Interdisciplinary Project

Ride Your Bike

FR Presentation

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ICT4SS
Information and Communications Technologies for Smart Societies

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Introduction

Introduction

Objective

Develop a system that rewards individuals for regular biking activities based on distance and trip frequency, while tracking user paths and collecting related statistics.

- Leveraging a user-friendly mobile application while monitors each journey, collecting essential statistics.
- Have a Web admin to manage events, awards, and trip history.
- Incorporate measures to detect potential fraudulent practices.
- Implement various reward mechanisms, drawing inspiration from gamification strategies such as scoring systems.

Introduction

Requirements

User Requirements

- User friendly mobile application
- Interact with the community (rankings and events)
- Gamification leading to prizes

Functional Requirements

- Account management
- Provide a ranking list
- Show real-time statistics
- Tracking the user's path
- Store the travel history
- Avoid cheating by the user
- Calculate the total distance taken by the user for each trip

Technical Requirements

- Back-end (Image processing and anti-cheating system)
- Data Processing
- Web & Application
- Database

Introduction

Workplan

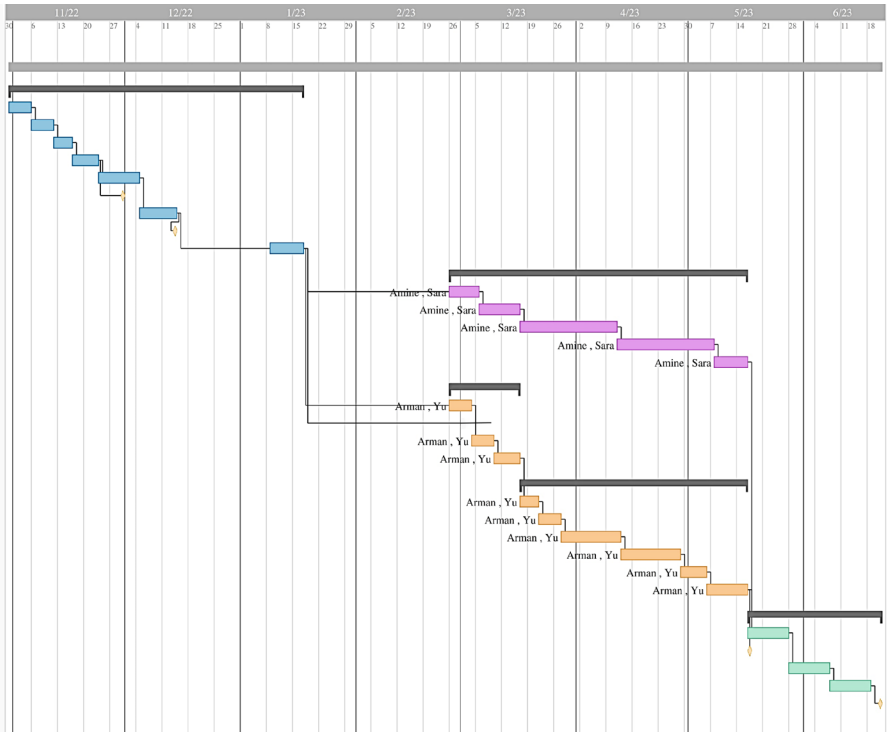
WBS

A

GANTT

B

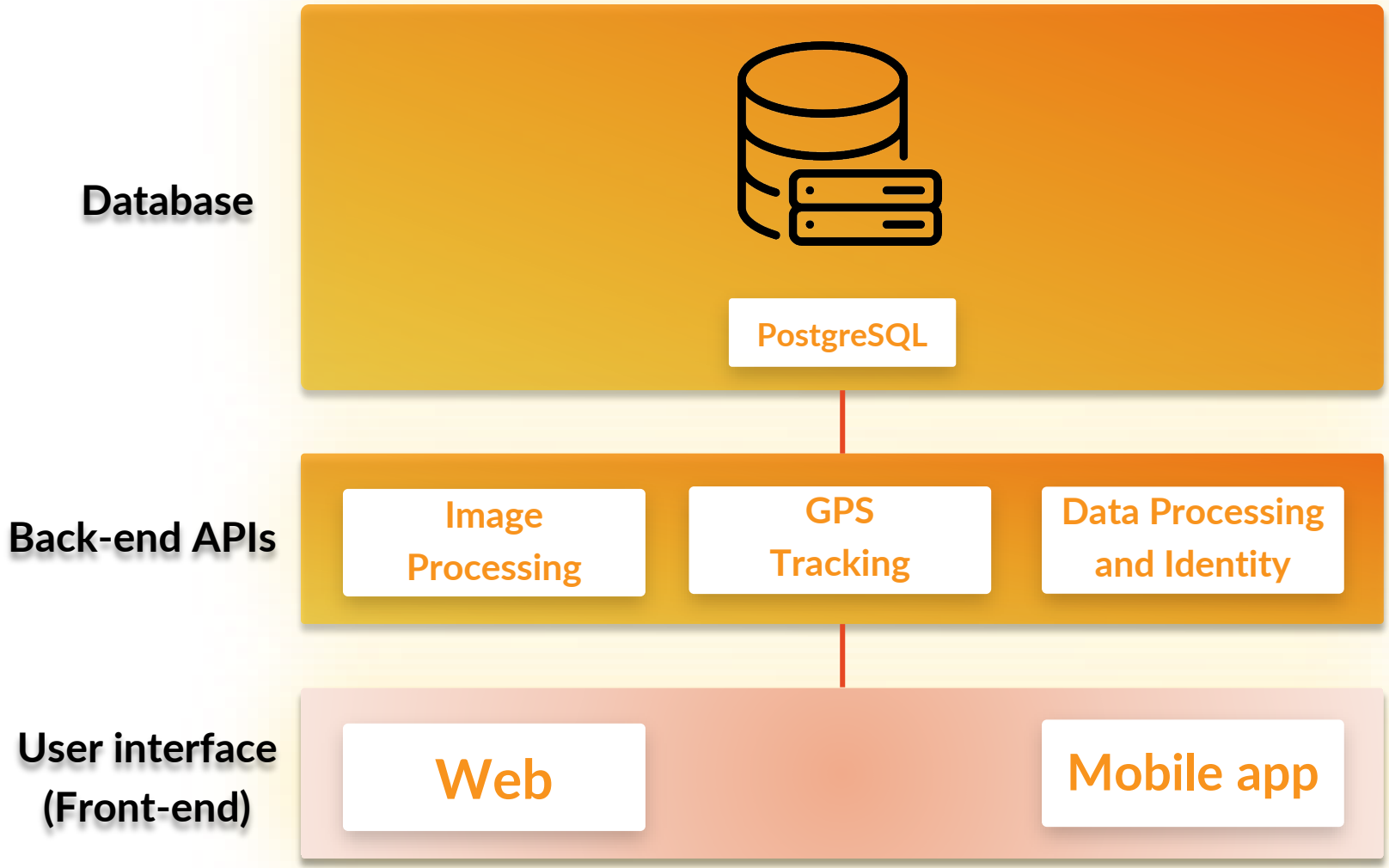
Ride Your Bike	start	end
System Structure Design	**10/31/22**	**01/17/23**
Database Technology	10/31	11/05
Microservices' Architecture	11/06	11/11
Web Interface	11/12	11/16
Mobile Application Structure	11/17	11/23
Tracking Design	11/24	12/04
SRR Presentation	11/30	11/30
Prizing Design	12/05	12/14
PDR Presentation	12/14	12/14
Syncing Design	01/09	01/17
Back-end Development	**02/26/23**	**05/16/23**
Identity (Login, User Management, Registration)	02/26	03/05
Web Admin Implementations	03/06	03/16
Tracking Algorithm and Implementations	03/17	04/11
Syncing Algorithm and Implementations	04/12	05/07
Prizing Algorithm and Implementations	05/08	05/16
Web Admin	**02/26/23**	**03/16/23**
Login and Registration Page	02/26	03/03
CDR Presentation	03/08	03/08
User Management Page	03/04	03/09
System Definition Pages	03/10	03/16
Mobile Application Development	**03/17/23**	**05/16/23**
Login Page	03/17	03/21
Home Page	03/22	03/27
Tracking Page	03/28	04/12
Prizing Page	04/13	04/28
Profile Page	04/29	05/05
Syncing Implementations	05/06	05/16
Debugging and Improvement	**05/17/23**	**06/21/23**
Tracking Algorithm	05/17	05/27
TTR Presentation	05/17	05/17
Prizing Algorithm	05/28	06/07
Sync Algorithm	06/08	06/18
FR Presentation	06/21	06/21



