Emergency Service Application for Traffic Accidents in Yogyakarta Area Using Location Based Service Method

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Abstract

Every hour, three people die in Indonesia due to traffic accidents. This staggering toll is largely driven by human error. A dire need for immediate action insists to provide a better emergency response system before it is getting worse. This research aims to design and develop an integrated emergency application connecting users with multiple service providers, and to assess its impact on improving response times and reducing traffic accident casualties, contributing to safer urban environments and better public health outcomes. The study uses diagrams to model user interactions and system components, including police, hospitals, and firefighters. A structured framework guides the research from data collection to system implementation and testing, ensuring the system enhances emergency response times. This research reveals that the emergency application was designed to provide quick access to police, hospital, and fire fighter department services. The homepage allows users to select a service and access either a phone number list or the nearest location via Google Maps. Testing confirmed successful navigation, phone number display, and map integration in both offline and online modes. Black Box Testing showed that all core features, including menu navigation and call redirection, functioned as expected. The app is intended to enhance emergency response times by providing immediate, efficient access to critical services.

Keywords: Emergency Application, Traffic Accident Response, System Design and Testing, Public Health

I. INTRODUCTION

Traffic accidents are a significant global issue that demands urgent and sustained attention. They cause considerable harm to victims, ranging from physical injuries to severe psychological trauma, and often lead to fatalities. According to recent global statistics, road traffic injuries are among the leading causes of death worldwide, particularly affecting low- and middle-income countries. These alarming figures underscore the critical need for preventive strategies and robust emergency response systems to mitigate the impact of traffic accidents [1]. In Indonesia, the situation is equally concerning. Police data indicate that approximately three people lose their lives every hour due to traffic accidents. Behavioral factors contribute to 61% of these incidents, while vehicle-related issues account for 9%, and environmental and infrastructural conditions make up the remaining 30% [2]. These statistics reveal the multifaceted nature of the problem and highlight the importance of a comprehensive approach to address it. The Indonesian Ministry of Transportation reported 103,645 traffic accidents in 2021, a 3.62% increase from the previous year, signaling a worrying trend that calls for immediate intervention, particularly in improving road infrastructure and emergency response mechanisms [3].

Yogyakarta City, one of Indonesia's major urban centers, exemplifies the severity of this issue. Studies show a 32.15% increase in traffic accidents from 2018 to 2019, with 2,642 cases handled by the police over five years, resulting in 3,718 victims, including 165 fatalities and 3,553 injuries of varying severity [5]. Despite efforts to address these challenges, the number of traffic accidents and their associated casualties in Yogyakarta has not declined, underscoring the need for innovative solutions to enhance emergency response capabilities. The delay in providing first aid to accident victims is a critical issue contributing to the high fatality and injury rates. This delay often results from a lack of accessible and reliable information about emergency services. Previous studies have proposed various Android-based emergency applications to address similar issues. For instance, Ali [6] developed an emergency call application to connect service providers with the public, while Saputra [7] created an Android-based ambulance service application to facilitate hospitals in obtaining accident location information quickly. Similarly, Arief [8] designed a location-based system application to enhance time efficiency in accessing emergency services.

The advancement of mobile applications for emergency management has demonstrated remarkable potential in addressing various challenges related to rapid response and coordination. For example, Sahria's "Genting" application facilitates direct communication between emergency service organizations and the community, enhancing response efficiency [9]. Fariza's system, tailored for natural disaster management, provides critical tools for regions vulnerable to such events [10]. Other notable contributions include Alwiah's smart city application designed to improve public services in Bogor [11] and Rahman's management application that bolsters

South Kalimantan's emergency response system [12]. Furthermore, Hanindra and Lisdarti developed specialized applications addressing crime and community emergencies, respectively [13], [14]. Although these applications are highly valuable in their specific domains, their narrow focus limits their ability to handle more complex, multi-agency emergency scenarios.

In parallel, academic research has made significant strides in exploring mobile technologies for emergency management. Studies on integrated systems, such as those utilizing mobile alerts, have demonstrated their capability to enhance emergency situation management through real-time notifications [17]. Similarly, the Smart Hospital Emergency System streamlines hospital responses by enabling patients to request services via mobile platforms [18]. Open-source initiatives have also gained traction, exemplified by the development of an emergency data collection application documented in the INES thesis series [19], while pilot studies on mobile emergency systems have shown their potential in healthcare applications [20]. Moreover, efforts to engage citizens as "human sensors" have harnessed crowd-sourced data for better situational awareness [21]. However, despite their promise, existing mobile emergency notification systems face barriers such as limited adoption and integration, highlighting the need for future enhancements [22]. Advancements in mobile cloud computing and cooperative tools have further enriched emergency management. Cloud-based systems have enabled resource sharing, improving the efficiency of healthcare responses during emergencies [23]. The M4EM: Mobile for Emergencies system exemplifies the use of cooperative tools to coordinate emergency management operations [24]. Additionally, applications for mass casualty incidents, such as emergency accident alerts and routine mobile services for medical emergencies, underscore the importance of mobile solutions in managing large-scale crises [25], [26]. Nonetheless, to address the growing complexity of emergencies, the focus must shift toward integrated and scalable systems capable of managing diverse scenarios involving multiple stakeholders. This underscores the transformative potential of mobile technologies in redefining emergency response strategies.

