SOFTWARE ENGINEERING PROJECT

ByStander

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Abstract

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Acknowledgement

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Chapter 1

Introduction

1.1 Background

Emergencies strike without warning, and panic often follows. When faced with danger, many people freeze or make poor decisions due to stress, potentially worsening outcomes for themselves and others. This natural stress response can prevent effective action precisely when clear thinking is most crucial.

In Thailand alone, emergency services receive over 4,300 calls daily (1.6 million annually), with traffic accidents (25.6%), unknown issues (20.4%), and medical emergencies like abdominal pain (10.6%) leading the statistics. These situations are particularly dangerous for vulnerable populations like children, the elderly, and those with existing medical conditions, who may require specialized attention during crises.

The consequences of delayed or ineffective emergency responses can be devastating: preventable injuries, loss of life, and lasting psychological trauma. Caregivers and bystanders, despite good intentions, may hesitate or act incorrectly due to emotional distress, leading to preventable harm. This gap between knowledge and action directly impacts survival rates and recovery outcomes.

Our smartphone application addresses this critical need by providing real-time emergency guidance through the technology already in users' pockets. By offering step-by-step instructions during crisis situations, clear direction to reduce panic, and specialized protocols for various emergencies, we can transform emergency response capabilities at the individual level. This research focuses on leveraging widely available mobile technology to improve emergency outcomes when every second counts.

1.2 Problem Statement

In emergency situations, the psychological phenomenon of stress-induced cognitive impairment presents a significant public health challenge. Despite the widespread availability of emergency protocols and safety guidelines, individuals frequently experience severe decision-making paralysis when confronted with high-stress scenarios. This cognitive disconnect—between theoretical knowledge and practical application under pressure—remains inadequately addressed in current emergency response systems.

Observed evidence indicates that approximately 80% of individuals experience significant mental processing disruptions during high-stress emergencies, manifesting as confusion, memory lapses, and decision-making hesitation. Furthermore, over 60% of people either freeze completely or make critical errors during emergencies, substantially reducing survival rates and positive outcomes. This phenomenon affects both untrained bystanders and individuals with prior emergency training, suggesting that traditional knowledge-based preparation may be insufficient.

This cognitive impairment is particularly problematic for caregivers of vulnerable populations, including those managing chronic conditions, elderly individuals, and children with special medical needs. The psychological pressure experienced by these caregivers can be even more pronounced, as the consequences of delayed or incorrect actions may be more severe for their dependents.

The gap between emergency knowledge and emergency performance represents a critical area for intervention. While considerable resources have been invested in emergency protocols, comparatively little attention has focused on overcoming the psychological barriers to implementing these protocols during actual emergencies. Our application aims to address this gap by examining the efficacy of real-time digital guidance systems in mitigating stress-induced cognitive impairment and improving emergency response outcomes across diverse scenarios and populations.

1.3 Solution Overview

Bystander is an AI-driven emergency assistance application designed to enhance response efficiency during critical situations. By leveraging real-time location data, the application identifies the most appropriate emergency contact, ensuring faster and more effective assistance. Instead of solely relying on a general emergency hotline, Bystander determines whether contacting local police, a nearby hospital, or specialized emergency services is the best course of action.

The core functionality of the application follows a structured process:

1. Incident Detection – When an emergency occurs, the app assists users in identifying the most suitable authority to contact.
2. Optimized Emergency Call Routing – The application recommends the fastest and most relevant emergency contact based on real-time location data.
3. Guided Response Actions – While awaiting professional assistance, users receive clear, step-by-step guidance to help manage the situation effectively.

1.3.1 Features

1. Real-Time Emergency Service Locator: Utilizes GPS tracking to determine whether calling the general emergency hotline or directly contacting a nearby hospital or police station is the best option.
2. AI-Generated Emergency Scripts: Automatically compiles a structured emergency report, including key details such as location and the nature of the incident, enabling clear and effective communication with responders.
3. Step-by-Step Emergency Guidance: Provides easy-to-follow instructions on handling various emergencies, such

as administering first aid or assessing an individual's condition before help arrives.

4. Community-Powered Guidance: Allows verified experts (e.g., medical professionals, emergency responders) to contribute video or text-based instructional content for different emergency scenarios. Content is categorized by emergency type (e.g., fire, traffic accident, medical emergencies) for ease of access.

