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Design and Development of Emergency Mobile Application Using Design Thinking and Agile Scrum: A Case Study of Batam City

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Abstract

Emergency response in Batam City, an area with high urban mobility and dynamics, is often hampered by slow reporting mechanisms. Residents must contact different numbers for each service in different areas, such as the fire department, ambulance, or police, causing confusion and wasting valuable time, especially in panic situations. The absence of an integrated system specifically creates significant inefficiencies in emergency service response. This study aims to design and develop an integrated mobile application that serves as a tool to accelerate the reporting and handling of emergency conditions and public utility services in Batam City. The methodology used combines the Design Thinking approach, which ensures that solutions are designed based on the real needs and experiences of users, with the Agile Scrum method, which allows for a flexible and iterative development process. This research successfully produced a functional application that was then comprehensively tested involving 53 participants, predominantly comprising digital-native residents of Batam City. Functionality testing confirmed the system's validity through Black Box testing, ensuring all core features operated according to technical specifications without errors. To measure usability, a System Usability Scale (SUS) test was conducted, resulting in an exceptional score of 88.82. This score, which places the application in the "Excellent" category, combined with consistent performance metrics, demonstrates the system's reliability in delivering an intuitive user experience. The main conclusion is that the developed application has proven to be highly viable, functional, and well-received by users. This application shows significant potential as an effective tool for improving the speed and efficiency of emergency service responses, and could serve as a model technological solution for public service integration in the City of Batam.

Keywords: *Emergency Application; Design Thinking; Agile Scrum; System Usability Scale*

1. Introduction

The rapid increase in population and economic activity in Batam City has created complex challenges, demanding responsive public services [1]. This growth escalates traffic accident risks [2] and unemployment-driven crime rates [3][4], consistent with local statistical correlations [5]. To address this, the government currently relies on a centralized telephone-based emergency service [6]. However, this conventional system is hampered by operational constraints, such as communication line congestion and the lack of immediate access to the nearest emergency unit's contact information [7]. The manual process of identifying the closest service provider often leads to critical delays, creating a significant disparity between the public's need for immediate aid and the system's actual response capability. This gap highlights the urgency for technological intervention, where mobile applications offer transformative potential for the local emergency ecosystem [8][9].

Currently, the reliance on conventional telephone lines presents significant limitations, particularly during panic situations where users struggle to recall specific numbers or identify which facility is closest to their location. While generic mapping applications exist, they often fail to account for the specific local context of Batam, suffering from outdated databases. Crucially, existing literature and prior developments have predominantly focused on single-domain solutions, creating separate applications for medical, fire, or police services which results in a fragmented user experience. This research addresses this limitation by

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offering a novel contribution: an integrated ecosystem that consolidates these services into a single platform, developed using Design Thinking and Agile Scrum methodologies applied specifically to the Batam City context. This dual-method approach ensures the solution is not only technically robust but also rigorously designed to minimize cognitive load, creating a tool uniquely tailored to local infrastructure challenges.

However, developing an effective application, especially one for an important function like emergency services, requires more than just technical functionality. The quality of a digital platform's user interface (UI) and user experience (UX) is a fundamental factor that determines its adoption and effectiveness. A carefully designed UI/UX ensures the application can be easily and intuitively operated by all users, even in conditions of panic or high stress [10]. This user-centric focus is critical, overlooking specific design challenges and user requirements is the primary reason why many emergency applications fail to be adopted effectively User-friendly design has been proven to significantly influence perception and trust, significantly, ultimately affecting the effectiveness of a digital platform [11] [12]. To achieve superior UI/UX quality that is truly user-centered, this study employs Design Thinking and Agile Scrum methodologies. These methodologies were chosen for their ability to facilitate the creation of solutions that address real community needs and problems[13] [14]. Design Thinking emphasizes empathy by actively involving potential users in the earliest planning stages[15] [16]. It also requires careful consideration of the social and cultural factors within Batam's heterogeneous community to ensure the developed solutions are widely accepted and used [17].

