# DEVELOPMENT OF VISUAL ANALYTICS FOR UMP CENTRALIZED EMERGENCY RESPONSE AND DISASTER ASSISTANCE SYSTEM (CERDAS)

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# Development Of Visual Analytics for UMP Centralized Emergency Response And Disaster Assistance System

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Thesis submitted in fulfillment of the requirements
for the award of the degree of
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Thank you all for your invaluable contributions and for being a part of my academic journey at UMP.

# ABSTRAK

Penggunaan data analytics sangat penting dalam menyelamatkan nyawa semasa kecemasan bukan sahaja di hospital tetapi juga di kolej dan universiti. Kegagalan mengenal pasti risiko dan mengambil tindakan segera semasa bencana dan keadaan kecemasan boleh menyebabkan kerugian nyawa dan harta benda bagi komuniti kampus. Kajian ini bertujuan untuk mengkaji kebolehpercayaan penggunaan data analytics untuk mengurangkan risiko yang berkaitan dengan bencana dan keadaan kecemasan di kampus. Prototaip sistem pelaporan dalam talian telah dibangunkan menggunakan perkhidmatan awan untuk mengumpul data yang berkaitan, menganalisisnya, dan memaparkan maklumat dalam papan pemuka dalam talian untuk membuat keputusan yang berinformasi. Kajian ini menunjukkan bahawa penggunaan papan pemuka mempunyai potensi yang tinggi untuk secara berkesan mengurangkan risiko dan mengenal pasti strategi campur tangan yang sesuai. Kajian ini menyumbang kepada usaha berterusan untuk meningkatkan perancangan dan pengurusan tindak balas kecemasan di institusi pengajian tinggi dan boleh digunakan pada universiti dan kumpulan komuniti besar lain untuk meningkatkan kebolehpasaran tindak balas bencana dan keadaan kecemasan mereka.

## ABSTRACT

It is essential to save lives during emergencies not only in hospitals but also in colleges and universities. Failure to identify risks and take prompt action during catastrophes and emergency situations could result in the loss of life and property for the campus community. This research aims to explore the feasibility of using data analytics to mitigate the risks associated with disasters and emergencies on campus. A prototype of an online reporting system was developed using cloud services to collect relevant data, analyze it, and present the information in an online dashboard for stakeholders to make informed decisions. The study shows that the use of dashboards has a high potential for effectively mitigating risks and identifying appropriate intervention strategies. This research contributes to the ongoing efforts to improve emergency response planning and management in higher education institutions and can be applied to other universities and large community groups to enhance their disaster and emergency response preparedness.

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| | |
|---|---|
| ADDIE | Analysis, Design, Development, Implementation, Evaluation |
| API | Application Programming Interface |
| CERDAS | Centralized Emergency Response and Disaster Assistance System |
| CFS | Centre for Foundation Studies |
| CIGC | Centre for Industrial and Government Collaboration |
| DDR | Design & Development Research |
| EDUUSM | Department of Emergency Medicine at Hospital Sains Malaysia |
| FK | Faculty of Computing |
| FKM | Faculty of Mechanical Engineering |
| GPS | Global Positioning System |
| IIUM | International Islamic Universit Malaysia |
| IMK | Engineering Mathematics Institute |
| LDA | Latent Dirichlet Allocation |
| NADMA | National Disaster Management Agency |
| Power BI | Power Business Intelligence |
| SNS | Simple Notification System |
| UMP | Universiti Malaysia Pahang |
| UniMap | Universiti Malaysia Perlis |
| USM | Universiti Sains Malaysia |
| UUM | Universiti Utara Malaysia |
| WHO | World Health Organization |

# CHAPTER 1

# INTRODUCTION

## 1.1 Introduction

Some higher education institutions possess specialized physical facilities, making them distinctive. They serve both teaching and research purposes, generate employment and economic benefits within their local and regional communities, and offer essential services like medical care and laboratory functions. In essence, universities operate as self-sufficient communities that provide various amenities, including housing facilities, food services, small businesses (such as retail stores and printing presses), and even hospitals (Ayanian & Weissman, 2002). However, they are also vulnerable to emergencies like natural disasters and man-made crises, which can impact their ability to function effectively such as earthquakes (Koshiba & Nakayama, 2021) and flood (Ke et al., 2023), chemical explosion (Balla et al., 2021) and cyber-attacks (Kassem et al., 2019). In addition, health emergencies such as pandemics and outbreaks of contagious diseases can also pose significant risks to campus communities (Bokszczanin et al., 2023; Schmitt et al., 2021; Xiong et al., 2020). For instance, on June 26, 2014, a fire broke out at Mahallah Abu Bakar in the Centre for Foundation Studies (CFS) on the campus of the International Islamic University Malaysia (IIUM) in Section 17, Petaling Jaya. Also on October 5, 2017, a fire broke out on the second floor of a three-story building that houses the Centre for Industrial and Government Collaboration and Engineering Mathematics Institute (CIGC and IMK) at the main campus of Universiti Malaysia Perlis (UniMAP). On the morning of August 27, 2019, a fire broke out at University Malaya. In addition, on July 20, 2021, four rooms on the third floor of the Universiti Utara Malaysia (UUM) student accommodation building in Sintok were destroyed in a fire this morning. A student from the School of Education Studies at Universiti Sains Malaysia (USM) was found dead on April 27, 2022, two days after he was suspected to have fallen from the eighth floor of Desa Siswa Tekun.