1.4 Target User

ByStander is designed for individuals who are at a higher risk of facing emergencies and require immediate assistance in critical situations. The key target users include residents of Thailand who are prone to emergencies, such as those who live with elderly individuals or sick patients who may require urgent medical attention. Or general individuals who have a higher chance of encountering emergencies, including those who frequently drive at night or work in high-risk environments.

- Age Group: 15-60 years old, ensuring accessibility for teenagers, adults, and middle-aged individuals who may need emergency support.

- Skill Level: Users with basic knowledge of technology, ensuring that the application is simple and intuitive for individuals with minimal technical experience.

- Industry or Domain Knowledge: None required, as the application is designed for general use without requiring prior expertise in emergency response or healthcare.

1.5 Benefit

The app helps people in emergencies by providing faster response times, making it easy to contact the right service quickly. It also ensures clear communication by using AI to create easy-to-understand reports, so users can explain their situation even when they are panicked. The app gives immediate guidance with step-by-step instructions, helping users

know what to do while waiting for help. It's also user-friendly and easy to use, even during stressful situations. The Community Powered Guidance feature offers localized advice from trusted experts, giving users the most relevant and up-to-date information to help them respond effectively in any emergency.

1.6 Terminology

1. Emergency (situation): An unforeseen combination of circumstances or the resulting state that calls for immediate action.
2. Cognitive Impairment : Problems with a person's ability to think, learn, remember, use judgement, and make decisions. Signs of cognitive impairment include memory loss and trouble concentrating, completing tasks, understanding, remembering, following instructions, and solving problems. Other common signs may include changes in mood or behavior, loss of motivation, and being unaware of surroundings. Cognitive impairment may be mild or severe. There are many causes of cognitive impairment, including cancer and some cancer treatments.
3. Geotagging: Adding location information to something, like a picture or a post, so people know where it was taken or where something is happening.
4. Emergency Hotline: A special phone number you can call for immediate help during an emergency, like calling 911 for urgent situations.

Chapter 2

Literature Review and Related Work

In this chapter, describe other solutions/research that address the same topic as your project. If you are working on a software project, create a list of alternative solutions and analyze them in the competitor analysis section. If you are working on a research project, describe your related work research in the literature review section.

2.1 Competitor Analysis

These are the application with similar functionalities to ByStander

1. **ICE - In Case of Emergency**
   The ICE application is designed primarily to store emergency contacts and medical information, such as allergies and emergency contacts, for quick access during an emergency. While this is helpful for ensuring that medical details are available in emergencies, it lacks the real-time guidance that ByStander offers. ByStander, with its AI-driven system, not only helps identify the appropriate emergency contact but also provides dynamic, step-by-step guidance during an emergency situation, enhancing decision-making under stress.

2. **First Aid by American Red Cross**
   The Red Cross app offers clear instructions for first aid procedures, ranging from CPR to treating burns or fractures. While the instructions are easy to follow and offer a valuable resource for immediate medical emergencies, the app does not address other critical aspects of emergency response, such as choosing the right emergency service or location-based routing. ByStander distinguishes itself by offering real-time, optimized routing and expert-powered guidance, beyond just first aid.

3. **911 Assistance Apps**
   Several local and national emergency assistance apps allow users to call emergency services and provide real-time location data to responders. These apps, while useful in urgent situations, generally lack the intelligent, context-sensitive decision-making that ByStander offers. For instance, ByStander tailors its response to the nature of the emergency and the user's location, offering step-by-step guidance and helping to reduce cognitive strain under stress.

Feature	ICE - In Case of Emergency	First Aid by American Red Cross	911 Assistance Apps	ByStander
Emergency Contact Storage	Yes	No	Yes	No
Real-Time Location-Based Routing	No	No	Yes	Yes
Real-Time Emergency Guidance	No	Yes (first aid only)	No	Yes
Step-by-Step Instructions	No	Yes	No	Yes
AI-Driven Guidance	No	No	No	Yes
Expert-Powered Content	No	No	No	Yes
Emergency Service Contact	No	No	Yes	Yes (optimized, based on location and type)
Scope of Emergency Types	General (contact info)	Medical emergencies (first aid focused)	General emergencies (mainly police/fire)	Wide range (medical, accident, fire, etc.)
User-Friendliness	High	High	High	High
Target User	General public, with emphasis on contact info	Individuals needing first aid instructions	Individuals needing to contact emergency services	General public, with tailored guidance for all types of emergencies
Customization	No	No	No	Yes (context-sensitive, AI-based, expert content)

