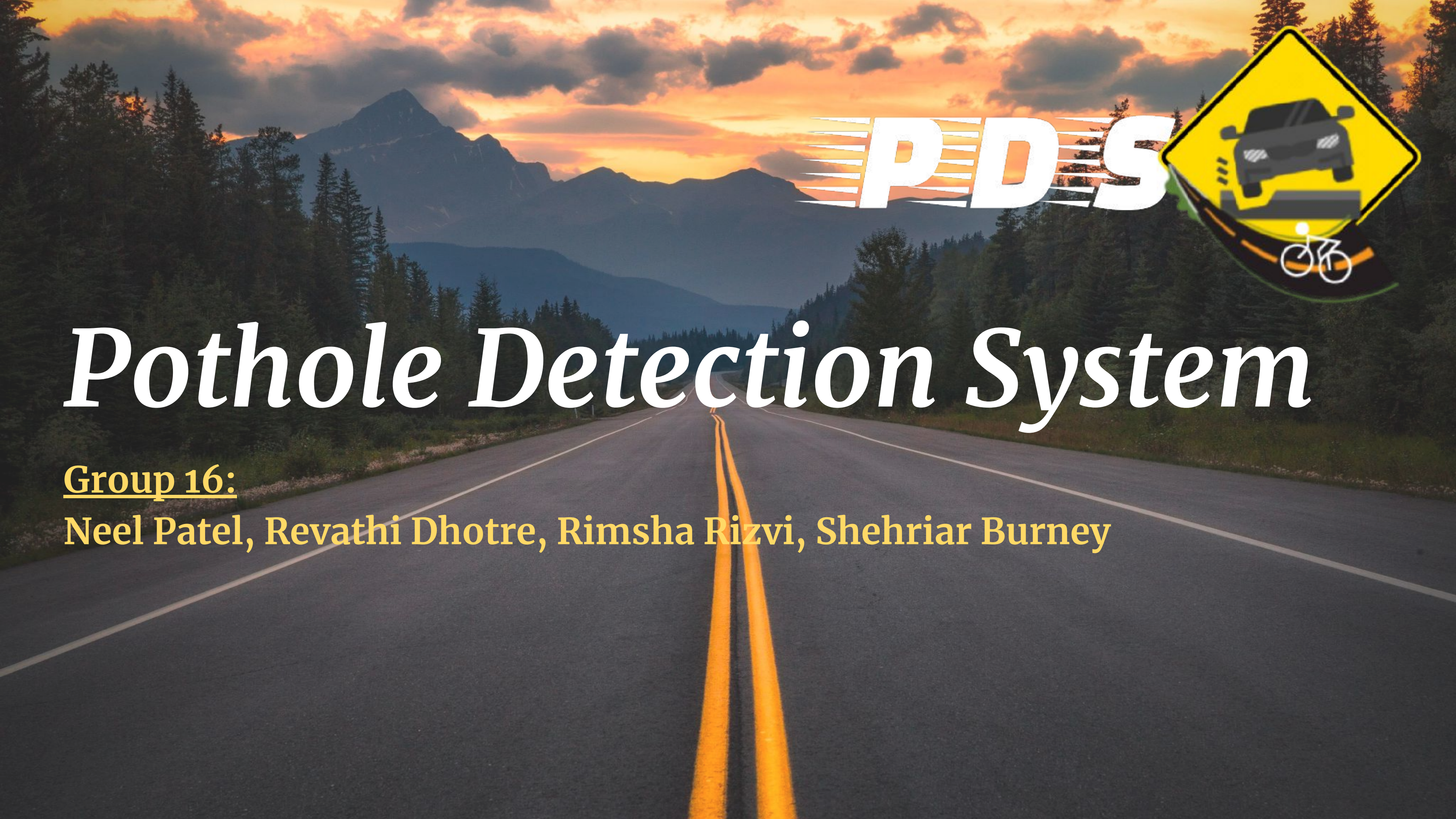

Pothole Detection System

Group 16:

