SafarNama

Group Number: 14

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Project Phase: Phase 2 – Design

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Contents

1. Problem statement

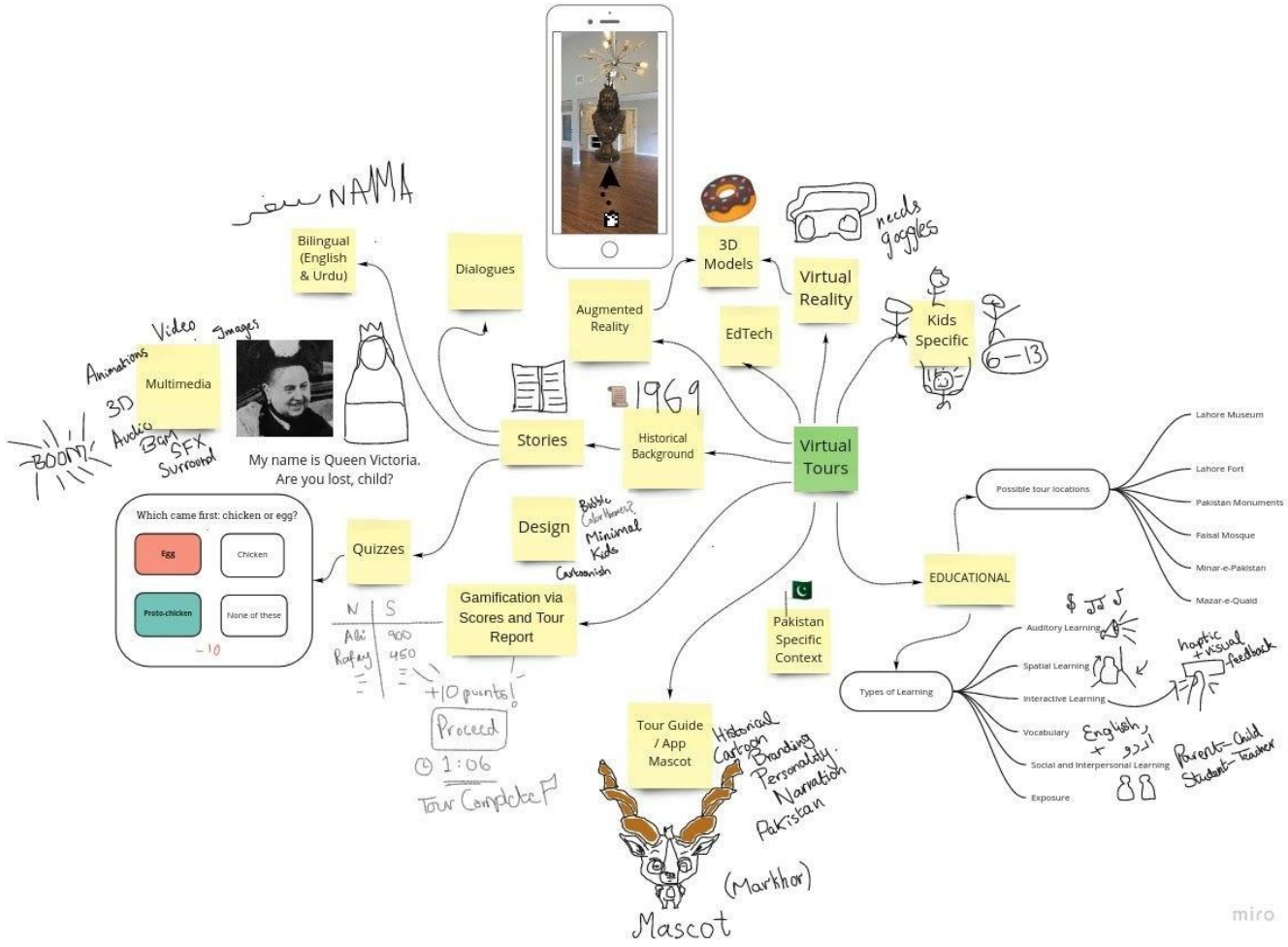
Advancements in knowledge have also led to the progression in how individuals attain this knowledge. The emphasis has shifted towards creative and critical thinking. The modern approach is more learner-centered and consists of activity-based learning. The active participation and consistent engagement of the learner is encouraged which promotes critical thinking. One method of active learning that can be used to instill critical thinking is taking children on educational field trips.

Children are not going or being taken on educational trips enough by schools and parents. They are confined at home due to the COVID-19 situation currently. There is also a lack of awareness of digital mediums which provide these opportunities virtually as well. They already have technological devices available at their home and are regular users of it. Moreover, children are interested in history and culture and have a spark to learn more about it. However, the methods used to teach about history and culture are lacklustre. Students do not develop any interest from studying history through textbooks and are instead bored by it. This is because they are not provided with real life experiences for the respective subject.

When educational field trips do occur, it is when children are too young to understand the context and do not retain anything. The focus should be to take trips at an age where they can understand and interact with the environment. It becomes the responsibility of their families to do so, who are bound by time constraints and too busy to do so regularly. Additionally, there are minimum efforts made to make trips engaging and interactive. Unexpectedly, there is also a strong language barrier in Pakistan, in gaining education from these trips or understanding any historical context at all.

2. Brainstorming (process and ideas)

- Realizing the lack of educational trips for kids in Pakistan, we devised ways, both physical and virtual, of making history and culture based tours more accessible.

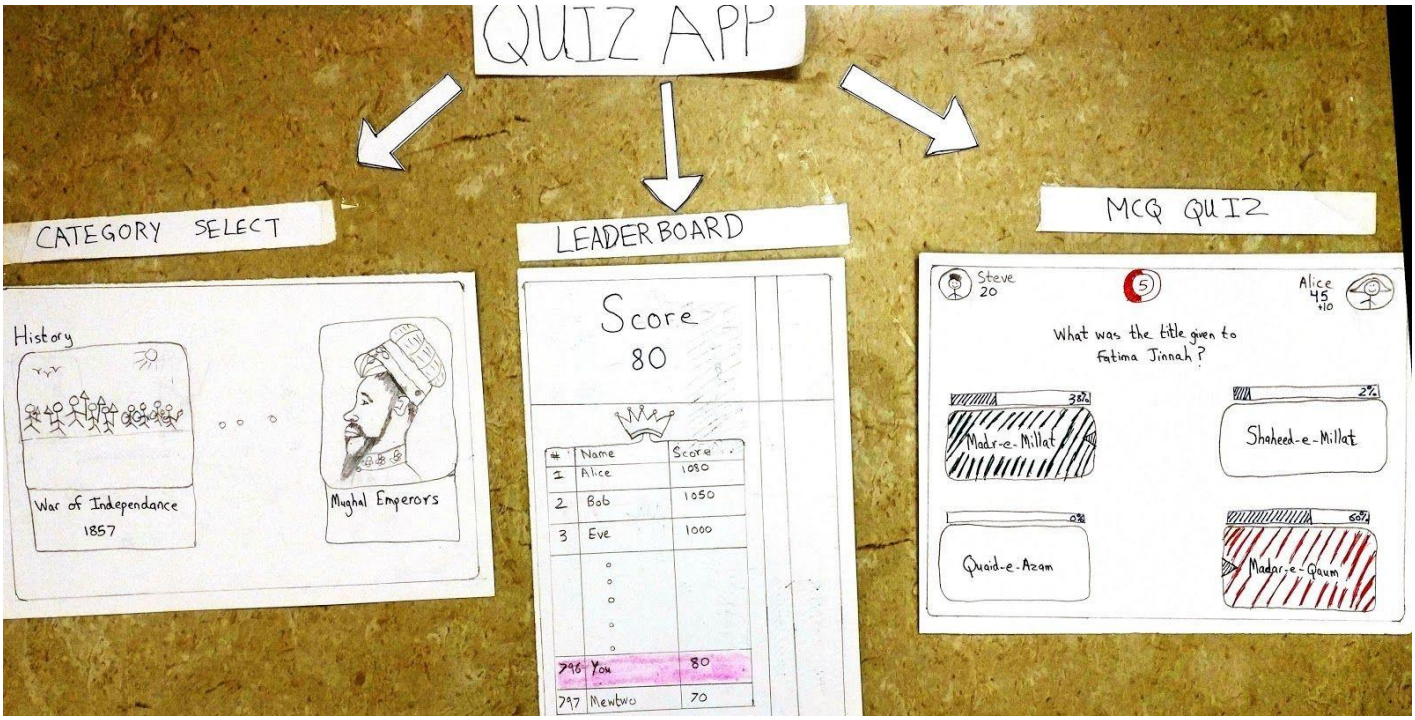


- Any possible solution would have to be bilingual (Urdu and English). Even while treating the entire issue as a first world problem, we noticed the huge language barrier and the level of English language reading skill in different children, so it should be up to the user's preference.
- In the case of a virtual solution, an immersive trip experience at home could be delivered by Virtual Reality / Augmented Reality including 3D Models, images and videos as other visual elements and sounds and music.
- Roleplay can simulate learning, and by involving the user as the main character of a story, possibly narrated by text or voice dialogues would be appreciated.

- Quizzes can be used for enforcing learning, but may make the experience complex or frustrating if not handled carefully.
- We further thought of gamification elements in the case of a virtual solution since they can further increase replayability and such a reward system set in place can incentivize learning as well, for example, using scores, time and leaderboards.
- Tour guides seem to be really important in making a tour more learning, engaging and assisting everyone to follow along and not get confused. We believe that we might be able to use a central character or mascot like that to voice our opinions and any necessary instructions as well.
- Parent/teacher supervision and involvement also seems to be desired as well so there must be some way of catering to that.
- Finally, we came up with all the multiple types of learning that usual trips offer - interactive, auditory, verbal, spatial, social and interpersonal learning, which we should focus on replicating for our solution.
- The attached digital mind map was collaboratively made using Miro for online brainstorming.

