SOFTWARE ENGINEERING PROJECT

ByStander
(Project Proposal)

BY

Worawalan Chatlatanagulchai
Sukprachoke Leelapisuth

DEPARTMENT OF COMPUTER ENGINEERING
FACULTY OF ENGINEERING
KASETSART UNIVERSITY

Academic Year 2025

ByStander
(Project Proposal)

BY

Worawalan Chatlatanagulchai
Sukprachoke Leelapisuth

This Project Submitted in Partial Fulfillment of the Requirement for Bachelor Degree of Engineering (Software Engineering)
Department of Computer Engineering, Faculty of Engineering KASERTSART UNIVERSITY
Academic Year 2025

Approved By:

Advisor . . . . **Date** . . . .
(Project Advisor's Name)

Co-Advisor . . . . **Date** . . . .
(Project Co-Advisor's Name)

Head of Department . . . . **Date** . . . .
(Head of Department's Name)

Abstract

Put your abstract paragraph here.

Acknowledgement

Put your acknowledgement paragraph here.

Worawalan Chatlatanagulchai
Sukprachoke Leelapisuth

Table of Contents

Content **Page**

List of Tables

List of Figures

Page

Chapter 1

Introduction

1.1 Background

In emergency situations, the critical nature of timely and effective response cannot be overstated. 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.

The statistical landscape in Thailand illustrates the magnitude of this challenge, with emergency services receiving over 4,300 calls daily (1.6 million annually). Traffic accidents account for (25.6%) of these emergencies, followed by unknown issues (20.4%), and medical emergencies like abdominal pain (10.6%). These statistics underscore the necessity for comprehensive and efficient emergency response systems to address these diverse and frequent crises.

When emergencies occur in unfamiliar settings or affect loved ones, people experience heightened levels of stress and panic. This emotional distress can significantly impair decision-making abilities. Many individuals don't know which emergency services to contact, and sometimes, calling general emergency hotlines can take longer than contacting nearby emergency facilities directly. However, unfamiliarity with local resources or simple lack of knowledge often prevents this more efficient approach.

The psychological impact of emergencies further complicates response effectiveness. People in crisis frequently struggle to communicate crucial information to emergency operators due to panic, making it difficult for responders to accurately locate the emergency and provide appropriate guidance. This communication breakdown can lead to critical delays in assistance.

In emergency situations, time is a decisive factor—a difference of just one minute can determine survival outcomes. Yet factors including panic, emotional distress over a loved one's condition, unfamiliarity with emergency protocols, or insufficient knowledge can all contribute to delayed or ineffective emergency responses by those first on the scene.

The consequences of these delays can be devastating: preventable injuries, loss of life, and lasting psychological trauma. Despite good intentions, caregivers and bystanders may hesitate or take incorrect actions due to emotional distress, resulting in preventable harm. This gap between emergency knowledge and emergency performance represents a critical area for intervention, as it directly impacts survival rates and recovery outcomes for those experiencing emergencies.

1.2 Problem Statement

Individuals experiencing emergencies face critical decision-making challenges when seconds count. These people—whether victims, caregivers, or bystanders—often experience overwhelming panic, stress, and anxiety that impair their ability to take effective action. This cognitive impairment is worsened by widespread lack of knowledge about appropriate emergency procedures and local resources, creating a dangerous gap between what people need to do and what they're actually capable of doing in crisis situations.

The problem becomes particularly severe during the initial moments of an emergency when time is the most critical factor. Without proper preparation, individuals waste precious minutes struggling to identify appropriate emergency contacts, communicate essential information clearly, or perform necessary first response actions. These delays occur precisely when rapid, decisive action would have the greatest impact on survival and recovery outcomes.

This issue demands attention because it directly affects matters of life and death. The consequences of ineffective emergency response extend beyond immediate physical harm to include long-term health complications, psychological trauma, and preventable fatalities. Furthermore, these negative outcomes disproportionately affect vulnerable populations such as children, the elderly, and those with existing medical conditions.

Given the unpredictable nature of emergencies and the universal cognitive limitations humans experience under extreme stress, a proactive solution that addresses preparation before emergencies occur represents the most promising approach. This leads us to consider how technology might bridge the gap between emergency knowledge and performance when it matters most.

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.

Bystander is designed to address three primary categories of emergencies:

1. Medical Emergencies: Covering situations ranging from cardiac events, strokes, and severe allergic reactions to childbirth complications, seizures, and diabetic emergencies

2. Accidental Emergencies: Addressing vehicle collisions, falls, drowning incidents, burns, electrical accidents, structural collapses, and hazardous material exposures.

3. Crime Emergencies: Providing support during active threats, assaults, robberies, domestic violence situations, and other scenarios requiring law enforcement intervention.

1.3.1 Features

1. **Speech-to-Text Emergency Detection**
   Users can press a "talk" button to speak into the application, which will transcribe their speech into text and use it analyze the transcribed text for emergency-related keywords (e.g., “choking”)

2. **Contextual Emergency Guidance Generation**
   Receive emergency-related keywords and generates step-by-step guidance or retrieves a life-saving instruction clip from the internet based on the context of the speech.

3. **Text-to-Speech for Guidance**
   After generating the emergency guidance, the application can convert the text-based instructions into speech for the user to follow hands-free.