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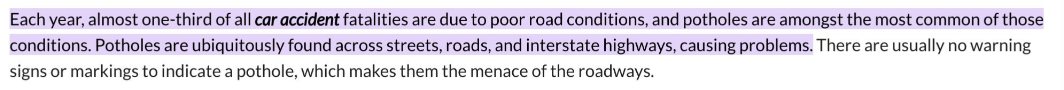
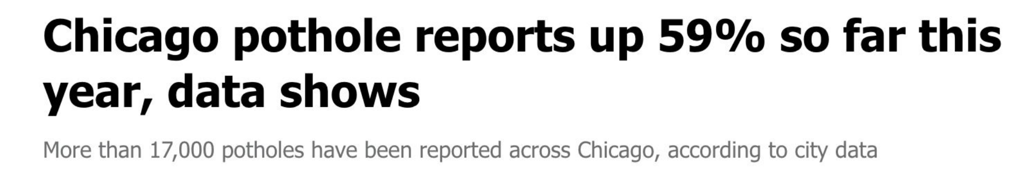
Purpose of the Application

In response to the growing concerns over road safety due to potholes, our application serves a crucial role. It leverages technology to detect and report potholes, reducing vehicle damage and preventing accidents. By bridging the gap between citizens and government agencies, the system ensures timely and efficient pothole repairs, making roads safer and travel smoother for everyone.

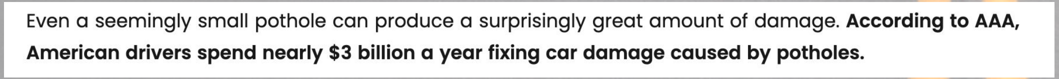


Each year, almost one-third of all ***car accident*** fatalities are due to poor road conditions, and potholes are amongst the most common of those conditions. Potholes are ubiquitously found across streets, roads, and interstate highways, causing problems. There are usually no warning signs or markings to indicate a pothole, which makes them the menace of the roadways.



Chicago pothole reports up 59% so far this year, data shows

More than 17,000 potholes have been reported across Chicago, according to city data



Even a seemingly small pothole can produce a surprisingly great amount of damage. **According to AAA, American drivers spend nearly $3 billion a year fixing car damage caused by potholes.**

What is *PDS*?

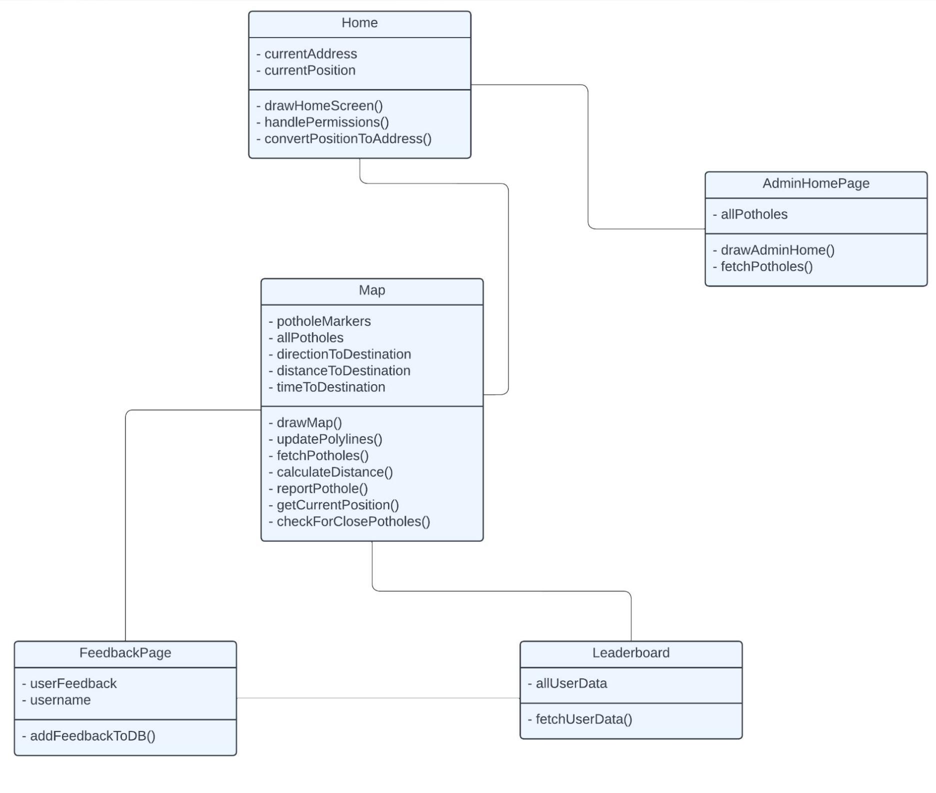
Empowering communities and authorities for safer, smoother roads with real-time pothole detection and reporting.