3. Design Alternatives

3.1. EduQuiz - (History and culture quiz Pakistani context, gamification points, scores, leaderboard, like QuizUp)

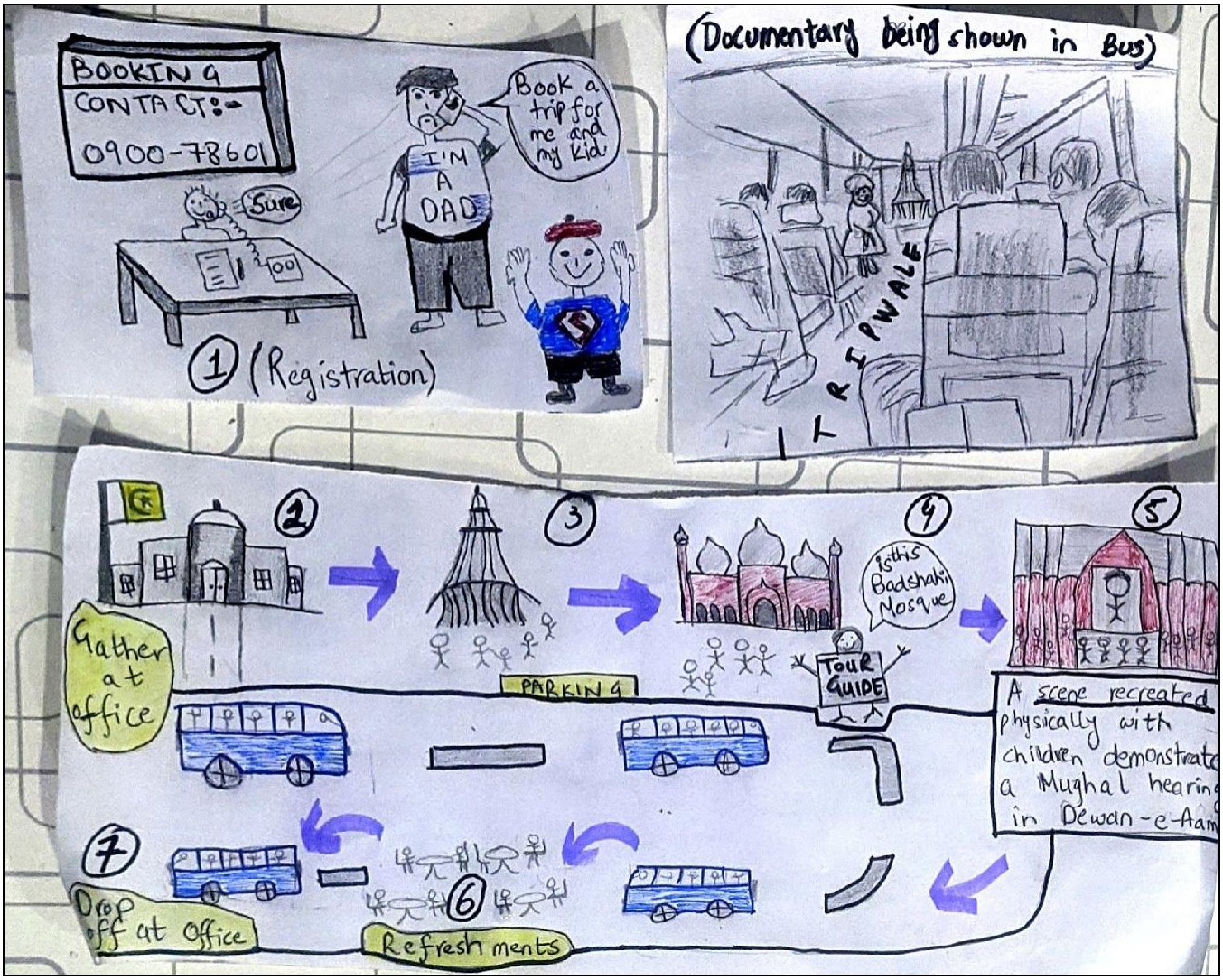


This will involve a quiz application that makes use of gamification elements to improve engagement. The app will allow users to choose a category of their choice, such as history, and then choose a specific topic from that category e.g. Mughal Emperors. Each topic will have timed MCQ quizzes which will also allow a user to play against other players. For each question, after the user has selected their answer, the app will also show the distribution of users who chose each option. After a user has completed a quiz, their score will be shown on a global leaderboard along with other users.

3.2. AR Tourist - (Virtual Tour only explore 3D models in your house, different marker types perspectives and interactions)

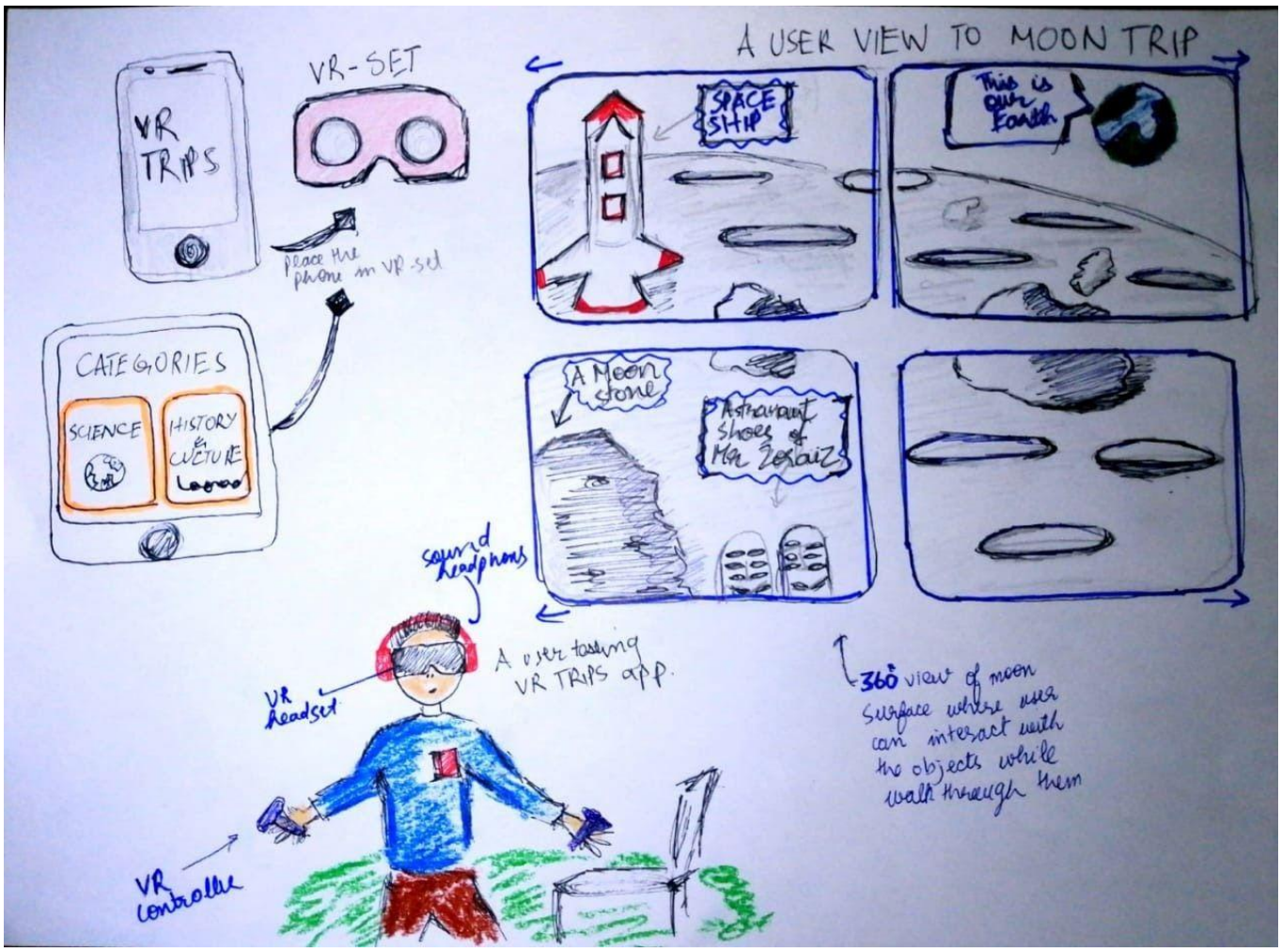
AR Tourist will involve bringing the tour experience to standard user devices via marker-based Augmented Reality, with the tours including 3D models augmented by visual overlay effects, sounds and music and interactions with artifacts like tapping to view more details/videos and scaling and rotating using finger gestures. It will include parent/teacher involvement, by having them set up the tour once it has been selected by printing the provided sheet of AR markers and hiding them around the house/school for their child/student to find and scan them driven by their curiosity to discover. On viewing all of the artifacts, the tour is completed.

3.3. Tripwale - Educational Travel Agency for Kids and Parents



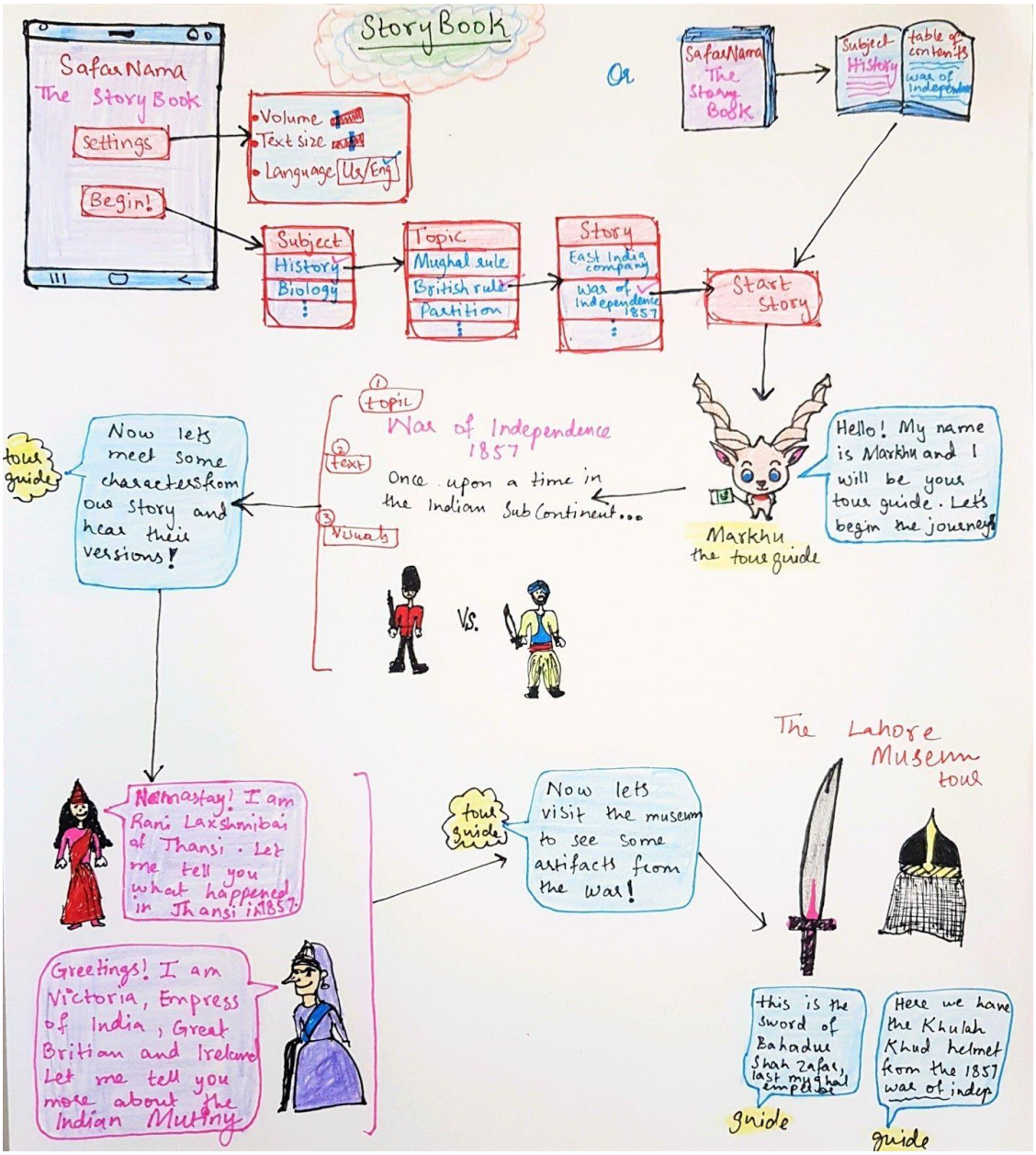
To provide a physical trip experience this design alternative will involve a travel agency dedicated to organize educational trips for kids and their parents. The parents can book educational trips, e.g a trip to Old Lahore, for their family, over the phone. The tour will begin from the company's office. A tour guide will accompany the group to provide valuable information about the places and/or artifacts. Each trip will include a physical demonstration of something relatable to the trip type, in this case a recreation of a Mughal era hearing. The group will then be served refreshments before being taken to the drop-off point.