Despite these advancements, there remains a gap in providing a comprehensive, multi-agency emergency response system tailored to urban traffic accidents. This study aims to develop an Android-based emergency application integrating services from the police, hospitals, and fire departments. The proposed application will feature quick call functionality to ensure immediate communication with service providers and a location search feature to help users identify the nearest service facilities. By addressing these critical needs, the application seeks to enhance the timeliness and effectiveness of emergency responses, thereby reducing fatalities and injuries resulting from traffic accidents in Yogyakarta City. The objectives of this research are twofold, namely to design and develop an integrated emergency application that connects users with multiple service providers and to evaluate the application's potential impact on improving emergency response times and reducing traffic accident-related casualties. By leveraging technology, this study aspires to contribute to the broader goal of creating safer urban environments and advancing public health outcomes.

II. METHOD

A. Research Stage

This research method is characterized by a meticulous and comprehensive approach investigating a particular problem, with the ultimate goal of identifying a solution. Researchers apply this method to ensure a detailed examination of the issue at hand by exploring its various dimensions and implications. In this study, the focus is on a widespread and recurring problems encountered in daily life, specifically the traffic accident reporting system in Yogyakarta City. Given the critical role of such systems in public safety and urban management, the research aims to systematically analyze the existing reporting processes, identify inefficiencies, and evaluate their effectiveness. By doing so, the study seeks to provide a deeper understanding of the challenges faced by the system and offer practical recommendations for improvement, ultimately contributing to a more efficient and responsive traffic accident reporting framework in the city. Through this approach, the research not

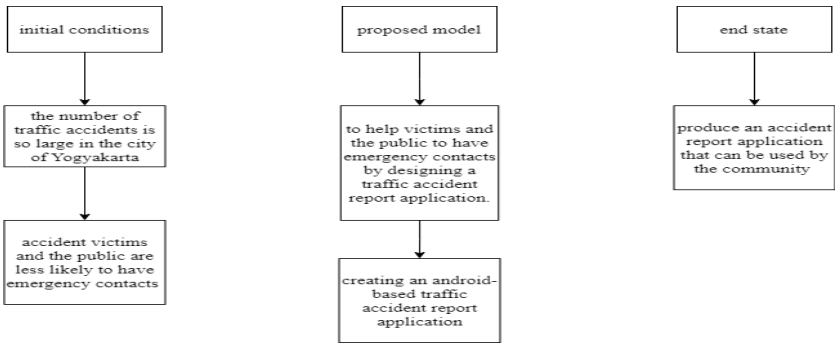

Figure 1 Research Stages

only addresses an immediate local issue but also provides insights that could be relevant to similar urban contexts facing comparable challenges.

B. Use Case Diagram

In this context, the use case diagram illustrates the interactions between the user and the system. It provides a visual representation of how the user engages with the system, highlighting the various actions or processes involved. The diagram below demonstrates these interactions, showcasing the specific scenarios where the user's input or actions trigger responses from the system, helping to clarify the flow and functionality of the system from the user's perspective.

