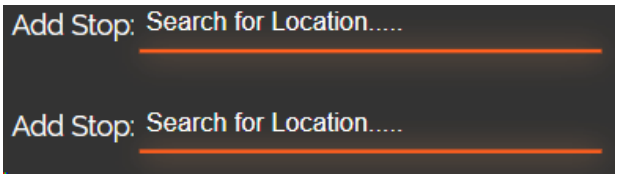
In this page the user can view posts globally, locally, their friends or their own posts. They can also post posts on this page.



4.7 Create A Ride Page

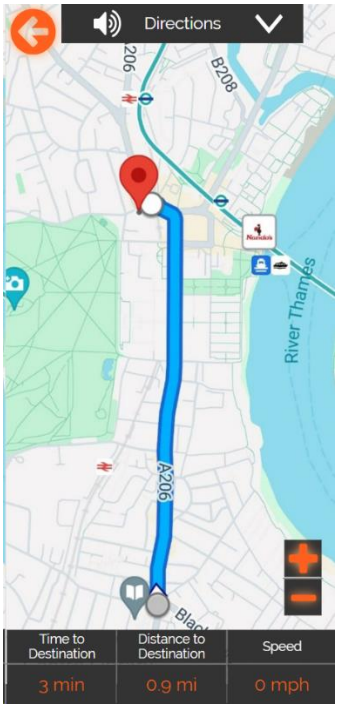
On this page the user is able to select their start point and end point. The user is able to add stops depending on their scenarios.

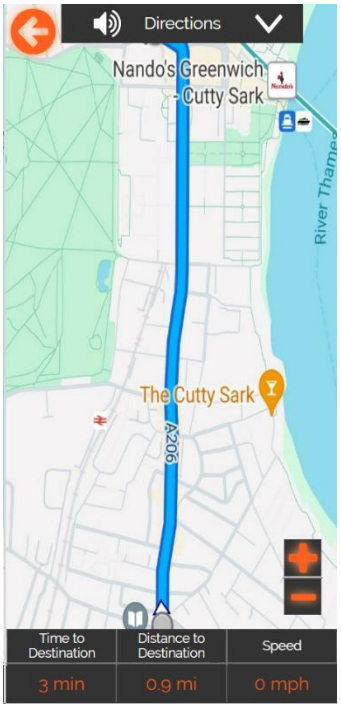


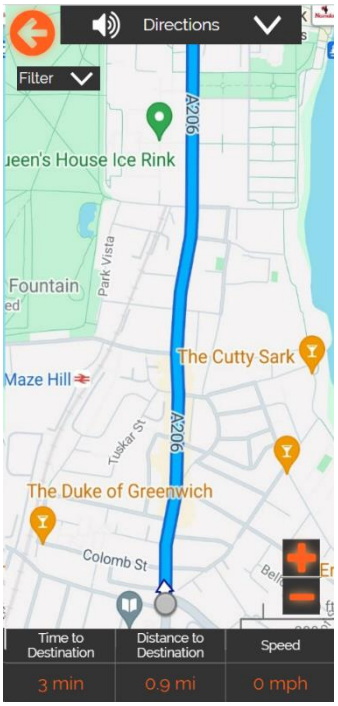


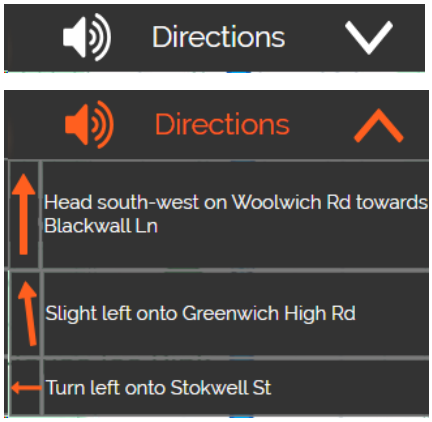
4.8 Route Page

The route page has the basic features that the users will require. The page shows the directions, the speed at real time, distance to destination, time till destination, filtering traffic or accidents and zoom in and out feature. On this page most of the target positions are placed at the edge of the screen as researched. This helps as the user's attention will not be diverted away from the main navigation panel. The filter feature has been implemented on the panel when zoomed in.