3.4. VR Trips - Virtual reality tours at home for History, Scienceand Culture with 3D visuals and interactions



The VR Trips app can cater to the need for virtual field/educational tours, using a VR headset to experience tours of Pakistan in Virtual Reality and a VR controller to interact with the visual elements (3D laser scanned or custom models and graphics for the select tour) in it for maximum immersion. For example, the History and Culture category may have the option of exploring the Mohan-jadaro Civilization in simulated VR and interacting with relevant artifacts, picking them up and looking at them from different viewing angles - all such relations and interactions being predefined by the application.

3.5. Storybook (Characters, history and culture based)



The storybook will have a tour guide who will take the user through the whole process of selection. The user will be able to choose a subject (e.g history), then a topic (e.g British rule in Subcontinent) and then a story (e.g war of independence). The guide will narrate the story and then introduce the user to different characters who will share their points of view. The guide will then show monuments and historical artifacts related to the topic (through a museum tour) and provide their descriptions. This way the user will be able to learn history from various angles and visit historical

places. Furthermore, the book will have the option to be read and heard in both English and Urdu, and the text font will have various sizes for visibility.

4. Literature Review/Other similar products

There are some already existing commercial products related to our problem area consisting of:

1. **Google Arts & Culture**
2. **Learn Interact Think's Pehchaan**
3. **Civilizations AR**
4. **colonial williamsburg**
5. **Metaverse**
6. **Discovering Egypt**

These products make use of different methods such as AR, VR, 360 videos, 3D models, storytelling, gamification, and various other interaction methods. These elements add a layer of interactivity and engagement for users which promotes learning. AR models are viewable using cameras and the user can interact with them. Google Arts & Culture introduces art filters, art transfers, art selfie, art projector, and pocket gallery which provide innovative ways to engage the user with the content. LIT's Pehchaan is a storybook which uses AR to take children on tours. The other apps make similar use of AR and gamification to promote interactivity.

The literature review presented different ideas on how to tackle the problem area. Four areas were explored which included: Active learning, Education technology, Augmented reality based learning, and virtual tours. The research looked for different types of applications that were developed for these areas and the evaluation of those applications. The applications involved a variety of techniques such as making use of active learning methods, gamification elements, Augmented Reality (AR) and Virtual Reality (VR). Different kinds of systems were tried as well which evaluated the use of the internet, online courses, live online teacher, storytelling videos for teaching, using clickers for MCQs, and virtual currency for encouraging students. Example applications from these include a game called "Ori-Gami" which used Spatial learning, a museum guide system, a tour guide robot, and using AR for lab experiments. The results showed that digital game-based learning was effective in various topics such as arts, storytelling, mathematics, and problem solving. The products and systems led to improvements in creativity, learning performance, engagement, collaboration amongst peers, content understanding, motivation and satisfaction. Memory retention and visual recognition was also boosted through the use of gamification and AR / VR. The use of technology also allowed students to work from home and at their own times. An interesting finding was that the use of AR encouraged the user to develop more interest in the field. However, there were some limitations to these approaches as well. A

major limitation was that the degree of learning depended on the pedagogy model being used and the use of a weak model led to users not being engaged and learning passively. Overuse of technology led to attention tunneling, usability difficulties, and ineffective classroom integration.

Our idea was inspired from a combination of these products. Our product makes use of active learning, keeping in mind a proper pedagogy model to keep the user engaged and motivated while also leading to improved learning. Our focus is on the history and culture of Pakistan and makes use of AR, storytelling and gamification elements.

5. The final design (SafarNama)

We chose SafarNama as the name of our application to give in a Pakistani cultural vibe. The term Safar means Journey when combined with Nama, the term **SafarNama** refers to a collection of journeys. The idea of the app is to provide an alternative to physical trips/journeys and thus the

name SafarNama turned out to be a good option.

From the 5 alternative designs mentioned above, we included ideas from 3 of those designs and included them in our final design **(3.1 EduQuiz, 3.2 AR Tourist, 3.5 Storybook)** . We included the idea of a quiz and gamification elements to our app using 3.1. The idea of the app to be made in AR was taken from the second alternative design (3.2), keeping in mind the physical constraints and the current worldwide situation. Finally, we added a story and roleplay elements as well as character dialogues to our app based on design alternative 3.5. The idea of VR Trips **(3.4)** was not chosen because it adds a physical constraint of having an expensive VR set. Moreover, the design alternative Tripwale **(3.3)** was not utilized because of the constraint of children and parents being confined at home due to the existing threat of COVID-19 and not being able to go on actual public physical tours.

When designing the final design, we decided on a conceptual model that allows the user to interact, engage and learn from the model. We added a number of features relevant to Pakistan context, including the tour guide to be a Markhor (national animal of Pakistan) for an implicit reference, the tours to be strictly in Pakistani context. We considered language constraints so the application can be both in English and Urdu, although we only showed the English implementation.

The majority of the features focus on making the app interactive, engaging and promote learning among the children. The features were identified and chosen keeping in mind the cultural and geographical background of the users.

Problems identified

Our main problem area is the lack of interest in history and culture in Pakistan. Analyzing the data gathered from the user research phase, we identified some problems which were major factors of this lack on interest:

- Teacher-centered approaches for learning lead to passive learning. This is especially problematic for subjects like History which are difficult to follow due to the methodology used to teach them.
- Lack of focus on enhancing applicative, analytical and evaluative skills in children at schools.
- Lack of active participation and engagement of students in the class. Classrooms lack interactive methodologies that can maximize potential learning.
- There is a strong language barrier in Pakistan, in gaining education from historical trips or understanding any historical context at all, and variability of English language skills among different children.
- Children are not going to / being taken on educational trips enough by schools and parents. The number of trips taken to historical and cultural places are quite less, and schools tend to prefer recreational trips more.
- More recently, the children are confined at home due to COVID-19 situation and thus physical trips are not possible at all.
- In Pakistan, there are minimum efforts made to make trips engaging and interactive.
- Lack of parent/teacher supervision or involvement in current applications, which is necessary as they wish to be a part of the experience and engage with their students/children directly or indirectly.

Given the vast range of problems identified during the User Research phase, we try to propose a solution that can cater most of the identified problems but there are limitations to what an app can cover. Hence, we focus on working on a certain set of problems and propose solutions keeping in mind the Pakistani context. The proposed solutions are mentioned below.

Solution to the problem

- Our app is based on a student-centered approach and involves active learning.
- It makes use of gamification, story-telling elements, and Augmented Reality (AR) to keep the user engaged, focused and incentivized in learning.
- The stories and dialogues composed by these trips are bilingual (Urdu and English), bypassing the language barrier for students, and delivering a custom experience based on the user's preference.

- Exploration and inspection of the models help the student create better mental models and retain more information, increasing spatial learning, immersion and engagement for a more entertaining experience as well.
- Provides easy and portable access to trips, right at home, virtually using standard devices (mobile phones or tablets).
- Engages not only children, but also allows parents to participate in their children's learning. Parent/teacher supervision and involvement is maintained using marker-based AR as the tour setup process involves them placing AR markers around the house/school to simulate a hide-and-seek game for their children/students respectively.

Features and Functionality

A general flow of our design solution's features and their functionality showcases how every feature is mapped to a solution for the specific problems encountered during our user research phase as previously mentioned.

Storytelling of the History and Culture of Pakistan

- A storytelling approach is adopted for this application based on Design Alternative 5.
- The user will be able to choose tours comprising underlying stories of different topics related to the history and culture of Pakistan.
- For a single story, the user will go through multiple AR markers in a specified order. If the user visits a marker out of order, they would be asked to visit an earlier marker before they can explore the current marker so that the story progresses in order.
- The models at each marker will use a combination of character dialogue and voiceover to describe their part of the story to the user.
- Each marker will build up the story until the final marker which will conclude the story.

Tour Guide

- Our mascot is Makhnu the Markhor, who will be the source of information and the companion of the user.
- Makhnu will also be the tour guide and will guide the user during the stages.
- The idea of the tour guide is borrowed from Design alternative 3.
- The tour guide will be explaining a particular tour to the user and will also provide valuable information and facts about the artifacts present in the tour.
- Makhnu will also conduct quizzes from the user.
- The models and the main character (the user) will also be involved in roleplays, where the models will be interacting with them.
- In addition, the interaction and communication between the tour guide and the user will be part of the roleplay feature of the application.

- The models, mascot and the user will interact via textbox based dialogues.
- The roleplay will conclude once the user ends the tour.

Quizzes

- There will be two forms of quizzes that take place during a story: progression quiz and final quiz. The quizzes will always be in MCQ format and may be augmented with supporting images.
- A progression quiz occurs at every model except for the first one.
- At a progression quiz, the user will be required to answer a random question related to the information provided by the previous model.
- If the user is unable to answer this question correctly, they will be unable to unlockthe story of the current model and will have to revisit the previous model to revise. The user will be unable to reattempt the progression quiz at the current model until they revisit the previous model.
- If the user answers the progression quiz question correctly, they will be told the story of the current model and progress forward.
- After all the models have been visited and cleared, a final quiz will take place which will comprise all of the information of the various models. The final quiz will be timed as well, only allowing the user to answer in a specified time-limit.
- This quiz will have multiple randomly picked questions.

Gamification Elements (Leaderboard, Tour History, Coins, Scores)

- The application will maintain two leaderboards. The leaderboards will be based on the tour statistics (time taken to complete the tour, artifacts discovered, final quiz score).
- The first leaderboard will be user specific. It will store the tour statistics for the specific device that the user is using to run the application. The user can compete with their family members with the help of this locally maintained leaderboard.
- The second leaderboard will be global. In this, the user will be able to compete with global users. This leaderboard will be based on the final quiz score on the particular stage.
- The user will be able to win coins (in-game virtual currency) at the end of every tour. The coins can be used to unlock new tours.
- This will introduce a gamification element to our application. Users will be able to enjoy a competitive experience where they will work hard to answer the quizzes correctly and that too in minimum possible time to climb the leaderboards.