Next, to translate the results of the design phase into agile, adaptive product development, we will integrate the Scrum methodology. Combining Design Thinking, which focuses on user understanding and solution innovation, with Scrum, which emphasizes iterative and flexible development, creates a solid framework. This user-centric approach is critical, as research by Sama et al. [18] demonstrates that user perception significantly influences the actual utilization of technology Complementing this, the adoption of Scrum is supported by Sama and Darvin [19], whose research confirms that this model provides a highly structured framework that ensures all functional requirements are systematically implemented. This framework ensures that the final product is on target, developed efficiently, and able to adapt to changing needs. Therefore, this study aim to design and develop a mobile application prototype that can effectively address the limitations of traditional emergency services. The goal is to create an integrated platform that offers quick and efficient access to various utility and emergency services for the people of Batam City, using Design Thinking and Agile Scrum methodologies to ensure UI/UX excellence. This combined methodology will ensure that the resulting application is technologically advanced, inclusive, easy to use, and widely adoptable, thereby improving the quality and speed of the emergency response system in Batam City.

2. Methods

This research employs Design Thinking for the design process and Agile Scrum for development. Initial planning began with data collection through interviews with five informants selected via purposive sampling. This sample size was chosen based on the principle of data saturation, where five representative users are considered sufficient to uncover the majority of core problems and needs. To ensure validity and reliability, the data collection process used a structured interview guide to maintain consistency, and the findings were verified by cross-referencing them with user behavior patterns in emergency situations.. Next, the problems that would form the basis of development were identified, and the application's features were determined. Using the collected data, the research entered the user interface prototyping stage in the form of a high-fidelity wireframe design. This design aims to describe the basic structure and layout of interface elements. The design will then be tested on 30 respondents with emergency experience to measure the success rate of the user interface (UI) from the user's perspective. After that, the project will proceed to the application development phase. This phase uses the Agile Scrum framework, which allows for a flexible, collaborative, and iterative development process. Finally, testing will be carried out by collecting quantitative data through the System Usability Scale (SUS) questionnaire. This questionnaire aims to evaluate important aspects such as the application's effectiveness, usability, and ease of use.

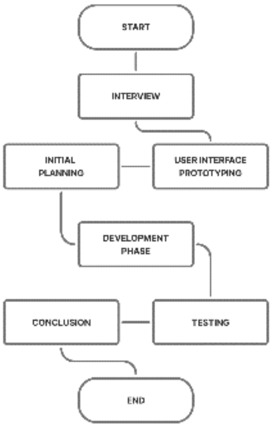

Figure 1. Research Methodology

2.1. Design Thinking

Design Thinking is a human-centric problem-solving method, as it can create innovative solutions by deeply understanding user needs, challenging assumptions, and redefining problems. This method includes processes such as Empathize, Define, Ideate, Prototype, and Test.

a. Empathize
In this phase, we identified user problems and needs by interviewing five individuals with emergency experience. The attached figure displays the resulting empathy map, where these insights have been synthesized to guide the user interface design process

