RAPID RESCUE : A REAL-TIME COLLISION DETECTION AND EMERGENCY RESPONSE SYSTEM

Venkata Swaraj Kotapati , Rushabh Kumar Jaiswal

{vkotapat, rjaisw15}@asu.edu

Arizona State University, Tempe, AZ

ABSTRACT

We present Rapid Rescue, a comprehensive safety and health monitoring mobile application. Rapid Rescue integrates real-time data from GPS, Accelerometer, and health monitoring components to provide users with a dynamic dashboard during driving sessions. It monitors vital signs, detects falls, evaluates vehicle speed, and ensures seamless communication through a Telegram bot. This paper outlines the major components, design, tech stack, information flow, and testing strategies of Rapid Rescue.

1. INTRODUCTION

In the realm of safety and health monitoring applications, RapidRescue is a central gateway for users. With a user-friendly interface for navigating into driving mode or entering profile data, it integrates advanced technologies to enhance user safety. The application utilizes an accelerometer sensor to detect sudden movements, serving as a vigilant monitor for potential accidents. Additionally, through a streamlined POST request to a Telegram bot, RapidRescue ensures rapid communication with pre-saved emergency contacts. Prioritizing user well-being, RapidRescue employs Fuzzy logic to identify anomalies in respiratory and health data. This intelligent approach significantly contributes to the overall safety framework, exemplifying a holistic commitment to user security and welfare. As we explore RapidRescue's design and functionalities, we unveil a comprehensive safety and health monitoring solution poised to make a substantial impact on user experiences.

2. ARCHITECTURE

RapidRescue's robust architecture is anchored by pivotal components, including the GPS Sensor, Accelerometer, Room Database, and various activity components. These elements collectively shape a cohesive system tailored for comprehensive safety and health monitoring.

The initiation of data collection from the GPS and Accelerometer components forms the cornerstone of RapidRescue's real-time monitoring capabilities. As this data is gathered, an advanced algorithm takes charge, meticulously evaluating collision probabilities. This analytical process is instrumental in providing insights into potential risks, facilitating proactive responses to emerging safety concerns.

Within the RapidRescue mobile application, this architecture ensures a streamlined and efficient structure. The orchestrated interplay of components facilitates seamless integration and communication, resulting in a dynamic dashboard presenting users with vital information during driving sessions. This design prioritizes effectiveness, allowing the application to furnish prompt and precise responses to diverse scenarios.

In essence, RapidRescue's architecture not only integrates essential hardware components but also emphasizes the incorporation of sophisticated algorithms. This synergy produces a potent system, delivering users a comprehensive safety monitoring experience with a keen focus on real-time awareness and responsiveness.
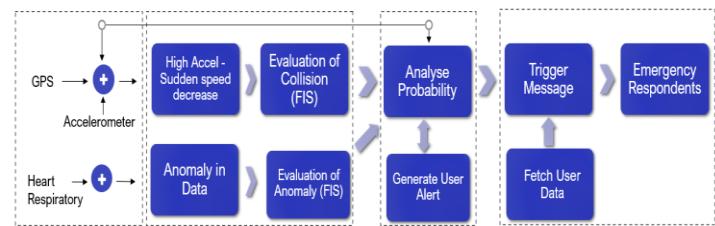

Figure 1 : RapidRescue Component Architecture Diagram

3. THE APPLICATION SUITE

The RapidRescue Application Suite is a comprehensive integration of components designed to ensure user safety and well-being. The suite encompasses crucial functionalities, seamlessly combining cutting-edge technologies for a holistic monitoring experience.
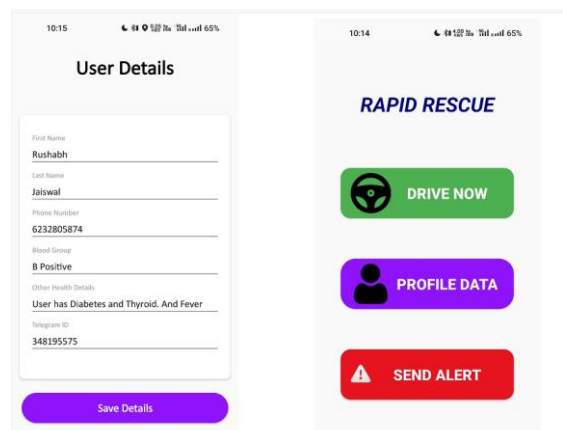

Figure 2: a) User Profile; b) Home Screen Components

The RapidRescue application comprises several essential components contributing to its comprehensive functionality:

The Driving Mode feature offers a dynamic dashboard, providing real-time updates on Respiratory Rate, Heart Rate, and Speed. This component is designed to promptly activate the alerting system in response to sudden falls or collisions, ensuring a vigilant approach to potential risks.