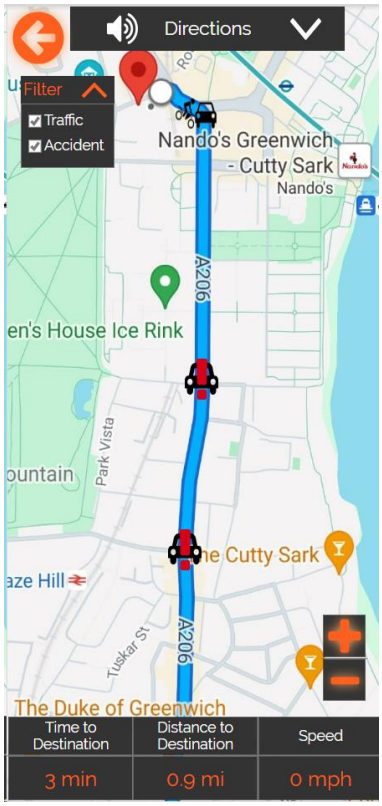




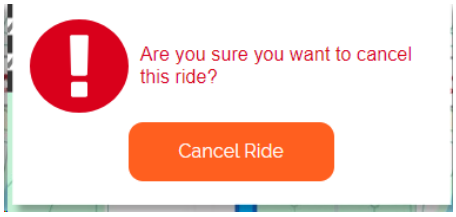




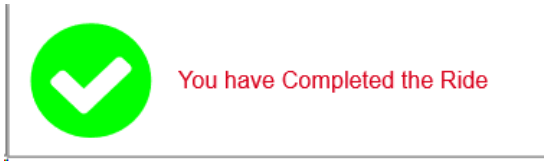
The directions are in a Dropbox. So, that it does not obstruct the navigation panel.



When the user uses the Dropbox filter, they will be able to choose from the traffic, accident, or both. The chosen option is displayed on the navigation panel.



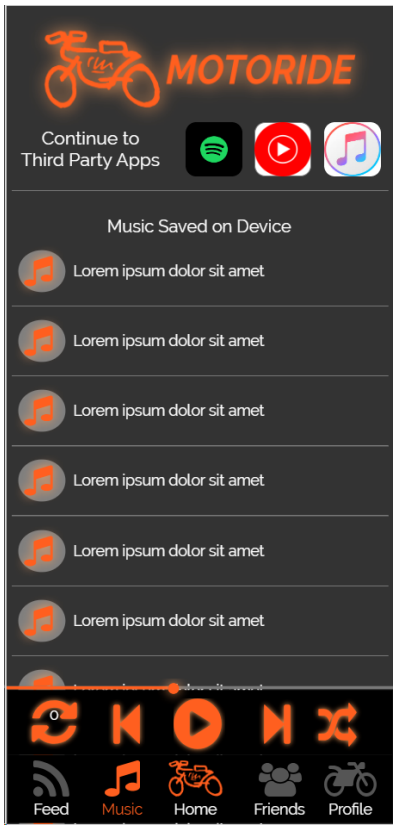
This message is displayed when the user wants to quit the ride.



This message is displayed when the user has completed the ride.

4.9 Music Page

Music page is a generic music page. Here the users will be able to go to third party apps to play music on the background or play music which is already available on their devices.



The music system has the basic play and pause functionality.

This feature allows user to replay the same music again

5. Research Study

5.1 Research Question

How do target positions such as buttons placement at the edge of the screen impact accuracy, and whether it leads to an increase in user satisfaction and enhance safety during motorbike rides or not?

5.2 Participant

The targeted participants for this research will be leisure motorbike riders who are aged from 18 and above with different riding experience. These participants will be selected from online motorbike communities, social media, or motorbike clubs. This will ensure that the participant pool will have a wide range of perspectives on the interactive prototype.

5.3 Study Design

i. Pre-Study Questionnaire

The Pre-Study Questionnaire will help collect information on the participant pool on their riding habits, experience with technology in motorbikes, and preferences with navigation and music on rides

ii. Prototype Familiarization

Here the participants will be introduced to the prototype, where the main focus will be the targeted positions at the edge of the screens. This will help them get a clear understanding of how the prototype works.

iii. Riding Scenarios

The participants will be simulated to a typical motorbike ride where they will have to interact with the prototype with both target position on the centre and edges. This will allow to compare the impact on accuracy, user satisfaction and safety.

iv. Data Collection

The data collected will include accuracy, response time to different target positions and any noticeable changes during rides.

v. Post-Study Interview

The participant pool will engage on a one-on-one interview to get more in-dept qualitative insights with their experience with different target positions. A deeper understanding of their preference, challenges and suggestions will be viewed.

5.4 Analysis

The quantitative data collected from rides and questionnaires will be analysed to identify trends and correlations. The qualitative data collected from the interviews will be used to extract key themes and insights relating to the target position placement.