4. **Emergency Facility Finder and Recommendations**
   The application uses location data to find nearby emergency services like hospitals, police stations, or emergency centers, and suggests which facility to contact first based on decision rules.

5. **Phone Operator Script Generation**
   The application generates a script for the user to speak to an operator based on the emergency’s context, using the keywords from the transcribed speech.

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 facing 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.
5. Emergency Response: The coordinated efforts and actions taken by individuals or services to address an emergency situation with the goal of minimizing harm.
6. Emergency Script: A script for people in emergency situations to speak to operators
7. Bystander Effect: A social psychological phenomenon where individuals are less likely to offer help in an emergency when others are present.

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

Current emergency response applications, while valuable, present significant limitations in addressing the complex challenges faced by individuals during crisis situations. A comprehensive analysis of existing solutions reveals critical gaps that ByStander aims to overcome with its innovative approach.

1. **JS100 Application (Android, iOS)**
   JS100 Application offers an SOS function that allows users to share their location during emergencies with a single tap. While the app effectively pinpoints a user's location for emergency services, it provides no guidance or contextual assistance during the emergency itself. This critical gap means users must rely solely on their own knowledge during stressful situations, potentially leading to poor decision-making when quick, informed actions are most needed. In contrast, ByStander not only facilitates emergency contact but delivers AI-driven, personalized guidance based on the emergency type, significantly improving outcomes by reducing panic and providing clear direction during critical moments.

2. **First Aid by American Red Cross**
   The First Aid by American Red Cross app provides users with easy-to-follow instructions for a variety of first aid procedures, such as

performing CPR, treating burns, fractures, and other common medical emergencies. While these instructions are clear and offer valuable assistance for immediate medical situations, the app falls short in addressing other critical aspects of emergency response. It does not provide guidance on selecting the correct emergency service or suggest the nearest facilities for assistance. In contrast, ByStander distinguishes itself by not only offering detailed first aid instructions but also providing real-time location-based routing and expert-powered guidance. This integration of dynamic response options enhances the app's utility in a broader range of emergencies, beyond just first aid.

3. **Emergency+ (Australia)**
   The Emergency+ app is a GPS-based service designed to help users locate the nearest emergency services in Australia. By using the user's current location, it allows them to quickly reach the correct emergency service provider. The app displays essential details like the address and contact number for services like police, fire, and ambulance. However, it does not provide the in-depth, real-time guidance or the AI-driven emergency assistance that ByStander offers. ByStander takes it a step further by offering location-based guidance and optimized decision-making based on the nature of the emergency, providing both immediate and actionable support.

ByStander addresses these limitations by integrating advanced technologies identified in current research with practical emergency response needs. Unlike existing applications, ByStander combines AI-driven decision support with location-based routing and expert-verified guidance to create a comprehensive emergency response system. Building on the findings of Kirubarajan et al. (2020) regarding AI's potential in emergency medicine, ByStander leverages artificial intelligence to provide real-time, actionable insights that can significantly reduce cognitive load during emergencies. This approach directly addresses the issues of panic-induced cognitive impairment highlighted in emergency response literature, offering users clear, contextually relevant guidance when they need it most.

Feature	ByStander	First Aid by American Red Cross	Emergency+ (Australia)	JS100 Application
First Aid Instructions	Comprehensive guidance	Detailed but static instructions	Basic information only	None
Emergency Service Selection	AI-assisted selection	Not available	Manual selection	One-button Alert System
Location-Based Routing	Real-time routing to nearest appropriate facility	Not available	Basic GPS location sharing	GPS location sharing only
AI-Driven Assistance	Personalized guidance based on emergency context	Not available	Not available	Not available
Panic Detection	Automatic detection of user distress	Not available	Not available	SOS button only
Step-by-Step Crisis Guidance	Dynamic guidance adapting to situation changes	Static instructions only	Not available	Not available
Community Expert Input	Localized guidance from verified experts	General information only	Not available	Not available
Stress-Resistant Interface	Specifically designed for high-stress usability	Standard interface	Standard interface	Basic interface

Multiple Emergency Types	Medical, accidental, and crime emergencies	Medical emergencies only	All types but limited guidance	NO specific categorization
Area of available	Thailand	United States	Australia	Thaland

Table 2.1: Comparison of Emergency Assistance Applications

2.2 Literature Review

Emergency situations create unique cognitive challenges that can significantly impair an individual's ability to respond effectively. [1] has documented how panic leads to communication breakdowns, confusion, and decision paralysis in emergency scenarios, highlighting the critical need for interventions that can offset these psychological limitations. This research underscores the importance of developing tools that can maintain rational decision-making capabilities even when users are experiencing extreme stress—a core design principle behind ByStander's interface and AI assistance system.

The prevalence of panic-induced decision-making in emergency contexts is further supported by [2], who found that a substantial portion of emergency department visits for non-cardiac chest pain are triggered by panic attacks. This research highlights how psychological distress can lead to resource misallocation in emergency medical services, reinforcing the need for applications like ByStander that can help users make more informed decisions about when and how to seek emergency assistance.