Marker-based AR (Parent/teacher involvement and physical activity)

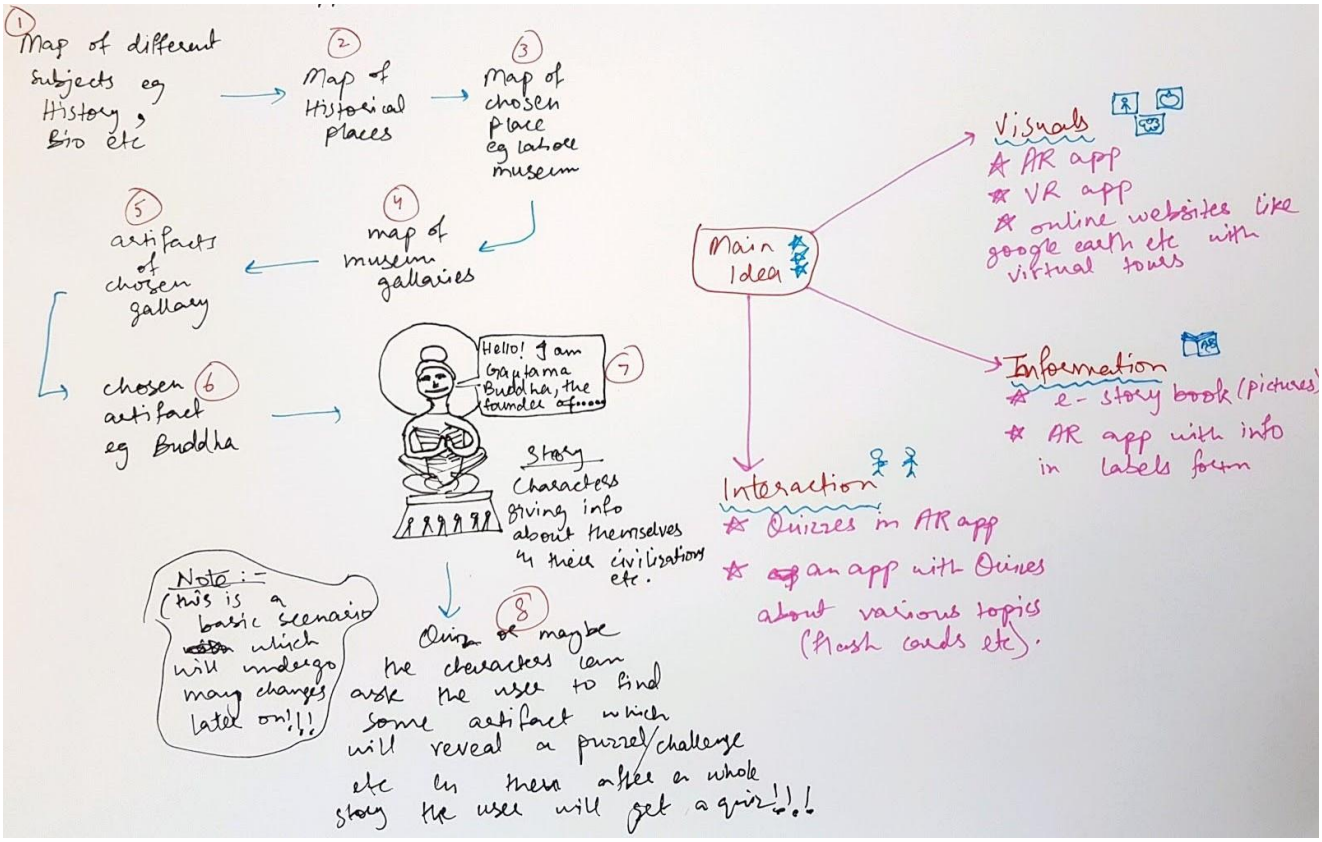
- Parents / teachers will be able to download a printable sheet consisting of specific AR markers mapped for every exhibit/model/characters and clear instructions on how to use them.
- For every tour, they have to print and cut out these markers and then manually place them around the house in the order they desire.
- This will form a custom hide-and-seek tour game for their children to play for thevirtual tour. Physical activity and interactions will be encouraged for children as they scour for these markers around their house or school in a search for the unknown, driven by previously mentioned gamification incentives and curiosity to find the next mystery artifact/character and uncover new historical information.
- Parents/teachers can view statistics of the tour when it ends.

Multiple AR-based Interactions

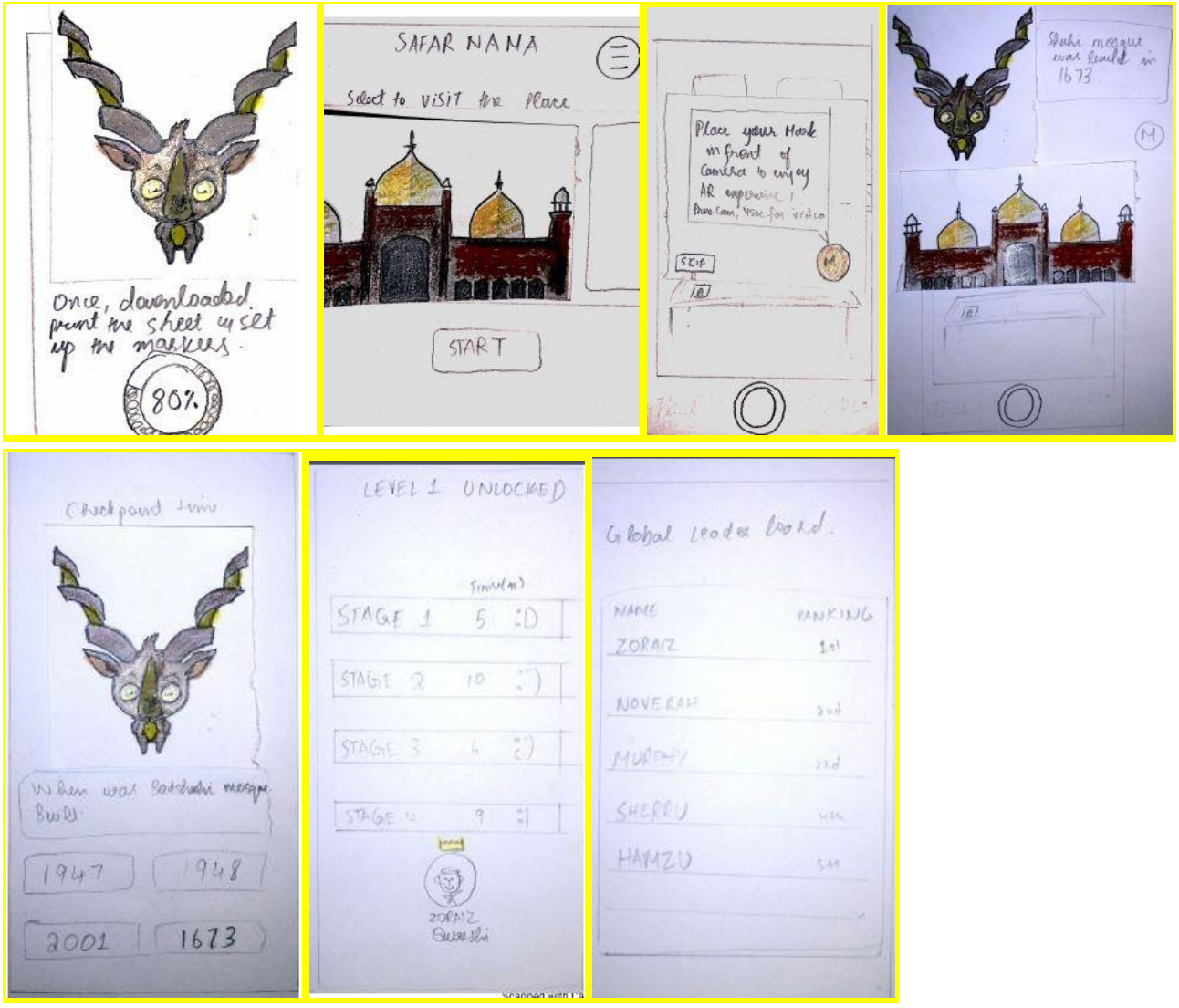
- Users will be able to take snapshots with the projected 3D models any time in the tour. These may be also used to fulfill objectives later depending on the underlying story of the tour.
- A complete tutorial will be initially provided on finger gesture based interactions with the 3D models/exhibits that will include:
    - Tapping to trigger animations and dialogues
    - Twisting for rotation on the model's axis
    - Pinching to scale the model up or down upto restricted sizes
- Inventory/backpack to view portable artifacts provided during the tours to fulfill certain objectives.

6. Sketches

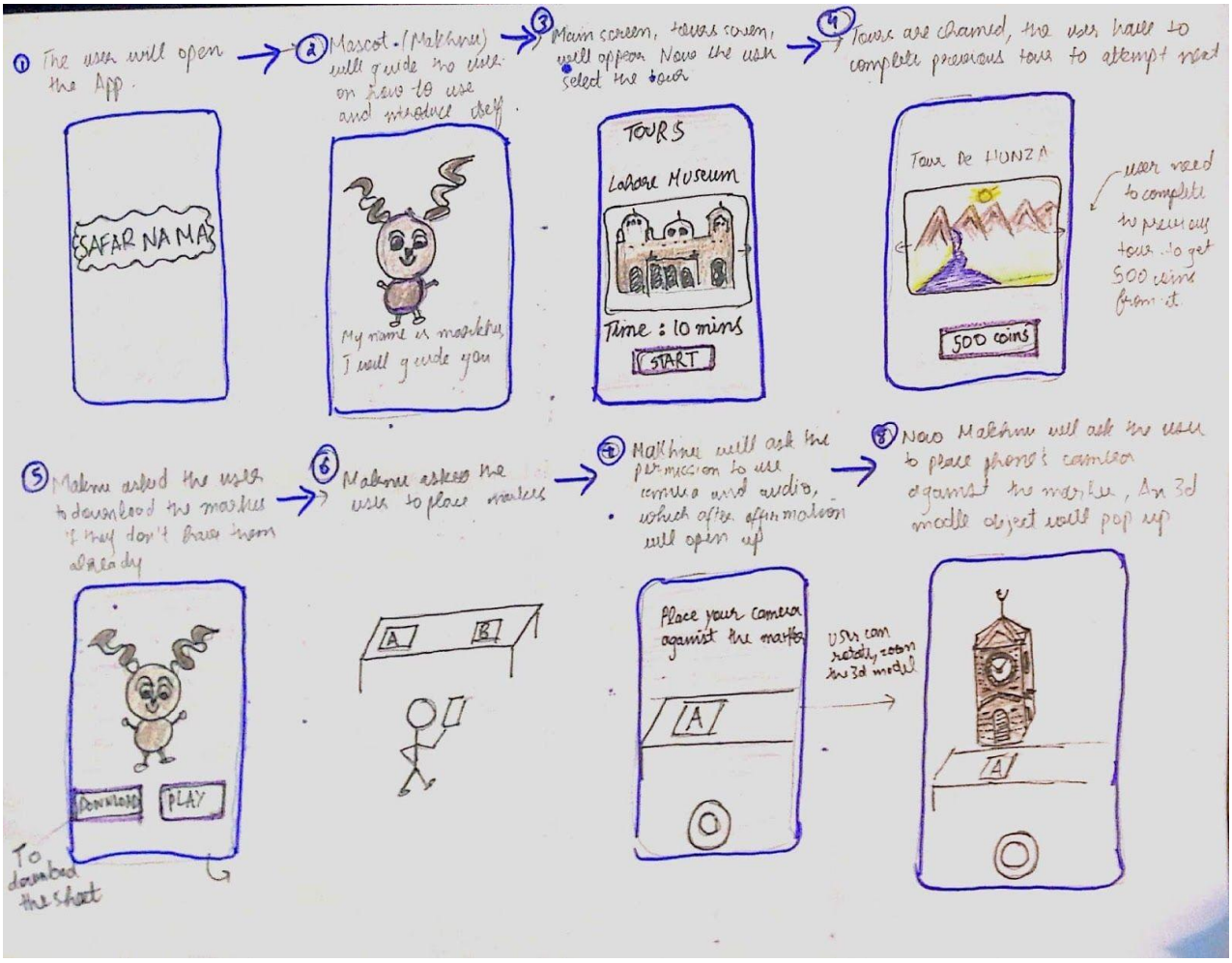
This was our first draft that we brainstormed for the final design consolidating the main ideas from design alternatives 1, 2 and 5 to just focus on the needs.

