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SiliconSahaaya: An AI-Powered Smart Civic Grievance Management System

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Abstract: ***Rapid urbanization has significantly increased civic issues such as garbage overflow, potholes, drainage blockage, water leakage, broken streetlights, and road damage. Existing grievance management systems often suffer from poor complaint routing, delayed response mechanisms, lack of transparency, and dependency on manual department selection. These challenges reduce citizen satisfaction and create inefficiencies in public administration. To address these limitations, SiliconSahaaya, an AI-powered smart civic grievance management system, is proposed to automate the process of civic issue reporting and complaint resolution. The system enables citizens to register complaints through image uploads, GPS-based location detection, and mobile-friendly interfaces. By integrating Artificial Intelligence and Machine Learning techniques such as XGBoost, TF-IDF with Logistic Regression, TextBlob/VADER sentiment analysis, and YOLOv8 object detection, the platform intelligently analyzes complaints, predicts issue priority, categorizes civic problems, and automatically routes grievances to the relevant government departments. The proposed system also includes a React Native mobile application, real-time notifications using Firebase Cloud Messaging, SMS services through Twilio, email notifications using Nodemailer, and secure authentication using JWT and OTP verification. Furthermore, the platform integrates Leaflet.js-based geographic hotspot detection, enabling authorities to identify frequently affected areas and make data-driven urban planning decisions. SiliconSahaaya improves grievance resolution efficiency, reduces manual intervention, enhances transparency, and promotes smarter civic governance through AI-driven automation.***

Keywords: ***Smart Governance, Civic Grievance System, Artificial Intelligence, XGBoost, YOLOv8, Sentiment Analysis, Smart Cities, Complaint Classification, GPS Tracking, Civic Analytics. Verification, Supabase, Android WebView, Web Application, IoT.***

I. INTRODUCTION

1.1 Overview

The increasing urban population and expanding city infrastructure have led to a rise in civic problems requiring immediate attention. Issues such as road damage, overflowing waste, water leakage, broken streetlights, drainage blockages, and sanitation failures negatively affect citizens' quality of life. Although many municipal grievance systems exist, most platforms remain inefficient due to poor complaint categorization, delayed responses, lack of transparency, and confusing interfaces.

Traditional grievance platforms often require citizens to manually select the responsible government department while filing complaints. Since most citizens are unaware of departmental structures, complaints are frequently assigned incorrectly, resulting in delays and inefficient issue resolution.

To overcome these challenges, SiliconSahaaya introduces an AI-powered smart civic grievance management system that automates complaint processing and improves citizen-government interaction. Citizens can report issues through a web or mobile platform by uploading issue images, enabling GPS-based location tracking, and submitting complaint descriptions.

The system utilizes advanced machine learning models including XGBoost, TF-IDF with Logistic Regression, and sentiment analysis techniques to intelligently process complaints, predict severity levels, and route grievances automatically to the appropriate authorities. Furthermore, the integration

of YOLOv8 object detection enhances image-based issue recognition for civic problems.

Additionally, SiliconSahaaya provides real-time notifications, interactive dashboards, chatbot assistance, and civic hotspot detection maps to support authorities in identifying frequently occurring issues and improving urban management strategies.

1.2 Objectives

The primary objective of SiliconSahaaya is to create an intelligent civic grievance management platform that simplifies complaint filing and improves issue resolution efficiency.

The major objectives are:

- To develop a user-friendly platform for reporting civic issues.
- To automate complaint categorization using AI and machine learning techniques.
- To implement image-based civic issue detection using YOLOv8 and OpenCV.
- To capture accurate complaint locations through GPS integration.
- To identify civic issue hotspots using geographic mapping and analytics.
- To improve transparency and citizen engagement in public governance

II. LITERATURE SURVEY

The development of smart governance systems has gained considerable attention due to increasing urbanization and the growing need for efficient civic administration. Existing civic grievance systems frequently experience challenges such as delayed complaint handling, poor transparency, and inefficient complaint categorization.