An emergency can be defined as a sudden, unforeseen, and typically dangerous situation that poses an immediate threat to health, life, property, or the environment and necessitates prompt action(Sarwar, 2018). Campus emergencies, ranging from natural disasters to man-made crises, can severely affect the safety and well-being of students, faculty, and staff. Figure 1.1 demonstrates various types of campus emergencies along with their corresponding examples. Natural disasters like floods, earthquakes, tornadoes, and wildfires can cause significant damage to buildings and infrastructure, leading to transportation disruptions, power outages, and water shortages(Toya & Skidmore, 2007). They can also result in serious injury and loss of life if people are not prepared or evacuated in time. In the context of students, transportation disruptions during floods can have a significant impact on their ability to access food. If food distribution channels are limited or supply chains are disrupted, it can make it difficult for students to purchase affordable and nutritious food. As a result, they may have to resort to eating less nutritious or more expensive food, or even go without food altogether. Furthermore, if transportation disruptions prevent emergency food aid from reaching affected areas, students who are already facing food insecurity may be at an even greater risk of going hungry. This can have a significant impact on their physical and mental health(Othman et al., 2022), as well as their overall wellbeing.

Man-made disasters, such as accidents, acts of terrorism, or violence, can also cause harm to people and property, and immediate emergency response measures may be required(Park, 2011). Examples of such disasters include chemical explosions(Morshidi et al., 2018; Mulcahy et al., 2013), mass shootings(Kowalski et al., 2021), and cyber-attacks(Ramim & Levy, 1 C.E.). Furthermore, the call for digital transformation of higher education has increased the vulnerability to cyber-attacks as universities become more reliant on technology especially for academic operation. As a result, universities have experienced significant data breaches involving the personal information of students, staff, and alumni. For example, in 2018, a hack of the University of Yale in the United States put the personal information, including social security numbers and addresses, of 119,000 students and staff at risk(Hailey Fuchs, 2018). Such cyberthreats not only disrupt educational processes and create barriers to learning, but are highly potent to cause significant emotional distress and trauma. This can affect their academic performance, mental health, and overall sense of student’s wellbeing.

Hybrid disasters, which are a combination of natural and man-made disasters, can have compounded effects and are more complex to respond to. Covid-19 can be considered a type of hybrid disaster because it has both natural and human-made elements. On the one hand, it is caused by a natural virus that originated in animals and spread to humans(A. Zhu et al., 2023). On the other hand, its impact has been intensified by human activities such as international travel(Hohlfeld et al., 2022) and the lack of effective public health measures(Ullah & Harrigan, 2022) in some areas. Furthermore, the pandemic has led to various other disasters, such as economic downturns (Hyman et al., 2021) and social unrest(Warsame & Price, 2021), which are also man-made disasters extending the critical impact on higher education. The pandemic has also created significant mental health challenges for students. The stress and uncertainty of the pandemic, coupled with the social isolation and disruption to routine, have led to an increase in anxiety, depression, and other mental health issues(Bokszczanin et al., 2023). The impact of campus emergencies' events can be severe and long-lasting. Some of the other consequences include:

1. Loss of life and injury: Emergencies can cause injuries and loss of life, particularly if individuals are not properly prepared, treated or evacuated. For example, three students in China die in laboratory explosion (Zhuang Pinghui, 2018).
2. Property damage: Emergencies can cause significant damage to buildings and infrastructure, leading to disruptions in transportation, power outages, and water shortages. For example, Tropical Storm Allison caused 10 million gallons of water inundated the UTHSC-H Medical School basement, resulting in over 1 million gross square feet of space being unusable for several months(Goodwin & Donaho, 2010).
3. Reputation damage: Emergencies can damage the reputation of the institution and negatively impact the enrollment of future students.
4. Legal liabilities: Emergencies can lead to legal liabilities, such as lawsuits from individuals who were harmed or injured during the event.

