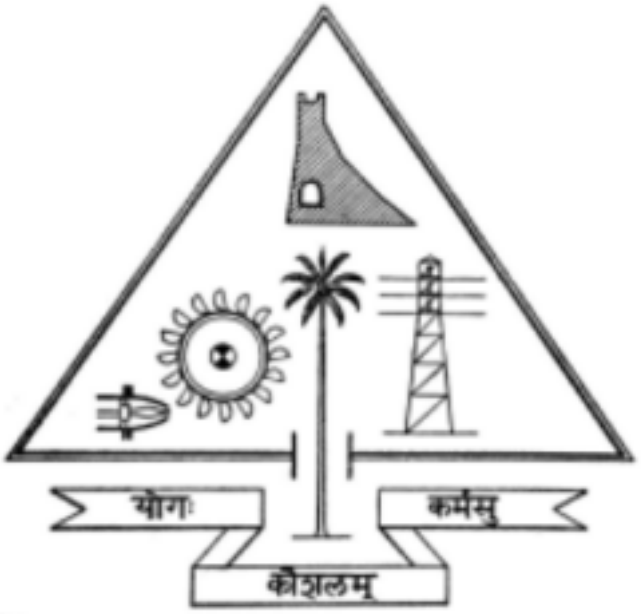
Software Requirements Specification
for
Pothole Detection Using IoT Devices
Government Engineering College, Thrissur



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1 Introduction

1.1 Purpose

The purpose of the software requirements specification (SRS) document for pothole detection using IoT is to clearly define the requirements and specifications for the development of a system that can be used to identify and track potholes in real-time. The SRS document serves as a blueprint for the development team, stakeholders, and project managers to understand the functional and non-functional requirements, constraints, and performance criteria of the system. The document aims to ensure that the pothole detection system is designed, developed, and implemented according to the requirements of the users and stakeholders, complies with legal and regulatory requirements, and is technically feasible and cost-effective. Additionally, the SRS document serves as a basis for testing and validation of the system's functionality and performance, ensuring that the final product meets the expectations and requirements
of all stakeholders involved in the pothole detection process.

1.2 Scope

The application is intended to enhance road safety and reduce the risk of accidents caused by potholes. The mobile application will issue audible alerts to drivers when they are approaching severe or potentially hazardous potholes. These alerts are intended to improve driver awareness and prompt them to take necessary precautions, potentially preventing accidents and damage to vehicles. The application will maintain an up-to-date map of pothole locations. Users can access this map at any time to view the distribution of potholes nearby. This feature empowers users with valuable information about road conditions.

Term	Definition
SRS	Software Requirements Specification
Stakeholder	Any person who is interested in the project
User	The reviewer of the product or target audience.

1.3 Document Conventions and Acronyms
1.4 References

1. Deep Learning Model for Pothole Detection and Area Computation | 2021 | Surekha Arja/pure D.R.Kalbande
2. Pothole Detection Based On Accelerometer Method | 2022 | Sreelakshmi Girisan N. V. Swetha
3. Pothole Detection using CNN and YOLO v7 Algorithm | 2022 | Tarun Kumar Reddy Rajaram V
4. Sensor-based espial of potholes and humps on roads with instant notification alert using IoT | 2022 | G.Prakash Raadha S Tanu Swami
5. Accelerometer Sensor Network For Reliable Pothole Detection | IEEE | 2021 5th ISMSIT https://ieeexplore.ieee.org/document/9604743

1.5 Overview

This SRS document describes a pothole detection application using IoT devices. The application will be used to detect and report potholes in real-time, helping to improve road safety and reduce vehicle damage. The application will consist of three main components:

IoT devices: These devices will be deployed on vehicles and will be responsible for collecting data about the road surface

Cloud server: The cloud server will store the data collected by the IoT devices and will be used to analyze the data and detect potholes,

Mobile app: The mobile app will be used by users to view the location of potholes and to receive alerts when a pothole is detected near their current location.

2 Overall Description

2.1 User Interfaces

The user interface (UI) of the Pothole Detection Application using IoT devices is the mobile app that users will interact with. The UI should be simple and user-friendly, allowing users to access the information and features they need easily.

Here are some of the key features that the UI should include:

- A map of the user's current location and the location of all nearby potholes.
- The ability to zoom in and out of the map.
- The ability to filter the map to show only potholes of a certain size or severity.
- The ability to set up alerts so that users are notified when a pothole is detected near their current location or a location of their choice.
- The ability to report new potholes.

- The ability to view a history of all potholes that have been reported.
- The UI should also be visually appealing and easy to navigate. The use of clear and concise labels, icons, and other visual elements can help to make the UI more user-friendly.

Here are some additional considerations for the design of the UI:

1. The UI should be accessible to users with disabilities. This means that the UI should be designed in a way that allows users to interact with it using a variety of input devices, such as a keyboard, mouse, or touchscreen.
2. The UI should be localized for different languages and cultures. This means that the UI should be translated into different languages and should be designed in a way that is culturally appropriate.
3. The UI should be regularly updated to reflect new features and improvements. 4. By following these considerations, the UI of the Pothole Detection Application using IoT devices can be designed to be both user-friendly and effective.

2.1 Software Interfaces

Frontend

Mobile app:
Native mobile apps can be developed using frameworks such as Flutter, React Native, and Xamarin.

