SOFTWARE ENGINEERING PROJECT
FPAY AS YOU GO

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AIM

- We aim to develop a facial recognition-based payment system for the shuttle services on our campus and beyond.
- Our concept presents a simple and efficient approach to ensure that all shuttle boarders pay the travel fare and that the shuttle services do not suffer any losses.
- It makes the commute convenient for the shuttle boarders, as they don't have to wait in queues to make the payment.

LITERATURE SURVEY

S. No.	Title	Authors	Techniques discussed	Advantages	Drawbacks
1.	High Performance Facial Expression Recognition System Using Facial Region Segmentation, Fusion of HOG & LBP Features and Multiclass SVM	B. Islam, F. Mahmud and A. Hossain, 2018 10th International Conference on Electrical and Computer Engineering (ICECE).	Facial Region Segmentation. Histogram of Oriented. Gradients (HOG) Features. Local Binary Patterns (LBP) Features. Feature Fusion. Support Vector Machine (SVM) Classifier.	Improved Accuracy. Robustness. Efficient Feature Extraction. Easy to implement. Applicability.	Limited Dataset. Sensibility to Noise. Insufficient data pre-processing Lack of Comparison.
2.	An Efficient Convolutional Neural Network Approach for Facial Recognition	A. Mangal, H. Malik and G. Aggarwal, 2020.	Data Preprocessing. Convolutional Neural Network Architecture. Transfer Learning. Data Augmentation. Softmax Classifier.	High Accuracy. Robustness. Efficiency. Transfer Learning. Scalability.	Training Data Bias. Overfitting. Computational Resources. Limited Interpretability. Privacy Concerns

LITERATURE SURVEY

S. No.	Title	Authors	Techniques discussed	Advantages	Drawbacks
3.	A Facial Expression Recognition Method Based on a Multibranch Cross-Connection Convolutional Neural Network	C. Shi, C. Tan and L. Wang, in IEEE Access, vol. 9, pp. 39255-39274, 2021	Data Preprocessing. Multibranch Cross-Connection Convolutional Neural Network Architecture. Transfer Learning. Data Augmentation. Softmax Classifier.	High Accuracy. Robustness. Multibranch cross-connection approach. Scalability. Flexibility. Generalizability.	Limited Scope. Computational Resources. Privacy Concerns. Lack of interpretability. Dataset Bias.
4.	Facial Recognition using the OpenCV Libraries of Python for the Pictures of Human Faces Wearing Face Masks during the COVID-19 Pandemic	J. Vadlapati, S. Senthil Velan and E. Varghese, 2021	Image Preprocessing. Feature Extraction. Face Mask Detection. Face Recognition. Evaluation.	Practical Solution. Easy Implementation. Accurate Mask Detection. Effective Feature Extraction. Evaluation Metrics.	Limited Accuracy. Limited Robustness. Limited Scalability. Privacy concerns. Biases and errors.

LITERATURE SURVEY

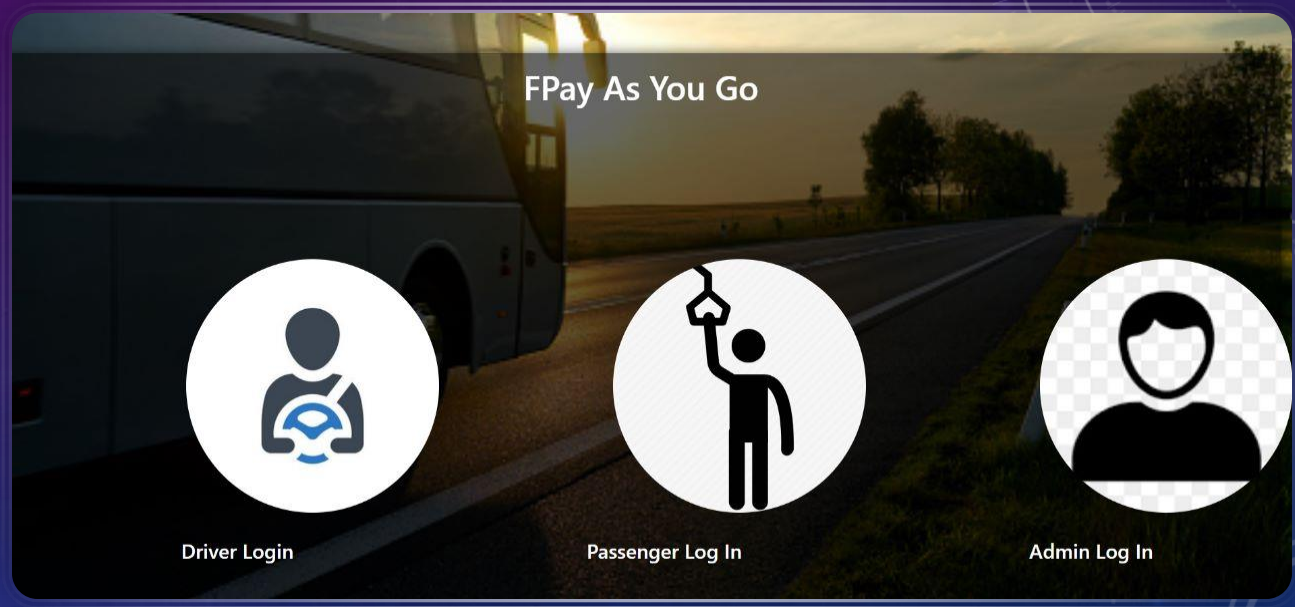
S. No.	Title	Authors	Techniques discussed	Advantages	Drawbacks
5.	Deep Learning based Facial Recognition System for Attendance Maintenance	K. G. Saravanan, J. Rani, D. C. Jullie Josephine, M. Parameswari, H. Venugopal and J. Ramal, 2022	Convolutional Neural Networks (CNNs). Transfer Learning. Face Detection. Face Alignment. Classification.	High Accuracy. Robustness. Efficiency. Scalability. Automation.	Privacy Concerns. Bias. Reliance on high-quality data. Cost. Vulnerability to attacks.
6.	A Novel Facial Expression Intelligent Recognition Method Using Improved Convolutional Neural Network	M. Shi, L. Xu and X. Chen, in IEEE Access, vol. 8, pp. 57606-57614, 2020	Data Preprocessing. Feature Extraction. Feature Selection. Classification. Evaluation.	High Accuracy. Efficiency. Robustness. Novelty. Generalizability.	Dataset Bias. Computational Complexity. Limited scope. Lack of comparison. Limited Evaluation.

JUSTIFICATION OF SCOPE

- The literature survey present primarily two methods of facial recognition – SVM +HOG (Support Vector Machine) and CNN (Convolutional Neural Network).
- We have chosen SVM+HOG as our method of facial recognition due to the following reasons:
  - Images of Passengers are trained faster with SVM+HOG method.
  - In our application, passengers have to be recognized quickly during the shuttle onboard so the computation time should be less. The computation time of SVM+HOG is lesser.
  - SVM+HOG can be more robust to variations in lighting and pose than CNN, as the HOG features are based on local gradients and are therefore less sensitive to global changes in illumination or viewpoint.
- Our dataset won't be limited or overfitting as equal number of photos of every passenger are used to train the model.
- Our project explores a new application of Facial Recognition to ease the payment process of shuttle services.