Table 2.1: Comparison of Emergency Assistance Applications

2.2 Literature Review

In emergency situations, panic often plays a critical role in exacerbating an individual's ability to respond effectively, potentially leading to poor decision-making and delays in seeking help. According to Aguirre (2005), panic can lead to a breakdown in communication, confusion, and hesitation, which worsens the outcomes in emergency scenarios. This psychological phenomenon is especially dangerous in high-stress situations, where quick and decisive action is crucial to minimize harm. Panic can disrupt normal cognitive processing, leading individuals to either freeze or make erratic decisions that are not based on a rational assessment of the situation [1]. Research also indicates that emergency evacuations and crises are significantly impacted by social psychology and the widespread tendency to panic, which can delay the response efforts and hinder the coordination of emergency services [1].

In emergency medical contexts, panic-related cognitive impairment becomes even more pronounced. Foldes-Busque et al. (2017) highlight the prevalence of emergency department (ED) visits triggered by panic attacks, particularly in patients presenting with non-cardiac chest pain. Their study found that a substantial portion of ED visits can be linked to panic attacks, suggesting that individuals experiencing psychological distress may seek emergency care unnecessarily, further overwhelming medical resources. This highlights the need for interventions that can reduce panic and support individuals in managing emergency situations more effectively [2].

Artificial intelligence (AI) has emerged as a promising technology in mitigating cognitive impairment during emergencies. AI offers the potential to enhance decision-making by providing real-time, actionable insights based on vast amounts of data, which can help individuals navigate stressful scenarios more effectively. Kirubarajan et al. (2020) reviewed the role of AI in emergency medicine, noting that AI technologies, such as machine learning and deep learning, can significantly improve the accuracy of diagnoses, particularly in the context of acute radiographic imaging and patient outcome predictions. These technologies help reduce cognitive overload by offering data-driven support that minimizes human error. Additionally, AI's ability to analyze data in real time could help in predicting emergency events or identifying critical issues, allowing for faster and more efficient interventions [3].

In the context of emergency response, mobile applications have become a key tool for enhancing real-time communication and decision-making. Several studies have demonstrated the benefits of mobile apps that utilize geolocation and other technologies to provide location-based emergency response. For instance, de Guzman and Ado (2014) developed a mobile emergency response application using geolocation for command centers, which allows emergency personnel to quickly identify the most critical situations based on geographic information. Similarly, Romano et al. (2016) explored how mobile apps could enable citizens to act as "human sensors" during emergencies by gathering real-time data from users on the ground. These applications help by offering step-by-step guidance for first responders and citizens, reducing the reliance on by-

standers' decision-making under stress and enhancing coordination among emergency teams [4, 5].

The integration of AI into mobile applications further amplifies their potential. Mobile apps that combine AI and machine learning capabilities can guide users through emergencies by providing personalized instructions based on real-time data, such as the user's location, the nature of the emergency, and previous emergency patterns. As Kiran Grant et al. (2020) explain, AI has transformative potential in emergency medicine by enabling faster and more accurate decisions, such as predicting patient outcomes and assisting in diagnostic processes. AI-enabled mobile applications could significantly improve the way users respond to medical emergencies by offering tailored, real-time guidance, thus alleviating the cognitive load and reducing the impact of panic on decision-making [6].

As research continues to evolve in both AI and mobile technology for emergency response, it is evident that these innovations have the potential to revolutionize the way individuals and emergency services handle crises. By reducing the cognitive impairments caused by panic and offering real-time, data-driven support, AI and mobile apps can significantly enhance emergency outcomes and improve response times [3, 6]. The development of mobile applications that integrate AI, like the one proposed in this research, offers a comprehensive solution to the challenges posed by panic and cognitive overload in emergency situations.

Chapter 3

Requirement Analysis

3.1 Stakeholder Analysis

1. **General Public (User)**
   Individuals who may face emergencies and need quick access to assistance. They rely on the app to locate help and receive clear, step-by-step guidance during critical situations.

2. **Caregivers, Family Members, and Parents**
   Those responsible for vulnerable individuals, such as the elderly, people with medical conditions, or children who cannot assist themselves. They require tailored instructions to handle emergencies effectively.

3. **Emergency Services (Indirect Stakeholders)**
   Police, hospitals, and first responders who receive emergency calls. The app provides structured reports to help them assess situations quickly and respond efficiently.