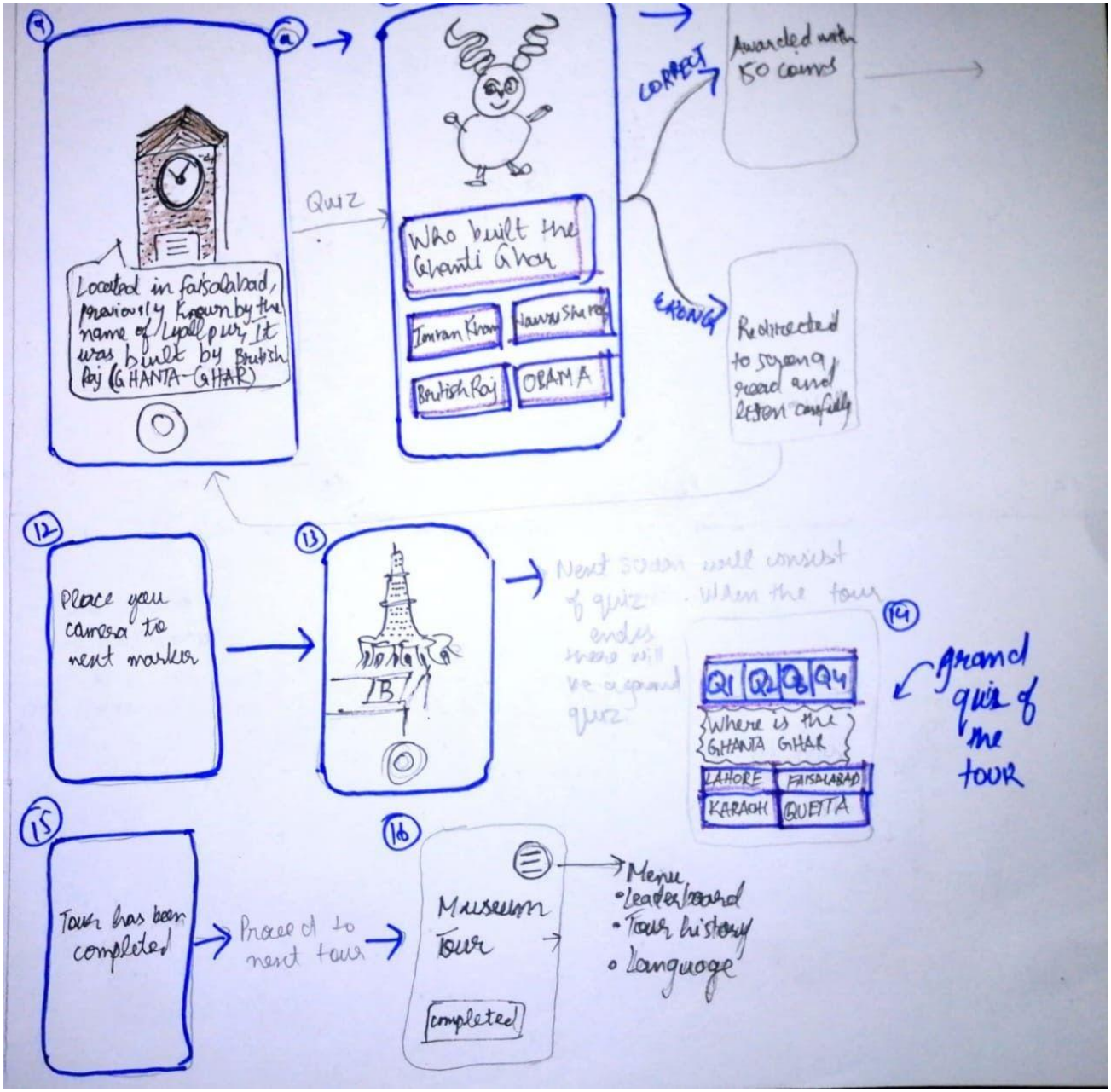


We further refined it as follows and after adding user desires, more interactivity, and gamification elements to incentivize the user further, increasing replayability of our virtual tours and engaging them further. Basic early sketches of some primary screens for our application:



Our current final design flow can be represented like:


1 The user will open the App.
SAFAR NAMA
2 Mascot (Makhnu) will guide the user on how to use and introduce itself.
My name is Makhnu, I will guide you
3 Main screen, tours screen, will appear. Now the user select the tour
TOURS
Lahore Museum
Time : 10 mins
START
4 Tours are claimed, the user have to complete previous tour to attempt next
Tour de HUNZA
500 coins
user need to complete previous tour to get 500 coins from it
5 Makhnu asked the user to download the marker if they don't have them already
DOWNLOAD
PLAY
To download the sheet
6 Makhnu asked the user to place markers
A
B
7 Makhnu will ask the permission to use camera and audio, which after affirmation will open up
8 Now Makhnu will ask the user to place phone's camera against the marker, An 3d model object will pop up
Place your camera against the marker
A
User can rotate, zoom the 3d model
A


Located in faisalabad, previously known by the name of Lyallpur, It was built by British Raj (GHANTA-GHAR)
Quiz
Who built the Ghanti Ghar
Imran Khan
Nawaz Sharif
British Raj
OBAMA
CORRECT
Awarded with 50 coins
WRONG
Redirected to screen, read and listen carefully
Place you camera to next marker
IB
Next season will consist of quiz... when the tour ends there will be a grand quiz
Q1 Q2 Q3 Q4
Where is the GHANTA GHAR
LAHORE
FAISALABAD
KARACHI
QUETTA
grand quiz of the tour
Tour has been completed
Proceed to next tour
Museum Tour
completed
Menu
• Leaderboard
• Tour history
• Language

7. Scenarios

7.1. Parent-children home use

Ali feels sad as he can't go to school, field trips or even play outside with his friends due to Covid-19. Worried for her son's education, physical health and happiness, his mother decides to install the app SafarNama on her phone so her son can engage in some meaningful activity in the form of a tour while also learning history. Following the app's instructions, she gets a sheet, prints it and cuts the AR markers. She then hides the markers in various places in the house while Ali is sleeping (this way the parents can also interact). When Ali wakes up she gives him her phone to start the tour. After starting it, the app tour guide Markhu appears and asks Ali to look for the markers and scan them in order for the tour to begin. Ali looks for the first marker (by moving around the house, searching under and behind household items). After finding it, he scans it. He meets a character/object during the tour, listens to their story (from the exhibit) and then has to solve a quiz related to the story. After successfully answering the questions of the quiz, he receives an artefact (its description is also added). If he fails to answer the question, he is sent back to the previous character to listen to the story again. Ali then finds the rest of the markers and completes the story. Ali feels very happy after finishing the tour. His mother is happy to see her son engaged in both physical activity and study.

7.2. Teacher-students school use and competitive tour

A History teacher, Eve, wants to try the app “SafarNama” with her students: Alice, Bob and Carol. She is aware that the app is educational and also intrigues students to learn about History and Culture. She starts by selecting a stage, downloading and finally printing the AR markers for that stage. She then spreads the various AR markers throughout the school for her students to locate. The students are tasked with completing the level by Eve. As the game starts, each student disperses to different parts of the school to locate the markers. As the students discover the markers, they are either told the story of the exhibit or are told to visit some other exhibit before they can interact with the current exhibit. Moreover, apart from the first exhibit, each exhibit involves asking a question related to the previous exhibit. Failure to answer this question means that the student has to return to the previous exhibit. After the students have visited and cleared all exhibits, they are given a final quiz, which is the amalgamation of all of the tales they have heard so far. The quiz consists of multiple questions of the MCQ format, where each has to be answered within a time limit. Completing the final quiz ends the tour and the students are presented with their score for the tour. Eve inspects each students’ tour statistics to see the time that it took them to complete the course. Additionally, all the devices used for the tour show a global leaderboard of the quiz scores for the current tour. Since Carol answered all of the questions

correctly, she is on top of the leaderboard with 500 points, followed by Bob with 450 points and finally Alice with 420 points. Carol is satisfied with herself in securing the highscore, however Alice and Bob are determined to get another chance at another level to grab the top score spot.

7.3. New stage update and solo touring

Oscar receives a notification on his phone informing him that a new stage has been added to SafarNama. Upon inspecting the new stage, he discovers that he needs more coins before he can unlock the stage. Therefore, he replays old-levels, scoring higher in them to receive more coins while also moving up in the leaderboards. Finally, he earns enough coins to unlock the new stage. After unlocking the stage, he presses the get sheet button to receive the sheet of markers that is required for the new stage. He prints this sheet, cuts the various markers and places them throughout his room so that he can start playing the new level.

