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VISION-AI: VISUAL INTELLIGENCE SYSTEM FOR OPTIMIZED COMPLAINT REGISTRATION AND ASSIGNMENT USING AI

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Abstract:

In today's rapidly evolving technological landscape, the swift and accurate handling of service complaints is crucial for maintaining customer satisfaction and operational effectiveness. Conventional complaint management methods often rely on manual processes that are slow, error-prone, and inefficient. These limitations result in delayed resolutions and poor user experience. To address these challenges, this project presents VISION-AI: Visual Intelligence System for Optimized Complaint Registration and Assignment Using AI, an integrated solution that combines the capabilities of Artificial Intelligence. The VISION-AI system offers a user-friendly complaint submission interface via a Telegram bot, allowing users to register issues using text and images. To reduce manual data entry and minimize human errors, the platform employs Optical Character Recognition (OCR) using Tesseract, which automatically extracts fault codes from submitted images. Complaint data is processed and managed through a Flask-

API and securely stored in a SQLite database, for efficient data retrieval and analysis.. It also incorporates the (MCTS) algorithm to predict the most effective technician. Designed for scalability and future enhancement, planned upgrades to VISION-AI include real-time technician tracking, predictive maintenance, and a fully decentralized complaint resolution process, aiming to deliver a smarter, more robust, and highly responsive service management system.

Keywords : Predictive, Decentralized, Transparency, Traceability, Tamper-Proof Record.

1. INTRODUCTION

User Interface User Experience Machine Learning Comma-Separated Values Database Management System Application Programming Interface Integrated Development Environment Hypertext Transfer Protocol Graphical User Interface JSON WebToken Internet of Things MMIT, Department of Computer Engineering 2024-25 vii VISION-AI: Visual Intelligence System For Optimized Complaint Registration And Assignment Using AI Chapter 1 INTRODUCTION In today's fast-paced, customer-driven world, providing high-quality service is not just a value addition but a core requirement for retaining customers and building brand reputation. As expectations around speed, reliability, and transparency continue to rise, the ability to manage and resolve service complaints efficiently has become a key differentiator for organizations. Failure to address issues quickly often results in negative user experiences, loss of customer trust, and decreased operational productivity. Traditional complaint-handling systems still used in many organizations often involve manual procedures such as phone calls, paperwork, or physical visits to service centers. These outdated methods suffer from various inefficiencies like delayed complaint processing, poor tracking, inconsistent communication, and a lack of real-time data flow. In high-volume environments, such limitations can create significant bottlenecks, making it difficult to resolve issues in a timely and organized manner. To solve these challenges, the proposed system, VISION-AI: Visual Intelligence System for Optimized Complaint Registration and Assignment Using AI, introduces a smart and automated framework for managing service complaints. The goal of the platform is to digitize and streamline the entire complaint lifecycle—from issue registration to technician assignment and resolution—by leveraging the latest advancements in artificial intelligence, automation, and secure record-keeping. The VISION-AI platform features a conversational interface built on Telegram, allowing users to easily raise complaints by submitting descriptive text or images of the problem. This design eliminates the need for users to visit a physical center or navigate complex service portals, thereby improving accessibility and convenience for all users, including those in remote locations. A powerful component of the system is the Optical Character Recognition (OCR) engine powered by Tesseract, which analyzes the uploaded images to extract relevant fault information such as error codes or device identifiers. This automated extraction reduces dependency on manual input, speeds up data processing, and minimizes human error in the early stages of complaint registration. To ensure efficient complaint resolution, VISION-AI integrates an intelligent technician assignment mechanism. This module uses the Haversine Distance Formula to calculate the proximity between the customer and available technicians and applies the Monte Carlo Tree Search (MCTS) algorithm to predict the most suitable technician based on success probability, skill set, and workload balance. This targeted approach ensures that complaints are handled by the right personnel in the shortest possible time.

2. LITERATURE SURVEY:

Paper I:

AI-Powered Chatbots: Transforming Customer Service in 2025

This study discusses the advancements and future impact of AI-powered chatbots on customer service. It highlights how these intelligent agents provide scalable, personalized, and efficient support around the clock, significantly reducing human workload. AI chatbots are capable of handling large volumes of queries by understanding contextual information, which allows for instant and consistent responses. The paper predicts widespread adoption of AI chatbots across various industries by 2025, driven by their ability to enhance the overall customer experience through faster resolution times and continuous availability. Additionally, the study emphasizes the evolving sophistication of natural language processing and machine learning technique.