4. **Medical Professionals and Experts**
   Healthcare providers, paramedics, and first-aid trainers who contribute to emergency guidance. Their expertise ensures the information given to users is medically accurate and reliable.

5. **Developers**
   The team responsible for designing, building, and maintaining the app. They ensure that emergency detection, AI-generated reports, and user interaction are efficient, accurate, and accessible.

3.2 User Stories

1. **General Public (Users)**
    - I need to find the nearest emergency service quickly so I can receive help as soon as possible.
    - I want clear, step-by-step guidance so I can take the right actions while waiting for responders.
    - I need an emergency script to help me explain my situation clearly under stress.
2. **Caregivers, Family Members, and Parents**
    - I need emergency instructions tailored to my dependent's condition so I can respond appropriately.
    - I want to check if my dependents are safe during an emergency so I can assist them if needed.
    - I need simple, easy-to-follow steps so I can guide my dependent in an emergency without confusion.
3. **Emergency Services (Indirect Stakeholders)**
    - I need structured reports from users so I can quickly understand the situation before arriving.
4. **Medical Professionals & Experts**
    - I want to provide easy-to-follow instructions so people receive accurate, life-saving guidance.
    - I need to ensure emergency protocols in the app follow medical best practices.
5. **Developers**
    - I need to ensure the app runs smoothly so users can quickly access emergency guidance.
    - I want to improve the step-by-step instructions so they are clear, accurate, and easy to follow.

- I need to optimize AI-generated emergency scripts so users can communicate their situations effectively.
- I want to make the interface simple and intuitive so anyone, including children, can use it without confusion.

3.3 Use Case Diagram

<TIP: Write a use case diagram for your project here. Refer to an article “What is a use case diagram?” by Lucidchart for help./>

3.4 Use Case Model

A use case is a detailed description of how a system interacts with an external entity (such as a user or another system) to accomplish a specific goal. Use cases provide a high-level view of the functionality of a system and help in capturing and documenting its requirements from the perspective of end users.

<TIP: Write use cases for your project here. Make sure to use the appropriate type of use case for each scenario (brief, casual, and fully-dressed use case)./>

3.5 User Interface Design

<TIP: Put the initial design of your application here. You can showcase a detailed design of a specific page or a sitemap of your application. See an example below./>

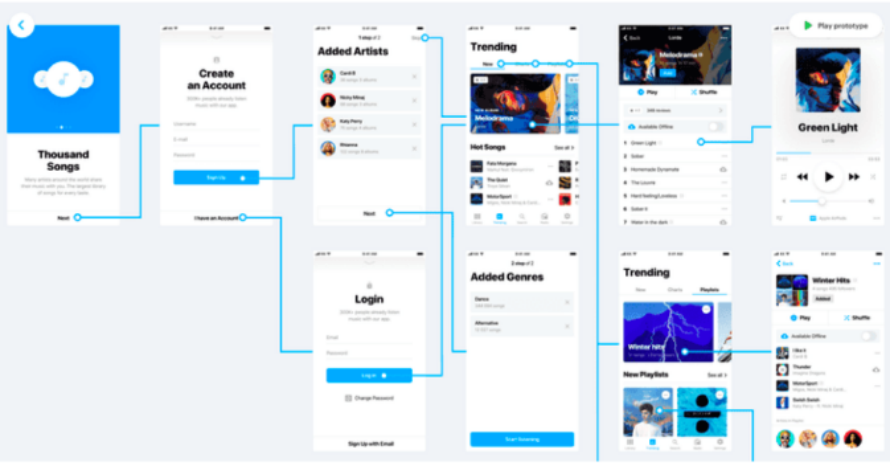

Figure 3.1: User Interface Design

Chapter 4

Software Architecture Design

<TIP: Describe how you design your application using Unified Modelling Language (UML). There should be at least two diagrams that describe the software architecture. You may add additional or remove unnecessary diagrams. However, there needs to be a coherency between them at the end./>

4.1 Domain Model

<TIP: Describe the business concept of your project. Showcase a domain model that captures the said concept./>

4.2 Design Class Diagram

<TIP: Showcase a design class diagram for your project and explain how it works here. You can group classes into packages or layers to communicate your design better./>

4.3 Sequence Diagram

<TIP: Sequence diagrams describe how the software runs at runtime. You do not have to create a sequence diagram for every scenario. However, there should be one for all the main ones./>