Artificial intelligence offers promising solutions to these challenges. [3] examined AI's role in emergency medicine, noting its potential to enhance diagnostic accuracy and reduce cognitive overload through data-driven support. Similarly, [4] highlighted AI's transformative potential in emergency medicine through faster and more accurate decision-making capabilities. These findings inform ByStander's AI-driven approach, which aims to provide users with personalized, real-time guidance based on emergency type, location, and historical patterns.

Voice recognition technology represents another critical component of emergency response systems. [5] explored speech-to-text recognition systems that can accurately convert spoken language into text, even in noisy environments. Their research demonstrates how such technology can be particularly valuable in emergency situations where manual input may be difficult or impossible. ByStander incorporates these findings by implementing voice recognition features that allow users to communicate emergency details hands-free, addressing scenarios where physical interaction with the device may be limited.

Decision-making algorithms in emergency contexts have been explored by [6]. Their research emphasizes how AI can effectively navigate complex decision trees to provide optimal recommendations based on multiple variables—a capability directly applicable to emergency response scenarios where numerous factors must be considered simultaneously. ByStander leverages this approach by implementing decision support algorithms that can rapidly assess emergency type, severity, l ocation, and available resources to recommend the most appropriate response actions.

The challenges of complexity in decision-making, particularly under stress, are further examined by [7]. This analysis highlights how cognitive load increases exponentially with decision complexity, and how this effect is amplified under stress—precisely the condition most emergency victims experience. ByStander addresses this challenge by simplifying complex decisions into manageable steps guided by AI, effectively reducing cognitive burden during crisis situations.

Regional research specific to Thailand's emergency response systems, such as the study by [8], provides valuable insights into local emergency service infrastructure and challenges. This research informs

ByStander's region-specific implementations, ensuring that the application is optimized for Thailand's unique emergency response ecosystem.

Finally, practical applications of AI in emergency response settings are documented by [9]. This analysis showcases successful implementations of AI technologies in emergency dispatch centers, highlighting significant improvements in response times and resource allocation. ByStander builds upon these proven concepts by extending AI assistance directly to users through a mobile interface, creating an end-to-end solution that bridges the gap between emergency victims and professional responders.

By synthesizing these research findings, ByStander creates a comprehensive approach to emergency response that addresses both the psychological limitations of users and the practical challenges of emergency service access. The application's integration of AI decision support, voice recognition, location-based routing, and stress-resistant interface design directly applies current research to create a solution that significantly improves emergency outcomes across multiple crisis scenarios.

Chapter 3

Requirement Analysis

3.1 Stakeholder Analysis

1. **People who are exposed to danger more than others**
   This group includes individuals whose lifestyle, occupation, health conditions, or environmental factors place them at elevated risk for emergencies. These stakeholders have a higher statistical likelihood of experiencing emergencies and often face them in challenging contexts. They need a solution that addresses their specific risk factors and can provide tailored guidance for their particular situations. By-Stander's AI-powered contextual awareness and specialized guidance for different emergency types directly addresses their elevated risk profile.

2. **Caregivers of a patient or family members**
   Those responsible for vulnerable individuals, such as the elderly, people with medical conditions, or children who cannot assist themselves. Caregivers often face high-stress emergency situations involving individuals with complex medical needs. They need specialized guidance that accounts for the specific conditions of those in their care. By-Stander provides condition-specific emergency protocols and can store critical medical information for quick retrieval during emergencies, allowing caregivers to respond more effectively while managing their own stress

3. **Emergency Sevice Operator**
   Police, hospitals, and first responders who receive emergency calls. Emergency operators face significant challenges in quickly gathering accurate information from callers who are often in panic states and

unable to communicate effectively. ByStander's ability to compile structured emergency reports with precise location data, automatically gather key medical information, and facilitate clearer communication directly addresses their operational challenges. The app becomes a valuable intermediary that improves information quality and reduces time-to-dispatch.

4. **Medical Professionals or Emergency Officers (Indirect Stakeholders)**
   Healthcare providers, paramedics, and first-aid trainers who contribute to emergency guidance. Though not direct users of the app, these professionals benefit significantly from the improved emergency response it facilitates. Some of them arrive at scenes where better initial actions have been taken, receive more complete information about the emergency, and encounter patients who have received appropriate preliminary care. This improves their ability to provide effective treatment and potentially leads to better outcomes.

3.2 User Stories

1. **People who are exposed to danger more than others**
   - As someone working in a high-risk environment, I want quick access to emergency procedures so I can provide proper care until professional help arrives.
   - As a person who frequently works alone, I need to easily identify which emergency service to contact first so I can ensure the fastest response in critical situations.
   - As someone who visits unfamiliar locations regularly, I want location-aware emergency facility recommendations so I can contact the closest appropriate help regardless of where I am.
   - As a worker in a hazardous industrial setting, I need pre-written emergency scripts for different types of accidents so I can provide precise details about chemical exposure or machinery injuries when under extreme stress.