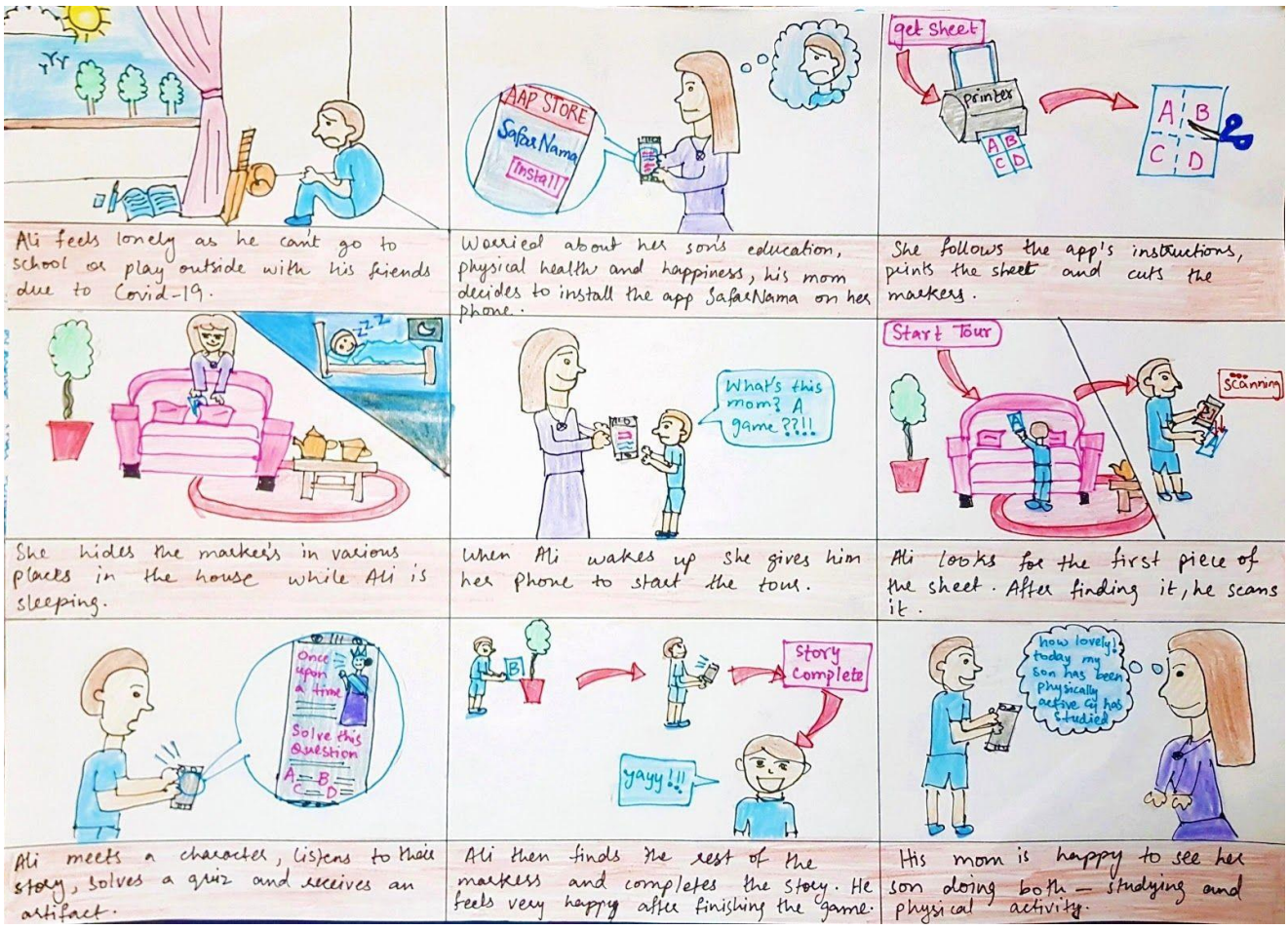
7.4. Parent inspecting tour statistics

Ali's mother wants to know more about her son's performance in the last tour level that he completed. She opens the app, goes to the particular tour level and selects its tour history. She is able to see how well her son performed through various statistics. She can now keep track of her son's improvement in the subject by checking her son's performance after every level and compare the scores and statistics of various levels.

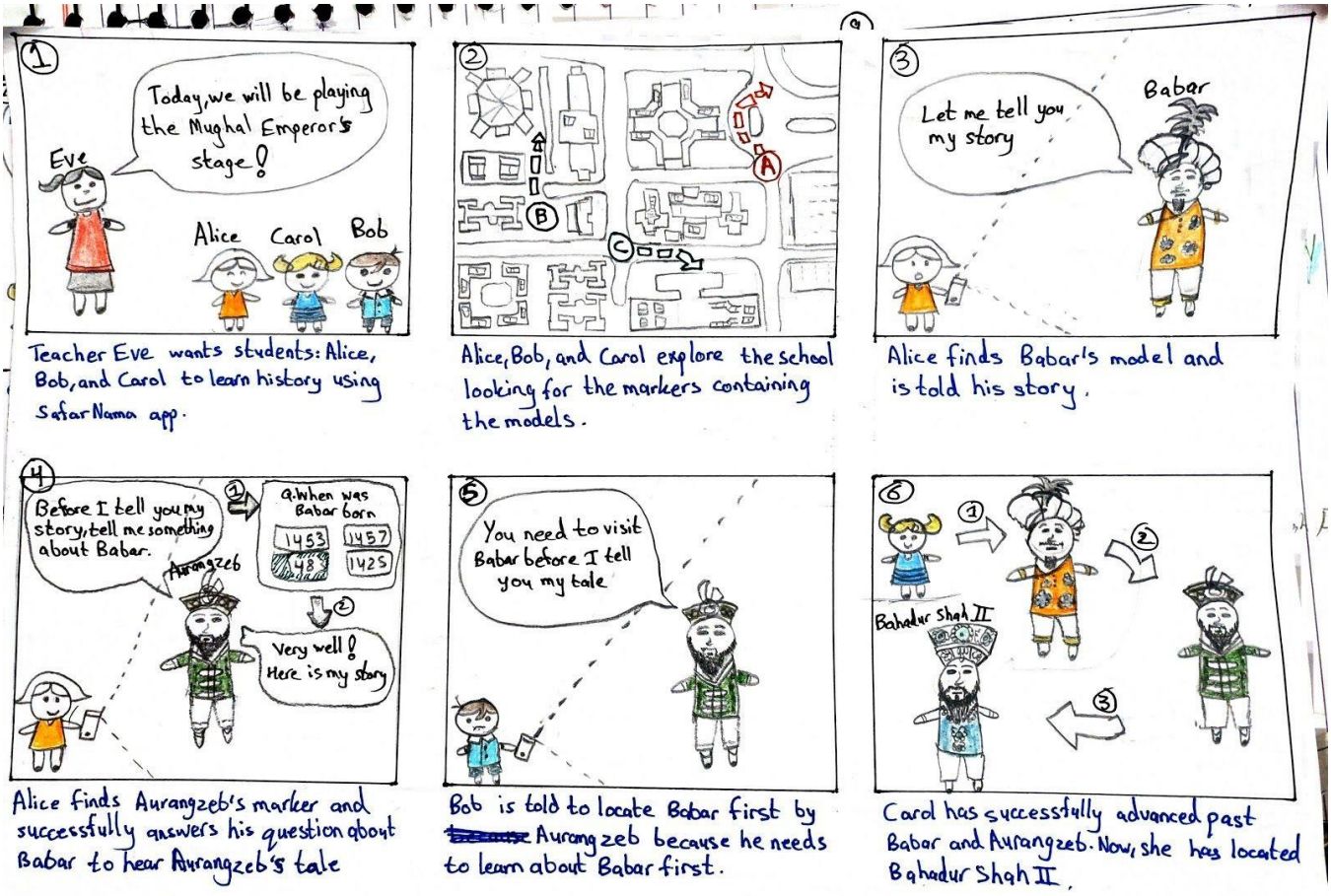
8. Storyboards

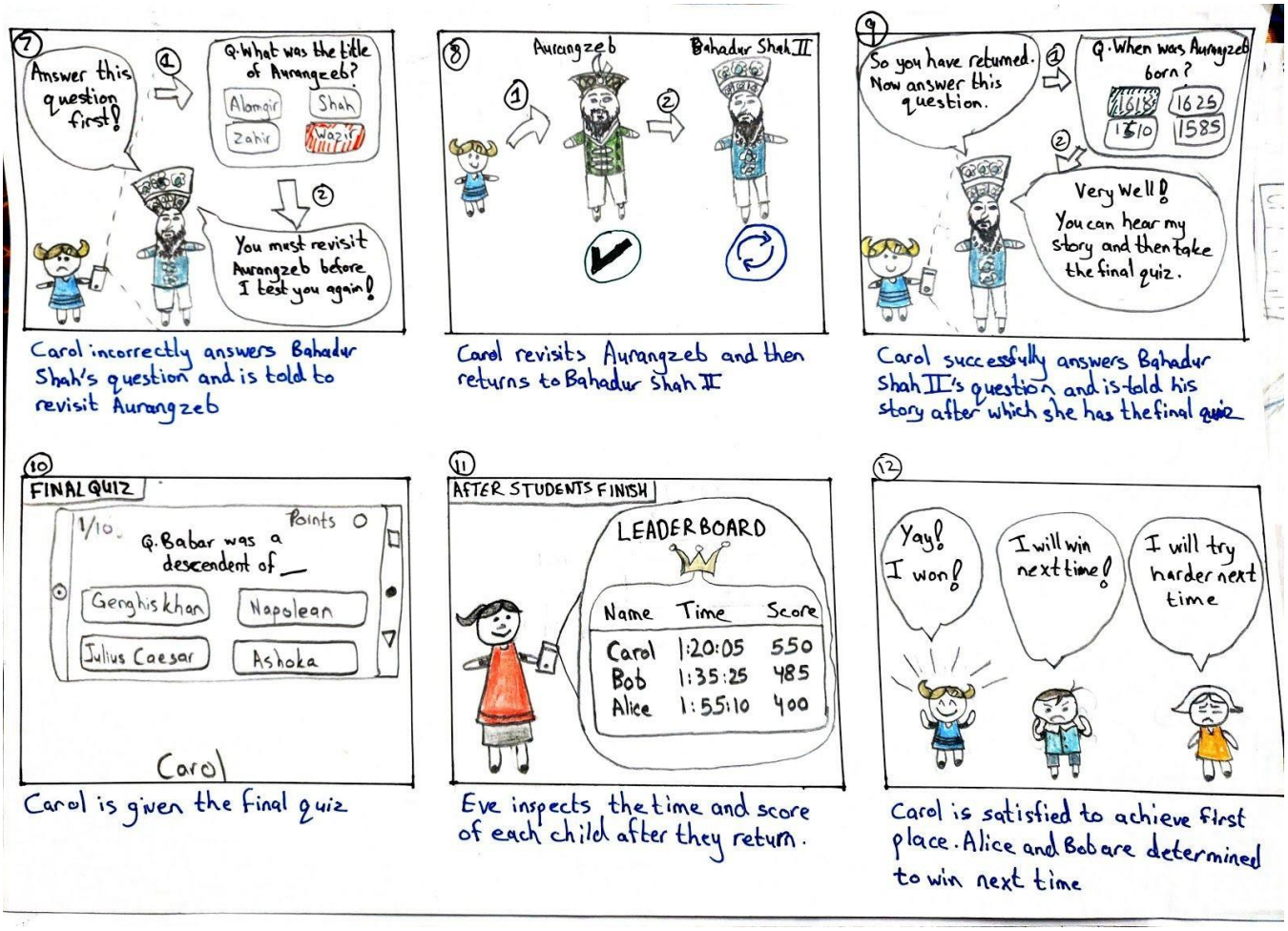
Animated videos for scenarios 7.1 and 7.3 have also been attached on the drive. The following are the sketch storyboards for corresponding scenarios.