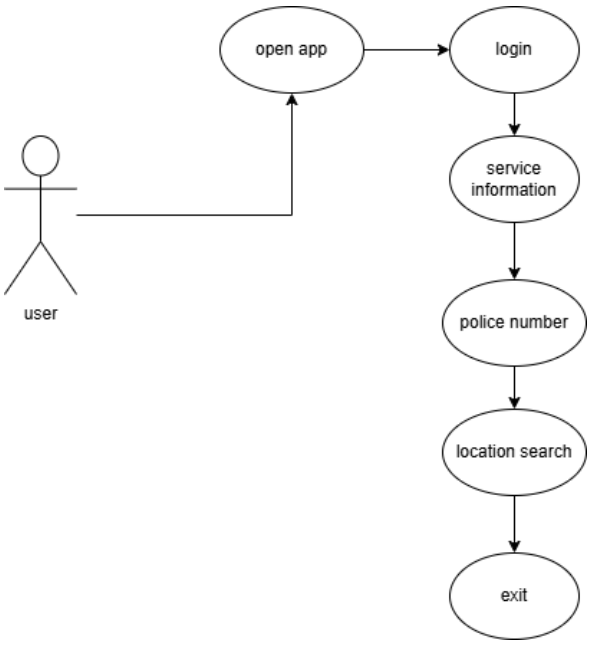

Figure 2 Use Case

The diagram above illustrates the various options available to the user within the application. Upon opening the app, the user is first presented with the main menu, which serves as the central hub for navigation. From there, the user can access a range of features, such as obtaining service information, which provides details about available services. Additionally, the user has the option to search for a specific police number or find the location of the nearest police station for convenience. Finally, when the user is finished, they can choose to exit the application, completing their interaction with the system.

C. Activity Diagram

An activity diagram is a visual representation used to model the processes that occur within a system. It provides a clear depiction of the sequence of actions or steps that unfold in a given process, with these steps typically arranged vertically to illustrate their order. Serving as an extension of the Use Case, the activity diagram builds upon the basic flow of activities, adding more detail and structure to show how each action or decision flows from one to the next. Through this diagram, the complexity of system interactions is simplified, offering a comprehensive overview of how various tasks and operations are interconnected within the system.

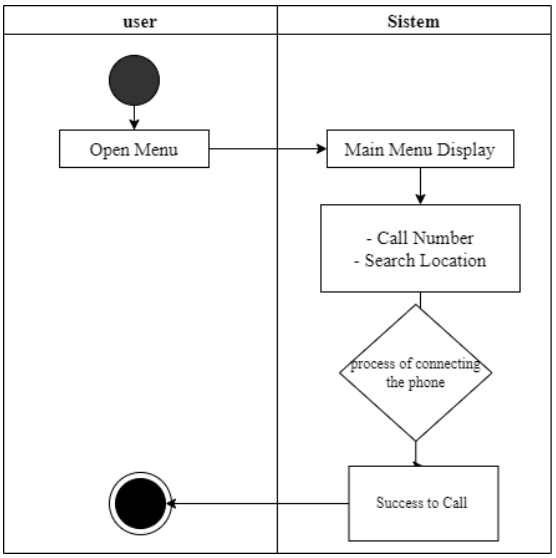

Figure 3 Activity Diagram

This activity diagram illustrates the process of interaction between the user and the system for making a call. The process begins when the user opens the menu, indicated by the black ellipse (start point). The system then displays the main menu, which provides two options: "Call Number" and "Search Location." After the user selects one of the options, the system initiates the process of connecting the call. At this stage, the system checks whether the connection process is successful. If the connection is successful, the system proceeds to the "Call Successful" stage, represented by the final activity box. The diagram concludes with a black ellipse (end point), indicating the completion of the process. This diagram effectively demonstrates a simple yet clear communication flow between the user and the system.

D. Class Diagram

The class diagram provides a detailed depiction of the structures and relationships between the various objects within the system. It visually represents how different components interact with one another, showcasing the connections and dependencies that define the overall system architecture. The diagram, as illustrated in the image below, serves as a valuable tool for understanding the system's organization and the roles of individual objects within it. Through this representation, the complex relationships and hierarchies become clearer, aiding in the analysis and design of the system.

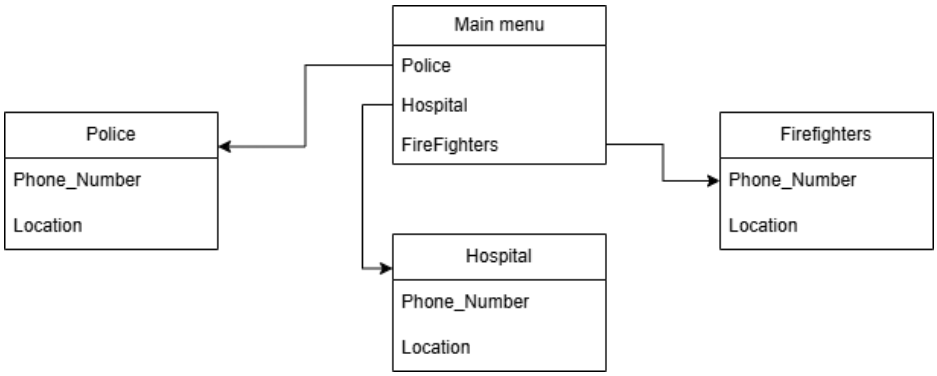

Figure 4 Class Diagram

The class diagram provides a visual representation of the relationships between the core entities in the system: "Police," "Hospital," and "Firefighters." It highlights how these three classes are interlinked, demonstrating their interactions and mutual dependencies within the system. Each class plays a crucial role, and the diagram suggests that they may share certain attributes or methods, allowing them to work together seamlessly and support the

system's overall functionality. This interconnectedness ensures that the system operates efficiently, with each entity contributing to a collaborative effort in managing and responding to incidents effectively.