2. **Caregivers of a patient or family members**
    - As someone responsible for a patient with mobility issues, I need location-based facility recommendations that consider accessibility so I can choose appropriate emergency services.
    - As a caregiver who may need to make quick decisions, I want clear step-by-step guidance for common emergency situations related to my patient's condition so I can act confidently during a crisis.
    - As someone caring for a non-verbal child with special needs, I want emergency scripts that include their specific diagnosis, behaviors, and needs so medical professionals can provide appropriate care immediately.
3. **Emergency Operator**
    - As an emergency operator handling diverse calls, I want callers to provide clear, structured information so I can quickly assess the situation and dispatch appropriate resources.
    - As someone coordinating emergency responses, I need callers to accurately communicate their location and the nature of the emergency so I can send the right help to the right place.
    - As an emergency responder coordinator, I need callers to understand which details are most important to share first so I can prioritize response appropriately.
    - As an operator handling calls from unfamiliar areas, I want callers to be aware of nearby emergency facilities so I can coordinate with the most appropriate local resources.
4. **Medical Professionals or Emergency Officers (Indirect Stakeholders)**
    - As an emergency responder arriving at a scene, I need civilians to have taken appropriate initial actions so the situation hasn't worsened during wait time.

- As a hospital emergency staff member, I want incoming patients to be directed to the most appropriate facility for their condition so resources are used efficiently across the healthcare system.
- As a medical professional dealing with time-sensitive emergencies, I want patients to arrive at facilities that can immediately address their specific needs so treatment isn't delayed by subsequent transfers.

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

This is the tentative UI design of ByStander

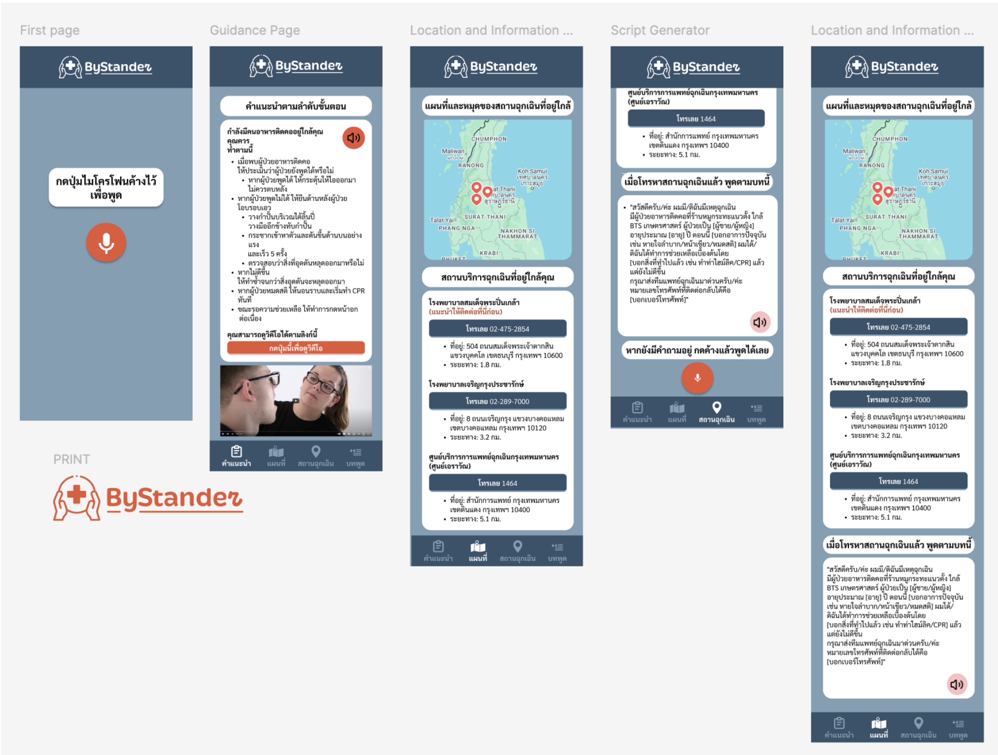

Figure 3.1: User Interface Design

Chapter 4

Software Architecture Design

4.1 Domain Model

4.2 Design Class Diagram

4.3 Sequence Diagram

4.4 Algorithm

4.5 AI component

The AI component forms the core intelligence of the emergency response system, providing speech recognition, emergency guidance, text-to-speech capabilities, facility recommendations, and communication assistance. This document outlines each feature's implementation and deployment strategy.

4.5.1 Feature 1: Speech-to-Text Emergency Detection

Input/Output

- Input: Voice recording of user describing emergency in Thai
- Output: Transcribed text and extracted emergency keywords

Processing Logic

1. Capture voice recording through device microphone
2. Preprocess audio for noise reduction and normalization

3. Send to Gowajee.ai API for Thai-optimized transcription
4. Process transcribed text through NLP pipeline for keyword extraction
5. Identify critical emergency terms using specialized medical lexicon
6. Classify emergency type based on extracted keywords

Model Used

- Primary Model: Gowajee.ai speech recognition model optimized for Thai language
- Secondary Model: BERT-based NLP model fine-tuned for Thai emergency keyword extraction
- Deployment Strategy: Cloud API with lightweight offline backup model

4.5.2 Feature 2: Contextual Emergency Guidance Generation

Input/Output

- Input: Transcribed text and extracted emergency keywords
- Output: Step-by-step emergency guidance text and related video references

Processing Logic

1. Analyze extracted keywords for emergency classification
2. Query emergency procedures database for relevant protocols
3. Generate contextually appropriate guidance based on emergency type
4. Structure output in clear, simple language optimized for crisis situations
5. Tag relevant instructional video content where applicable