Scenario 7.1



Scenario 7.2


1
Today, we will be playing the Mughal Emperor's stage!
Eve
Alice
Carol
Bob
Teacher Eve wants students: Alice, Bob, and Carol to learn history using SafarNama app.
2
A
B
C
Alice, Bob, and Carol explore the school looking for the markers containing the models.
3
Let me tell you my story
Babar
Alice finds Babar's model and is told his story.
4
Before I tell you my story, tell me something about Babar.
Aurangzeb
1
Q. When was Babar born
1453
1457
1425
2
Very well! Here is my story
Alice finds Aurangzeb's marker and successfully answers his question about Babar to hear Aurangzeb's tale
5
You need to visit Babar before I tell you my tale
Bob is told to locate Babar first by ~~because~~ Aurangzeb because he needs to learn about Babar first.
6
1
2
3
Bahadur Shah II
Carol has successfully advanced past Babar and Aurangzeb. Now, she has located Bahadur Shah II.



Carol incorrectly answers Bahadur Shah's question and is told to revisit Aurangzeb

Carol revisits Aurangzeb and then returns to Bahadur Shah II

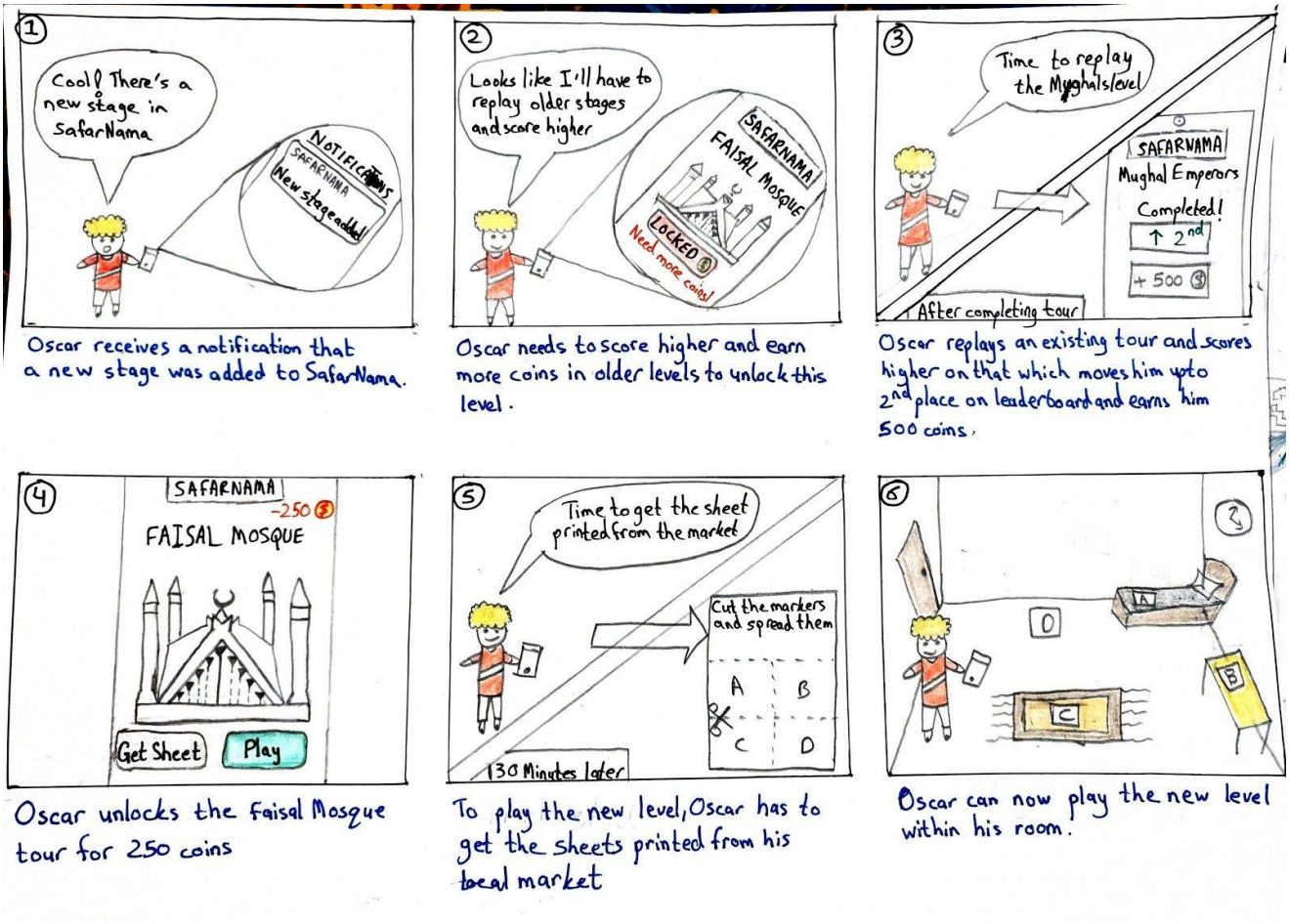
Carol successfully answers Bahadur Shah II's question and is told his story after which she has the final quiz

Carol is given the final quiz

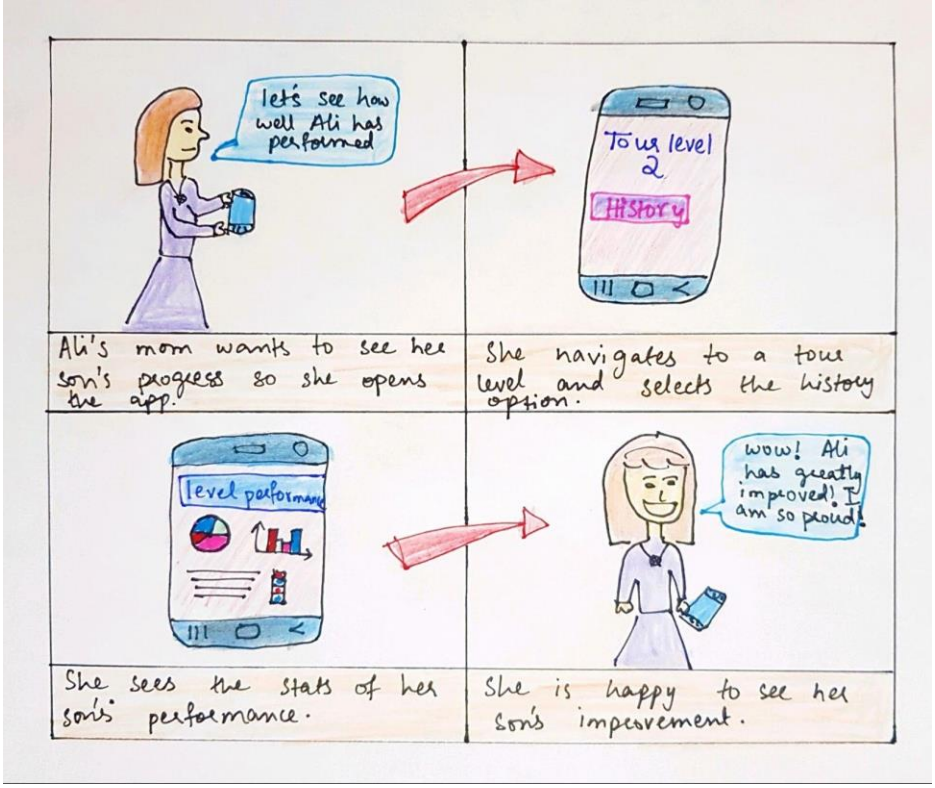
Eve inspects the time and score of each child after they return.

Carol is satisfied to achieve first place. Alice and Bob are determined to win next time

Scenario 7.3


1
Cool! There's a new stage in SafarNama
NOTIFICATIONS
SAFARNAMA
New stage added!
Oscar receives a notification that a new stage was added to SafarNama.
2
Looks like I'll have to replay older stages and score higher
SAFARNAMA
FAISAL MOSQUE
LOCKED
Need more coins!
Oscar needs to score higher and earn more coins in older levels to unlock this level.
3
Time to replay the Mughals level
SAFARNAMA
Mughal Emperors
Completed!
↑ 2nd
+ 500
After completing tour
Oscar replays an existing tour and scores higher on that which moves him upto 2nd place on leaderboard and earns him 500 coins.
4
SAFARNAMA
-250
FAISAL MOSQUE
Get Sheet
Play
Oscar unlocks the Faisal Mosque tour for 250 coins
5
Time to get the sheet printed from the market
Cut the markers and spread them
A
B
C
D
130 Minutes later
To play the new level, Oscar has to get the sheets printed from his local market
6
3
A
B
C
D
Oscar can now play the new level within his room.

Scenario 7.4



9. Low-fi prototyping (Process)

- 13x7 cm screens representing a large Android phone were drawn on paper and a large wooden frame to cover the edges was created that was to be handled by the user using an attached stick handle as well. All of the screens had stick handles attached for the ease of the person in charge of computing the paper prototype.
- Horizontal prototyping was used to show the process flow and verify how data was efficiently communicated through our main UI components, how they were used and explored. All of the necessary buttons contributing to the horizontal features were interactive from the About Us to the FAQs etc.
- The complete vertical flow for the entire tour experience was implemented for a single tour for The Lahore Museum, going into the complete lower-level details of it as this was the primary component. The complete tutorial was also included without sacrificing any detail as well as all main dialogues, but the tour was kept short (only 2 exhibits) just for the testing experience and to limit testing time.
- Only the English language was selectable as the internal story and dialogue language for tours for the application as we tested on users who had sufficient English language skills.

- The user received a custom final score based on how they performed in the tour. Pre-defined leaderboards and tour history screens were ready as well, generally referring to the user as “Me”. Features that were not important like Google Play authentication or sign-in to sync the leaderboard were excluded as well.
- The complete AR Camera experience was simulated by having the user cut the AR marker sheet themselves, place it around them, and then pick up the mobile frame as instructed by the facilitator when their camera turned on so they could inspect these markers and have upright hovering models (paper cutouts) pop out in real. The tutorial was also done in upright mode as well as all interactions (apart from the quiz) during the tour for maximum accuracy to the actual experience.
- Video recording was done to capture the complete experience of the user in detail to find trends later from this data along with simultaneous note-taking for 2 users to note down issues with the application on the spot.
- All paper prototype screens have been attached along with a flow video.