E. Framework

The research framework serves as a detailed roadmap for the research process, providing a clear and structured plan for each stage of the study. It outlines the logical progression of tasks, beginning with the identification of the research problem and continuing through to the final stages of the research process. The framework begins with selecting the research topic, followed by a thorough search for relevant literature to build a theoretical foundation. Researchers then develop a proposal, which includes objectives and methodologies, before moving on to data collection and analysis. This framework guides researchers by offering a systematic overview of the research flow, ensuring that each step is approached methodically. As a result, the framework not only helps researchers stay focused and organized but also prevents confusion by clearly outlining what needs to be done at every stage. In essence, it acts as a guiding map, ensuring the research is conducted effectively and efficiently, with a clear understanding of the path forward.

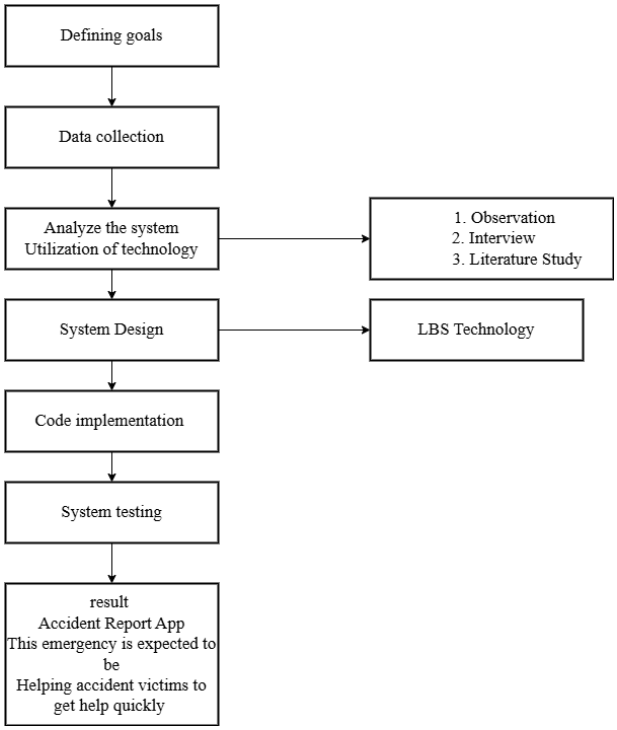

Figure 5 Framework

The process begins with defining the goals, in which the research is conceptualized by identifying the problem, setting the boundaries of the study, and clarifying the objectives and benefits that the research aims to achieve. Following this, data collection takes place using three methods. First, observation involves gathering data by directly witnessing accident scenes. Second, interviews are conducted through question-and-answer sessions with local authorities such as police officers and community members. Third, a literature study is carried out by reviewing theoretical studies to gather additional data. Once the data is collected, the analysis stage begins, where the data is examined through the lens of technology utilization, specifically using the Kotlin programming language in Android Studio software. This leads to the system design phase, which focuses on developing the structure of the system, including designing input/output mechanisms and the overall system interface. The next step is the code implementation phase, where the system is programmed, and commands are entered into the design to ensure that it functions as expected. After the coding process is completed, the system undergoes testing using the black box testing method to ensure that it performs as intended. Finally, the system is implemented and validated, confirming its feasibility and ensuring that it meets the objectives outlined at the beginning of the process.

F. Location based Service

In Indonesia, the adoption of Location-Based Services (LBS) has gained significant momentum, with several services already available to users. One such service is 'Where Am I?', developed by XL Communication, which provides users with real-time location information. Additionally, INDOSAT offers a service that helps users determine the location of the nearest gas station, making it more convenient for drivers to find fuel stations in their vicinity. These services, among others, are just a few examples of how LBS technology is being integrated into everyday life. The growing availability and use of these services have had a positive impact on the development of LBS in Indonesia, enhancing both accessibility and convenience for users. As LBS continues to evolve, it is expected to play an increasingly important role in shaping various industries, from transportation to retail, in the country as seen in the following figure:

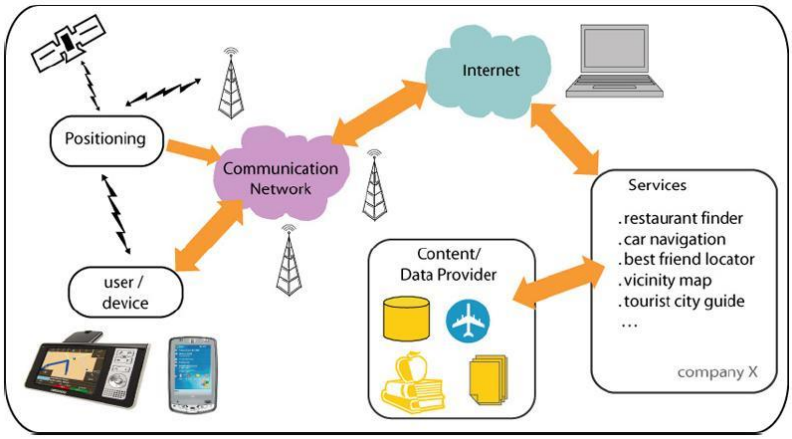

Figure 6. LBS Supporting Components

Location-based services rely on four main components in their technology infrastructure to ensure smooth operation. The first is the mobile device, which is crucial for these services. This includes smartphones, PDAs, and other devices that can serve as navigation tools, often utilizing GPS for precise location tracking. The second component is the communication network, which is a mobile telecommunications network that facilitates the transfer of user data from the device to the service provider. Next is the positioning component, which determines the user's location. This position is typically determined through either the telecommunications network or GPS technology. The fourth component is the content provider, which offers various services to users, such as route finding and position calculation. Finally, content and data providers play a similar role, supplying necessary data and content to support these services.

III. RESULTS AND DISCUSSION

A. Designing and Developing an Integrated Emergency Application

1. Homepage

This page functions as the primary interface that appears when the user launches the application, providing a streamlined entry point to essential services. It prominently features three key emergency service options: the Police, Hospital, and Fire Department. These options are designed to offer immediate access to critical help in times of need. Upon selecting one of these services, the user is redirected to a dedicated menu page tailored to the specific service they have chosen. Each service page offers further details and instructions to assist the user in contacting or accessing the relevant emergency responders.

The design of the application ensures that all three emergency services are readily available at the user's fingertips, offering a clear, organized structure for quick navigation. This accessibility is particularly beneficial in urgent situations, such as traffic accidents, where rapid intervention is crucial. By enabling users to select and connect with the closest and most appropriate emergency service, the application aims to minimize delays in obtaining assistance. The objective is to enhance the likelihood of a timely response and provide victims of accidents with the support they need, thereby improving the overall effectiveness and efficiency of emergency response in critical situations. This system is built to prioritize user convenience, ensuring that help can be reached swiftly and efficiently, regardless of the specific emergency at hand.

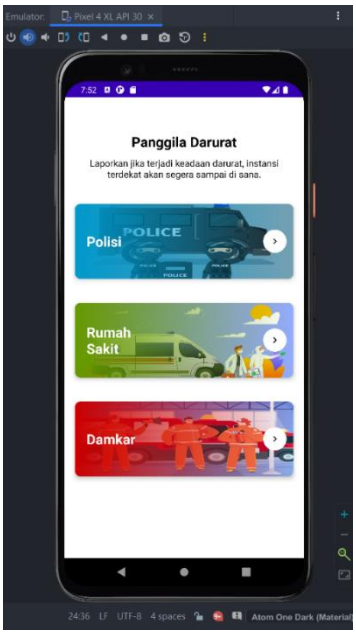

Figure 7 Homepage

2. Service Menu Display

This page serves as the next step after the user selects one of the emergency services from the main menu. It presents two distinct menu options that allow users to choose the method most suitable for their needs in contacting or locating the necessary emergency service. As depicted in the image below, users can select one of the two available options, each designed to facilitate a different form of assistance. The interface is structured to be both clear and efficient, ensuring that users can navigate the options easily and select the one that best fits their immediate requirements.