Say and Do • **Searching Contacts Manually:** The user's main action is searching for emergency numbers on the internet, which they acknowledge is an inefficient action that wastes valuable time. • **Calling General Call Centers (112/119):** Users call general emergency numbers but feel the process takes a long time and does not directly connect them to the nearest unit. • **Complaining About the Location Process:** Users actively complain about how difficult it is to explain their location to operators amidst panic, describing it as a 'nightmare' and a fatal classic problem.	**SEE** • **Others Panic and Confused:** Users see people around them also panicking and confused about who to contact, or even not knowing which hospital is the nearest. • **Dependence on Google:** Users see themselves and others reflexively searching for emergency contact information via Google in the middle of a panic situation—an act they realize wastes time. • **People Taking Initiative:** Because they don't know when help will arrive, users see others finally taking victims directly to the hospital using private vehicles.	**Pain** • **Don't Know Which Service is Closest:** The biggest difficulty most frequently mentioned is not knowing which service (ambulance, hospital, police) is located closest to the incident. This is the core problem your app can solve. • **Arrival Time Uncertainty:** Frustration peaks due to the lack of certainty or estimated time of how long it will take for help to arrive. • **Non-Integrated and Location-Based Systems:** Users feel frustrated that in the GPS era, emergency systems are still manual, not integrated, and do not automatically detect location to find the nearest service.
Think and Feel • **Anxious About Time:** Users feel that every second is extremely precious, and their primary thought is, "Help must arrive right now." This indicates an urgent need for speed. • **Frustrated and Helpless:** Users feel frustrated and helpless while waiting for help with an uncertain arrival time. Your application could reduce this feeling by providing certainty. • **Hard to Think Clearly:** In a panic state, users admit they cannot think clearly at all, sometimes even going blank (freezing up). This underscores the importance of a 'one-touch solution' that doesn't require complex thinking.	**Hear** • **The Backend System is Slow:** Users hear and believe that the delay issue lies not with the officers in the field, but with the slow backend information system in finding the nearest unit. • **Delay Stories Are Common:** There are many stories from people around about ambulances or police arriving late. This shows that the problem is felt widely by the community. • **Convoluted Calling Process:** Users hear complaints that the verification and location determination process by operators takes time and becomes a major bottleneck.	**Gain** • **Directly Connected to the Nearest:** The main hope is an application that can intelligently determine the user's location and immediately connect or send a signal to the nearest emergency service unit. • **"One Button" System (Panic Button):** Users want one large, easily accessible emergency button. With one press, all important data such as location will be sent automatically. • **One-Tap Call:** From the list, users can immediately make a call to the selected service with just one touch, without needing to search or type the number manually.

Figure 2. Empathy Map

b. Define
Define Through this stage, the interview findings and thematic analysis were transformed into a comprehensive list of requirements. These requirements highlight the core issues identified during the empathy phase and represent the critical functional needs of potential users. The key requirements derived are:

- Quick Access Panic Button: A prominent, single-touch interface for instant reporting, eliminating the need to search for contacts manually.
- Integrated Services: A unified platform consolidating ambulance, police, and fire services into a single access point.
- Smart Routing: Calls must automatically connect to the nearest physical emergency post rather than a central operator to minimize response time.
- GPS Auto-Detection: Real-time location tracking to immediately transmit coordinates, replacing inaccurate verbal descriptions.
- Minimalist UI: A simplified, intuitive design specifically optimized for users experiencing high-stress cognitive load.

c. Ideate
This stage determines which features to create based on the list of requirements. Then, map out the application framework based on the stages that potential users will go through. This mapping is done using a sitemap.

d. Prototyping
This stage involves creating prototypes from the data we obtained in the Ideate Stage. These prototypes are high-fidelity wireframes of the application.

e. Testing
This testing phase uses usability testing instruments to evaluate the effectiveness and ease of use of the prototype. The usability testing questionnaire will be administered to 30 respondents with experience in emergency situations.

2.2. Agile Scrum

Following the design phase, the application development proceeded using the Agile Scrum framework. This methodology was selected to enable iterative delivery and rapid adaptation to changes. The development process was executed over four sprints, with a fixed duration of two weeks (14 days) per sprint. To ensure efficient workflow management, the research team was organized into specific Scrum roles: the Product Owner, responsible for prioritizing features based on the Design Thinking findings; the Scrum Master, tasked with facilitating the process and removing obstacles; and the Development Team, responsible for the technical implementation and coding of the prototype. The Scrum cycle consists of the following stages, the first step in implementing Agile Scrum is to compile a product backlog. This backlog is a prioritized list of all the features and functionalities required by the system. The requirements are collected and formulated as User Stories (US) to help understand their value from the user's perspective. Then, they are broken down into Backlog Items (PBI) that are ready to be worked on.