5.5 Ethical Considerations

1. Participants will be informed with detail information about the research and will be required to give consent before participating.
2. The personal information of the participant will be kept confidential.

6. Conclusion

To conclude, the literature research provided a solid foundation to build an interactive prototype. This allowed to combine the theoretical concepts into the prototype and allow the designs to be more comprehensive. However, it felt that there were many theoretical concepts, which made it a cluster of data waiting to be broken down to be understood, this made it progressively harder to understand and apply those theories into the prototype.

The design process mainly focused on building specific features such as the navigation page and music page which limited potential interactions. If the design process included more features, it would have brought in requirements which could make the prototype more versatile and appealing.

Future implementation to this project would be to add adaptive AI system which would help the rider to create a more intuitive system based on their preferences. Another implementation would be that riders themselves could set the placement of the target positions which would make the interaction more user-centric.

Overall, this project helped in understanding the importance of literature research when it comes to implementing user interaction with the system. It also helped in understanding that an interactive system should be tailored to the user and not to your own preferences as a designer.

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Appendix 1

The main database used for this research was Google Scholar. Here it was noticed that it would provide links to the ACM Digital Library. The main search term queries were HCI and Motorbike with synonyms of “Human Computer Interaction,” “Motorbike Navigation,” “Motorbike Apps,” “Modes of Interaction with HCI” and many others. The key terms were explored and used as the search term, and after getting related topics, the search term was more defined to relate to the topic. Google Scholar helped provide a broader search result however many results were outside what was required.

Appendix 2

Pre-Study Questionnaire

This questionnaire is made to understand the impact of target position placement on accuracy, user satisfaction and safety of the interactive prototype when riding a motorbike. Your input is very valuable and thank you for participating in our research study.

Participant Information

1) What is your age?
    - 18-25
    - 26-35
    - 36-45
    - 46-55
    - 56-65
    - Over 65
2) What is your gender?
    - Male
    - Female
    - Non-binary
    - Prefer not to say
3) What is you motorbike experience?
    - Less than 1 year
    - 1-2 years
    - 3-4 years
    - 5-6 years
    - 7-8 years
    - 9-10 years
    - More than 10 years
4) How frequently do you ride motorbikes?
    - Daily
    - Several times a week
    - Once a week
    - Several times a month
    - Once a month
    - Rarely
5) Do you have any experience with technology on motorbikes?
    - None
    - Basic (e.g., basic music system)
    - Moderate (e.g., navigation system)
    - Advanced (e.g., interactive smart apps)

Riding Preference

6) Which riding environment do you prefer?
    - Urban
    - Sub-urban
    - Rural
    - All of the above
7) Which riding conditions do you prefer?
    - Day

- Night
- Both

8) Which mode of interaction do you prefer?
   - Voice overs
   - Physical control such as touchscreen buttons
   - Both
   - Neither

Technology Usage

9) Are you familiar with interactive applications on motorbike rides?
   - Very familiar
   - Somewhat familiar
   - Not at all familiar
10) Any previous experience with similar applications?
   - Yes
   - No

Expectations and Preferences

11) Is accuracy important in an application during your motorbike ride?
   - Very important
   - Important
   - Neutral
   - Not important
   - Not at all important
12) Do access control on the application have to be easy?
   - Very important
   - Important
   - Neutral
   - Not important
   - Not at all important
13) What positions will you prefer these controls(e.g., touchscreen buttons)
   - Near the centre of the screen
   - Near the edge of the screen
   - A combination of both
14) What factors do you think improve your satisfaction during motorbike rides?
   Open Response
15) Do you have any concerns with the safety when using this system?
   Open Response

Appendix 3

Post-Study Interview Questions

Interaction with the interactive prototype

1) How was the placement of the target positions, such as buttons, when interacting with prototype?
2) Did you find it intuitive? Why or why not?
3) Did you find it any point of time that the placement of the target positions affected your accuracy?
4) Which placement do you think influenced your focus on the directions on the road?
5) Which placement do you think made your riding experience better and more enjoyable?

Safety Considerations

6) Did you find any safety concerns relating to the placement? If so, please explain?
7) Do you think the placements distracted you on the road?

Comparative Feedback

8) How would you compare both placements, in terms of how easy it was to use, its accuracy and safety?
9) Do you have a personal preference for specific placement?

Improvement and Suggestion

10) Do you have any contributions to improve the placement of the target position to the overall design of the system?
11) Any additional suggestions on the use of interactive systems on motorbikes?

Thoughts on the Research Study

12) How was your overall experience during this research?