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Real Time Disaster Information Aggregation Software

Mobile Based Intelligent Emergency Monitoring System

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Abstract: Natural disasters like floods, earthquakes, cyclones, landslides, and wildfires seriously harm infrastructure and human lives. The lack of integrated, real-time information often causes delays in emergency response and disaster management efforts. In order to collect, evaluate, and present disaster-related data from a range of sources, such as news feeds, social media, government APIs, Internet of Things sensors, and satellite data, this study proposes a Real Time Disaster Information Aggregation Software. The system uses data aggregation techniques and machine learning algorithms to filter, classify, and prioritize disaster notifications. The proposed tool provides risk analysis, real-time notifications, and interactive map visualization to assist communities, emergency response teams, and law enforcement. The technology enhances situational awareness and speeds up decision-making in an emergency.

Index Terms **- Disaster Management, Real-Time Monitoring, Emergency Response.**

I. INTRODUCTION

The frequency and intensity of disasters, which are unanticipated catastrophic events that severely disrupt communities and inflict a substantial loss of life and property, have grown recently as a result of growing urbanization and climate change. Traditional crisis management systems mostly rely on human reporting and fragmented information sources, which frequently results in delayed response times, while individuals rely on news channels and social media platforms where the information may be scattered, partial, or unconfirmed. Real-time catastrophe information aggregation systems provide a solution to this issue by bringing together data from multiple reliable sources onto a unified platform. Disaster-related data can be gathered, processed, examined, and visualized in real time by using cloud computing, application programming interfaces (APIs), geographic information systems (GIS), and machine learning techniques. In order to improve emergency response and situational awareness, this project focuses on creating a centralized online and mobile-based system that provides users with real-time, location-based notifications and displays disaster alerts via an interactive map interface.

II. PURPOSE

The main purpose of developing Real Time Disaster Information Aggregation Software is:

- To collect disaster-related information from multiple sources in real time.
- To verify and classify disaster data using machine learning techniques.
- To provide live alerts and map-based visualization.
- To help government agencies and emergency responders act quickly.
- To reduce misinformation and improve disaster awareness.

The system ensures that users receive accurate, verified, and location-specific disaster alerts.

III. SCOPE

Official weather services and government disaster management APIs will be integrated as part of the project's scope to collect accurate and current data on floods, earthquakes, cyclones, fires, and other disasters. To identify, screen, and classify posts related to disasters and remove irrelevant or misleading content, the system incorporates social media data analysis using Natural Language Processing (NLP) methods. Users can view disaster sites, impacted areas, and risk ratings on an interactive interface by using real-time map visualization provided by platforms such as OpenStreetMap or Google Maps.

IV. EXISTING SYSTEM

At the moment, a variety of sources, including news websites, government portals, social media platforms, and weather applications, provide information about disasters. These platforms offer crucial updates, but because they are uncoordinated and run separately, the information is dispersed and fragmented over several channels.

V. PROPOSED SYSTEM

The proposed Real Time Disaster Information Aggregation Software consists of the following modules:

1. **Data Collection Module**

- Collects data from APIs (Weather API, Disaster Management APIs).
- Scrapes verified news sources.
- Collects social media posts using keyword filtering.

2. **Data Processing & Filtering Module**

- Removes duplicate information.
- Filters fake or irrelevant posts.

3. **Alert & Notification Module**

- Sends real-time alerts to users.
- Location-based notification system.
- Emergency contact integration.

4. **Visualization Module**

- Interactive disaster map.
- Color-coded risk levels.
- Heatmap representation for affected areas.

VI. SYSTEM ARCHITECTURE

- Data Sources (APIs, Social Media, Sensors)
- Data Processing Engine
- Database (Firebase)
- User Interface (Mobile App)