Table 1. Identified User Needs

Id	User Story
US1	As a user, I want to be able to easily and quickly access emergency contact information so that I can immediately contact the relevant parties in the event of an emergency
US2	As a user, I want to enable my location so that the app can display the nearest agency contacts
US3	As a user, I want to see a complete list of agency contacts so that I still have alternatives to contact if the nearest agency cannot be reached
US4	As a user, I want to search and filter the list of agencies so that I can find the contact I need more quickly
US5	As a user, I want to see detailed information about an institution, including its location on a map and all available contact numbers, so that I can choose the most effective way to contact it
US6	As a user, I want to access emergency response information and guidelines so that I know what initial steps to take before help arrives
US7	As a user, I would like to have the option to create an account and log in to the app so that I can save my personal preferences

To visualize user interactions with the application's main functionality, we utilize a Use Case Diagram, as illustrated in Figure 2. This diagram effectively represents the functional requirements identified in the User Stories.

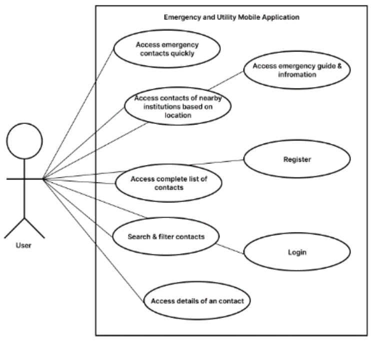

Figure 3. User Interaction Use Case Diagram

Table 2. Prioritized Product Backlog Items

Id	Backlog Item
PB1	Home (Quick access to emergency contacts)
PB2	Location & nearest agency
PB3	Complete list of agency contacts
PB4	Search & filter agencies
PB5	Agency details
PB6	Information & guidance
PB7	Authentication (login & register)

After the Product Backlog (PBI) has been defined and prioritized, the next stage is Sprint Planning. During this stage, the team establishes specific objectives, or Sprint Goals, and selects which PBIs will be worked on during a single Sprint cycle. Each selected PBI is then broken down into smaller technical tasks to ensure timely completion.

Table 3. Application Development Sprint Plan

Sprint	Sprint Goal	PBI
Sprint 1	Providing quick access to emergency contacts and nearby agencies	PB1, PB2
Sprint 2	Provides a complete list of emergency contacts as well as search and filter features	PB3, PB4
Sprint 3	Providing agency details and emergency guidance information	PB5, PB6
Sprint 4	Improving the user experience	PB7

Once planning is complete, development begins with a Sprint, which is a core work cycle of fixed duration (for example, two weeks). During this period, the team focuses entirely on developing the chosen Product Backlog Items (PBIs). Each feature must meet the team's Definition of Done (DoD) criteria before it can be reviewed. To maintain coordination and overcome obstacles, the team holds a Daily Scrum. This is a short meeting where each member provides a functional update: what was completed yesterday, what will be worked on today, and what obstacles are being faced. Once the Sprint work is complete, the team conducts a Sprint Review. During this review, the team demonstrates the functioning features to the product owner and stakeholders to obtain feedback. This feedback is used to adjust the priorities of the next product backlog. Finally, the team holds a Sprint Retrospective, which is an internal reflection session designed to identify what went well and what can be improved in terms of the work process. The results of this session are implemented as improvement measures in the next sprint.

2.3. System Testing Method

Testing is conducted to ensure the application meets both user expectations and technical reliability standards. This research employs a comprehensive testing strategy, covering three key aspects: usability, performance, and accuracy. First, usability testing is measured using the System Usability Scale (SUS) method. To ensure the application's reliability and effectiveness, a comprehensive testing strategy was employed, covering usability, performance, and accuracy. The usability testing involved 30 participants, primarily Batam residents aged 18-45, who operated the application on their personal Android devices to simulate a natural usage environment. Before completing the System Usability Scale (SUS) questionnaire, participants were required to execute specific task scenarios, identifying the nearest emergency unit based on their real-time location and retrieving facility details. In addition to subjective usability, technical performance was evaluated by measuring the Average Response Time (ART) for data retrieval, while location accuracy was validated by comparing the application's calculated distance against standard mapping services (Google Maps) to verify the correctness of the nearest-location sorting algorithm. After that, participants will be asked to answer a set of questions using a Likert scale ranging from 1 to 5. Refer to Table 4 for details.