1. For Users: **Report & Navigate**: Easily report potholes and navigate around them using real-time updates through the Google Maps integration

2. For Governmental Officials: **Informed Decision-Making**: Access detailed reports on pothole locations and sizes, enabling efficient allocation of resources for road maintenance

3. Overall Effectiveness: **Enhanced Road Safety**: Significantly reduces vehicle damage and accidents caused by potholes, promoting safer travel for all

Solution Overview



Home

- currentAddress
- currentPosition

- drawHomeScreen()
- handlePermissions()
- convertPositionToAddress()

AdminHomePage

- allPotholes

- drawAdminHome()
- fetchPotholes()

Map

- potholeMarkers
- allPotholes
- directionToDestination
- distanceToDestination
- timeToDestination

- drawMap()
- updatePolylines()
- fetchPotholes()
- calculateDistance()
- reportPothole()
- getCurrentPosition()
- checkForClosePotholes()

FeedbackPage

- userFeedback
- username

- addFeedbackToDB()

Leaderboard

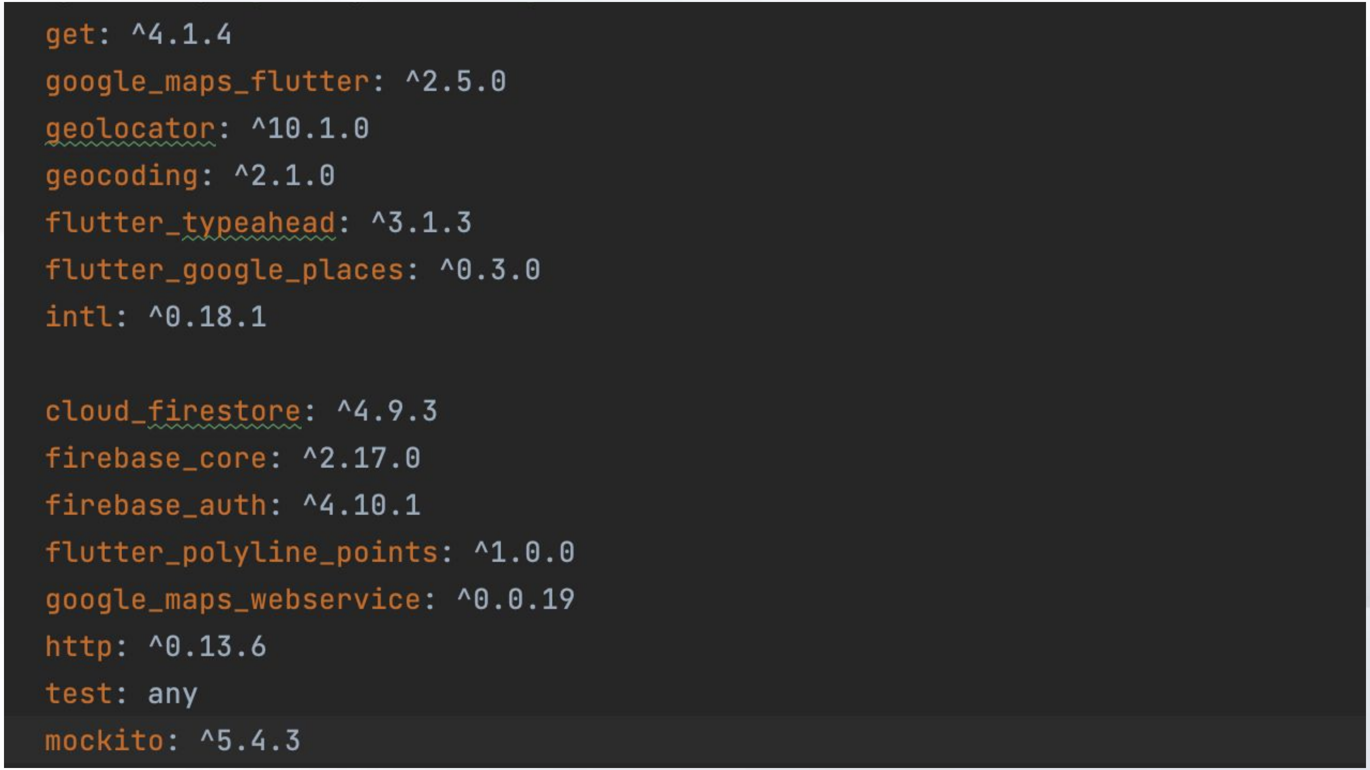
- allUserData

- fetchUserData()