VII. ADVANTAGES

The recommended Real Time Disaster Information Aggregation Software has numerous advantages for improving disaster awareness, response efficiency, and information reliability. One major benefit is that it aggregates data in real-time from many trustworthy sources, such as government portals, weather APIs, and verified digital platforms. This ensures that in an emergency, clients receive accurate and up-to-date information. By consolidating disaster-related data into a single, consistent interface, as opposed to typical systems where information is scattered across several platforms, this technology eliminates confusion and saves critical time. When a crisis occurs nearby, users can receive location-based warnings thanks to Firebase Cloud Messaging and the smooth cloud synchronization made possible by the application's Flutter and Firebase construction.. By clearly showing impacted areas, the dynamic map visualization improves situational awareness and aids in decision-making for both citizens and authorities. By using filtering and validation procedures prior to issuing alerts, the system also reduces false information. Scalability, dependability, and safe data storage are guaranteed by the usage of cloud-based infrastructure, and a broad user base may access it thanks to its mobile-friendly design. All things considered, the software facilitates quicker catastrophe response, increases public safety, facilitates emergency communication, and helps create more effective disaster management procedures.By including screening and validation procedures prior to publishing warnings, the system also lessens false information, enhancing the reliability of information that is disseminated. Automated data processing speeds up reaction times and lessens the need for human engagement during emergencies. Additionally, because the application supports real-time updates, any changes made to the catastrophic status are immediately reflected in the system. From a technical standpoint, using Firebase authentication ensures secure user access, protecting personal data and preventing unauthorized use. Overall, the initiative improves citizen-authority collaboration, promotes proactive risk awareness, speeds up emergency response, and makes disaster reporting more transparent. The solution significantly contributes to more intelligent and efficient disaster management practices by leveraging modern technologies including real-time databases, cloud computing, and mobile application development.

VIII. RESEARCH METHODOLOGY

A) Research Design

The Real-Time Disaster Information Aggregation Software (RTDIS) is developed and assessed in this study using a Design Science Research (DSR) methodology. Technology-driven research where the main goal is to develop and evaluate a novel artifact that solves a practical issue is ideally suited for design science research. A mobile-based catastrophe information system that is intended to gather, compile, and display disaster-related data in real time is the artifact in this study. By offering a centralized, real- time reporting and visualization platform, the system was designed to close the gap between the incidence of disasters and the transmission of information. The software integrates Flutter for cross-platform mobile application development, Firebase for cloud- based backend services and real-time database synchronization, and OpenStreetMap (OSM) for geospatial visualization. The research emphasizes both the construction of the system and its empirical evaluation in terms of performance, usability, scalability, and reliability under simulated disaster scenarios.

B) System Architecture

The client-server cloud-based architecture used by the RTDIS system is intended to guarantee scalability and real-time data synchronization. The three main layers of the architecture are the geographic visualization layer, the cloud backend layer, and the mobile client layer.The main user interface is the mobile client layer, which is created with Flutter. Users can sign up, authenticate, and submit disaster reports with optional photographs, location, disaster type, severity rating, and description. Additionally, the app gives users real-time updates and shows live disaster alerts on an interactive map.Firebase services are used to implement the cloud backend layer. Firebase Authentication ensures secure user login and identity verification. Firebase Realtime Database or Firestore enables instantaneous data synchronization across devices, ensuring that newly submitted reports are immediately visible to all users. Firebase Cloud Messaging (FCM) is integrated to deliver push notifications for emergency alerts.The geospatial visualization layer utilizes OpenStreetMap APIs to render disaster locations dynamically. Geographic coordinates submitted by users are stored in Firebase and are used to place markers on the map interface. Whenever new data is pushed to the database, the map updates automatically, reflecting the latest disaster information in real time.

C) Data Collection Methods

The study uses primary and secondary data sources to assess the realism and performance of the system. The smartphone application gathers user-generated disaster reports, which make up the primary data. GPS coordinates taken straight from the user's mobile device, disaster type, severity classification, descriptive text, timestamp, and optional multimedia content are all included in each report. To guarantee chronological tracking and synchronization, these entries are precisely time-stamped in Firebase.System testing and validation were conducted using secondary data sources. These include disaster management portals that are open to the public, repositories of meteorological data, and datasets from past disasters.Such datasets were used to simulate real-world disaster scenarios and assess how effectively the system handles diverse types of disaster information.