According to the World Bank (2024), digital governance platforms significantly improve communication between governments and citizens by increasing transparency and reducing administrative inefficiencies. However, conventional grievance systems still lack intelligent automation and predictive analytics.

Research conducted by Chen and Guestrin (2016) demonstrated that XGBoost is highly effective for predictive modeling due to its scalability, speed, and improved accuracy. The algorithm has become widely adopted in real-world classification and regression applications.

Similarly, studies on Natural Language Processing (NLP) show that TF-IDF and Logistic Regression models are highly efficient for text classification tasks, particularly in categorizing textual complaints into predefined issue categories. Dr. J. Narendra Babu [7][8][9] explored IoT applications in smart systems and emphasized combining embedded hardware with cloud connectivity for scalable IoT solutions

Sentiment analysis using TextBlob and VADER has been extensively applied to analyze user emotions and urgency levels in citizen feedback systems. These techniques help prioritize complaints requiring immediate attention.

Recent advancements in computer vision technologies such as YOLOv8 have enabled real-time object detection with improved accuracy. Such technologies can support image-based civic issue recognition for potholes, garbage accumulation, road damage, and infrastructure failures.

Furthermore, geographic information systems and mapping frameworks such as Leaflet.js have been increasingly used for hotspot detection, helping city authorities identify recurring civic issues geographically.

SiliconSahaaya integrates these technologies into a unified platform for intelligent civic grievance management and smart governance.

III. PROPOSED METHODOLOGY

3.1 System Architecture

SiliconSahaaya follows a modular and scalable system architecture designed to simplify civic issue reporting and improve grievance resolution efficiency. The platform combines web technologies, mobile application support, Artificial Intelligence,

Machine Learning, IoT-based inputs, and geographic analytics to build an intelligent public grievance ecosystem.

The architecture of the proposed system consists of the following major layers:
1. Presentation Layer
The presentation layer acts as the interface between users and the system. It includes:
Web Application: Developed using React.js and Tailwind CSS for responsive user interaction.
Mobile Application: Built using React Native, enabling citizens to register complaints directly through smartphones.

This layer allows users to:
1. Submit complaints
2.Upload issue images
3.Capture GPS location
4.Track complaint status

2. API and Backend Layer
The backend layer is responsible for handling business logic and communication between modules.
Technologies used:
1.Node.js
2.Express.js REST API
Responsibilities include:
1.Complaint management
2.User authentication
3.Department assignment
4.Notification management
5. Data processing
6.Secure API communication

1. Database Layer
The system stores complaint details, user information, geographic locations, complaint status, and historical issue records in PostgreSQL.

The database supports:
1. Complaint history
2. User management
3.Department allocation
4.Status tracking
5.Geographic analytics

4. Artificial Intelligence Layer
This is the core intelligence component of SiliconSahaaya.
The AI layer includes:
XGBoost Model

Used for:
1.Complaint priority prediction
2.Smart grievance routing
3.Severity estimation
TF-IDF + Logistic Regression

Used for:
1.Complaint text classification
2.Automatic issue categorization
YOLOv8 + OpenCV

Used for:
1.Image-based issue recognition
2.Detecting potholes, garbage, drainage problems, damaged roads
5. Geographic Analytics Layer
The platform uses Leaflet.js for map visualization and hotspot detection.

Functions include:
1.GPS-based issue tracking
2.Civic issue heatmaps
6. Notification Layer
Citizens receive updates through:
1.Nodemailer Email Notifications
This ensures transparency in grievance resolution.

3.2 Workflow of the Proposed System
The functioning of SiliconSahaaya is divided into intelligent automated steps.
Step 1: User Complaint Registration
The citizen accesses the web or mobile application and submits a complaint by:
1.Entering issue description
2.Uploading an image3.Allowing GPS access

Step 2: Image and Data Processing
The uploaded complaint image is analyzed using YOLOv8 object detection and OpenCV to recognize civic problems.