Model Used

- Primary Model: Fine-tuned Deepseek LLM (7B parameter version)
- Training Dataset: Emergency procedures from Thai medical websites, first aid protocols, medical emergency keyword database

4.5.3 Feature 3: Text-to-Speech for Guidance

Input/Output

- Input: Generated emergency guidance text
- Output: Clear audio instructions in Thai language

Processing Logic

1. Optimize text for audio readability (punctuation, pauses)
2. Add SSML markup for emphasis on critical instructions
3. Process through TTS engine with emergency-appropriate voice profile
4. Stream audio for immediate playback while buffering remainder
5. Adjust speaking pace based on emergency type severity

Model Used

- Primary Model: Narakeet API with Thai language pack

4.5.4 Feature 4: Emergency Facility Finder and Recommendations

Input/Output

- Input: User's GPS location, emergency type, time of day
- Output: Prioritized list of appropriate emergency facilities with contact information and routing

Processing Logic

1. Query Google Maps API for nearby emergency facilities
2. Filter facilities based on emergency type compatibility
3. Apply multi-factor ranking algorithm considering:
   - Geographic proximity
   - Facility specialization relevance
   - Current availability based on time
   - Historical response efficiency
   - Traffic conditions
4. Generate recommendation list with clear reasoning
5. Prepare facility contact information and routing guidance

Model Used

- Primary Model: Deepseek LLM with geospatial processing extensions
- Integration: Google Maps API for location intelligence
- Dataset: Comprehensive emergency facility database for Thailand with capabilities matrix
- Algorithm: Weighted decision model with emergency-specific priority factors

4.5.5 Feature 5: Emergency Script Generator

Input/Output

- Input: Emergency type, user location, target facility, emergency details
- Output: Structured communication script for speaking with emergency operators

Processing Logic

1. Identify easy-to-reference landmarks near user location via Google Nearby Search
2. Select appropriate script template based on emergency type
3. Structure information in operator-preferred sequence:
   - Emergency type and severity
   - Location with landmark references
   - Victim status and key details
   - Requested assistance type
4. Optimize language for clarity in high-stress situations
5. Format script for easy reading during emergency call

Model Used

- Primary Model: Fine-tuned Deepseek LLM for script generation
- Integration: Google Maps API and Google Nearby Search
- Dataset: Script templates for different emergency types, landmark database
- Enhancement: RLHF training with emergency operator feedback

Chapter 5

AI Component Design

5.1 Business Context & AI integration

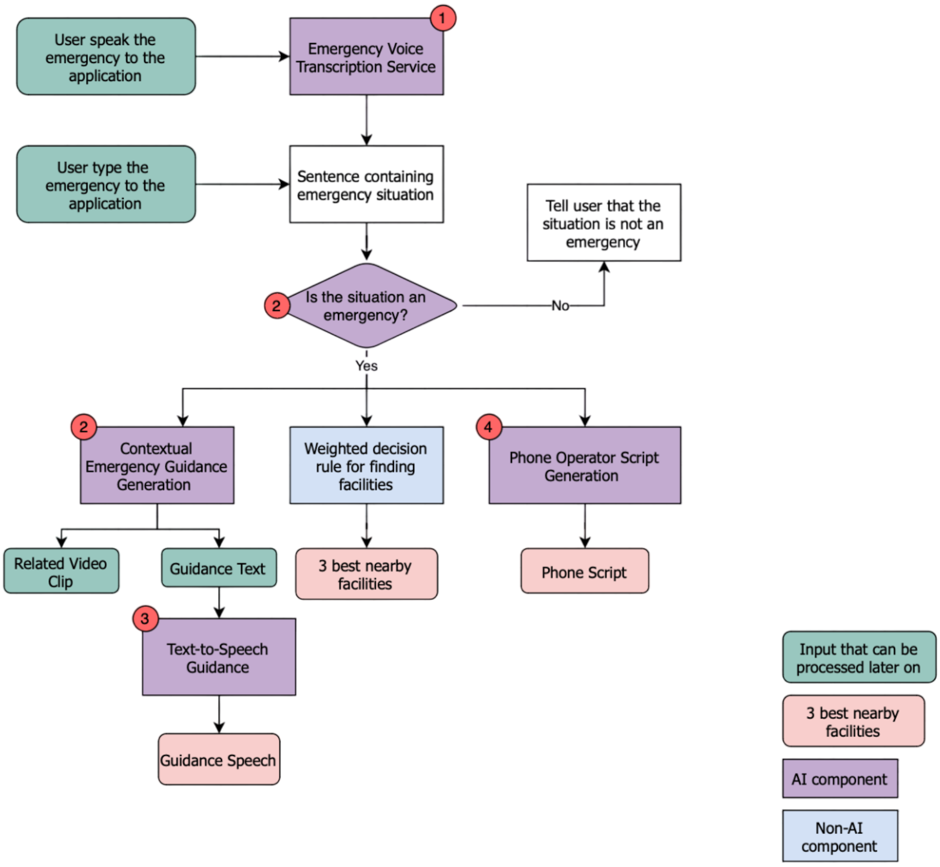

Figure 5.1: Business workflow including AI components and non-AI component part

AI components that will be used in the application:

5.1.1 Emergency Voice Transcription Service

In moments of crisis, individuals often find it significantly more challenging to type coherently than to speak. AI-driven STT addresses this by allowing users to verbally describe their emergency. This task is suitable for AI because real-world emergency speech is extraordinarily complex; it can be spoken rapidly under stressful situations, contain strong emotions, and occur in environments with background noise—all factors that make rule-based systems impractical.