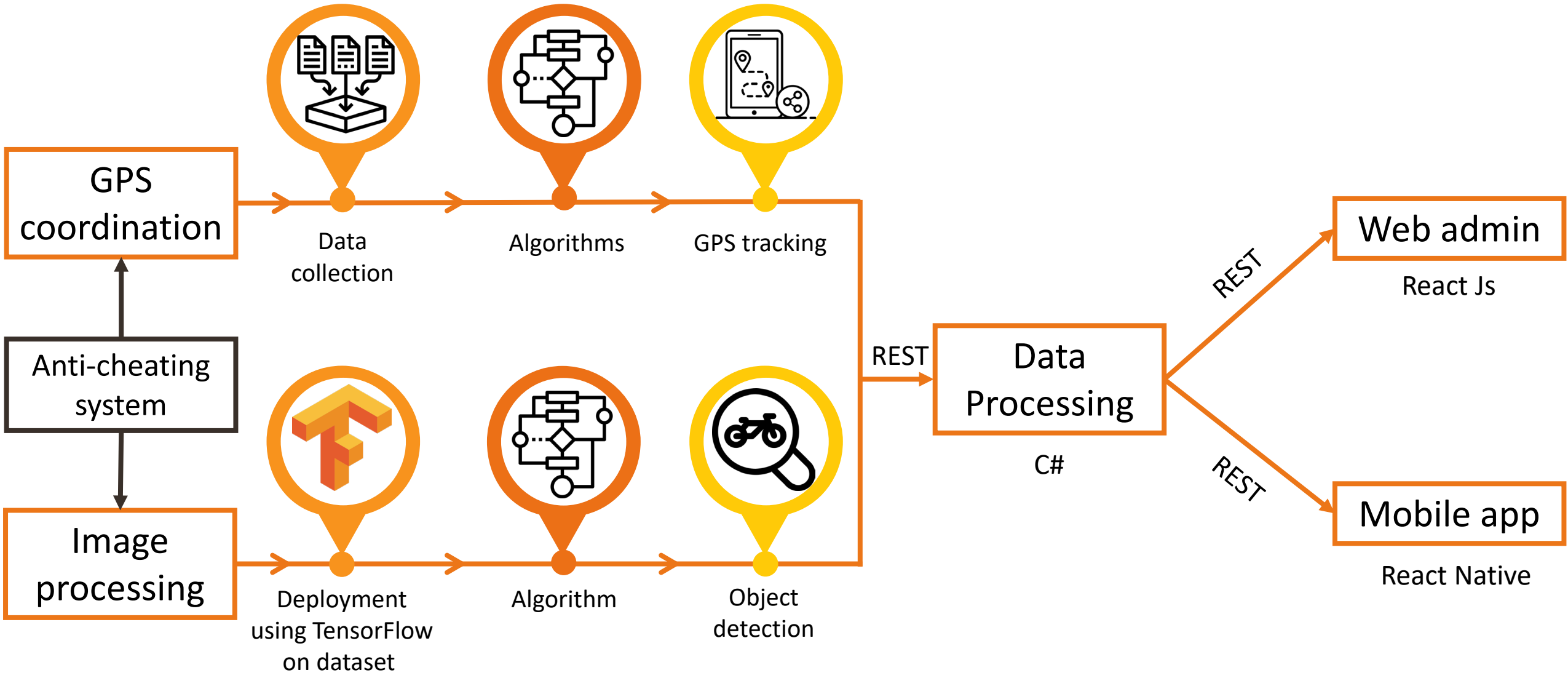
System Architecture

System architecture

High-level Stack



System architecture



Mobile/Web Application

Web Application

Admin login (A)