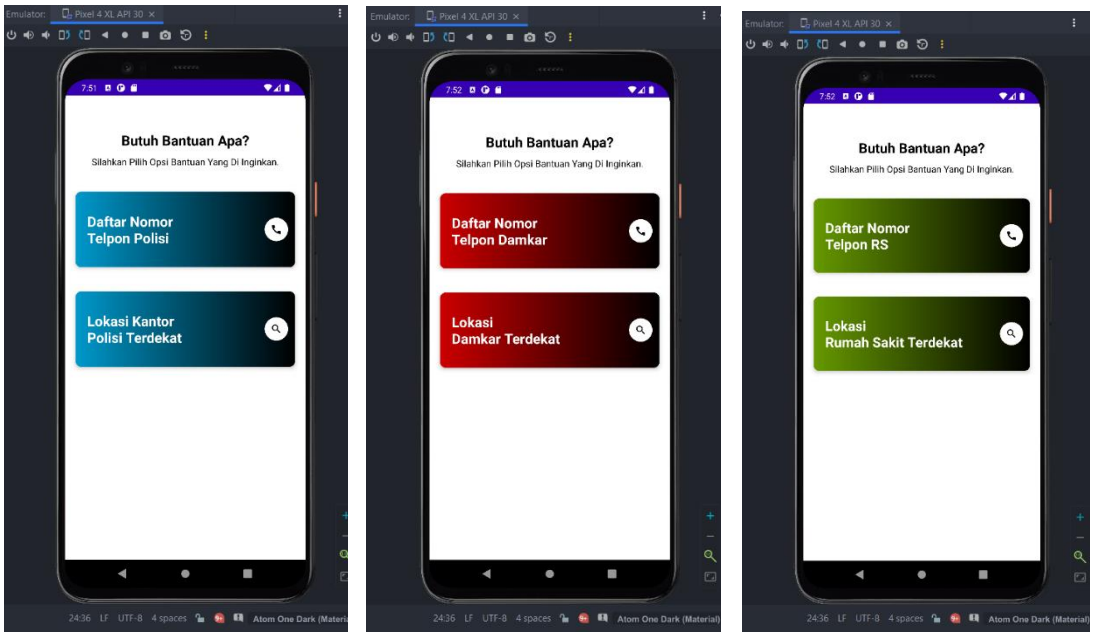

Figure 8 Service Menu Display

If the user selects the "phone number list" option, they will be automatically directed to a dedicated page containing a list of phone numbers for the relevant emergency agencies. This page is designed for users who prefer to initiate contact directly through a phone call. The phone numbers provided will connect the user to the appropriate service, ensuring that they can reach out for help as quickly as possible. On the other hand, if the user

chooses the “nearest location” option, they will be led to a Google Maps page, which automatically detects the user’s current location and searches for the nearest agency. This feature ensures that users can easily find the closest emergency service, providing a convenient and quick way to reach out the nearby help in case of an urgent situation. By offering these two options, the application is tailored to accommodate different user preferences and needs, ensuring that help can be accessed swiftly and efficiently.

3. Phone Number List View

The Phone Number List View is a crucial feature within the application, offering users a comprehensive, easily accessible list of contact numbers for emergency services in Yogyakarta area. This list includes phone numbers for essential agencies such as the Police, Fire Department, and local hospitals, all of which are vital in the occurence of an emergency. The display ensures that users have immediate access to the necessary contact information, enabling them to swiftly reach out for assistance when every second counts. The inclusion of these services makes the application an invaluable tool for those in need of urgent help, particularly in situations like accidents, fires, or medical emergencies.