10. Results of paper prototype testing

The paper prototype testing was conducted in-person on the four users. User 1 was a Computer Science Sophomore at LUMS. User 2 was a child in grade 2. Users 3 and 4 were both Computer Science Seniors at LUMS. Testing videos for User 2 and User 3 have been attached on the basis of distinctiveness and feature coverage.

Aiming to communicate the idea of Safarnama and testing our app’s interaction with the user, we performed usability testing. One of our team members acted as a human-computer and was responsible for changing screens and performing app interactions in response to the user’s input. The other acted as a facilitator who was a guide and was also reading the dialogues for the user.

For our users, the app was pre-opened to the loading screen. After loading completed, the users selected the language in which they wanted to play the game. Now the users reached the main screen containing multiple tours.

Since our app features levelled progression, the user must complete and score highly on unlocked tours before they have enough coins to unlock new tours. On the main screen, our users tried to access a locked tour but the app showed that they did not have enough money to unlock the tour. Hence, they were guided to finish the Lahore Museum tour.

Before starting the tour, the mascot Makhnu appeared and guided the users on how to proceed further. Makhnu asked the users to download the sheet with the markers. The downloaded sheet was handed over to the users, which they separated by cutting it into two pieces, A and B.

Now, the users pressed the play button, and a dialogue box appeared to request camera permission. After the permission was granted, the users were asked to hold the phone prototype and place it over the markers. On placing the camera over the marker labelled “A”, a 3D model of queen Victoria appeared and the users were given a tutorial on the model manipulation features such as moving the device, rotating the model, zooming in and zooming out. After this, the users tried these features themselves. During this feature testing, our computer was constantly syncing the model with the user actions. Next, a dialogue box appeared in which Queen Victoria introduced herself. Throughout the testing, the users were able to map the advancement of dialogue to the “>>” next button without external help. After the dialogue ended, Makhnu appeared with a quiz. The quiz consisted of the information provided by the queen. All of our users answered the "War of Independence” question correctly, after which they were awarded the coins. Moving onwards, the users were eligible to move to the next model. The users were asked to place the phone prototype over the “B" marker and a model of the exhibit, Bahadur Shah Zafar, appeared in which he explained his life story.
Following this, another quiz appeared, and Users 1, 3 and 4 answered it correctly. However,
User 2 didn’t answer it correctly and had to revisit the previous exhibit again. User 2 was unsure about which marker to proceed to, and was guided to place the phone over Marker A, after which the Queen’s model popped up and the dialogue restarted. After this, marker B could be revisited by User 2. User 2 visited Bahadur Shah Zafar again and answered the quiz correctly this time. Now, the Lahore Museum tour was completed for all the users, and the coins (in-game currency) were added to their account.

The users wanted to further explore the app, so they clicked on the menu button which contained the Leaderboard, language settings, FAQs, etc. The user clicked on the leaderboard and a leaderboard with the overall scores of different players (including the user) appeared.
This concluded the Lo-Fi paper prototyping test.

These arrangements were done to evaluate the features of SafarNama before translating them to the Hi-fi prototyping.

Issues:

- Inability to recognize the mascot’s origin/animal during the loading screen for 3 out of 4 users.
- Difficulty in recognizing that swiping on the main screen can change the tours.
- There were no instructions for scanning AR markers and how AR works as we had incorrectly assumed that it was common, but none of our users understood that context until they realized it later when the AR Camera Mode opened.
- Users were unaware that they had to get the marker sheets first without being prompted by the facilitator.

- Missing information on the perfect camera placement angle for target scanning (parallel to marker preferred) and distance to maintain, as most users tried placing the device exactly over the marker.
- Missing urge to go look for the exhibits after AR Camera opens as 2 out of 4 users were confused on what to immediately do until they were guided.
- Missing explicit hints on which exhibits to find first and order of the story progression, however, the alphabets A and B did urge them to scan A first, apart from User 1 making the mistake to scan B first.
- Difficulty in understanding that the user had to return to the previous exhibit after they failed the quiz in the current exhibit. This happened with User 2 who had to be guided by the facilitator on what to do.
- Quizzes were too simple and simply factual. The answer choices were also easy to distinguish.
- An immediate quiz by the same exhibit after it explains its history is especially too easy to answer as the user retains maximum details.
- The story dialogues were too short and not that interactive for our paper prototype. Simple text dialogues are also not enough to engage the user, they must be augmented by multimedia (images, videos, animations of the model and sounds).
- Some of the dialogues were difficult for the younger User 2 to understand due to the vocabulary.
- Difficulty of the younger user 2 to read some of our dialogues as Urdu language mode was not offered.
- A lot of issues with the tutorial, probably due to the overlay attempt using thin wooden sticks. The users were unsure whether they could interact with the exhibit during the tutorial when a new finger gesture was introduced, and immediately tried it.
- Twist to rotate finger gesture was incorrectly understood by 3 out of 4 users as they instead tried to rotate the device frame.
- The device camera movement part of the tutorial was also misunderstood for the paper prototype because of the icon and since the exhibits were in 2D so there was nothing to explore around.
- The lack of a “tutorial completed” screen confused users on when they could start playing the game. This was added for later users and the issue was resolved.
- Missing Next and >> buttons in a lot of places as they are crucial to navigating the dialogues and cut scenes.

Tentative Design Changes

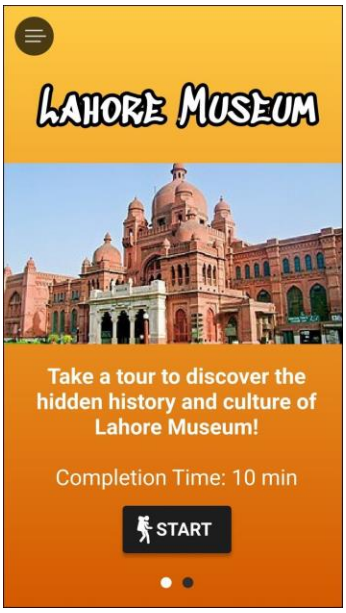
- Change the design of mascot to have shorter horns and introduce the mascot in major screens as “Makhnu the Markhor” to help with identifying his species.
- Add more visual cues to notify the user that they can change tours on the main screen. Show some part of the next tour as well as its name on the side of the screen to attract the user's attention so that they are able to map that more tours are available from the current screen by swiping. Dots at the bottom of the screen to show that multiple tours are available. Small arrows on the sides of the screen to provide visual cues.
- Add information about AR markers on the tutorial screen. Include a tutorial screen where a user is shown scanning the AR marker from a distance of 1 meter and parallel to the marker.
- Instead of just showing the various available gestures on the tutorial stage, the user will be asked to perform the shown gesture before they are shown the next gesture in the tutorial.
- Add different and more realistic animation for the twisting gesture.
- If the user presses play on a stage that they have not played before, without clicking on the get sheet button, the mascot will verify if the user wishes to proceed without getting the sheet. Add a red notice informing the user that the game cannot be played without the sheet. In the game, where the user has access to their camera, add a get sheet button on the top right if the user needs to access that after starting the stage.
- After the tutorial has completed, the mascot will inform the user that they have to go look for the markers while also providing a hint of which marker to look for.
- Add the face of the mascot on top of the screen. The user can click on the mascot’s face to call the mascot and get a hint on what to do to proceed i.e. which marker to locate.
- After a user fails a quiz, they are informed about which exact exhibit they need to revisit. If the user tries to visit the failed exhibit again without returning to the previous exhibit, they are provided the same dialogue to return to the previous exhibit.
- Improve the length of the stories by adding more information.
- After the user has successfully completed an exhibit, they are informed by the mascot about which marker to look for next to progress.
- Add images and clips of what the story is describing. Add voiceover to the exhibit so that the user can listen to the text if they prefer. Animate the models so they appear more interactive to the user.
- Increase the difficulty of each succeeding quiz by asking more general questions related to the story.
- Design the story and dialogue with simple language, keeping in mind that the target audience consists of children from grade 5 to grade 8 of diverse backgrounds.
- Add visual cues such as an animated ">>" icon for all supported dialogues so that the user is aware that they can click to advance the dialogue.

11. First draft of the final (hi-fidelity) Interface

1

2

3

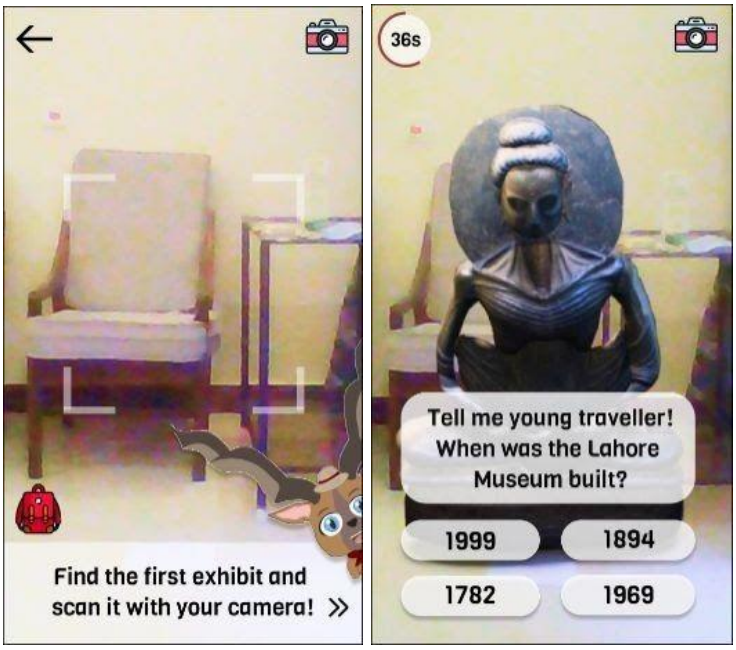


4

5

6

7 8



Screen flow for first draft of hi-fi interface (designed in F igma):

- Splash Screen **[1]**
- Language Select **[2]**
- Home **[3]** - A horizontal swipeable list of Historical/Cultural Tours in Pakistan displayed with name (e.g. Lahore Museum), image, general information and completion time, as well as a Menu button which opens the Side Menu.
- Side Menu **[4]**, including the following elements:
    - Total Coins earned
    - Leaderboard - Syncs via Google Play Services sign-in and ranks the user in the global Safarnama leaderboard by combining maximum coins earned from all tours collectively. **[5]**
    - Language
    - Tour History - showing local tour history and statistics for the device user
    - About Us
    - FAQs
- On clicking START for a specific tour, the Tour Guide / Mascot appears. Offers GET SHEET and PLAY options **[6]** (Tap the GET SHEET button to download the AR marker sheet with instructions otherwise when the user is ready with the tour setup they will tap PLAY).
    - After a general introduction, the application then opens the AR Camera Mode and the tour guide / mascot urges the child to look for exhibit AR markers and scan them. **[7]**

- On scanning the first exhibit's marker, along the exhibit's 3D model, an overlay tutorial is initiated - showcasing the camera, model rotation, scaling and dialogue selection features. Upon telling its history, the exhibit proceeds with a random MCQ quiz from the knowledge the user has learned so far. **[8]**