Table 4. Questionnaires Statements

No	Statements
1	I think I will use this app often
2	I find this application too complicated to use
3	I find this application easy to use
4	I need help from someone else or a technician to be able to use this application
5	I feel that the various functions in this application are well integrated
6	I feel there are too many inconsistencies in this application
7	I feel that others will quickly understand how to use this application
8	I find this application very confusing to use
9	I feel confident using this application
10	I need to learn a lot before I can use this application

The results will be analyzed using the System Usability Scale (SUS) method, based on Formula 1 and the conclusions drawn from Figure 3.

$$\left[\sum_{i=odd}^{n} X_i - 1\right] + \left[\sum_{i=even}^{n} 5 - x_i\right] = SUS\ Score \tag{1}$$

For odd questions, X is reduced by 1. For even questions, X is reduced by the value given by the respondent. The respondent's value is subtracted from 5. Then, the sum is multiplied by 2.5 to obtain the final score.

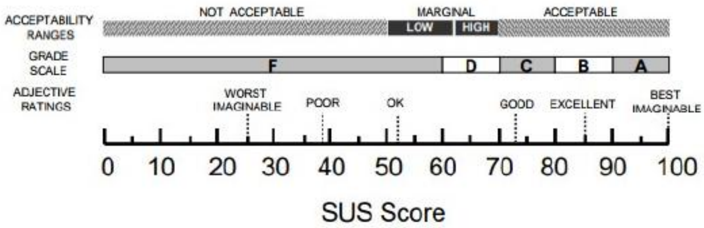

Figure 4. System Usability Scale (SUS)

Second, Performance Testing is conducted by measuring the Average Response Time (ART). This test aims to determine the system's speed in retrieving data from the server. The measurement focuses on the latency between the user's input and the application displaying the nearest emergency unit information. A low response time is critical for an emergency application to ensure rapid assistance.

Third, Accuracy Testing focuses on the reliability of the location-based service algorithms. This test compares the distance calculated by the application against the actual distance provided by standard mapping services (Google Maps). The goal is to verify that the system correctly identifies and sorts the nearest police stations or hospitals based on the user's real-time coordinates, ensuring the suggested emergency unit is genuinely the closest option available.

3. Result and Discussion

This section presents the results of designing and developing an emergency mobile application for Batam City, utilizing an integration of Design Thinking and Agile Scrum methodologies. The discussion is structured systematically, progressing from initial planning and feature implementation to final validation through usability (SUS), performance, and location accuracy testing to ensure system reliability.

3.1. Initial Planning

During the initial planning stage, we applied a user-centered Design Thinking methodology through three initial stages:

a. Emphatize

Insights from the interviews were used to support the research and guide the user interface design, summarized in an empathy map as shown in Table 5.

b. Define

At this stage, we analyze the insights from the Empathy Map to determine the root cause of the problem. The results are then compiled into a list of requirements, as shown in Table 6.

c. Ideate

To visualize this framework, we use a sitemap that outlines the hierarchy and relationships between pages in the user interface (UI) design.

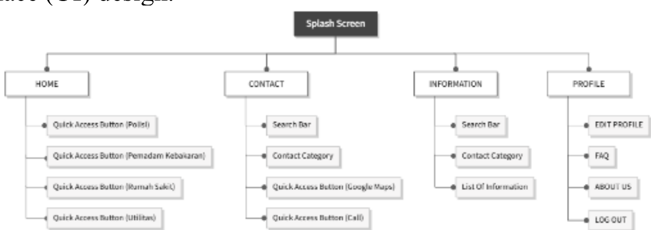

Figure 5. Framework Sitemap

3.2. User Interface Prototyping

Continuing the design process, the concept is realized as a high-fidelity prototype, which is then validated through testing sessions. These sessions evaluate the usability of the design by directly involving potential users.

a. Prototype

The prototype emphasizes accessibility and functionality in emergency situations. The main page features quick-access buttons for immediate contact with nearby emergency services. The Contact section centralizes essential numbers, and the Information page provides first aid guidelines. The Profile section enables users to manage their personal information.