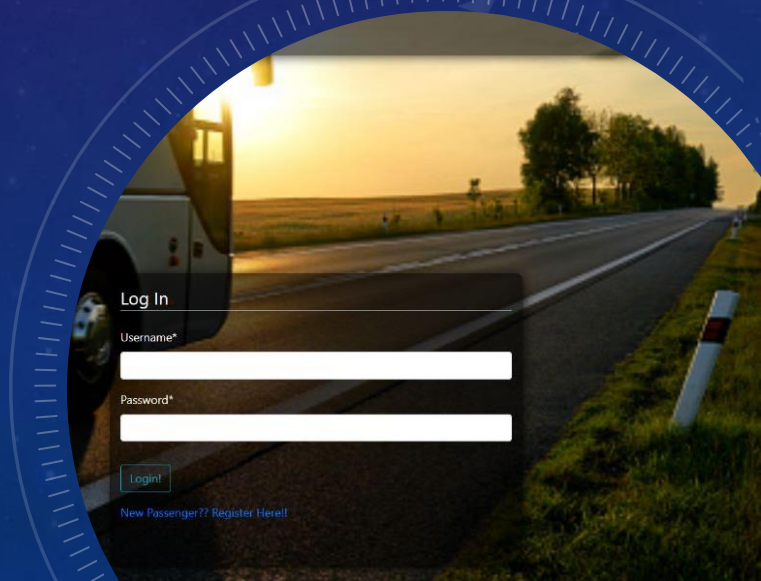
LOGIN/ REGISTER MODULE

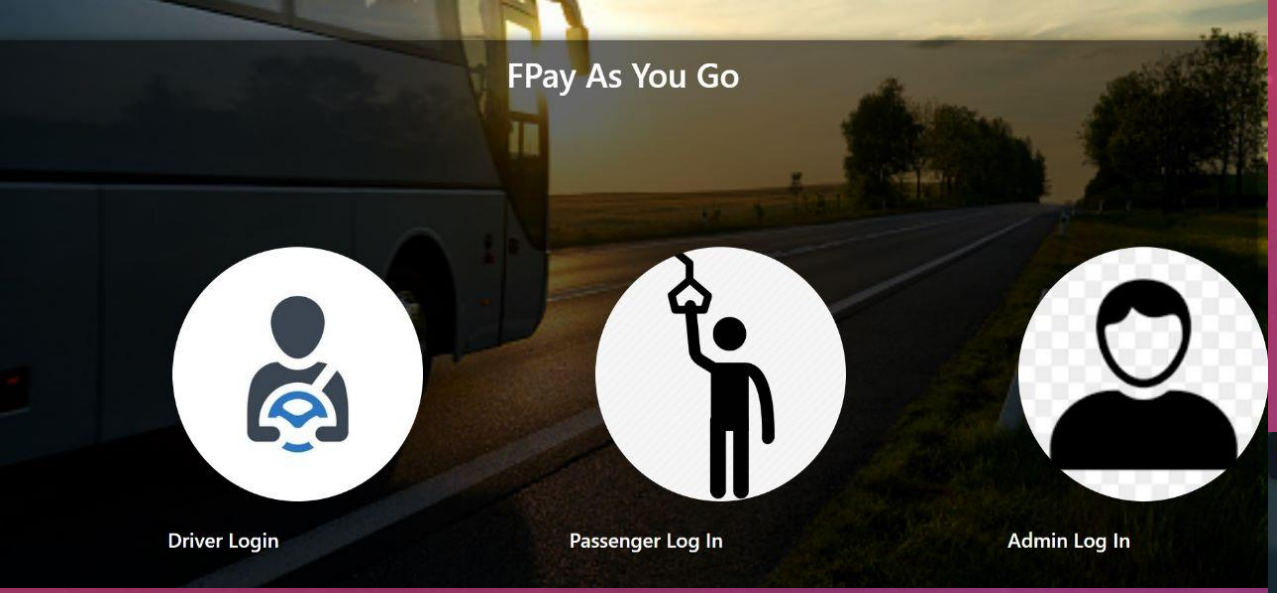
- User Login process is decomposed into Register and Sign-In processes.
- Driver and Student input valid credentials, the login process matches those credentials against the one stored in Verified User datastore. If it matches, then the user is granted access
- The user module allows users to register, log in, and log out. Users benefit from being able to sign on because this associates content they create with their account and allows various permissions to be set for their roles.
- Our project has separate logins for 3 different kinds of users based on their roles:
  - Driver
  - Passenger
  - Admin



LOGIN/ REGISTER MODULE

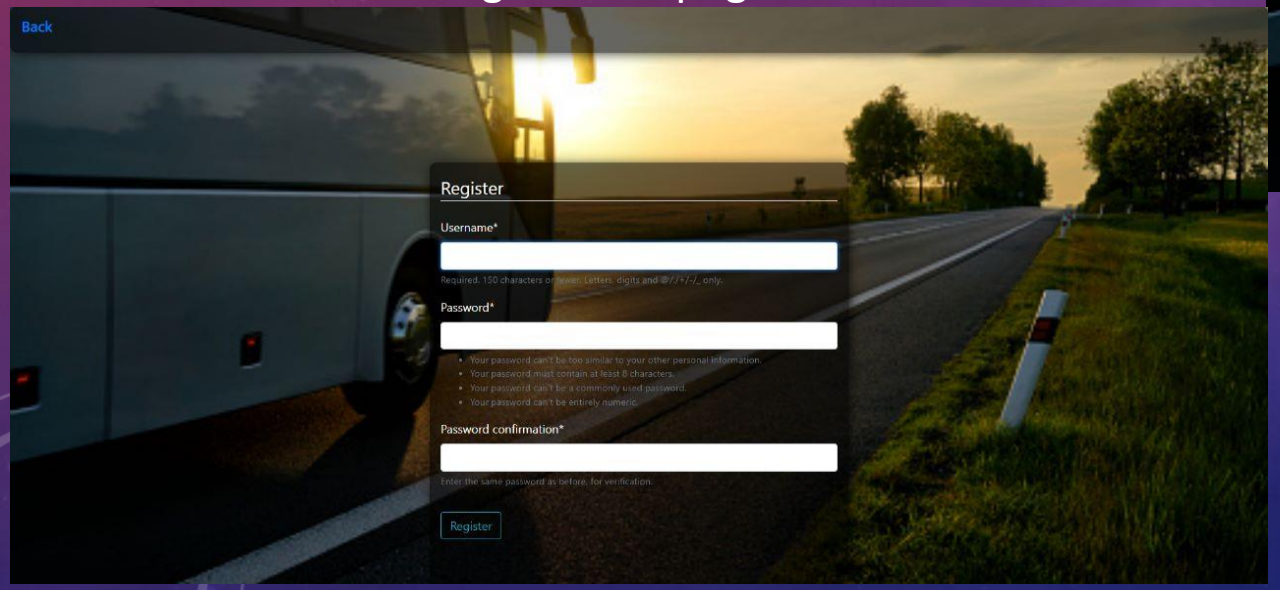
- The shuttle Driver clicks on Driver's Login and enter his account's username and password
- The credentials are validated through the database and the Driver is logged into his account after which he can start the system
- If the credentials entered by the driver are incorrect an error message "Invalid Credentials" is displayed and the driver is asked to fill the credentials again.
- Passengers/students can access their accounts by clicking on Passenger's login and entering their authentic credentials.
- If it's a new passenger he/she can register by entering Username and password . Type the password again for confirmation. Password should follow the given criteria for it to be accepted. After registration the passengers have to use the "upload photos" feature on their first login.
- Admins can also login by entering their credentials and then view records on their account