D) System Development Process

The Agile Software Development Model is used in the creation of RTDIS to guarantee flexibility and iterative improvement. In order to determine the functional and non-functional system requirements, a requirement analysis phase was first carried out. While non-functional needs concentrated on system responsiveness, dependability, scalability, and data security, functional requirements covered disaster reporting, authentication, map visualization, and alerting services.The database schema was set up in Firebase during the system design stage to effectively store user information and disaster reports. Wireframes for user interfaces were created to guarantee accessibility and ease of use. Strategies for map integration were also established to guarantee seamless communication between the visualization element and location services.Flutter in Android Studio was used for implementation, incorporating Firebase services for backend functionality. Minimal latency between data submission and display was ensured by configuring real- time database synchronization. Using stored geographic locations, OpenStreetMap was incorporated to dynamically render disaster marks.Tests were carried out on several levels. While integration testing guaranteed smooth communication between the mobile application, Firebase backend, and mapping services, unit testing confirmed the functionality of individual components. Immediate device synchronization was confirmed by real-time update testing. System stability was evaluated by doing performance testing under simulated load circumstances.The deployment phase involved generating Android builds through Android Studio and configuring cloud services via the Firebase Console. The application was tested on Android devices with moderate hardware specifications to simulate realistic usage environments.

E) Experimental Setup

The system was experimentally evaluated in a controlled simulated environment. For the purpose of testing scalability and real- time synchronization, several users were directed to submit disaster reports concurrently. In order to observe performance under various connectivity settings, network latency fluctuations were created. To guarantee stability, device compatibility testing was carried out across different Android versions.The Android Studio IDE, Flutter SDK, Firebase Console, and Android handsets with a minimum of 4GB RAM comprised the hardware and software environment. In a setting that was almost identical to the real world, this configuration offered a useful setting for testing system performance.

F) Evaluation Metrics

System performance was evaluated using quantitative and qualitative metrics. Response time was measured as the duration between report submission and its visibility on other devices. Data accuracy was assessed by evaluating GPS coordinate precision and correctness of disaster classification. Scalability was measured by observing the system’s ability to handle concurrent data submissions without degradation in performance. Reliability was evaluated based on crash frequency and backend uptime stability.Usability testing was conducted through structured user feedback surveys, focusing on ease of navigation, clarity of interface, and overall satisfaction. The combination of technical metrics and user-centered evaluation ensured comprehensive system assessment.

G) Security and Privacy Measures

A key component of system design was security and privacy. To confirm user identification and stop unwanted access, Firebase Authentication was put in place. HTTPS encryption techniques were used to protect all data transfers. To manage sensitive operations, role-based access mechanisms were taken into consideration. Anonymization techniques were used as needed to safeguard privacy, and user data—especially location data—was managed appropriately.

H) Limitations of the Study

Despite its effectiveness, the study has certain limitations. The system depends heavily on stable internet connectivity for real- time data synchronization. The accuracy of disaster information is influenced by the reliability of user-submitted data. Additionally, the current implementation focuses primarily on the Android platform, limiting cross-platform accessibility. Integration with official government emergency APIs has not yet been implemented and remains a potential area for future development.

I) Ethical Considerations

Throughout the whole research process, ethical norms were rigorously upheld. Personal information was not misused or disclosed outside of the intended research scope, and user consent was acquired before data submission. The only objective of gathering location data was catastrophe management. The study employs data privacy rules and makes sure that all information gathered is handled responsibly.

IX. RESULTS AND DISCUSSION

Figure 1 illustrates the overall system performance evaluation of RTDIS. The system demonstrates strong operational efficiency across multiple evaluation metrics. Under concurrent load testing with 25 active users, the average response time was recorded at 3.2 seconds, indicating effective real-time synchronization through the Firebase backend infrastructure. Despite increased user load, the system maintained stable performance without significant latency spikes.In terms of spatial accuracy, GPS coordinate precision achieved 96.8%, confirming reliable geolocation tracking for disaster reporting. Disaster classification accuracy reached 94.5%, demonstrating the effectiveness of the data filtering and categorization mechanisms implemented within the system. Furthermore, usability evaluation results showed an overall user satisfaction rate of 89%, reflecting positive feedback regarding interface clarity, map visualization, and notification effectiveness.The combined results validate that RTDIS provides a scalable, accurate, and user-friendly platform for real-time disaster information aggregation. The integration of Flutter for frontend development, Firebase for cloud synchronization, and OpenStreetMap for geospatial visualization collectively contributes to the system's stability and efficiency. Overall, the findings confirm the system's suitability for real-world disaster monitoring and emergency response applications.