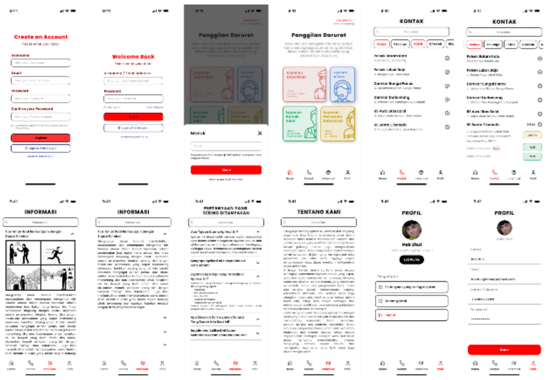

Figure 6. User Interface Prototype

b. Testing

Based on calculations from data collected from 30 respondents, the final results indicate an average System Usability Scale (SUS) score of 2,440. This yields an average SUS score of 81.33. According to the SUS scale, a score of 81.33 falls into the Grade A category, classified as "Excellent." These results demonstrate that the designed user interface (UI) prototype is highly usable. Users generally found the system to be easy to use, consistent, and straightforward.

3.3. Development Phase

Based on the results of the design and development of the prototype shown in Figure 6, the application was developed using the TypeScript programming language with the React Native library and Visual Studio Code as the IDE. The implementation of Agile Scrum allowed the development team to rapidly adapt to user feedback gathered during the Sprint Review phases. A significant iteration occurred between Sprint 1 and Sprint 2 regarding the core "Panic Button" interface. Initial testing revealed critical usability issues: users reported that the button size was too small, the color scheme lacked urgency (not prominent enough), and the button placement was confusing to locate quickly. Addressing this, the Product Backlog was immediately refined. In the subsequent sprint, the team prioritized redesigning the interface by enlarging the button, applying a high-contrast color to enhance visibility, and repositioning it to a more intuitive area of the screen. This adaptive process ensured that the final design was optimized for accessibility and speed, directly responding to real-world user needs. On the main page, users will immediately see a quick access menu.

Figure 7. Quick access screen

As shown in Figure 6, the quick access menu is displayed in the form of as several menu cards. By default, this menu displays emergency numbers for nearby agencies based on the user's current location.

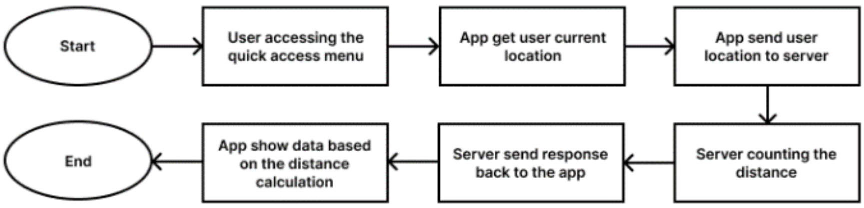

Figure 8. Quick access flowchart

In addition to the quick access menu, users can access a complete list of agencies, which available categories can filter. The list is sorted by the location closest to the user.

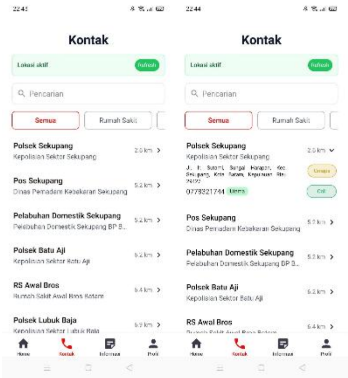

Figure 9. Contact list screen

Users can access guides and information on the information page, which provides tips and practical guides for first aid in case of an accident. They can also register an account on their profile page.