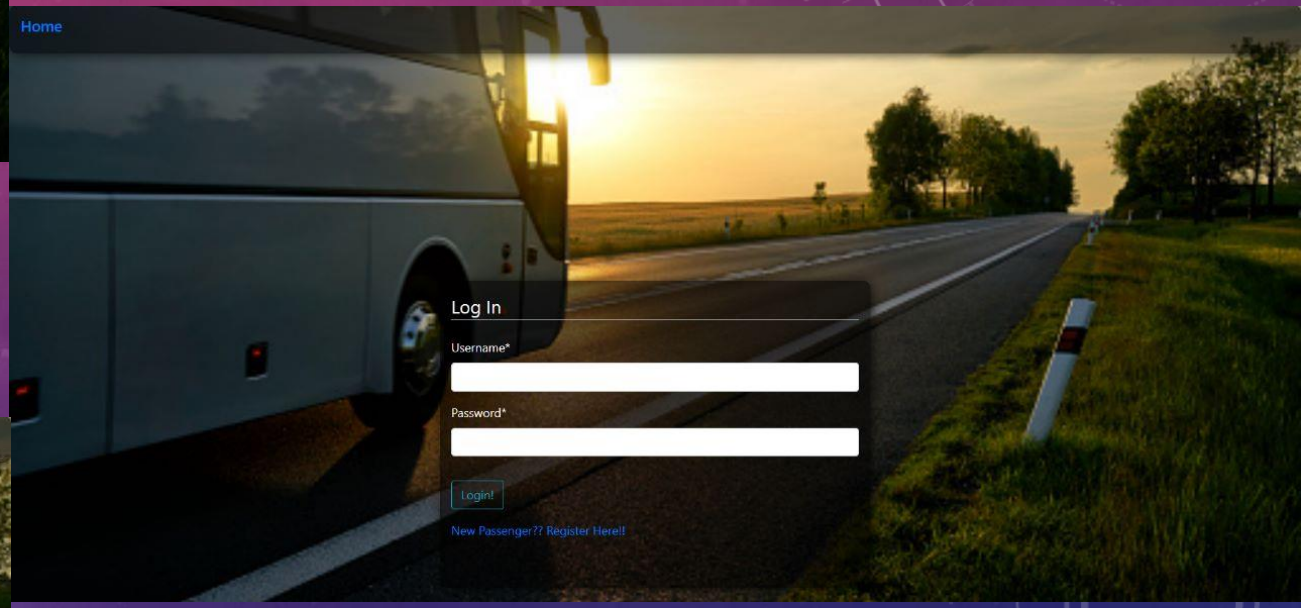




Home Page

Registration page





Login page

FACIAL RECOGNITION SYSTEM

- Passengers will have to use the "Upload Photos" feature on their first login. The system webcam will open and take photos of the passenger.
- Admin will have to use the "Train Images" feature to train the model using the images of the passenger.
- The model used is SVM + HOG (Support Vector Machine + Histogram Oriented Gradients.
- The driver will login to start the facial recognition during shuttle on-boarding.
- The passengers will be recognized and the ride fare will be reflected in their logins.

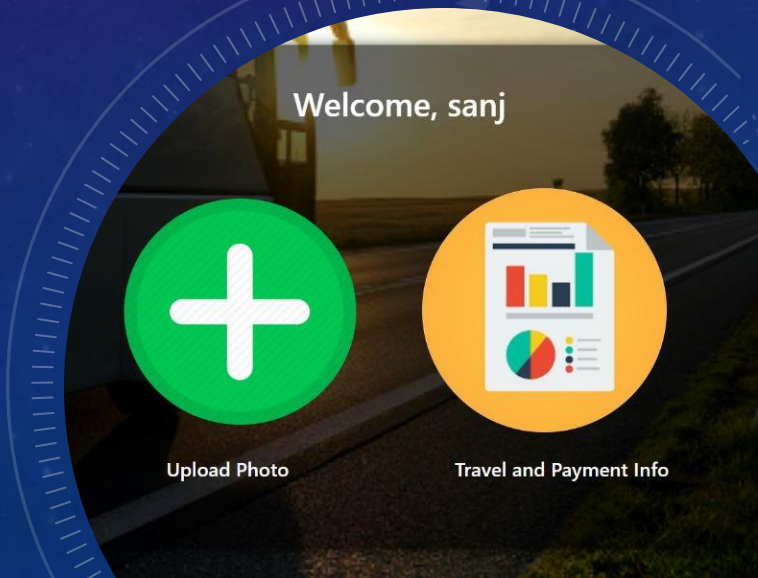
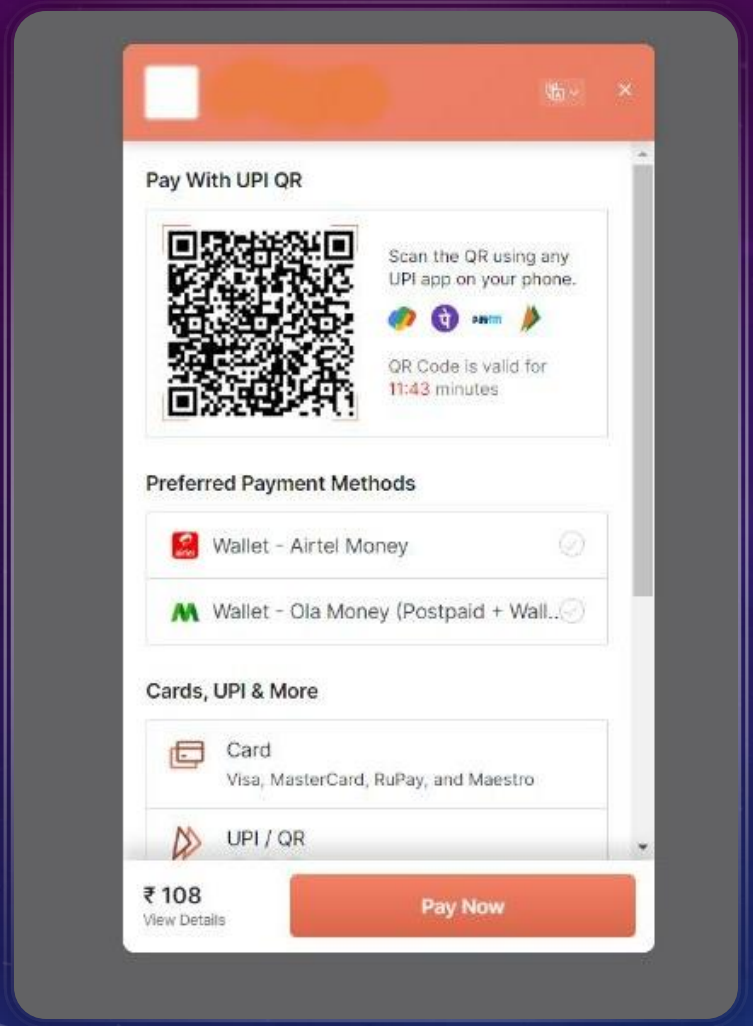