Web app:
Web apps can be developed using frameworks such as React, Angular, and Vue.js.

Backend

Cloud computing:
Cloud computing platforms such as AWS, Azure, and GCP can be used to host the backend of the application.

Big data:
Big data technologies such as Hadoop, Spark, and Hive can be used to store and analyze the large amount of data that is collected from the IoT devices.

Machine learning:
Machine learning frameworks such as TensorFlow, PyTorch, and scikit-learn can be used to develop algorithms to detect potholes in the data.

The specific technologies that are used will depend on the specific needs of the application. For example, if the application needs to be able to support a large number of concurrent users, then a cloud computing platform would be a good choice for the backend. If the application needs to be able to process a large amount of data quickly, then big data technology would be a good choice for the backend.

2.2 Product Functions

The product functions of a pothole detection application using IoT devices are to:

2.2.1 Real-time pothole detection

The system should be able to detect potholes from a threshold number of vehicles and send that data to the server.

2.2.2 Alerts for when a pothole is approached

Drivers can receive alerts as audible beeps on their smartphones when they are approaching a pothole. This allows them to take evasive action to avoid the pothole.

2.2.3 Continuous Pothole Mapping

The feature maintains an up-to-date map of pothole locations. Users can access this map at any time to view the distribution of potholes nearby. This feature empowers users with valuable information about road conditions.

2.24 Route Recommendations

Recommendations of routes will be given after

2.3 User Characteristics

Road authorities: Road authorities are responsible for the maintenance and repair of roads. They can use the pothole detection application to:

- Identify and prioritize potholes for repair
- Track the effectiveness of their road maintenance programs
- Collect data on the location, size, and severity of potholes over time to identify areas where roads are in need of repair

Drivers: Drivers can use the pothole detection application to:

- Avoid potholes and protect their vehicles from damage
- Improve their driving experience by planning their route to avoid potholes
- Receive alerts about potholes in real-time

In addition to these two main groups of users, the pothole detection application using IoT devices can also be used by other users, such as cyclists, pedestrians, and insurance companies.

Other users: Cyclists and pedestrians can use the pothole detection application to identify safe paths to walk or run. Insurance companies can use the data collected by the system to assess the risk of potholes in different areas. This information can be used to set insurance rates and provide discounts to drivers who live in areas with fewer potholes

2.4 Constraints

The pothole detection application using IoT devices is a complex system with a number of constraints, including:

1. Cost
2. Power consumption
3. Communication
4. Security
5. Accuracy

These constraints can be mitigated by using low-cost IoT devices, developing efficient algorithms, using energy-efficient components, using a variety of communication protocols, and using encryption and other security measures.

Overall, the pothole detection application using IoT devices has the potential to make a significant impact on road safety and vehicle maintenance by providing real-time information about the location of potholes

Other constraints include:

- Potential false information if a gutter is repaired (at least for the first few threshold vehicles)
- The accuracy of the GPS is not perfect, so there may be some errors in the location of the potholes

2.5 Assumptions and Dependencies

Assumptions:

1. The IoT devices can accurately collect data about the road surface.
2. The cloud server can process the data collected by the IoT devices in real time.

Dependencies:

1. IoT devices
2. Cloud server

3 Specific Requirements

3.1 Functional Requirement Specification

3.1.1 Pothole Detection

Use case name: Pothole Detection
Objective: To detect potholes in real-time and alert drivers to their presence.
Priority: High

Precondition: The IoT modules are installed in vehicles and are connected to the app.
Postconditions:

- Drivers are alerted to the presence of potholes in real-time.
- A map of potholes is generated and updated in real-time.

Flow of Events:

1. Basic Flow:
    1. The IoT modules collect data about potholes and send it to the app.
    2. The app analyzes the data and determines if a pothole is present.
    3. If a pothole is present, the app alerts the driver.
    4. The app updates the map of potholes.
2. Alternate Flow 1:
    1. If the IoT modules are not connected to the app, the app will not be able to detect potholes or alert drivers to their presence.

3.1.2 Pothole Reporting

Use case name: Pothole Reporting

Objective: To allow users to report potholes to road authorities.
Priority: Medium

Precondition: The user is logged into the app.

Postconditions:

- The pothole report is submitted to the road authorities.
- The user is notified that the pothole report has been submitted.

Flow of Events:

1. Basic Flow:
    1. The user selects the "Report Pothole" option from the app.
    2. The user enters the location of the pothole and any other relevant information.
    3. The user submits the pothole report.
    4. The app sends the pothole report to the road authorities.
    5. The user is notified that the pothole report has been submitted.
2. Alternate Flow 1:
    1. If the user is not logged into the app, they will not be able to report potholes.

3.2 Non-functional Requirements

3.2.1 Performance Requirements

1. The mobile application should be able to handle multiple user requests.
2. The response time of the application should be reasonable and should not exceed a threshold.

3.2.2 Portability

1. The system should be used in a wide range of different scenarios like city roads, rural roads highways, etc.

3.2.3 Security Requirements

1. Users are required to authenticate themselves before using the application.

3.2.4 Reliability

1. The system should be reliable and should not experience frequent outages or errors.
2. It should work with reasonable accuracy.

3.2.5 Maintainability

1. The system should be easy to maintain and update.

3.2.6 Availability

1. The system should be in working condition and run while the vehicle is turned on.