Paper II:

AI-Powered Technician Assignment Optimization in Smart Appliance Service Networks in 2025

This research focuses on optimizing field technician allocation through artificial intelligence in the context of smart appliance servicing. It proposes a model that considers real-time parameters such as technician availability, skill set, service history, and geographic proximity. The AI system dynamically assigns the most suitable technician to a customer complaint by analyzing both historical performance data and real-time system inputs. The study introduces a predictive scoring system that ensures each complaint is resolved by a technician with the highest estimated success rate. The model significantly reduces idle technician time and delays in service scheduling. It also integrates feedback loops for improving assignment accuracy over time. This paper provides critical foundational logic for systems like VISION-AI, where intelligent technician routing plays a central role in reducing downtime and enhancing operational efficiency in customer service environments. processing and machine learning technique.

Paper III:

OCR-based Automated Service Complaint System in 2024

The research focuses on the application of Optical Character Recognition (OCR) technology to automate the registration of service complaints in appliance maintenance. By extracting error codes and relevant information directly from images submitted by users, the system reduces the need for manual data entry, accelerates complaint logging, and streamlines the overall service workflow. This approach is particularly valuable for smart maintenance systems, enabling faster and more accurate identification of appliance faults and expediting the initiation of repair processes.

Paper IV:

AI integrated IoT framework for Real-time Complaint Resolution in Smart Appliances in 2024

This paper proposes a comprehensive framework that integrates Internet of Things (IoT) devices with artificial intelligence to facilitate real-time resolution of service complaints in smart appliances. IoT sensors continuously monitor appliance operations and transmit data to an AI analytics engine, which detects faults automatically. The system then assigns technicians optimally based on the nature of the fault and technician availability. This framework reduces human intervention in routine tasks, accelerates fault detection and repair, and improves resource allocation efficiency, thereby enhancing service quality and customer satisfaction.

Paper V:

Monte Carlo Simulations for Technician Assignment Optimization in Smart Appliance Service Networks in 2024

The study explores the use of Monte Carlo simulations to address uncertainty in technician assignment within service operations. By leveraging historical and real-time data, the simulation generates probabilistic models that help predict service demand and optimize technician dispatch decisions under variable conditions. This approach enhances the accuracy of assignments, reduces delays, and improves overall efficiency in service networks. The paper highlights the value of simulation techniques in complementing AI-driven scheduling algorithms for operational excellence. The authors of this paper introduce a Monte Carlo simulation-based approach to optimize technician assignment in dynamic service environments. The model evaluates thousands of possible technician-customer combinations, simulating different performance outcomes based on historical data, time constraints, distance, and technician ratings. By aggregating the results, the system identifies technicians with the highest probability of successfully completing the task within defined parameters. The paper details how the use of Monte Carlo Tree Search (MCTS) improves decision-making in uncertain, real-time scenarios. It further explores how simulation depth and branching factor affect accuracy and execution time. This probabilistic method is especially beneficial for AI systems dealing with multi-variable optimization problems, such as the VISION-AI platform, where it helps automate technician selection and improve service effectiveness under variable field conditions.

Paper VI:

AI-Powerd Technician Assignment Optimization in Smart Appliance Service Networks in 2024

Building upon previous research, this paper further develops AI techniques for technician assignment by focusing on integrating both historical patterns and real-time operational inputs. The machine learning algorithms utilized are tailored to respond dynamically to changing service environments, enhancing system responsiveness and technician success rates. The solution demonstrates significant improvements in service delivery times and customer satisfaction by continuously learning from new data and adjusting assignment strategies accordingly.

This study reaffirms the importance of artificial intelligence in service technician scheduling and task prioritization. It proposes an intelligent system that evaluates multiple factors including technician skills, availability, proximity to the customer, and prior job completion success. By assigning a dynamic score to each technician based on these variables, the model ensures that the right technician is assigned to the right task at the right time. The paper also introduces adaptive learning techniques to improve decision accuracy over time. The researchers validate their model using datasets from real-world service logs and demonstrate improved task completion rates and reduced travel times. This paper is particularly relevant to the assignment module of VISION-AI, as it supports the concept of combining predictive analytics with real-time input for smarter, context-aware service delivery.