IMAGE PROCESSING & SVM + HOG

1. Initialize the video stream (for Upload Image)
2. Capture images from the video stream.
3. Load HOG face detector and the shape predictor for alignment.
4. Perform Image Processing using OpenCV and face detection using HOG
    i. Re-size the images.
    ii. Convert the images to grayscale (for better model efficiency)
    iii. Find the coordinates of the image and return a frame around the detected face.
    iv. Extract the HOG (Histogram of Oriented Gradients) features from the images. The HOG features are calculated by dividing each image into small cells and calculating the gradient directions and magnitudes of the pixels within each cell.
5. Store the images along with the passenger identity.
6. When admin clicks on train images, SVM (Support Vector Machine) classifier is trained on the HOG features extracted from the images. The SVM is a supervised learning classifier that learns to separate the positive and negative examples based on the HOG features. The radial basis function kernel (RBF kernel) SVM are used for training and tracking.
7. When the driver starts facial recognition, steps 1, 2, 3 and 4 are repeated again.
8. Passengers are identified using the trained SVM classifier and HOG features extracted from the uploaded images.

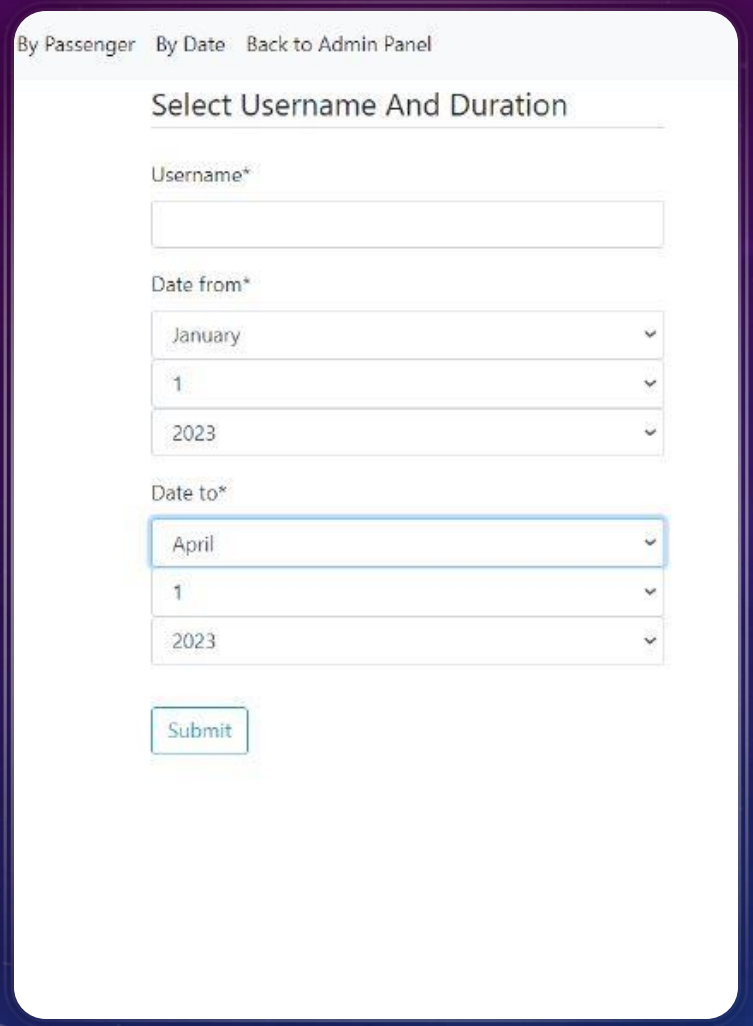


PAYMENT GATEWAY

- The passenger can make use of this integrated gateway to pay their dues.
- In our project, we have integrated the RazorPay payment gateway.
- The passenger is firstly supposed to enter their name, this is done so that the payment is recorded under the passengers full name, instead of the username(if they have used a different/short-form for their username).
- Then they would be directed to the payment interface.
- There they can select among multiple modes of payments like UPI, Credit/debit cards, wallets, etc