The GPS Sensor takes the lead in real-time monitoring, issuing collision alerts, and providing precise accident location information. Its seamless integration with other suite components enhances overall monitoring and reporting capabilities, fostering a robust safety net. The Room Database Component prioritizes data durability in SQL format, playing a crucial role in long-term storage. Serving as the repository for user profiles and emergency respondent details, it contributes to the efficiency and responsiveness of the entire RapidRescue system. The Home Page serves as the central hub, seamlessly integrating key functionalities for an efficient user-centric experience within the RapidRescue suite.

The User Profile Page enables users to input and save personal details, including emergency contact information. This component ensures personalized and effective response mechanisms within the RapidRescue system. The Accelerometer Component actively monitors sensor values and triggers alerts in the event of a sudden decrease. It plays a central role in enhancing the suite's real-time monitoring capabilities. The Telegram Bot Component establishes a crucial link for communication with the Telegram bot and emergency contacts. Operating as an integral part of the RapidRescue suite, it ensures prompt and effective responses to potential risks and emergencies.

3.1 Assessment Application
The Assessment Application within the RapidRescue suite integrates Fuzzy Logic components for a dual-focused analysis of user health monitoring and collision chance. This streamlined approach ensures a comprehensive evaluation, prioritizing user well-being and risk mitigation.

3.1.1 Fuzzy Logic for User Health Monitoring
The Assessment Application utilizes Fuzzy Logic components to interpret data related to respiratory rate, heart rate. This approach enhances the accuracy of health assessments, promptly identifying anomalies that warrant attention and contributing to the overall well-being of RapidRescue users.

3.1.2 Fuzzy Logic for Collision Probability Evaluation
Expanding its capabilities, the Assessment Application employs Fuzzy Logic components to assess collision probabilities. By processing real-time data from GPS and Accelerometer sensors, this framework evaluates the likelihood of collisions, considering factors such as speed and sudden movements. This nuanced evaluation contributes to the safety and security of RapidRescue users by facilitating timely interventions in potential risk situations.
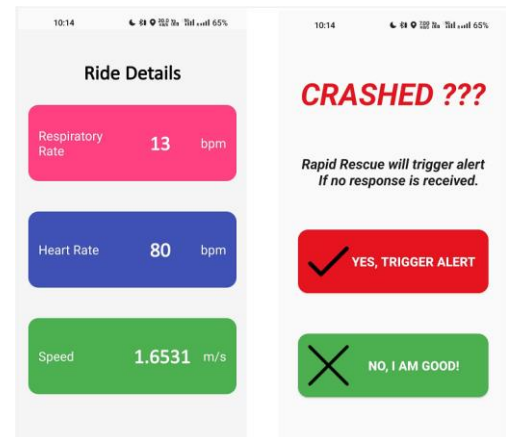

Figure 3: a) Decision System in Health Anomaly; b) Collision Detection

3.2 Training Applications:
In the development of training applications, RapidRescue employs a meticulous approach to health monitoring, particularly utilizing sensor data from Apple Watches. Continuously monitoring heart rate and respiratory data in both normal and unfit conditions form the basis of our comprehensive training methodology. For unfit conditions, our approach is grounded in extensive medical references, ensuring accuracy and relevance. We have devised heart and respiratory rate benchmarks based on thorough research and consultation with medical sources. This approach ensures that the training applications in RapidRescue are not only technologically advanced but also scientifically sound, offering users a reliable and effective tool for health and fitness monitoring.

4. IMPLEMENATAION:
RapidRescue is implemented using Kotlin, offering a modern and efficient development platform. Leveraging the Room SQL database ensures robust data management for user profiles and emergency details. The integration of Accelerometer and GPS sensors enhances real-time monitoring and collision detection capabilities. The Rapid Rescue Telegram Bot REST API facilitates seamless communication, strengthening the alerting system. Optimized for Android with a minimum SDK of 34 and compatibility with KitKat, the application combines advanced

technologies, sensors, and Fuzzy Logic for a comprehensive approach to user safety and well-being.

5. DEMONSTARTION:
Enable internet and location permissions at the launch for seamless functionality. Install Telegram, find the Rapid Rescue bot, and register by sending a "Hi" message. On the home page, input personal data and emergency contacts using the User Profile button. Click "Start Driving" to activate accelerometer and GPS services. Explore the real-time dashboard for instant heart rate, respiratory rate, and speed data. Encounter fall detection or speed changes, navigating to the confirmation page for alert options. Efficiently handle alerts by cancelling to redirect to the dashboard or triggering an alert to notify the specified emergency contact. Witness proactive health monitoring, including respiratory and heart rate scans. Predicted anomalies in health data prompt navigation to the confirmation page.

6. CONCLUSION :
RapidRescue marks a notable stride in safety and health monitoring applications, presenting users with a holistic solution for potential accidents and health-related concerns during driving. Through the integration of GPS, Accelerometer, and health monitoring components, the application ensures a comprehensive approach to user well-being. The effectiveness of RapidRescue is underpinned by its well-structured architecture, robust tech stack, and rigorous testing strategies. With continuous support from Google for Android phones, RapidRescue is poised to have a significant impact on enhancing user safety and overall well-being.

7. REFERENCES:
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