3. PROPOSED SYSTEM

3.1. Architecture Diagram:

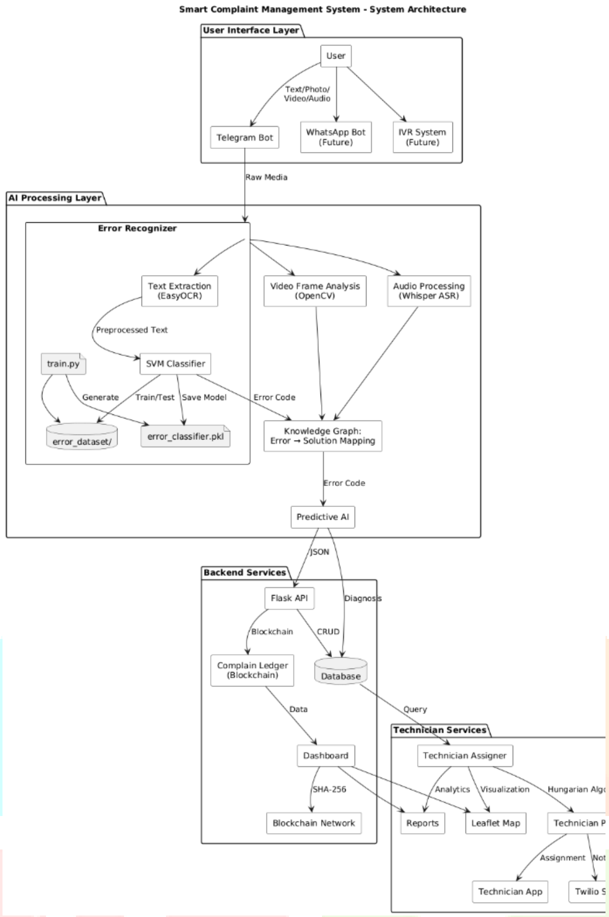

Diagram 3.1 System architecture of VISION-AI

3.2. Module Description:

User Interface layer:

The User Interface Layer serves as the front-end communication point between the end user and the system. In the current implementation of VISION-AI, users register complaints primarily through a Telegram Bot, which acts as a conversational interface. This bot allows customers to describe their issue, provide contact information, and upload supporting media such as images or videos showing error codes from malfunctioning appliances. The system is designed to be modular and extensible; hence, future enhancements will include integration with other platforms such as WhatsApp Bots and Interactive Voice Response (IVR) systems. These additional channels will broaden

AI Processing Layer:

At the core of the system lies the AI Processing Layer, which intelligently analyses the complaint data submitted by the user. The process begins with an Error Recognizer module, which interprets input media to detect appliance faults. If a video is uploaded, the system utilizes OpenCV for frame-by-frame extraction and visual analysis. In case of audio inputs (planned for future IVR integration), Whisper ASR, a state-of-the-art speech-to-text engine, will transcribe the audio into actionable text. For images, the system employs EasyOCR to extract appliance error codes or on-screen diagnostic information. These extracted codes are then matched to a predefined Knowledge Graph, which maps known error codes to potential faults and suggested solutions. The output of this AI processing is further passed to the Predictive AI module, which uses algorithms such as Monte Carlo Tree Search (MCTS) to estimate the best technician to resolve the issue, based on historical performance, success rate, and proximity.

Backend Layer:

The Backend Layer manages server-side logic, data storage, secure communication, and system coordination. A Flask API acts as the central controller, processing HTTP requests from the Telegram bot and the dashboard, and routing them appropriately. All structured complaint data—such as chat ID, user message, extracted error code, assigned technician, and timestamps—is securely stored in an SQLite database. To ensure tamper-proof logging, a blockchain-inspired ledger is used, where each complaint is hashed and linked in a chain-like structure. This feature brings transparency and auditability to complaint tracking. The

Dashboard, developed using Flask and Bootstrap, allows service administrators to view and manage real-time complaint data, technician allocation, and service analytics. The architecture also supports future extension into a decentralized blockchain network, should a need arise for public, distributed consensus-based auditing.

Technician Layer:

Technician Layer governs the intelligent allocation and real-time management of field technicians. The Technician Assigner component, in collaboration with the Predictive AI, evaluates which technician is best suited for a given task. Factors like geographical distance, availability status, efficiency score, and success probability (predicted using MCTS) are considered in assignment. A pool of technician profiles is maintained in the Technician Pool, which includes their contact information, service area, and past performance records. The Leaflet Map module helps visually plot both technicians and complaints, enabling administrators to view service coverage and dispatch efficiently. Additionally, modules like the Technician App (optional) and Twilio SMS notifications (planned) are included in the design to enhance communication, allowing field technicians to receive updates, confirmations, or changes via mobile or SMS. These components ensure faster resolution times and a better-managed workforce.