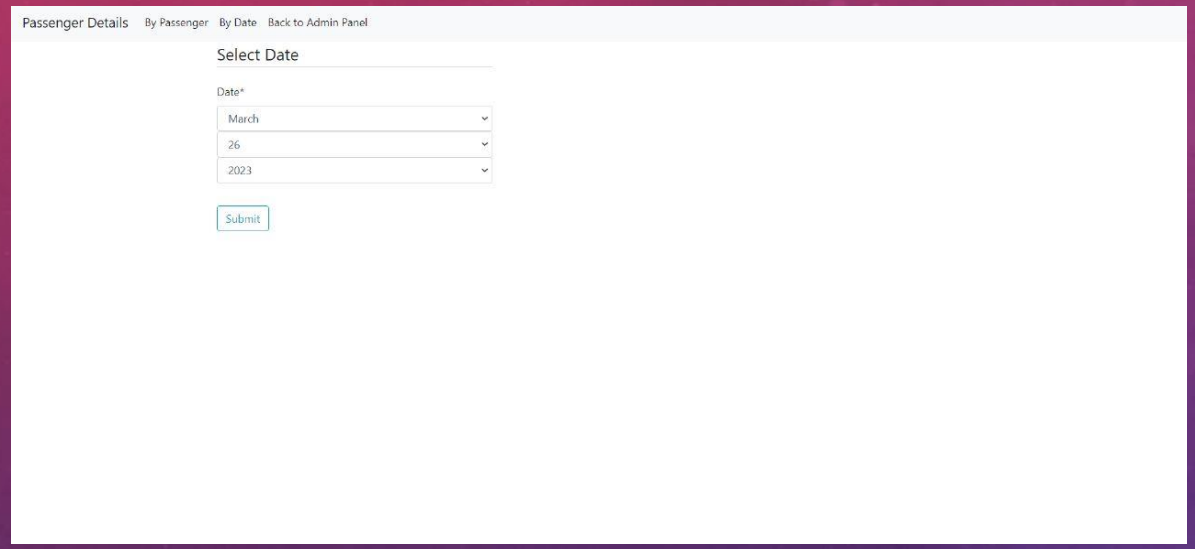
PAYMENT GATEWAY

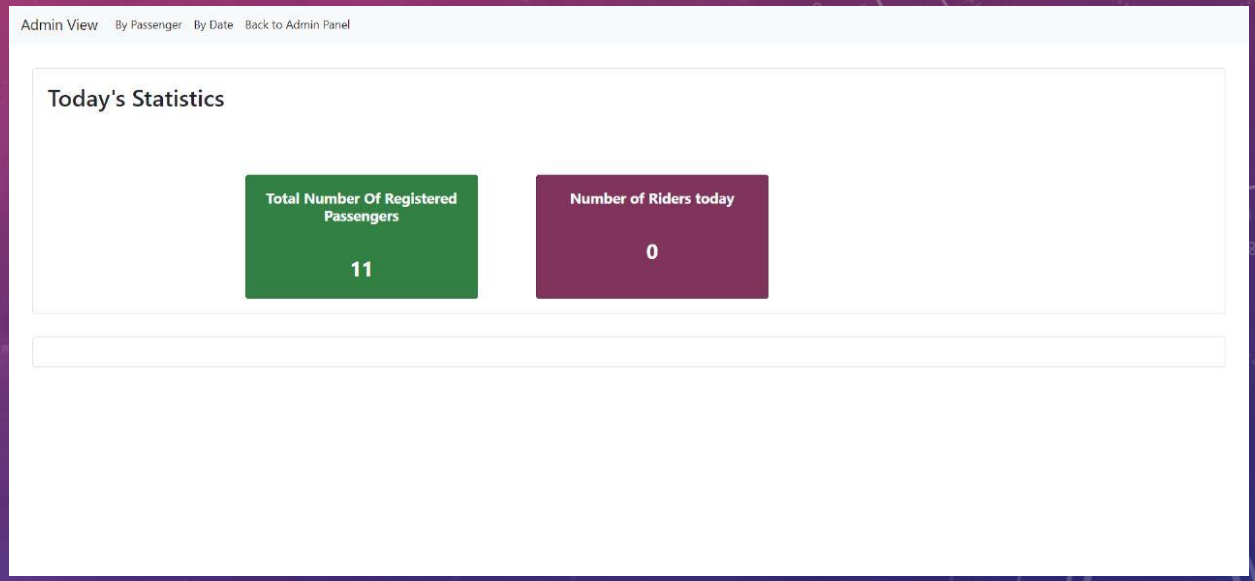
- The amount to be paid will be pre-loaded from the database, as per their travel history and corresponding payment status.
- The required details of the payment recipient are pre-fed.
- After selecting the mode of payment (and providing required details if needed) the payment will be processed
- If the payment is successful, the user will be redirected to 'success' page, else will be notified of failure.

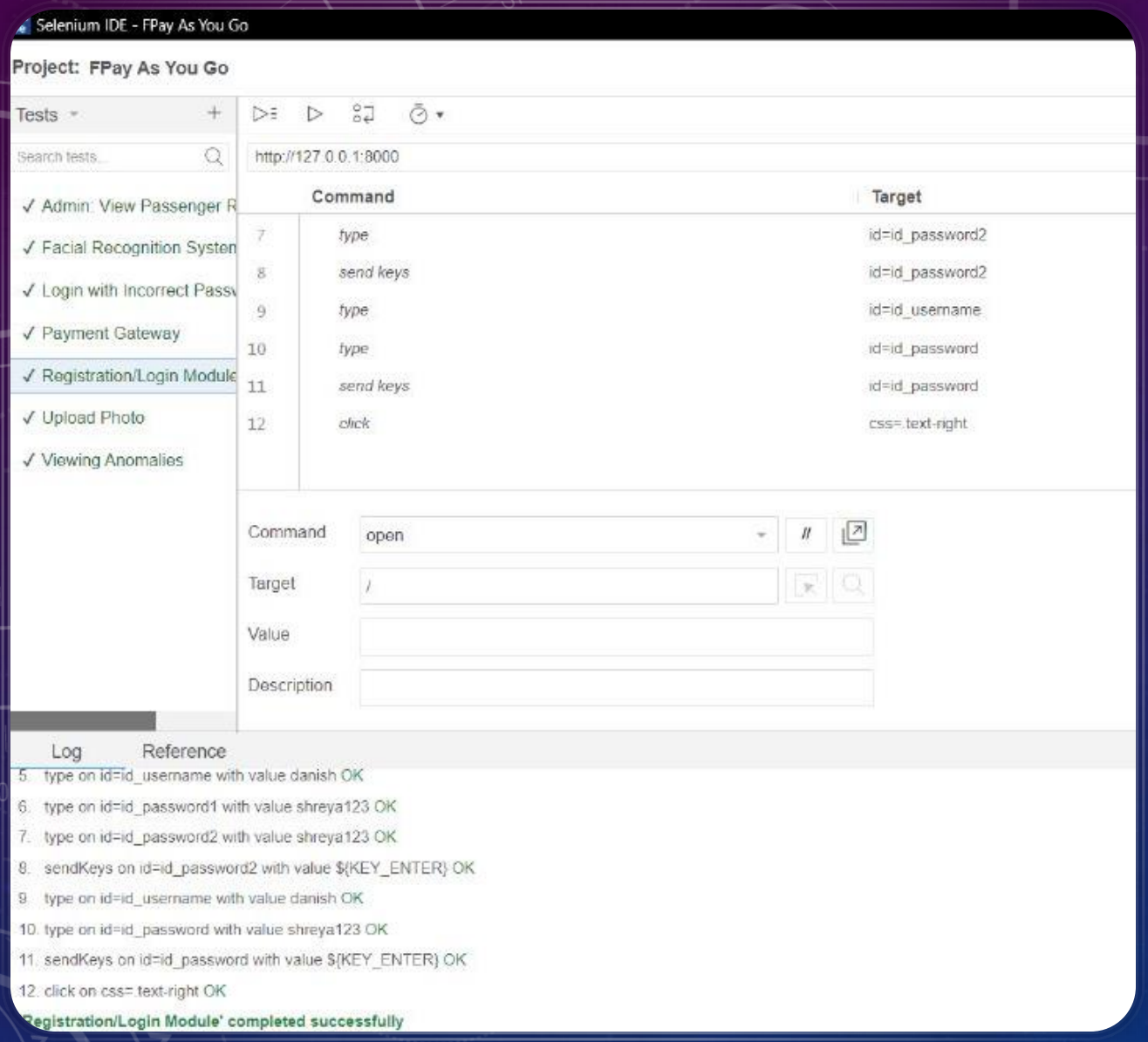


PAYMENT/ TRAVEL RECORDS

Authenticate	Authenticate the admin user by verifying their credentials.
Retrieve	Retrieve the list of payment records from the database.
Display	Display the passenger trip records in a table format, showing relevant information such as boarding date, boarding time, amount due, payment date, passenger name, and other trip details.
Provide	Provide filters or sorting options to allow the admin user to narrow down the payment records based on specific criteria, such as boarding date range, passenger, or trip details.
Allow	Allow the admin user to search for a specific payment record by entering relevant keywords or information, such as payment ID, passenger name, or trip details.