Application Demonstration

https://youtu.be/C7SI7JuKmVM

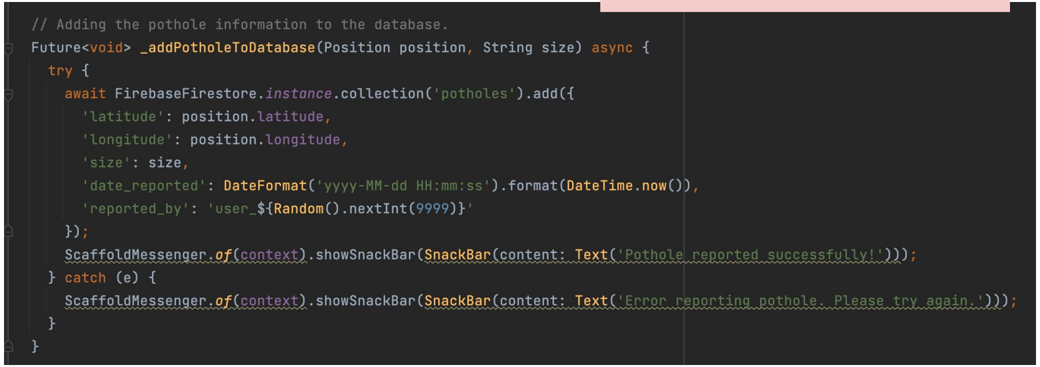
Dependencies Used



```
  get: ^4.1.4
  google_maps_flutter: ^2.5.0
  geolocator: ^10.1.0
  geocoding: ^2.1.0
  flutter_typeahead: ^3.1.3
  flutter_google_places: ^0.3.0
  intl: ^0.18.1

  cloud_firestore: ^4.9.3
  firebase_core: ^2.17.0
  firebase_auth: ^4.10.1
  flutter_polyline_points: ^1.0.0
  google_maps_webservice: ^0.0.19
  http: ^0.13.6
  test: any
  mockito: ^5.4.3
```