Furthermore, the nuances of the Thai language, including tones and regional variations, add another layer of complexity that AI models are better equipped to learn and interpret.

While perfect transcription is the goal, an initial system might accept an accuracy of more than 80% of words that are correctly captured. Because even the texts are not 100% right, the AI model that will processed on this transcribed text will eventually be able to understand the context and give the accurate information to the users.

5.1.2 Contextual Emergency Guidance Generation

When facing an emergency, individuals often don't know the correct immediate actions to take and may be too panicked to search for reliable information.

This AI component will assess the situation described by the user, whether it's through transcribed speech or direct text input and determine if it constitutes an emergency, and then generate specific, actionable guidance with related video clips from the internet. The suitability of AI, such as a specific-to-giving-guidance Large Language Model (LLM), for this task stems from the immense scale and complexity of potential emergency scenarios. Each type of emergency has numerous variables and requires tailored responses that are difficult, if not impossible, to generate with predefined rules. An LLM can process the user's description, understand the context, and provide relevant instructions.

For this AI model, the tolerance for error in the guidance provided is extremely low. False or misleading information in a life-or-death situation is unacceptable, so the factual accuracy of the guidance must approach 100%.

5.1.3 Text-to-speech for guidance (TTS)

During high-stress events, users may find it difficult to read and process long text information. Offering an option for users to listen to the guidance instead of reading it can significantly improve understanding and user experience.

AI-powered TTS is ideal here because modern neural TTS models can produce highly natural, clear, and appropriately toned speech in Thai, which is far superior to robotic-sounding alternatives and beneficial to calm and effective understanding in a crisis.

While the core message must be perfectly conveyed, some minor imperfections that do not affect clarity might be acceptable, aiming for a high level of naturalness and digestibility, maybe above an 80-90% threshold as perceived by users.

5.1.4 Phone operator generation

When users need to contact official emergency services or specific facilities, they may struggle to clearly and concisely convey all necessary information, especially if they are disoriented or panicked, or have difficulty pinpointing their location.

This AI component will generate a personalized, structured script in Thai, containing all critical details for the user to read to the operator. AI is well-suited for this because it can dynamically get information such as the nature of the emergency (derived from earlier inputs) and the user's precise current location (obtained via device GPS) and use them to produce an effective message.

The accuracy of the information within this script—especially location, type of emergency, and number of people involved—must be near

100%, as this information is crucial for an effective emergency response by the authorities.

5.2 Goal Hierarchy

For each AI component, the goal hierarchy will be listed as follows:

5.2.1 Emergency Voice Transcription Service

- **System Goal:** Reliably and rapidly transcribe a user's spoken description of their emergency situation into Thai text, providing an intuitive and easy-to-use voice input interface.
- **User Goal:** To quickly and easily communicate their emergency to the application using their voice, without the need for typing, especially when under stress. Evaluate by collecting user feedback.
- **AI Model Goal:** To accurately convert spoken Thai words into text, demonstrating robustness against background noise, emotional speech, and varied accents (within Central Thai focus). Evaluated by using Word Error Rate (WER) which has to be below 20% (WER $<$ 20%) in noisy conditions and below 10% (WER $<$ 10%) in quieter conditions. The data collected for evaluating will come from transcribed diverse test sets of Thai speech recorded in various situations.

5.2.2 Contextual Emergency Guidance Generation

- **System Goal:** To provide users with clear, accurate, actionable, and contextually appropriate step-by-step emergency guidance in Thai and choose the right video for the user, immediately after an emergency is identified. This will be evaluated by the overall system success rate in delivering relevant guidance (target >98% based on expert review of simulated scenarios), time-to-display guidance from input submission (target <3 seconds), and UI/UX ratings for clarity and presentation of guidance (target >4/5 via user surveys).

- **User Goal:** To quickly understand what to do (and what not to do) to ensure their safety and manage the emergency situation effectively. This will be evaluated through user surveys on the guidance provided (target >90% correct understanding of critical steps), perceived usefulness surveys (target >4.5/5), and user-reported confidence scores after receiving guidance (target >4/5).
- **AI Model Goal:** To correctly classify the type and severity of the emergency (whether it's an emergency or not) based on textual input and generate accurate, relevant, and complete guidance with correct video clip. This will be evaluated by accuracy and safety of guidance content , relevance score (target >4.5/5 based on user ratings), completeness score (target >4.5/5 ensuring all critical steps are included, rated by experts), and, for internal classification step, an emergency type classification F1-score of >0.95. Evaluation data will come from response guidance data set from trusted sources.