- Exclusively accessible to admin
- Credential fields: username/email and password

Event page (B)

- Create events by admins only
- View/edit all existing events with their details

Event details:

1) General information: Description, Capacity, Start and End date
2) Awards: for different ranks, create awards regarding the event
3) Users: showing all the users registered to the event

Web Application

Award page (C)

- View/edit all existing awards
- Create new awards

Trips page (D)

- View all trips
- Trip details

User management (E)

- View all registered users to the app
- Create users
- See details such as username, email, etc.
- Reset password

Mobile Application

Application flow

Login page

A

- Login credential fields
- Get user data such as trips, events, awards, etc.

Home page

B

- Latest trip history
- Start button

Camera & Image Verification page

C

- Use the camera to capture an image of user's bike, verify if the bike is valid through an image recognition algorithm
- Detect the bike while user is riding

Trip summary page

D

- A map showing user's path
- Showing statistics such as average speed, total distance and duration

Mobile Application

Trips page

E

- Allowing users to view a list of their past trips
- Trip details such as the map and statistics.

Awards page

F

- Your Awards: All the awards the user has earned through events or individual trips.
- Monthly Awards: Available awards for each month based on the user's rankings.

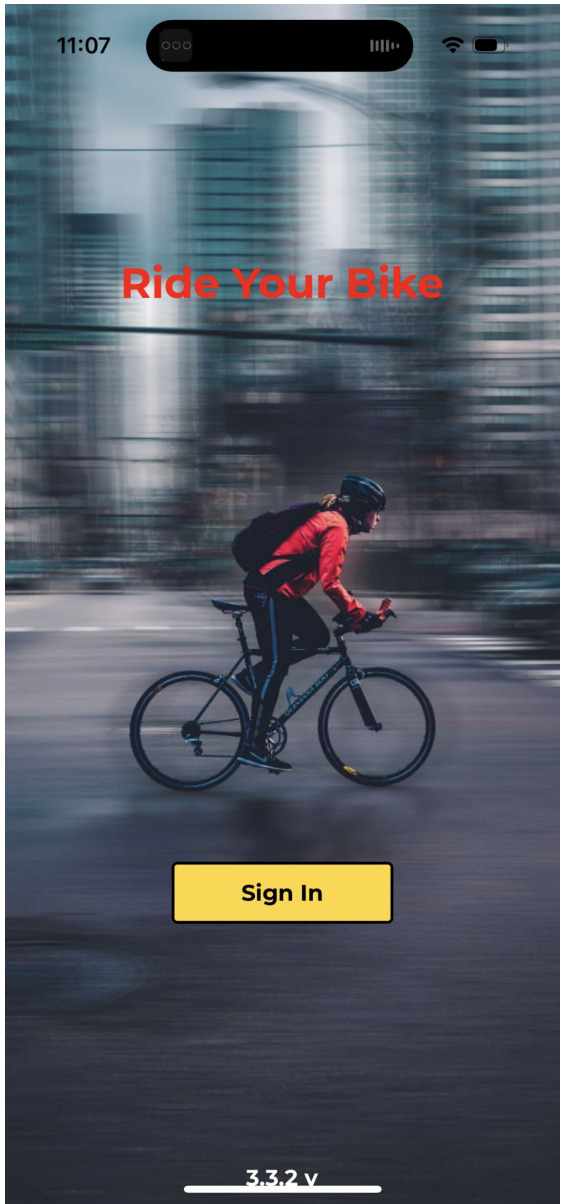
Events page

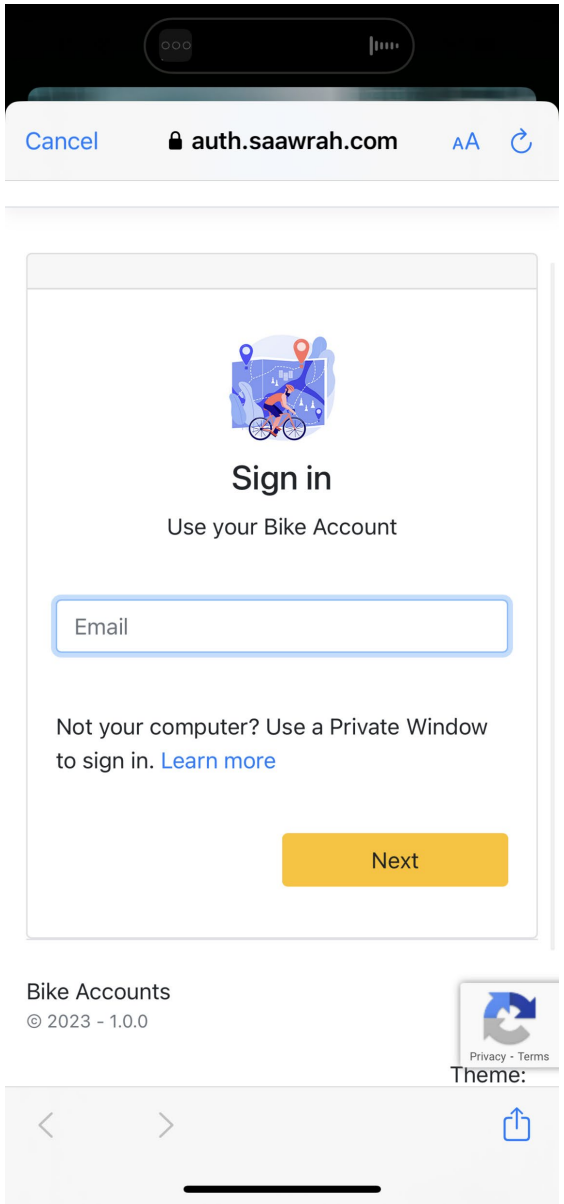
G

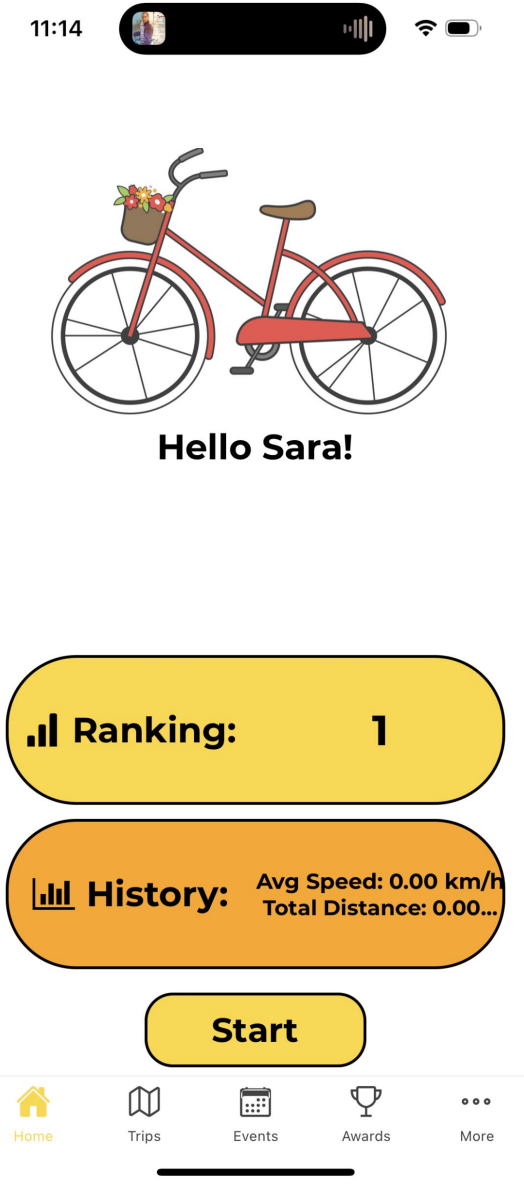
- Allowing users to explore and participate in available events.
- Users can register or cancel their registration for an event.
- Showing event description, date and awards.