Passenger Details
By Passenger
By Date
Back to Admin Panel
Select Date
Date*
March
26
2023
Submit


Admin View
By Passenger
By Date
Back to Admin Panel
Today's Statistics
Total Number Of Registered Passengers
11
Number of Riders today
0

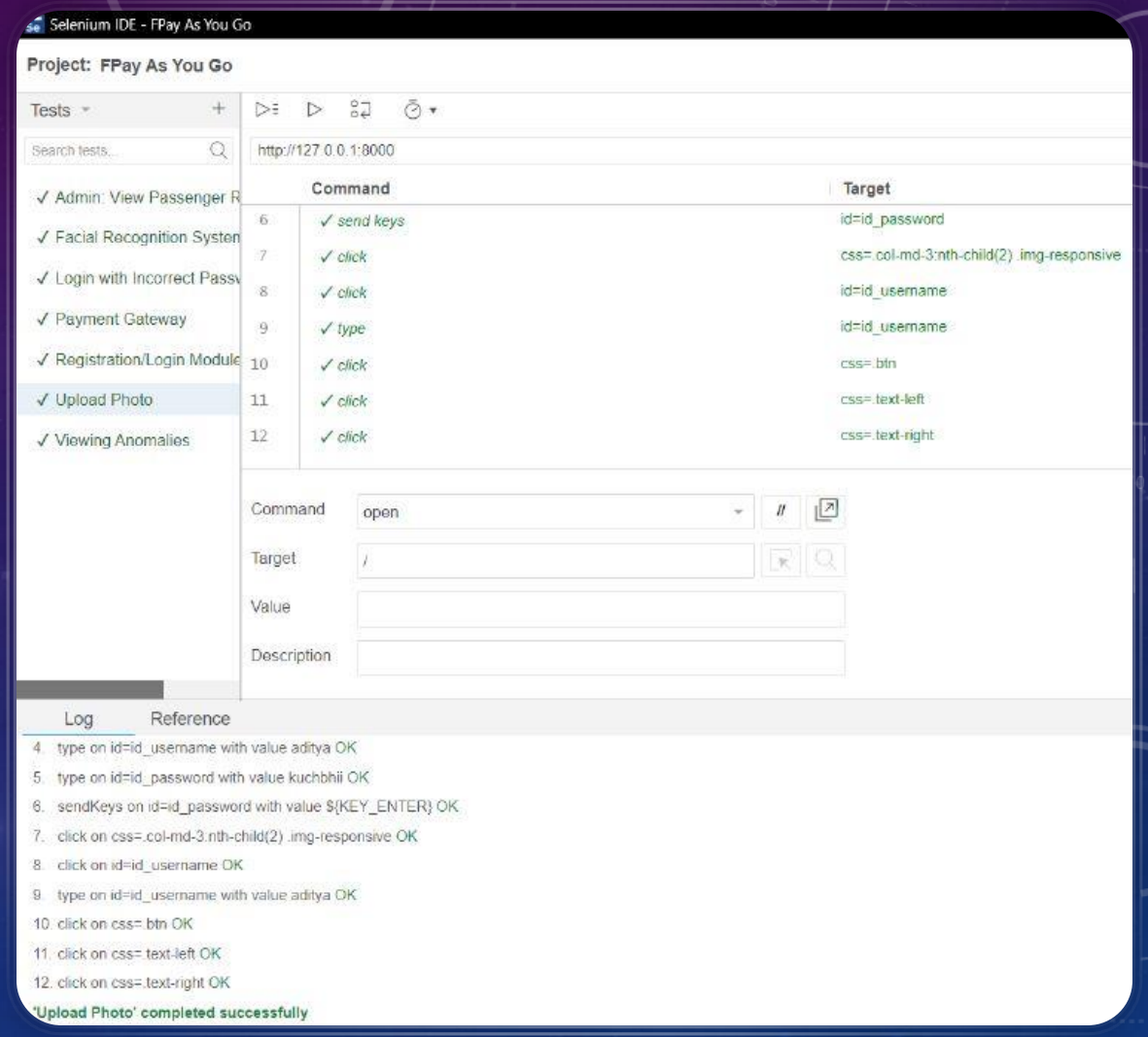


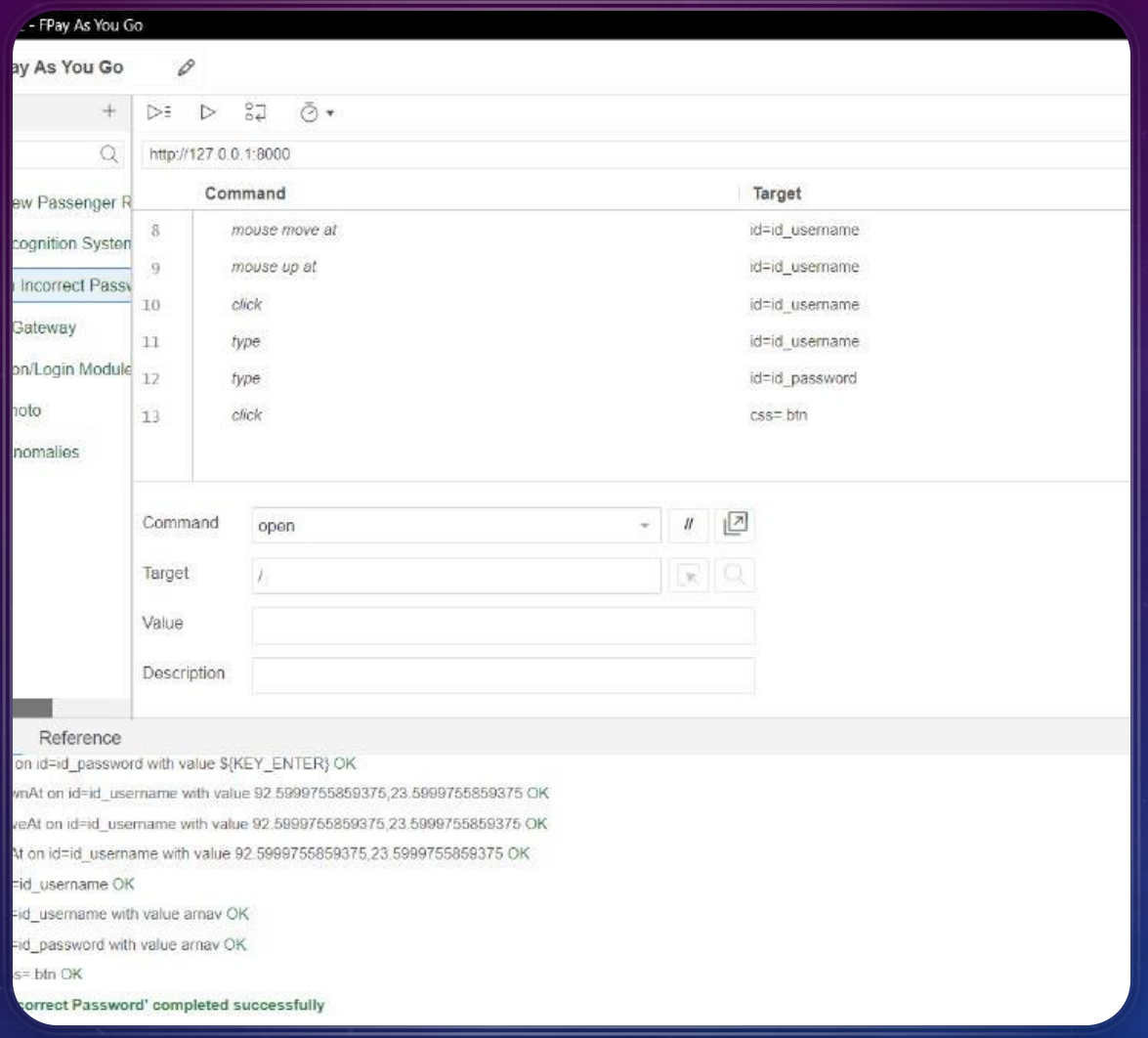
TESTING REPORT

LOGIN AND REGISTRATION,
LOGIN WITH VALID CREDENTIALS

TESTING REPORT

UPLOAD PHOTOS FUNCTIONALITY



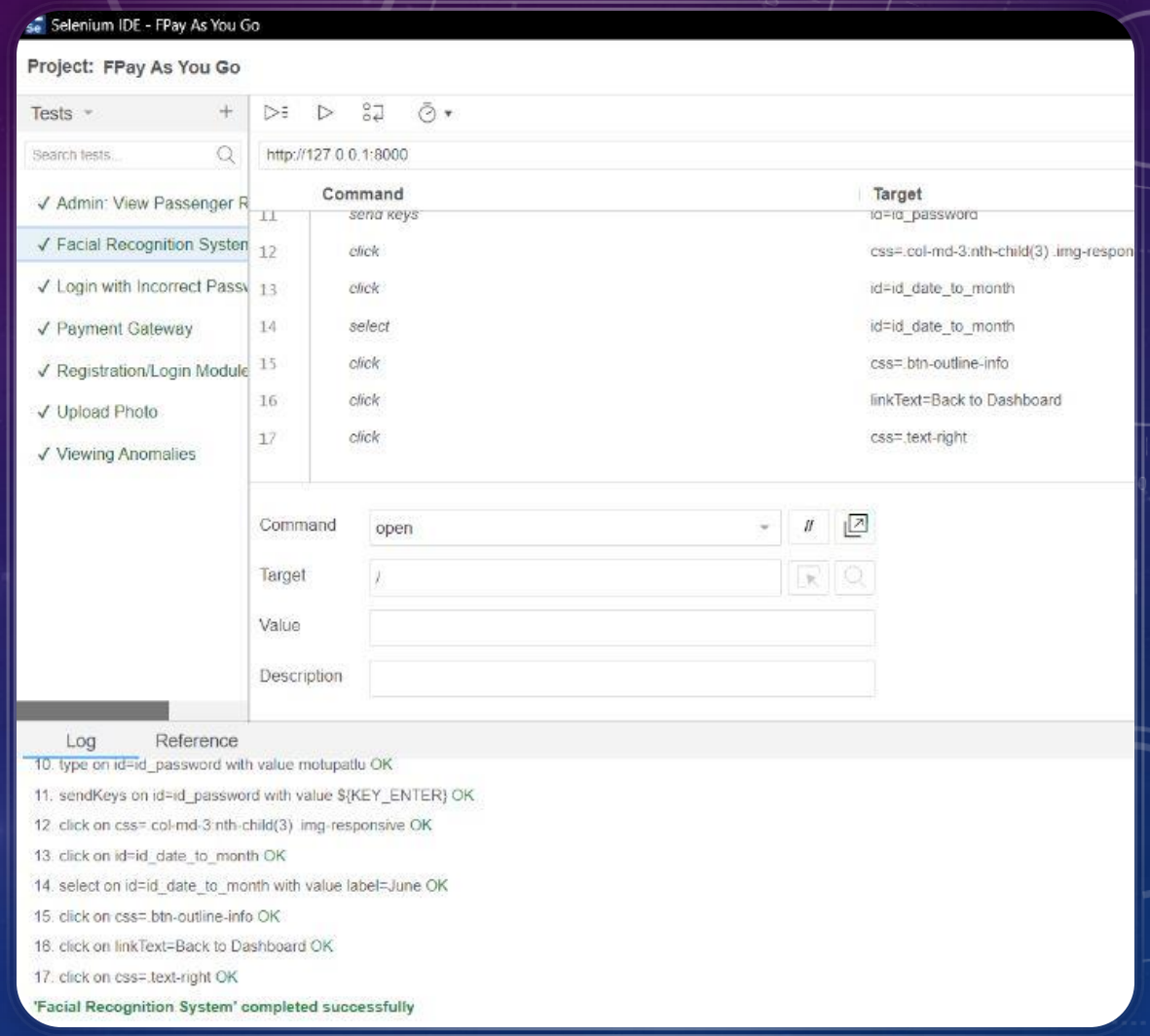


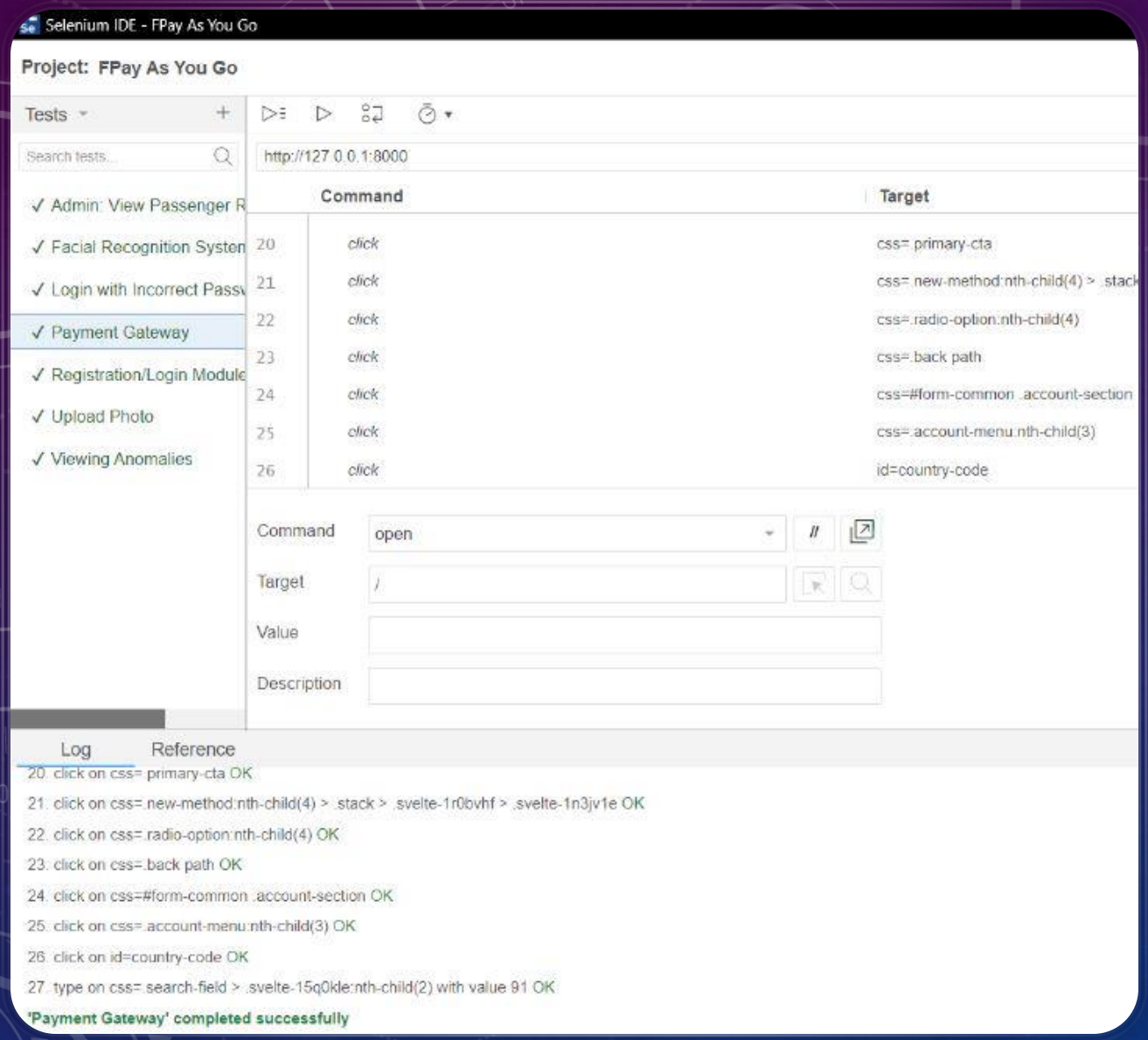
TESTING REPORT