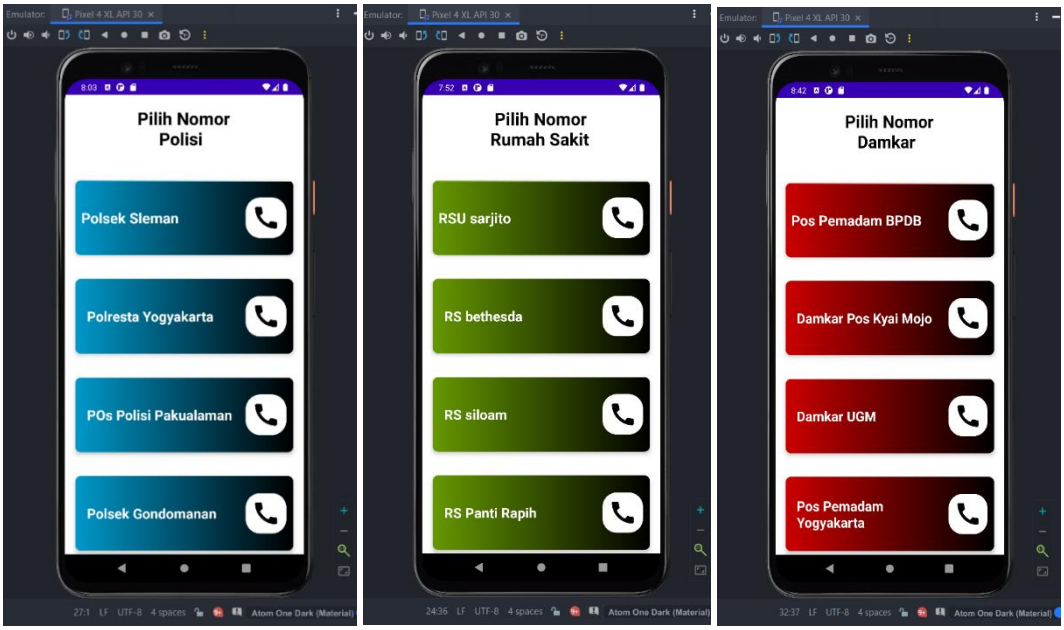

Figure 9 Phone Number View

This display becomes visible when the user selects the “Phone Number List” option from the previous menu. The interface is designed for user convenience, featuring a clean and organized layout where each agency’s phone number is clearly listed alongside its name. This ensures that users can quickly identify the relevant service and make contact without confusion or delay. Additionally, the list may be organized by category or urgency, making it even easier for users to find the right contact depending on the nature of the emergency. The main objective of this feature is to minimize the time it takes for users to get the help they need, eliminating the need for them to search for emergency numbers during critical moments. By providing direct and immediate access to these important services, the Phone Number List View plays a significant role in ensuring that users can take quick action when faced with a life-threatening situation, ultimately improving emergency response times and outcomes.

4. Display of Connected Call and Google Maps View

This display is designed to enhance the user experience by facilitating direct communication with emergency services. When the user selects a service from the available options, the interface ensures a seamless transition by automatically redirecting the user to a telephone call. This allows for an immediate, two-way communication link between the user and the operator of the selected emergency service, such as the police, fire department, or a hospital. The user does not need to manually dial the number or navigate through additional screens, streamlining the process of seeking assistance in urgent situations. Once the call is initiated, the user can communicate directly with the operator, providing essential information and receiving guidance or support as needed. This feature ensures that users are not only able to contact emergency services without delay but can also

have an effective and efficient conversation with the operator. The system is designed to minimize response times and remove any barriers that might hinder users from getting the help they require in critical moments. By automatically connecting the user to the appropriate service, the display ensures that help is just a phone call away, providing peace of mind and facilitating quick emergency responses.

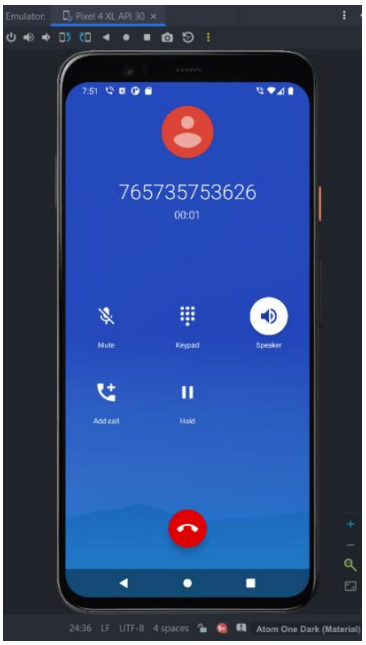

Figure 10 Connected Call

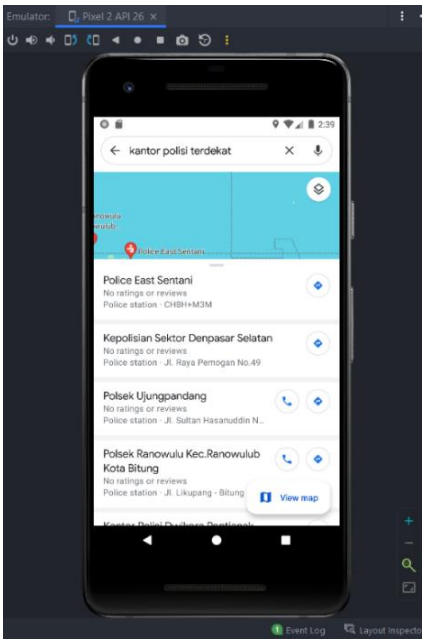

Figure 11 Google Maps View

The display is triggered when the user selects the "nearest service location" option within the application. Upon selection, the system automatically processes the user's current location and searches for the nearest available service provider based on the previously chosen agency, such as the police, fire department, or a hospital. This feature utilizes location-based services to determine the closest agency to the user, ensuring that the results are accurate and up-to-date. The goal is to make it as easy as possible for users to find the nearest emergency service when they need it the most, especially in high-pressure situations like accidents or natural disasters. By automatically identifying the closest service location, this feature streamlines the process of reaching out to emergency services. In case of an emergency, the user does not have to waste valuable time searching for the nearest service provider or navigating complex maps. Instead, they are quickly presented with the location of the nearest agency, allowing them to make an offline call or head to the location without unnecessary delays. This functionality is designed to enhance the user's ability to respond swiftly and effectively during a crisis, ensuring that help can be reached as quickly as possible, whether through direct contact with the agency or by physically arriving at the service location.