Mobile application

Test application



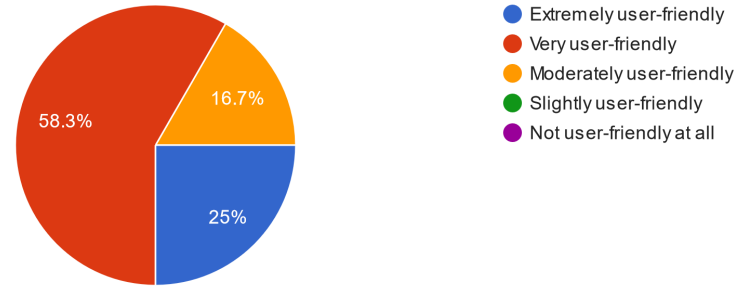




Mobile Application

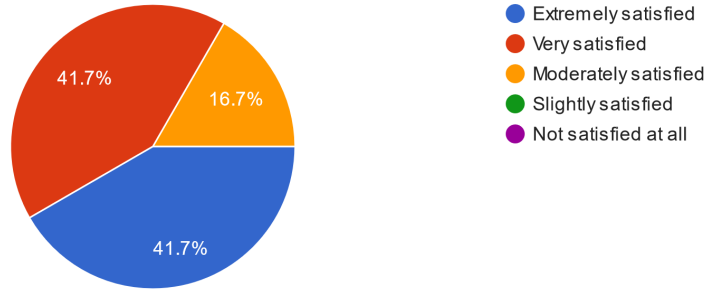
1) How would you rate the user-friendliness of the app?

27 responses



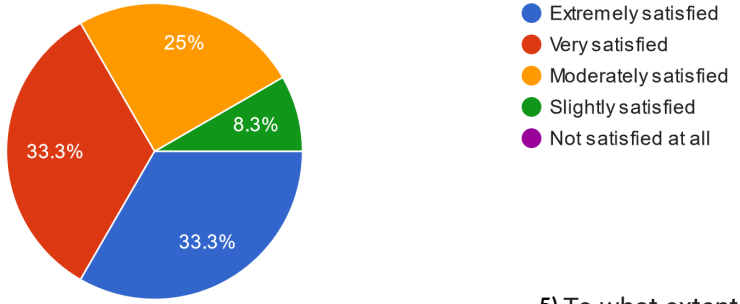
2) How satisfied are you with the performance of the app?

27 responses



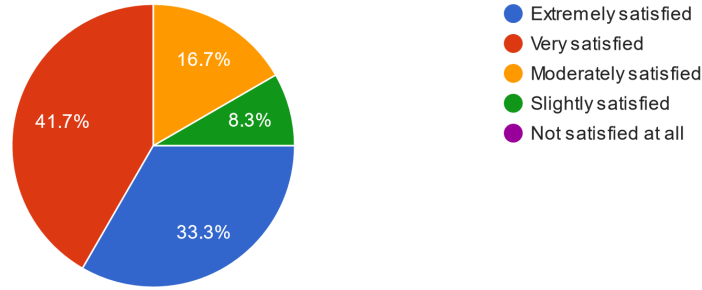
3) How satisfied are you with the awards provided by the app?