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Examples:
1.Garbage overflow
2.Potholes
3.Broken streetlights
4.Water leakage
5.Illegal dumping

Step 3: Complaint Classification
Complaint text is processed using:
TF-IDF + Logistic Regression
to determine:
1.Complaint category
2.Relevant department
3.Type of issue

Step 4: Sentiment Analysis
The complaint description undergoes analysis through:
1.TextBlob
2.VADER
This determines:
1.Citizen urgency
2.Emotional severity
3.Complaint seriousness

Step 5: Priority Prediction
The XGBoost model predicts complaint priority levels such as:
1.High Priority
2.Medium Priority
3.Low Priority
based on:
1.Complaint type
2.Severity
3.Sentiment score
4.Historical issue data

Step 6: Automatic Department Assignment
The complaint is automatically assigned to the correct civic authority without requiring manual department selection.

Step 7: Notifications
Status updates are delivered through:
1.Mobile push notifications
2.SMS alerts3.Email notifications

Step 8: Civic Hotspot Detection
Repeated complaints from the same region are analyzed to identify civic hotspots using map-based clustering.
Authorities can use this data for:
1.Infrastructure planning
2.Preventive maintenance
3.Smart city governance

3.3 Tech Stack Architecture

SiliconSahaaya integrates multiple technologies to provide a robust and scalable platform.

Frontend Technologies
1.React.js for dynamic web interfaces
2.Tailwind CSS for responsive UI design
3.Leaflet.js for geographic mapping

Backend Technologies
1.Node.js runtime environment
2.Express.js REST API for server-side operations

Artificial Intelligence & Machine Learning
1.Python
2.XGBoost
3.Scikit-learn
4.TF-IDF
5.Logistic Regression6.TextBlob

Computer Vision
1.YOLOv8
2.OpenCV

Mobile Application
1.React Native
2.Camera Integration
3.GPS Services

Authentication
1.OTP Verification using Twilio
2.JWT Token-based Authentication
Report Generation
Puppeteer PDF Generation

Data Visualization
1.R Programming
2.ggplot2

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3.Plumber API

3.4 Modules Description
Authentication Module
Provides secure OTP-based login using JWT authentication.
Complaint Registration Module
Allows citizens to file complaints using text, images, and GPS location.
Image Analysis Module
Processes complaint images using OpenCV and YOLOv8.
AI Classification Module
Categorizes complaint type automatically.
Priority Prediction Module
Uses XGBoost to assign complaint severity.
Sentiment Analysis Module
Determines urgency from complaint text.
Department Routing Module
Assigns complaints automatically to appropriate authorities.
Notification Module
Sends real-time alerts to citizens.
Hotspot Detection Module
Identifies repeated civic issues geographically.
Dashboard Module
Provides analytics and monitoring for administrators.
Chatbot Module
Helps citizens navigate the complaint filing process

IV. RESULTS

The integration of AI-enabled complaint processing minimized incorrect complaint routing and improved classification efficiency. The automated department assignment feature reduced citizen dependency on manual department selection.

The use of YOLOv8 object detection improved issue recognition accuracy for image-based complaints. Similarly, sentiment analysis enhanced complaint prioritization by identifying emotionally urgent grievances.

The Leaflet.js hotspot detection system enabled administrators to visualize civic issue-prone regions and identify frequently affected locations.

Key Outcomes Achieved:
1.Faster complaint registration
2.Smart complaint categorization
3.Automatic department assignment
4.Priority prediction using AI
5.Real-time notifications
6.GPS-based issue tracking
7.Civic hotspot identification
8.Improved transparency and citizen engagement