<ChatGPT: Creating a sequence diagram for every use case is not strictly necessary, but it can be a valuable tool in certain situations. Sequence diagrams are particularly useful for illustrating the interactions

between different components or objects in a system over time, showcasing the flow of messages or actions between them./>

4.4 Algorithm

<TIP: Optional, If you are working on a research project that proposes a new algorithm, you can describe your algorithm here. It can be in the form of pseudocode or any diagram that you deem appropriate./>

Chapter 5

Software Development

5.1 Software Development Methodology

<TIP: Describe your software development methodology in this section. />

5.2 Technology Stack

<TIP: Describe your technology stack here. See the following example from ThaiProgrammer.org />

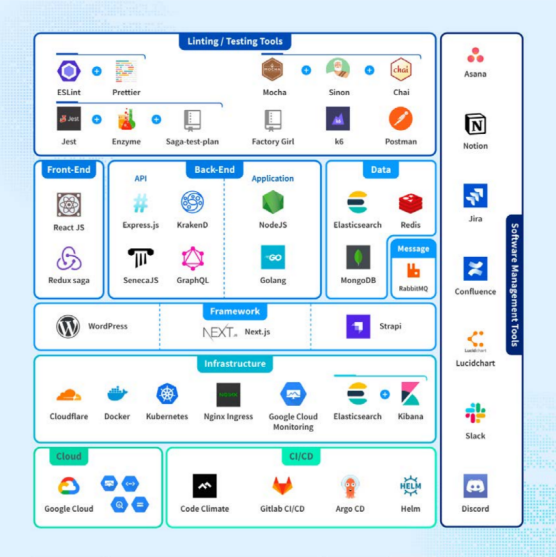

Figure 5.1: Example technology stack

5.3 Coding Standards

<TIP: Describe your coding standard for this project here. />

5.4 Progress Tracking Report

<TIP: Show that you have been working on this project overtime. It can be in the form of a burndown chart or a contribution graph from GitHub./>

Chapter 6

Deliverable

6.1 Software Solution

<TIP: Share a link to your Github repository. Showcase screenshots of the application and briefly describe each page here. />

6.2 Test Report

<TIP: Describe how you test your project. Place a test report here. If you use continuousintegration and deployment (CI/CD) tools, describe your CI/CD method here. />

Chapter 7

Conclusion and Discussion

<TIP: Discuss your work here. For example, you can discuss software patterns that you use in this project, software libraries, difficulties encountered during development, or any other topic. />

Reference

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[1] B. E. Aguirre, "Emergency evacuations, panic, and social psychology," *Psychiatry*, vol. 68, no. 2, pp. 121–129, 2005.

[2] G. Foldes-Busque, I. Denis, J. Poitras, R. P. Fleet, P. Archambault, and C. E. Dionne, "A closer look at the relationships between panic attacks, emergency department visits and non-cardiac chest pain," *Journal of Health Psychology*, vol. 24, no. 6, pp. 717–725, 2017.

[3] A. Kirubarajan, A. Taher, S. Khan, and S. Masood, "Artificial intelligence in emergency medicine: a scoping review," *JACEP Open*, vol. 1, no. 6, pp. 1691–1702, 2020.

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[6] K. Grant, A. McParland, S. Mehta, and A. D. Ackery, "Artificial intelligence in emergency medicine: Surmountable barriers with revolutionary potential," *Annals of Emergency Medicine*, vol. 75, no. 6, pp. 721–726, 2020. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0196064419314659

[7] Overleaf, "Learn latex in 30 minutes," https://www.overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes.

Appendix A

Appendix A: Example

<TIP: Put additional or supplementary information/data/figures in appendices. />

Appendix B

Appendix B: About LaTeX

LaTeX (stylized as LaTeX) is a software system for typesetting documents. LaTeX markup describes the content and layout of the document, as opposed to the formatted text found in WYSIWYG word processors like Google Docs, LibreOffice Writer, and Microsoft Word. The writer uses markup tagging conventions to define the general structure of a document, to stylize text throughout a document (such as bold and italics), and to add citations and cross-references.

LaTeX is widely used in academia for the communication and publication of scientific documents and technical note-taking in many fields, owing partially to its support for complex mathematical notation. It also has a prominent role in the preparation and publication of books and articles that contain complex multilingual materials, such as Arabic and Greek.

Overleaf has also provided a 30-minute guide on how you can get started on using LaTeX. [7]