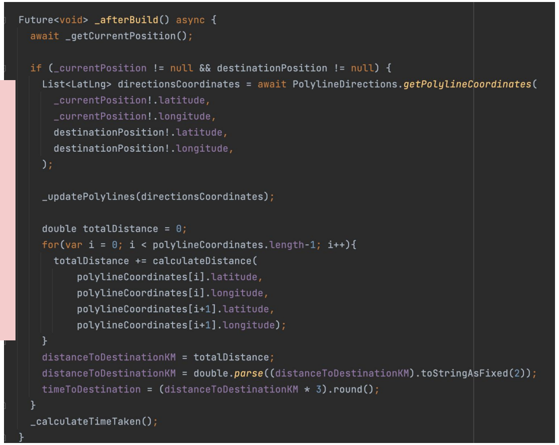
Code Snippets

Reporting Pothole to the Database



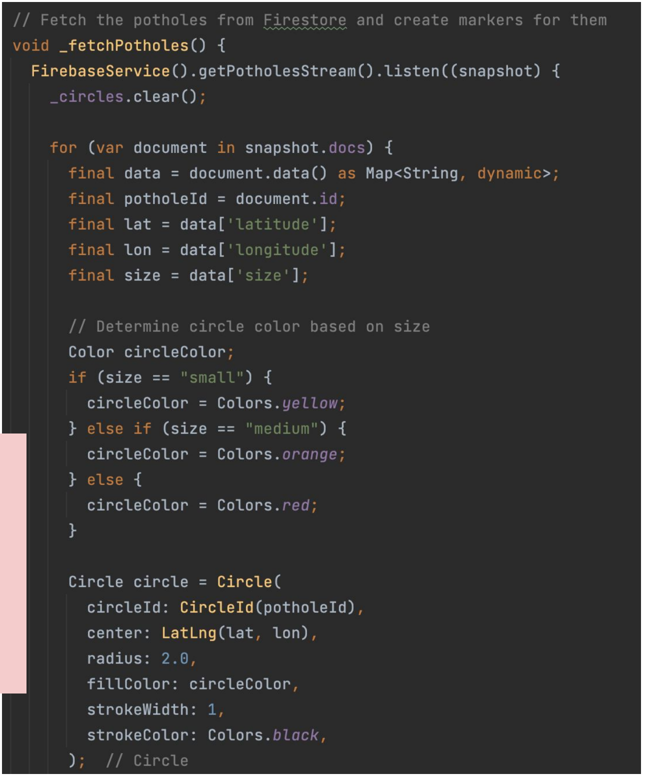
```dart
// Adding the pothole information to the database.
Future<void> _addPotholeToDatabase(Position position, String size) async {
  try {
    await FirebaseFirestore.instance.collection('potholes').add({
      'latitude': position.latitude,
      'longitude': position.longitude,
      'size': size,
      'date_reported': DateFormat('yyyy-MM-dd HH:mm:ss').format(DateTime.now()),
      'reported_by': 'user_${Random().nextInt(9999)}'
    });
    ScaffoldMessenger.of(context).showSnackBar(SnackBar(content: Text('Pothole reported successfully!')));
  } catch (e) {
    ScaffoldMessenger.of(context).showSnackBar(SnackBar(content: Text('Error reporting pothole. Please try again.')));
  }
}
```

Retrieving current location and destination location. Calculating it’s time & distance



```dart
Future<void> _afterBuild() async {
  await _getCurrentPosition();

  if (_currentPosition != null && destinationPosition != null) {
    List<LatLng> directionsCoordinates = await PolylineDirections.getPolylineCoordinates(
      _currentPosition!.latitude,
      _currentPosition!.longitude,
      destinationPosition!.latitude,
      destinationPosition!.longitude,
    );

    _updatePolylines(directionsCoordinates);

    double totalDistance = 0;
    for(var i = 0; i < polylineCoordinates.length-1; i++){
      totalDistance += calculateDistance(
          polylineCoordinates[i].latitude,
          polylineCoordinates[i].longitude,
          polylineCoordinates[i+1].latitude,
          polylineCoordinates[i+1].longitude);
    }
    distanceToDestinationKM = totalDistance;
    distanceToDestinationKM = double.parse((distanceToDestinationKM).toStringAsFixed(2));
    timeToDestination = (distanceToDestinationKM * 3).round();
  }
  _calculateTimeTaken();
}
```