27 responses



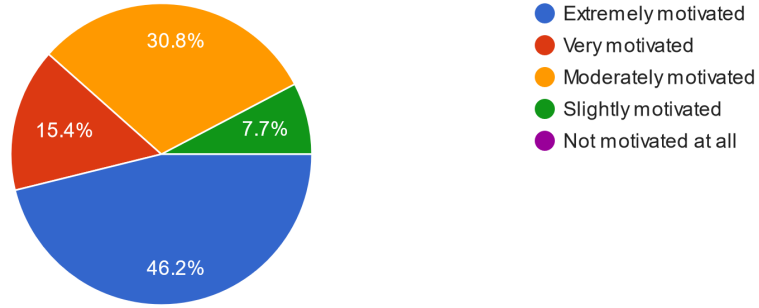
4) How satisfied are you with the events published by the app?

27 responses



5) To what extent does the app motivate you to ride bikes?

27 responses



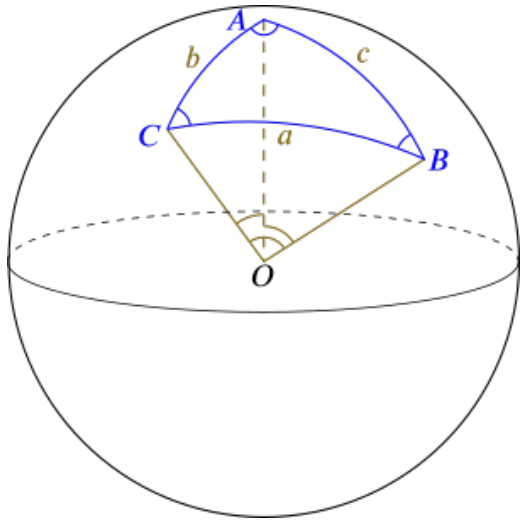
Tracking Algorithm

Tracking Algorithm

Description

The algorithm aims to track biking activities and detect potential cheating behaviour based on the recorded data. It takes a DataFrame containing timestamps, latitude, longitude, and speed as input.

- Calculating the time intervals and distances between consecutive data points.
- Computing the current speed by dividing the distance by the time span.
- Utilizing the *Haversine* formula to calculate the distance between latitude-longitude coordinates with high precision.



Tracking Algorithm

Detect Cheating

> Cheating detection involves comparing the computed speed with a threshold of 25 km/h.

- Choice of threshold:
  Based on Strava and OSM dataset, research and analysis

- If the speed surpasses the threshold, the data point is flagged as potential cheating.