5.2.3 Text-to-speech for guidance

- **System Goal:** To audibly deliver the generated emergency guidance to the user in a clear, natural-sounding, and easily understandable Thai voice, ensuring successful delivery of the audio stream. This will be evaluated by the feature adoption rate for TTS (users receiving guidance decide to listen), and task completion rate (percentage of users listening to the full guidance when initiated).
- **User Goal:** To listen to and comprehend the emergency guidance without needing to read text, allowing them to focus on their surroundings or actions. This will be evaluated by collecting user feedback on the listening experience (target >4/5 for satisfaction), perceived clarity (target >4/5), and preference over reading in a stressful situation (qualitative feedback and preference scores from surveys).
- **AI Model Goal:** To convert Thai text guidance into high-quality speech with natural intonation and pronunciation, ensuring understanding even in potentially noisy environments. This will be evaluated using a Mean Opinion Score (MOS) for naturalness and intel-

ligibility. Data for evaluation will be Thai text samples, including emergency-specific terms, assessed by Thai listeners.

5.2.4 Phone operator generation

- **System Goal:** To provide the user with a concise, accurate, and easy-to-read Thai script containing all critical information needed for an effective call to emergency services or a relevant facility. This will be evaluated by the script generation success rate (target >99% for valid inputs), and time-to-generate-script (target <2 seconds from request).

- **User Goal:** To feel confident and prepared to communicate all necessary details clearly and accurately when calling an emergency operator. This will be evaluated through user-reported confidence scores before and after script generation (target increase in confidence), perceived ease of communication using the script (target >4/5 in simulated call scenarios or post-actual use feedback), and user satisfaction surveys regarding script clarity and completeness from their perspective (target >4.2/5).

- **AI Model Goal:** To generate a personalized Thai script that accurately summarizes the emergency (type, severity, specific needs), user's precise location that is easy to understand for facility phone operator, number of people involved, and any other critical details, ensuring factual correctness of this information approaches 100%. This will be evaluated by the informational accuracy and completeness of the script (target 100% for critical facts like location and emergency type, as verified by expert review against checklists), conciseness (qualitative expert rating), and adherence to standard Thai emergency communication protocols (expert rating >4.5/5). Evaluation data will come from human reviews of scripts generated for diverse scenarios according to the correct script.

5.3 Task Requirements Analysis using AI Canvas

5.3.1 AI Task Requirements:

For each AI component, the goal hierarchy will be listed as follows:

Emergency Voice Transcription Service

- **REQ (Requirement):** The AI must accurately convert a user's spoken description of an emergency, delivered in Central Thai, into accurate Thai text, even when there is moderate background noise or emotional speeches spoken.
- **SPEC (Specification):** The system will use a speech recognition model. This model will process real-time audio input from the device's microphone. It will incorporate techniques for noise reduction and be robust to variations in speech rate and emotional tone common in emergencies. The output will be a string of Thai text.
- **ENV (Environment):** The speech must be in the central Thai language. The environment can contain some noise but not too much to the point that the model can't detect any words.

Contextual Emergency Guidance Generation

- **REQ (Requirement):** The AI must analyze the user-provided description of their situation (either typed or from STT), accurately identify the nature and potential severity of the emergency, and generate appropriate, actionable, step-by-step guidance in clear and simple Thai. It should also be able to recognize non-emergency queries. It should also be able to find the correct video clip relating to the context of the emergency.
- **SPEC (Specification):** This component will utilize a Large Language Model (LLM), which is a fine-tuned version of the Claude model. The LLM will be trained and fine-tuned on a knowledge base of Thai emergency procedures, first aid guidelines, safety protocols. It

will process Thai text input and output a structured set of guidance steps with a related video clip. The system should include safeguards against generating harmful or incorrect advice.

- **ENV (Environment):** The AI receives Thai text input which may be imperfect (e.g., typos from typed input, transcription errors from STT, vague or incomplete descriptions from a panicked user). The system must be able to handle a wide spectrum of emergency types prevalent in Thailand (e.g., traffic accidents, medical emergencies like heart attack/stroke, fires). The output guidance must be easily digestible on a mobile screen.

Text-to-speech for guidance

- **REQ (Requirement):** The AI must convert the Thai textual emergency guidance generated by the system into clear, natural-sounding, and easily understandable spoken Thai.
- **SPEC (Specification):** An AI-based Text-to-Speech (TTS) engine optimized for the Thai language will be used. It will take Thai text strings (the guidance steps) as input and synthesize high-quality audio output. The voice should have a calm, clear, and reassuring tone. Options for adjusting speaking rate could be considered.
- **ENV (Environment):** The AI receives Thai text as input from the guidance generation feature. The output is audio played through the device's speaker or connected headphones. The user might be listening in a noisy or distracting environment, emphasizing the need for clarity.

Phone operator generation

- **REQ (Requirement):** The AI must generate a concise, factually accurate, and easy-to-read script in Thai that the user can relay to an emergency phone operator or other relevant facility. The script must include all critical information.

- **SPEC (Specification):** This will use an LLM model, prompted with the specific emergency details (derived from user input/STT) and easy-to-understand location data (from device GPS, potentially augmented by Google Maps/Nearby Places API for landmark identification). The LLM will be instructed to structure this information into a standardized format suitable for Thai emergency dispatchers, prioritizing key details like "What is the emergency?", "Where is it?", "Who is involved?", "What is the current status?".

- **ENV (Environment):** The AI requires access to the user's location data (with permission) and the summarized details of the emergency. Input includes the type of emergency and precise location coordinates/address.