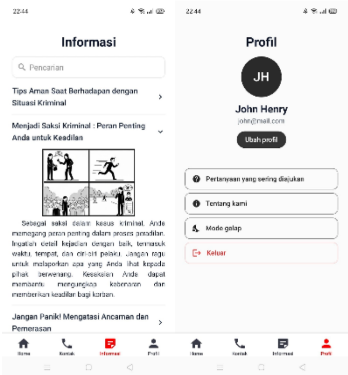

Figure 10. Information & profile screen

Functional validation of the system is performed through black box testing. This type of testing verifies that the application's output matches the expected results for each usage scenario, as outlined in Table 7.

Table 7. Black Box Testing

Test Case	Expected Results	Results
Access the main menu and emergency contacts	Quick access buttons appear and can be pressed	Valid
Activate user location	Nearby agencies appear based on the user's location	Valid
View the contact list and perform a search	The agency list appears, and the search results are accurate	Valid
Open agency details	Complete information and the list of numbers appear	Valid
Access emergency information & guidance	Emergency guides appear with relevant content	Valid
Login or register a user account	Users can login or register	Valid

3.4. System Testing

a. Usability Testing Result

After the development phase, a usability assessment was conducted involving 53 participants who were provided with a demonstration video and the application installation file (APK). Based on the collected responses, the application achieved a System Usability Scale (SUS) score of 88.82%, indicating an "Excellent" level of usability. This high achievement can be attributed to several influencing factors, particularly user characteristics; the majority of participants were "digital natives" aged 18-45 with high Android familiarity, which, combined with the simplified Design Thinking-based UI, minimized the learning curve. Furthermore, as local Batam residents directly affected by the limitations of the current manual system, their high "Perceived Usefulness" likely contributed positively to the satisfaction score.

In terms of comparative assessment, this high usability score distinguishes the application from generic mapping services (e.g., Google Maps) often used as a fallback for finding emergency locations. While generic apps offer vast data, they impose a high cognitive load—requiring users to type keywords, filter results, and visually interpret complex maps. In contrast, the 88.82% SUS score validates the effectiveness of the proposed "One-Tap" design strategy. By stripping away non-essential features and automating the "nearest location" sorting, this application significantly reduces the mental effort required, offering a superior user experience for high-stress emergency contexts compared to the multi-step navigation required by standard map applications.

Furthermore, this study offers a distinct perspective when compared to similar emergency application research conducted in other developing cities. While previous studies often prioritize backend optimization, such as the implementation of complex pathfinding algorithms for traffic routing, this research places greater emphasis on the Human-Computer Interaction (HCI) aspect through Design Thinking. Our findings suggest that in cities like Batam, where centralized command center infrastructures are less integrated than in capital regions, the primary user pain point is not merely route efficiency, but the accessibility and verification of information. By shifting the focus from algorithmic complexity to usability this research demonstrates that a simplified "One-Tap" interface is more effective for local adoption than feature-heavy systems often proposed in other metropolitan contexts

b. Performance Testing Result

Performance testing was conducted to measure the latency of the application in retrieving the nearest police station or hospital data. The test was performed using two connection types: Wi-Fi and 4G Mobile Data, with 10 trials for each scenario. The results are presented in Table 8.

Table 8. Average Response Time Testing

Network Type	Average Latency (ms)	Status
Wifi Connection	845 ms (0.84 s	Fast
4G Mobile Data	1,250 ms (1.25 s)	Acceptable
Average	1,047 ms (1.04 s)	Pass

As shown in Table 8, the average response time is approximately 1.04 seconds. According to standard mobile app performance metrics, a response time under 2 seconds is considered optimal for keeping user attention. In an emergency context, this speed ensures that users can access vital information almost instantly without significant delay.

c. Location Accuracy Result

To ensure the reliability of the location-based feature, accuracy testing was conducted by comparing the distance calculated by the application against the actual distance measured via Google Maps. The test was performed from three random user locations in Batam City. The results are shown in Table 9.