4.MATHEMATICAL MODEL:

The mathematical model for the proposed system **VISION-AI** is designed to represent its functional flow from complaint registration to technician assignment using AI prediction and secure logging. Let the system be represented as a 5-tuple:.

$$S=\{I,P,D,A,O\}$$

Where:

I = Set of inputs

P = Pre-processing operations

D = Decision logic (Technician assignment)

A = Audit & logging module

O = Set of outputs

Input Set (I):

$$I=\{i1,i2,i3,i4\}$$

Where:

i1: Complaint text description

i2: Uploaded media (image or video)

i3: Location data

i4: Customer contact information

4.1. Pre-processing (P):

image/video is passed to:

OCR module (EasyOCR/Tesseract): Extract error code

Video frame analysis (OpenCV): If video uploaded

Whisper ASR (optional): For audio inputs (future)

$$focr(i2)=error\_code$$

4.2. Technician Assignment Logic(T):

Let,

$$T=\{t1,t2\}$$

Where:

t1=Haversine Distance Calculation

t2=MCTS for Technician Prediction

$$\text{Distance}(lat_1, lon_1, lat_2, lon_2) = 2r \cdot \arcsin\left(\sqrt{\sin^2\left(\frac{\Delta\phi}{2}\right) + \cos(\phi_1)\cdot\cos(\phi_2)\cdot\sin^2\left(\frac{\Delta\lambda}{2}\right)}\right)$$

MCTS prediction output:

P_{sucess}(technician)=

Estimated success rate

4.3 Audit Logging using Blockchain:

Each complaint record is hashed:

$$h_n = SHA256(data_n + h_n - 1)$$

Where:

h_n = Current hash

$data_n$ =Complaint details at transaction n

h_{n-1} = Hash of previous record

This forms an immutable chain:

$$A=\{h1,h2,...,hn\}$$

4.4 Output Set:

$$O=\{o1,o2,o3\}$$

Where:

o1: Complaint ticket ID

o2: Assigned technician and ETA

o3: Blockchain reference ID

4.4 Success Condition:

A complaint is successfully registered:

OCR extracts a valid code:

Technician with $P_{success}>0.6$

Distance < threshold

This mathematical model aligns with your system's modular architecture and includes AI prediction, geolocation, OCR, and blockchain hash chaining, as per your provided architecture and implementation.

This model supports the real-world implementation of AI-assisted complaint routing and secure transaction logging, forming the mathematical backbone of the VISION-AI platform.

5. EXPECTED OUTPUT:

The proposed system, VISION-AI: Visual Intelligence System for Optimized Complaint Registration and Assignment using AI, is expected to generate intelligent, real-time, and secure outputs for complaint registration and technician dispatch. Upon initiating a complaint through the Telegram Bot, users will be able to submit a description of the issue along with supporting images or videos. The system will process this media using Optical Character Recognition (OCR) technology to automatically extract error codes or textual messages visible on the appliance screen. These codes will be matched with a predefined fault knowledge base to diagnose the nature of the problem and recommend preliminary solutions, minimizing human intervention and enhancing diagnostic accuracy.

Once the fault has been identified, the system will determine the most suitable technician based on the user's location and historical service performance of available technicians. Using the Haversine formula, the physical distance between the user and each technician is calculated. This data is combined with success rate predictions derived from the Monte Carlo Tree Search (MCTS) algorithm to assign the technician with the highest likelihood of successful and timely resolution. The output will include the technician's name, contact details, efficiency score, and estimated time to service the complaint.

Additionally, the system will log each complaint securely in an SQLite database while simultaneously generating a hashed ledger entry using a blockchain-inspired structure. This ensures that each complaint transaction is immutable, traceable, and auditable for future reference. A unique complaint ID and digital hash will be generated and stored, providing tamper-proof verification of all service requests.

On the administrative side, a Flask-based real-time dashboard will display registered complaints, assigned technicians, their status, and location mapping through Leaflet integration. Administrators will have the ability to monitor complaint flows, technician availability, and system performance in real-time. The output of the system will also support future integration of feedback analysis, predictive maintenance suggestions, and secure public blockchain interoperability.

Overall, the expected outcome is a fully automated, intelligent complaint management system that reduces service delays, enhances fault detection accuracy, improves technician assignment efficiency, and maintains a secure, verifiable trail of complaint records. This system will contribute significantly to reducing downtime, increasing customer satisfaction, and modernizing traditional appliance support workflows through the integration of AI and blockchain technologies.

6. CONCLUSION:

The proposed system, **VISION-AI**, presents an AI-driven, modular, and secure solution for automating the complaint management process in appliance service operations. By integrating a Telegram-based interface with OCR-powered error detection, geolocation-based technician allocation using the Haversine formula, predictive modeling via Monte Carlo Tree Search (MCTS), and blockchain-inspired complaint logging, the system enhances accuracy, transparency, and efficiency. It simplifies user interaction, accelerates fault diagnosis, optimizes technician assignment, and ensures tamper-proof record keeping. The platform is scalable, adaptable for future integration with communication mediums like WhatsApp and IVR, and capable of evolving into a complete intelligent service management.

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