Figure 1: Home Page of SiliconSahaaya

Figure 2: Complaint Registration Interface

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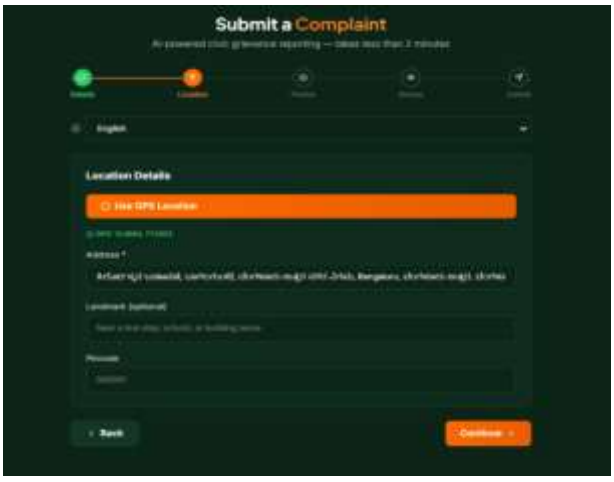
Figure 3: GPS-enabled Issue Detection

Figure 4: Admin Dashboard Analytics



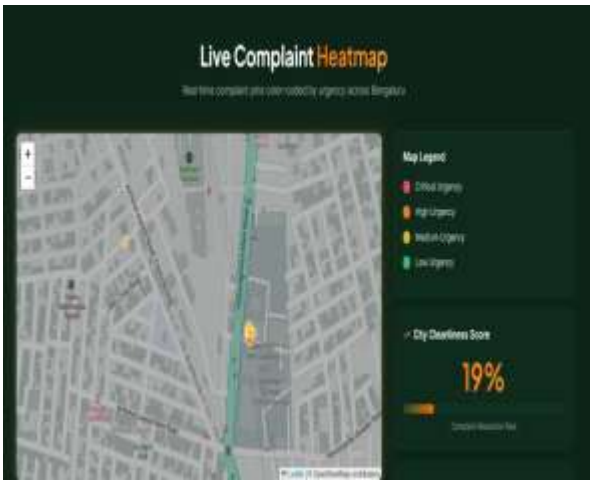
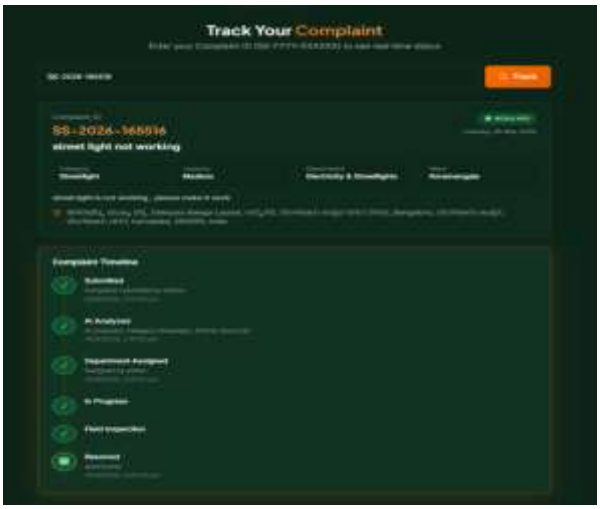


Figure 6: Civic Hotspot Detection MapFigure



7: Complaint Tracking Interface

V. CONCLUSION

SiliconSahaaya introduces an intelligent and scalable civic grievance management platform powered by

Artificial Intelligence, Machine Learning, Computer Vision, and Smart Geographic Analytics. The platform successfully addresses major challenges faced in traditional grievance systems, including incorrect department selection, delayed complaint resolution, lack of transparency, and inefficient complaint prioritization.

By integrating YOLOv8 object detection, XGBoost prediction, TF-IDF-based complaint classification, and sentiment analysis, SiliconSahaaya automates complaint processing and improves civic issue management efficiency.

The implementation of real-time notifications, chatbot assistance, GPS integration, and hotspot detection further strengthens citizen-government communication and supports data-driven governance. The project demonstrates how advanced technologies can be effectively utilized for smart governance and urban civic management.

VI. FUTURE SCOPE

Future improvements of SiliconSahaaya may include:

- Cloud deployment for higher scalability
- More advanced deep learning models for improved classification accuracy
- More Regional language support
- Voice-enabled complaint registration
- Blockchain integration for complaint transparency

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