- Login with invalid credentials

TESTING REPORT

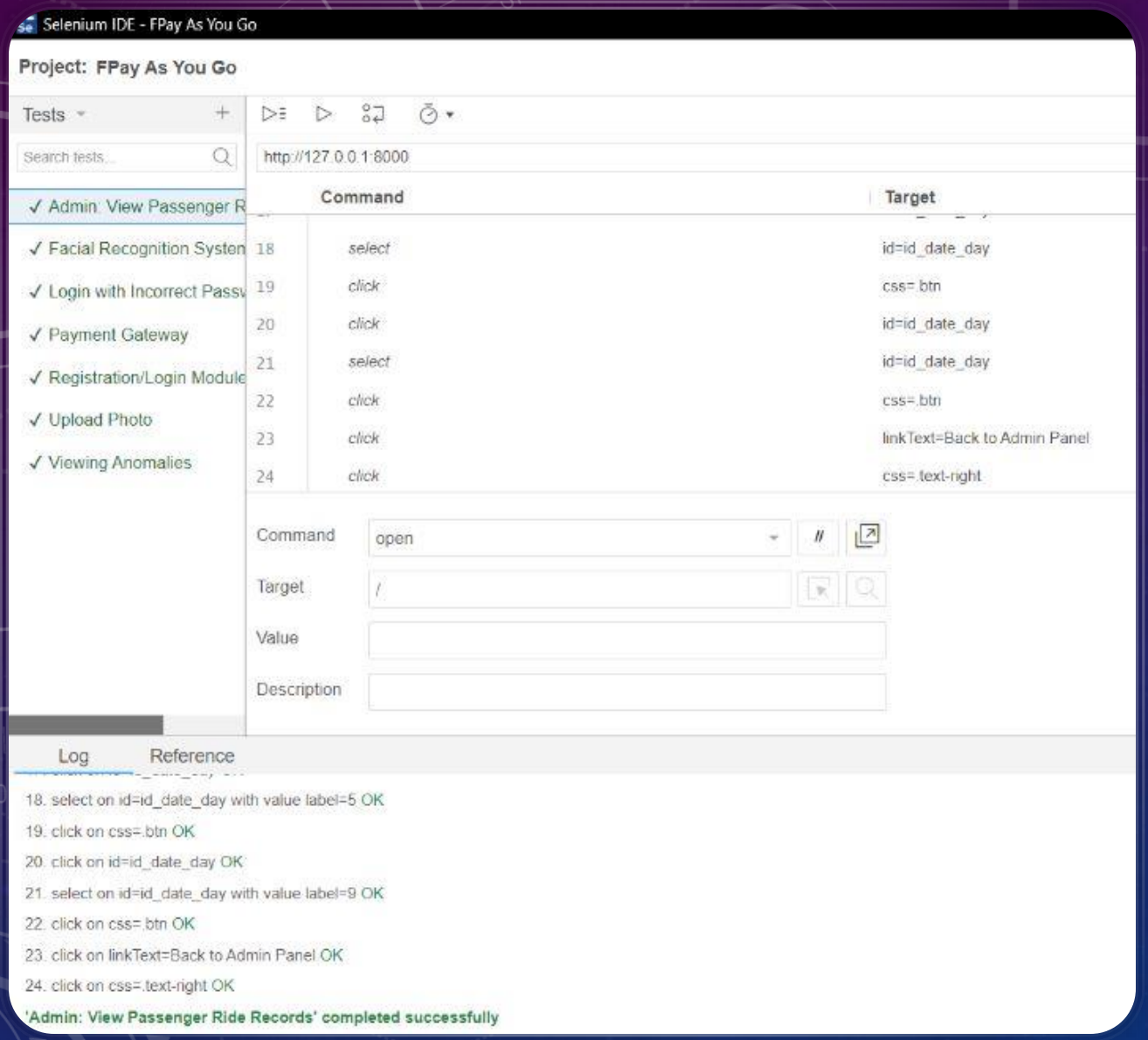
VIEWING ANOMALIES (UNKNOWN PASSENGER)





TESTING REPORT

PAYMENT GATEWAY



TESTING REPORT

ADMIN: VIEW PASSENGER RECORDS

CONCLUSION

- Making use of the HOG SVM classifier, we developed an efficient Facial-recognition based payment system for the shuttle services.
- The application accurately identifies the passenger, adds the travel fare to their account, and maintains all passenger travel records which can be accessed by the admin.
- It has an integrated payment gateway(RazorPay) to provide an easy-to-use payment interface.
- An efficient solution was provided for the problem stated.

FUTURE ENHANCEMENT

- Make a mobile app, as they have better accessibility and thus would attract more customers.
- Improve the processing speed, the main aim is to reduce the time required for training the model while making sure to not affect its accuracy
- Multiple payment gateways can be integrated for user convenience.
- This project can utilize VIT database to ensure valid database entries.

THANK YOU!