Table 9. Location Accuracy & Validation

User Location	Target Facility	App Distance (km)	Google Maps (km)	Deviation	Result
Batam Centre	RS Awal Bros	2.15 km	2.15 km	0 km	Accurate
Nagoya Hill	Polsek Lubuk Baja	1.20 km	1.22 km	0.02 km	Accurate
Sekupang Port	RSBP Batam	3.50 km	3.50 km	0 km	Accurate

The data in Table 9 demonstrates that the application has a very high accuracy rate with a negligible deviation (less than 20 meters). This confirms that the algorithm used to calculate distance and sort the nearest emergency units works correctly, ensuring users are always directed to the closest possible help.

3.5. Discussion

Interpretation of Usability Results based on Theory The System Usability Scale (SUS) score of 88.82 achieved in this study is not merely a quantitative metric but significantly reflects the theoretical quality of the interface. According to the interpretative ranges established by [20], this score positions the application in the "Excellent" category and corresponds to a "Grade A" scale, approaching the "Best Imaginable" standard. From a usability theory perspective, this high score validates that the "One-Tap" interface design successfully minimizes cognitive load. In the context of Human-Computer Interaction (HCI) for emergency systems, minimizing cognitive load is critical because users in panic situations experience a reduction in working memory capacity. The score indicates that the application meets the criteria for high "Learnability" and "Efficiency" (ISO 9241-11), meaning users can operate the system intuitively without a steep learning curve, which is the primary requirement for any life-saving technology.

Technical Reliability and Performance Complementing the usability findings, the technical performance test yielded an Average Response Time (ART) of 1.04 seconds. This result aligns with the "3-Second Rule" in web and mobile usability theory, which dictates that system feedback must occur instantly to maintain user flow and trust. The combination of an "Excellent" usability score and rapid technical response confirms that the application is not only easy to use but also robust enough to handle time-sensitive requests.

Practical Implications for the Batam City Government The findings of this study offer significant practical implications for the Batam City Government and related policymakers. Currently, emergency services in Batam are fragmented. The validated success of this integrated prototype suggests that the local government should consider shifting from a multi-channel manual reporting system to a unified digital ecosystem. Adopting this technology would support the "Batam Smart City" initiative by digitizing public safety infrastructure. Practically, implementing this system would allow responders (Police, Ambulance, Fire Dept) to bypass the time-consuming process of verbal location verification. This reduction in administrative time directly improves the "Golden Hour" response capability—the critical window where prompt medical or security intervention has the highest impact on saving lives. Therefore, this application serves as a feasible model for modernizing regional emergency management systems.

4. Conclusion

Research into the design and development of emergency and utility mobile applications for the City of Batam has successfully produced a prototype that is highly feasible and acceptable to users. The integration of Design Thinking and Agile Scrum methodologies facilitated the creation of solutions centered on real user needs, specifically addressing the demand for speed and ease of access in emergency situations. The application's acceptance was validated through the System Usability Scale (SUS) test, yielding a score of 88.82% ("Excellent"). Complementing this high usability, the technical assessment demonstrated system reliability with an Average Response Time (ART) of 1.04 seconds and precise location accuracy with negligible deviation. These results indicate that the developed application is not only functional but also a valid, reliable tool with great potential to improve the effectiveness of emergency response services in Batam City. Explicitly, these findings advocate for a policy shift within the Batam City Government to transition from fragmented manual reporting to a unified digital ecosystem, thereby directly supporting the operationalization of the 'Batam Smart City' roadmap.

However, while this research successfully validates the application's feasibility, it is important to acknowledge certain limitations. The usability testing was conducted with a sample of 53 participants, predominantly consisting of tech-savvy individuals in the productive age range. Consequently, these results may not fully represent the experience of elderly users or those with limited digital literacy. To address this and further enhance the system's effectiveness, future development should expand the demographic scope of testing and integrate features such as live maps and a direct communication module. These additions would allow real-time interaction between users and responders, providing immediate reassurance and critical situational updates.

5. Acknowledgement

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