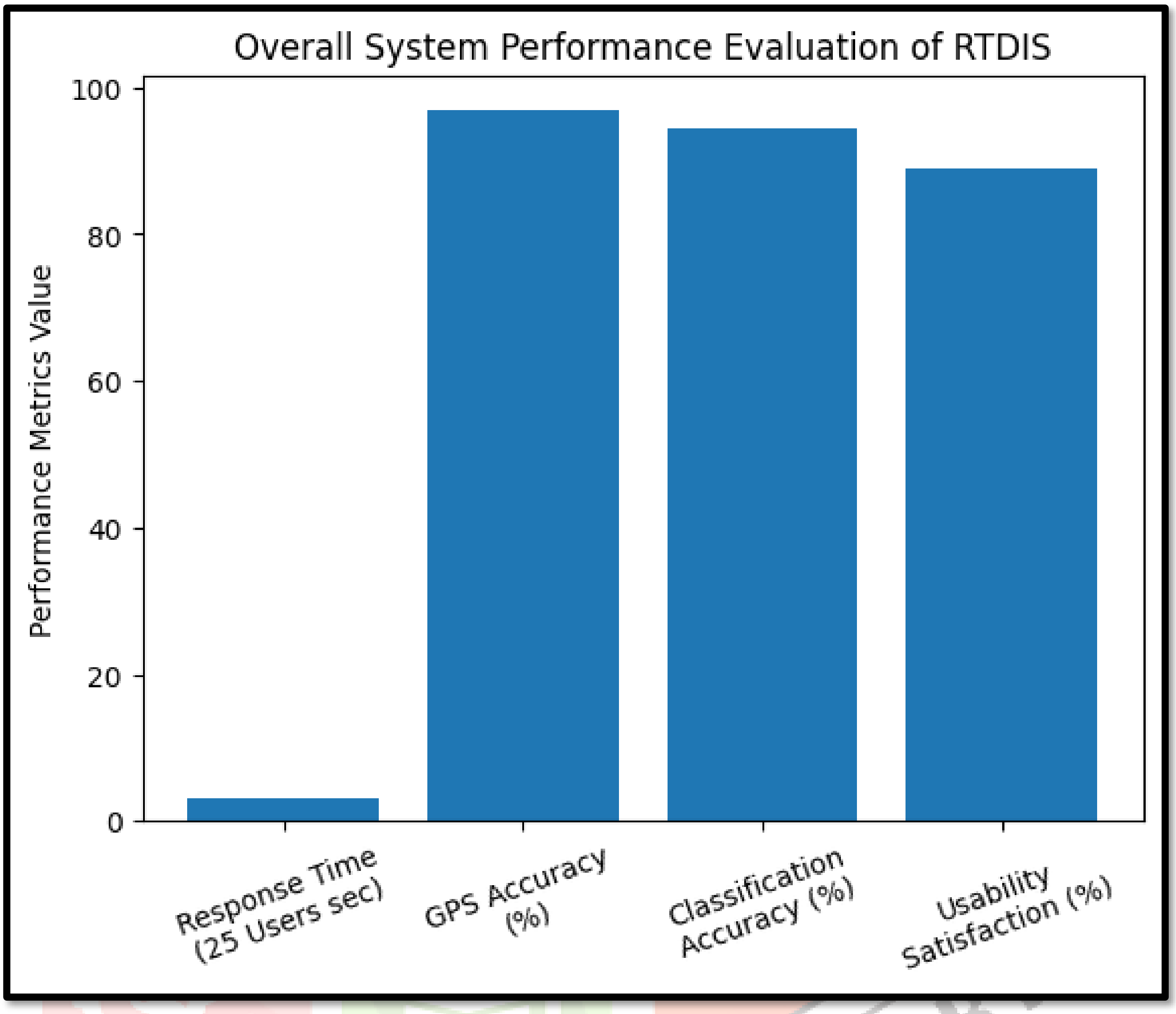

Figure 1: Overall System Performance Evaluation of RTDIS

X. CONCLUSION

The present study successfully designed and evaluated a Real-Time Disaster Information Aggregation Software (RTDIS) using Flutter, Firebase, and OpenStreetMap technologies. The system demonstrated low response latency, high geospatial accuracy, and strong user satisfaction under simulated disaster conditions. Experimental findings confirm that the platform is scalable, reliable, and suitable for real-time emergency information dissemination. Future enhancements may include integration with official government APIs, cross-platform deployment, and AI-based predictive analytics to further strengthen disaster preparedness and response efficiency

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