Retrieving pothole information from the database and showcasing it on the map

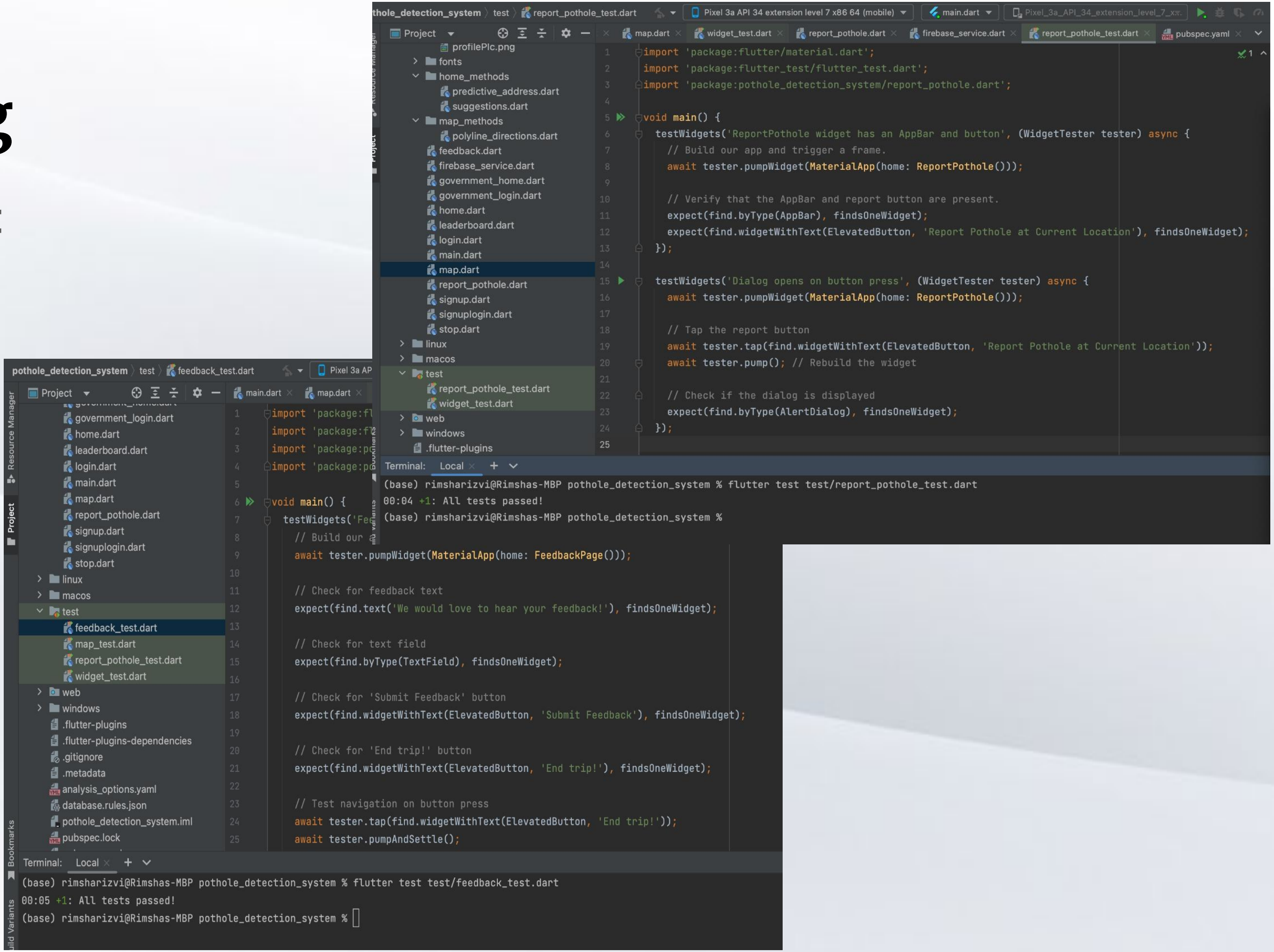


```dart
// Fetch the potholes from Firestore and create markers for them
void _fetchPotholes() {
  FirebaseService().getPotholesStream().listen((snapshot) {
    _circles.clear();

    for (var document in snapshot.docs) {
      final data = document.data() as Map<String, dynamic>;
      final potholeId = document.id;
      final lat = data['latitude'];
      final lon = data['longitude'];
      final size = data['size'];

      // Determine circle color based on size
      Color circleColor;
      if (size == "small") {
        circleColor = Colors.yellow;
      } else if (size == "medium") {
        circleColor = Colors.orange;
      } else {
        circleColor = Colors.red;
      }

      Circle circle = Circle(
        circleId: CircleId(potholeId),
        center: LatLng(lat, lon),
        radius: 2.0,
        fillColor: circleColor,
        strokeWidth: 1,
        strokeColor: Colors.black,
      );  // Circle
```

Unit Testing

Successfully Tested:

1. Widgets
2. UI
3. Buttons



```
import 'package:flutter/material.dart';
import 'package:flutter_test/flutter_test.dart';
import 'package:pothole_detection_system/report_pothole.dart';

void main() {
  testWidgets('ReportPothole widget has an AppBar and button', (WidgetTester tester) async {
    // Build our app and trigger a frame.
    await tester.pumpWidget(MaterialApp(home: ReportPothole()));

    // Verify that the AppBar and report button are present.
    expect(find.byType(AppBar), findsOneWidget);
    expect(find.widgetWithText(ElevatedButton, 'Report Pothole at Current Location'), findsOneWidget);
  });

  testWidgets('Dialog opens on button press', (WidgetTester tester) async {
    await tester.pumpWidget(MaterialApp(home: ReportPothole()));

    // Tap the report button
    await tester.tap(find.widgetWithText(ElevatedButton, 'Report Pothole at Current Location'));
    await tester.pump(); // Rebuild the widget

    // Check if the dialog is displayed
    expect(find.byType(AlertDialog), findsOneWidget);
  });
```

```
(base) rimsharizvi@Rimshas-MBP pothole_detection_system % flutter test test/report_pothole_test.dart
00:04 +1: All tests passed!
(base) rimsharizvi@Rimshas-MBP pothole_detection_system %
```