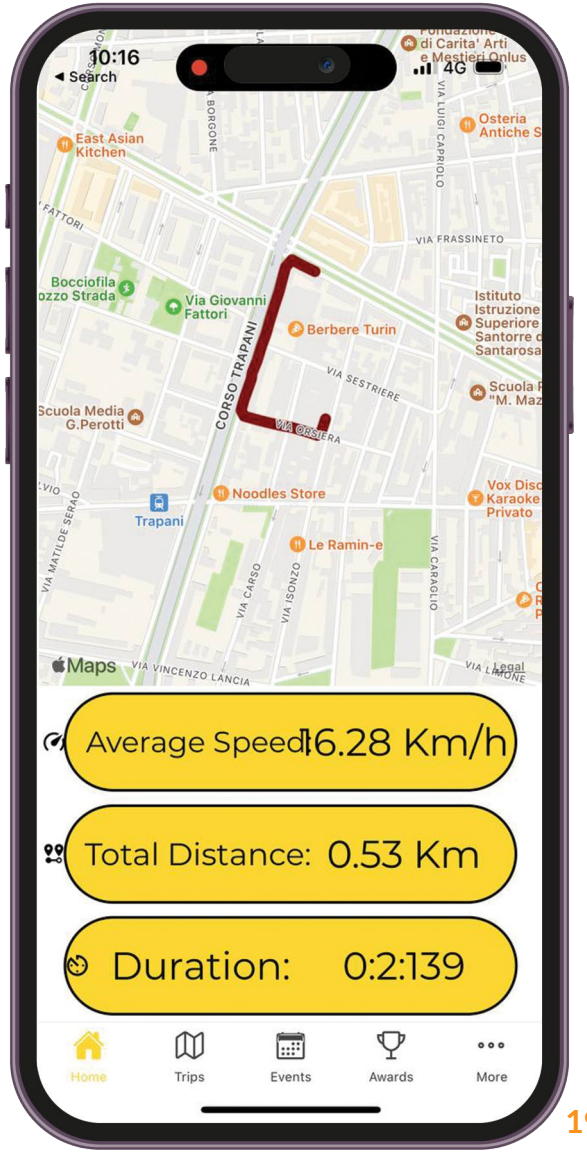
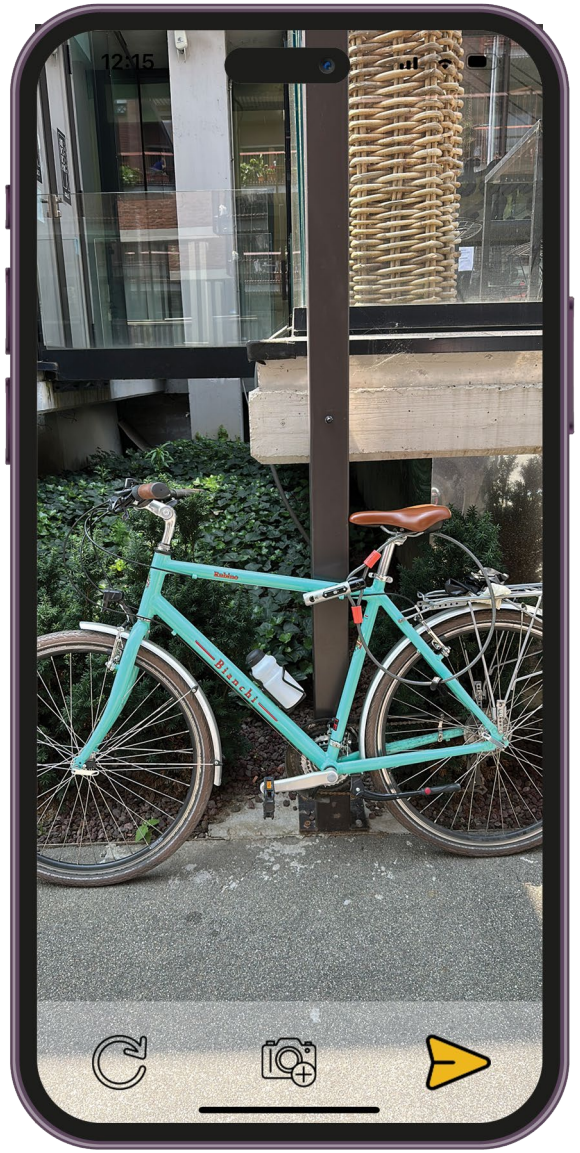


Image Recognition

Image recognition

Mask R-CNN

- State-of-the-art deep learning model for object detection and instance segmentation.
- Utilizing the MASK-RCNN model trained on the COCO dataset, our system incorporates advanced image processing techniques for accurate object detection and image segmentation.



Deploy the model → Post-processing → Model evaluation → Image recognition

Image recognition

We conducted a test using 20 images containing bicycles and 20 images containing other objects

- **Recall :** 100%
- **Precision :** 91%
- **Accuracy :** 95%
- **F2 Score:** 95%

Conclusion

Conclusion

All requirements have been met, and the mobile application and web app are fully functional, providing a rewarding platform for individuals engaged in regular biking activities based on distance and frequency

Potential future work:

Expansion of the Rewards System

- Explore additional reward mechanisms to further enhance user engagement and motivation.
- Incorporate partnerships with local businesses or sponsors to offer exclusive discounts or incentives for users.

Integration with Smart City Infrastructure

- Collaborate with city authorities to integrate the biking system with existing smart city infrastructure.
- Enable features such as real-time traffic updates, optimized route suggestions, and bike lane availability information.

Thank you

Do you have any questions?