B. Implementing and Evaluating the App's Impact on Emergency Response Times

Upon launching the application, users are immediately presented with a pre-configured database design that forms the core framework for their interaction with the app. This design serves as the initial interface, offering seamless navigation to various functions and services. The application is designed to operate in both offline and online modes, ensuring consistent usability under different connectivity conditions. In offline mode, the app retrieves and utilizes data stored locally, ensuring that users can still access essential information even without an internet connection. Conversely, in online mode, the app can connect to a server to provide real-time data, updates, and access to additional features, such as emergency contact information and service locations [20].

Once the user selects a service of interest, they are directed to an advanced page where they are presented with two primary options for assistance: a list of service contact numbers and a map showing the nearest service office locations. This dual approach allows users to quickly and efficiently address their needs, whether they require immediate assistance or simply need information about service provider locations. By selecting the list of service numbers, users are guided to a detailed directory of emergency contact numbers specific to the service provider agency they have chosen. This feature is designed with urgency in mind, enabling users to initiate a call directly

from the app with a single tap, which can be crucial in emergency situations [12], [13]. The inclusion of emergency numbers ensures that users have quick access to support, regardless of time or circumstance.

Alternatively, if the user opts for the nearest location option, the app directs them to the Google Maps interface, displaying a map that highlights the closest service provider office relative to the user's current position. This integration with Google Maps allows for accurate, real-time navigation, offering step-by-step directions to the nearest office. The app takes advantage of location-based services to ensure that users can find their way to the correct service office with ease [3]. By using the app's location functionality, users are provided with a reliable, efficient means of reaching their destination, enhancing the overall user experience. The design of the app emphasizes convenience, offering multiple ways for users to access vital services, either through direct communication or location-based navigation, in a manner that is both user-friendly and responsive to immediate needs. Furthermore, Black Box Testing is a method utilized to evaluate software or application performance, focusing on assessing whether the system functions as intended and meets operational and performance expectations. This testing method primarily examines the system's outputs in response to specific inputs, without considering the internal workings or structure of the software. In the present study, the author conducted tests on the main menu interface and one of the three emergency service features, specifically the Police services. The results of these tests are outlined below:

Table 1 Product Testing

Display	Input Data	Expected Result	Test Result	Conclusion
Main Menu Testing	Enter the main menu	Can display the main menu page	Successfully display the main menu	Successful
	Pressing the back button	Can exit the app	Successful exit	Successful
Testing Home Menu	Pressing the police button	Can enter the next menu	Successfully enter the next menu	Successful
	Pressing the hospital button	Can enter the hospital menu	Successfully enter the hospital menu	Successful
	Pressing the firefighter button	Can enter the firefighter menu	Successfully enter the firefighter menu	Successful
Testing the Agency Services Menu	Pressing the police number list button	Display the police phone number	Successfully displayed police contacts	Successful
	Pressing the nearest police station location button	Can enter the google maps page	Successfully enter the google maps page	Successful
Testing the Phone Menu	Pressing the desired police number	Can be redirected to call mode	Successfully enter call mode	Successful

The testing of the main menu revealed positive results in all aspects. Upon entering the main menu, the system successfully displayed the main menu page, confirming proper functionality. Additionally, pressing the back button allowed the user to exit the app smoothly, further indicating that the navigation controls were working as expected. The home menu was also tested by pressing each emergency service button, including the police, hospital, and firefighter buttons, all of which led to their respective menus. The system successfully directed the user to the appropriate pages for each service, confirming the accuracy of the navigation flow. Further tests on the Agency Services menu showed that the app responded effectively to user inputs. Pressing the police number list button displayed the correct police contact information, while selecting the nearest police station location button correctly redirected the user to the Google Maps page. Finally, the phone menu was tested by pressing the desired police number, which successfully initiated the call mode, completing the intended action. Overall, all tests across the main menu, home menu, agency services, and phone functions were successful, demonstrating that the application is operating correctly and efficiently.

IV. CONCLUSION

The application facilitates rapid access to critical emergency services, including police, hospitals, and fire departments, through an intuitive and user-centered interface. Key features of the application include a comprehensive list of emergency contact numbers and real-time location-based services via Google Maps, which enable users to identify and access the nearest emergency service provider efficiently. The results of functional testing demonstrated that the application operates effectively in both online and offline modes, with all core features performing as intended. The application's design ensures seamless navigation, with successful redirection to relevant service providers, and integration of telecommunication and mapping functionalities, which are critical for improving emergency response times. Furthermore, Black Box Testing verified the app's reliability, confirming that all menu options, contact lists, and location services functioned as expected without technical issues. The integrated emergency application presents a significant advancement in emergency response systems by offering timely, reliable, and efficient access to essential services. The application's design and functionality are poised to contribute to enhanced public safety and the effectiveness of emergency interventions, making it a valuable tool for urban environments and critical incident management.

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