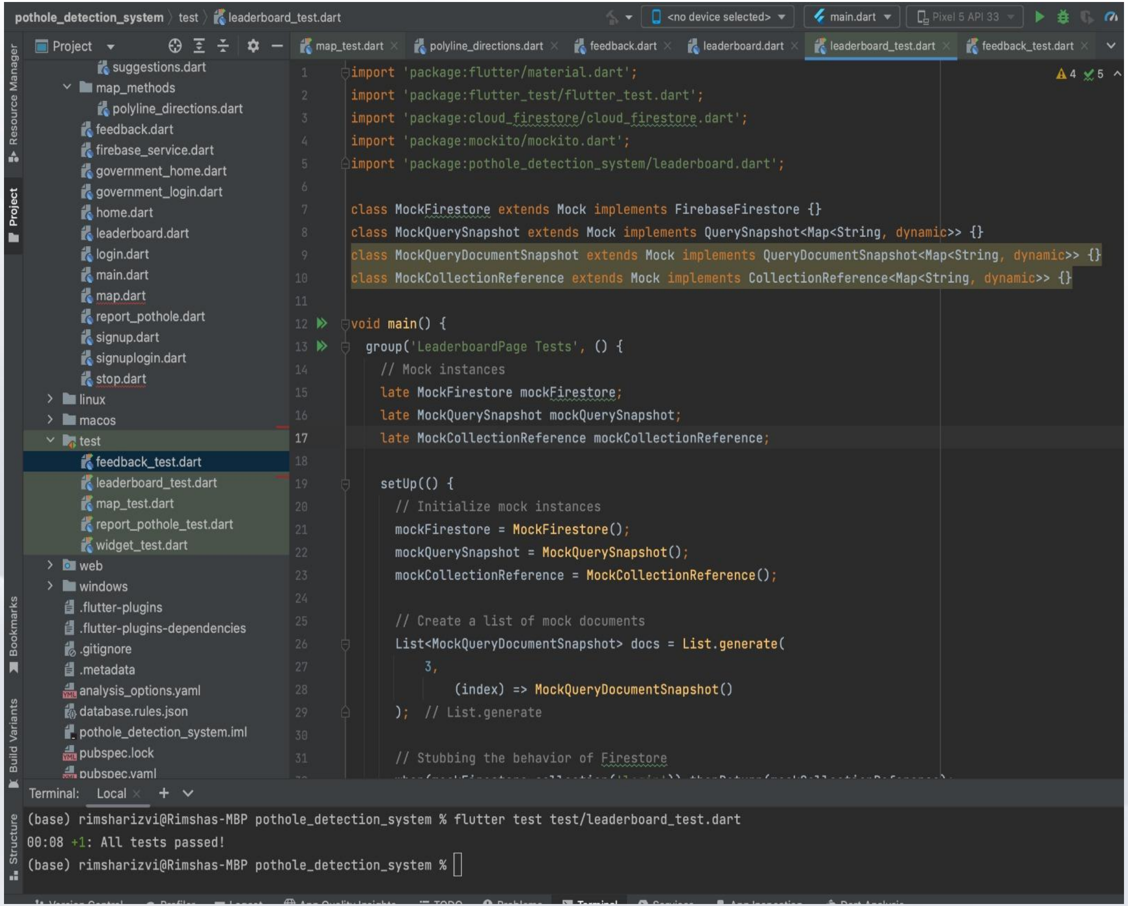
```
import 'package:fl
import 'package:f
import 'package:p
import 'package:p

void main() {
  testWidgets('Fe
    // Build our
    await tester.pumpWidget(MaterialApp(home: FeedbackPage()));

    // Check for feedback text
    expect(find.text('We would love to hear your feedback!'), findsOneWidget);

    // Check for text field
    expect(find.byType(TextField), findsOneWidget);

    // Check for 'Submit Feedback' button
    expect(find.widgetWithText(ElevatedButton, 'Submit Feedback'), findsOneWidget);

    // Check for 'End trip!' button
    expect(find.widgetWithText(ElevatedButton, 'End trip!'), findsOneWidget);

    // Test navigation on button press
    await tester.tap(find.widgetWithText(ElevatedButton, 'End trip!'));
    await tester.pumpAndSettle();
```

```
(base) rimsharizvi@Rimshas-MBP pothole_detection_system % flutter test test/feedback_test.dart
00:05 +1: All tests passed!
(base) rimsharizvi@Rimshas-MBP pothole_detection_system %
```