5.4 User Experience Design with AI

Table 5.1: Interaction Styles for AI Features

AI feature name	**Interaction Style**
Emergency Voice Transcription Service	Automate Style
Contextual Emergency Guidance Generation	Prompt Style
Text-to-Speech for Guidance	Annotate Style
Phone Operator Generation	Prompt Style

This is the UI design of the voice detection page. The user can press the button to start the voice detection and then the AI will transcribe the voice to text and show it on the screen. The user can also press the button again to stop the voice detection. Or the user can type the text in the text box and then press the button to start the AI to generate the emergency guidance.

This is the UI design of the contextual emergency guidance generation page. The user can see the emergency guidance and the video clip that is related to the emergency. The user can also press the button to listen to the guidance.

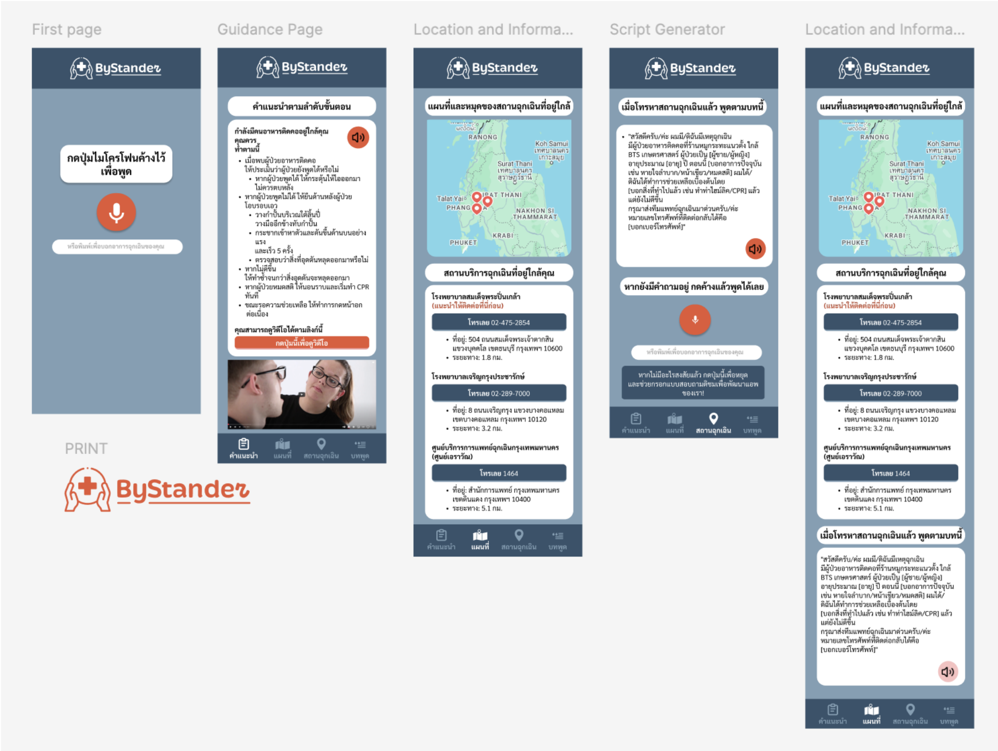

Figure 5.2: Overall UI design of ByStander

This is the UI design of the phone operator generation page. The user can see the script that the AI generated for them to read to the operator.

When the user is done with the process, they can press the button to complete and the app will direct user to the survey page.

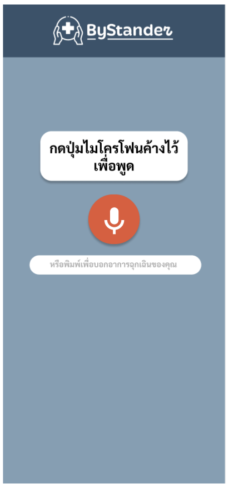

Figure 5.3: Emergency Voice Transcription Service UI

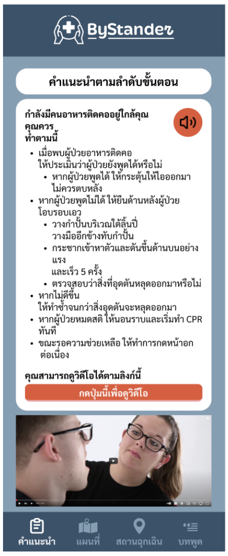

Figure 5.4: Contextual Emergency Guidance Generation with Text-to-Speech for Guidance Service UI

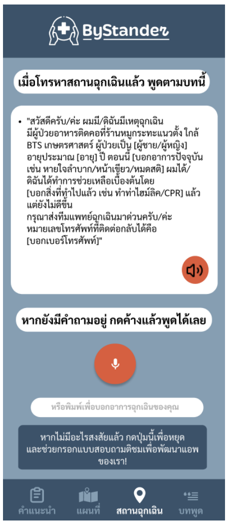

Figure 5.5: Phone Operator Generation UI

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

Bibliography

[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.

[4] 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

[5] “Voice recognition system: Speech-to-text,” https://www.researchgate.net/publication/304651244_VOICE_RECOGNITION_SYSTEM_SPEECH-TO-TEXT.

[6] “Artificial intelligence for decision making.”

[7] S. R. Bobo, “The weight of complexity in decision making.”

[8] “Ai in emergency response.”

[9] “How can ai improve emergency response?”

[10] 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. [10]