Unit Testing

Successfully Tested:

Firebase using mock data



```dart
import 'package:flutter/material.dart';
import 'package:flutter_test/flutter_test.dart';
import 'package:cloud_firestore/cloud_firestore.dart';
import 'package:mockito/mockito.dart';
import 'package:pothole_detection_system/leaderboard.dart';

class MockFirestore extends Mock implements FirebaseFirestore {}
class MockQuerySnapshot extends Mock implements QuerySnapshot<Map<String, dynamic>> {}
class MockQueryDocumentSnapshot extends Mock implements QueryDocumentSnapshot<Map<String, dynamic>> {}
class MockCollectionReference extends Mock implements CollectionReference<Map<String, dynamic>> {}

void main() {
  group('LeaderboardPage Tests', () {
    // Mock instances
    late MockFirestore mockFirestore;
    late MockQuerySnapshot mockQuerySnapshot;
    late MockCollectionReference mockCollectionReference;

    setUp(() {
      // Initialize mock instances
      mockFirestore = MockFirestore();
      mockQuerySnapshot = MockQuerySnapshot();
      mockCollectionReference = MockCollectionReference();

      // Create a list of mock documents
      List<MockQueryDocumentSnapshot> docs = List.generate(
          3,
              (index) => MockQueryDocumentSnapshot()
      );  // List.generate

      // Stubbing the behavior of Firestore
```

```
(base) rimsharizvi@Rimshas-MBP pothole_detection_system % flutter test test/leaderboard_test.dart
00:08 +1: All tests passed!
(base) rimsharizvi@Rimshas-MBP pothole_detection_system %
```

User Features

Get directions to location

User

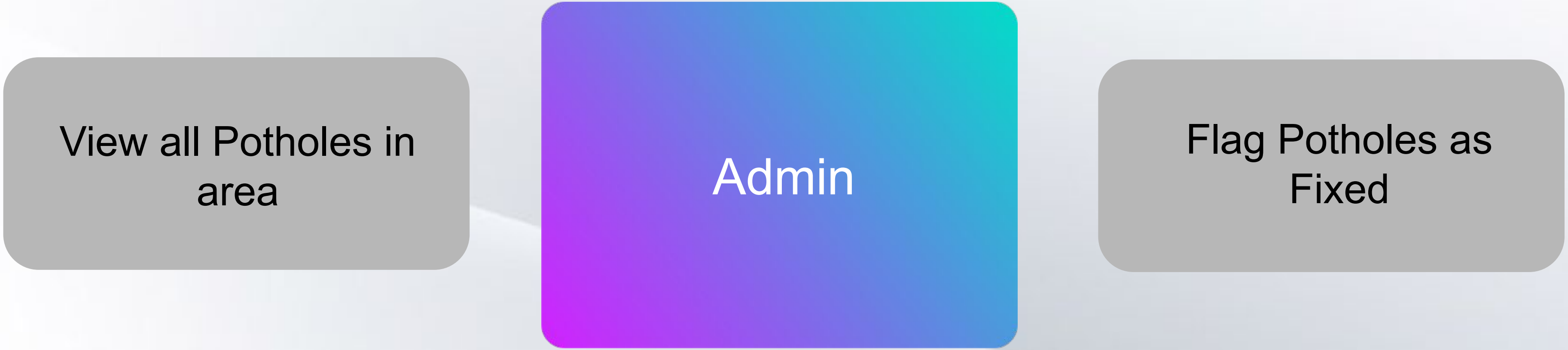
Flag Potholes as fixed

Report Potholes

Participate in leaderboard

Get travel information (ie. distance, time)

User Features



View all Potholes in area

Admin

Flag Potholes as Fixed

Thank you.

References (News Articles):

https://www.huesmanjonesandmiles.com/2022/05/potholes-cause-serious-car-accidents-injuries/#:~:text=Each%20year%2C%20almost%20one%2Dthird,and%20interstate%20highways%2C%20causing%20problems.

https://abc7chicago.com/city-of-chicago-pothole-claim-potholes-report-damage/12954160/

https://quotewizard.com/news/pothole-damage-costs-us-drivers-3-billion-dollars-per-year