Higher education institutions should prioritize the safety and wellbeing of their communities, recognizing that human life is priceless and that recovery from injuries can take a significant amount of time. Even though structures and objects can be reconstructed or replaced, the loss of life or the impact of an injury can have a long-lasting effect on the individuals involved and their loved ones. Therefore, it is crucial to invest in emergency response systems that can provide a swift response to emergency situations on campus.

An emergency response system in higher education refers to a comprehensive set of policies, procedures, and resources put in place to address emergency situations on a college or university campus. These systems are designed to provide a rapid response to emergency situations, including natural disasters, medical emergencies, and violent incidents, with the goal of ensuring the safety and security of students, faculty, staff, and visitors. The significance of an emergency response system in higher education cannot be overstated since environment in campuses are dynamic with thousands of people living, learning, and working in close proximity to each other(R. Zhu et al., 2020). One of the significant challenges is the need to communicate effectively during emergencies. Higher education institutions may have large and diverse populations, including students, faculty, staff, and visitors, which can make communication challenging. Effective emergency response in higher education requires a multi-faceted approach that includes comprehensive planning, training, and resources(Song et al., 2022). Educational institutions should have clear and regularly reviewed emergency plans in place, as well as robust communication protocols and systems. In addition, there should be adequate resources dedicated to emergency response, including personnel, equipment, funding and technology.

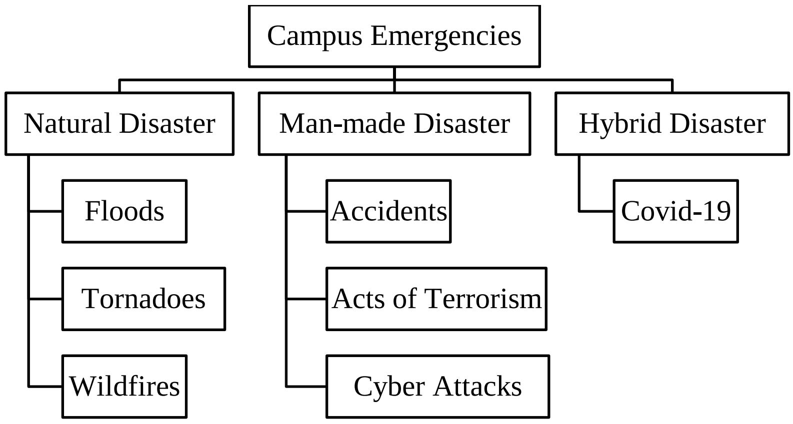



Figure 1.1: Types of Campus Emergencies

## 1.2 Problem Statement

There are several challenges remaining in the emergency response and disaster assistance system. The process of collecting data for emergency response and disaster assistance generates a massive amount of information, including reports, images, videos, and audio that cover various aspects of emergency and disaster situations(Pettet et al., 2022). Unfortunately, the sheer volume of this data often overwhelms emergency agents who lack the necessary tools to filter or refine it for future use. As a result, they may struggle to identify trends or patterns in the data, leading to delays in decision-making or even misinterpretation. In addition to the challenges mentioned earlier, the continued use of conventional and paper-based reporting systems as a primary practice in emergency response and disaster assistance can compound existing issues. Although these approach practically workable and less relying on technologies, these methods of data collection and reporting can be time-consuming and prone to errors, further exacerbating the challenges faced by emergency agents, personnel and victim. This can result in further delays in decision-making and potentially cause critical information to be lost or misinterpreted. There are several issues that can arise in emergency response systems:

1. Communication failures: Communication failures between emergency responders and victims or between different agencies can hinder the effectiveness of emergency response efforts.
2. Resource allocation: Emergency response efforts require the allocation of resources such as personnel, equipment, and supplies. Inadequate resource allocation can lead to delays or insufficient response efforts.
3. Inadequate training: Emergency responders must have adequate training to respond effectively to different types of emergencies. Inadequate training can lead to mistakes and ineffective response efforts.
4. Coordination difficulties: Emergency response efforts often involve multiple agencies and organizations, and coordinating their efforts can be challenging. Lack of coordination can result in duplication of efforts or conflicting response strategies.
5. Limited accessibility: People with disabilities or limited mobility may have difficulty accessing emergency services or evacuating during emergencies. Emergency response systems must be accessible to all members of the community.

6. Technological limitations: Emergency response systems rely heavily on technology, and technical failures or limitations can hinder their effectiveness. It is essential to have backup systems and contingency plans in place to address technical issues.

It is therefore crucial to develop and adopt modern and efficient systems for data collection, analysis, and reporting to improve emergency response and disaster assistance. To achieve the goal of improving emergency response and disaster assistance, implementing an information system that utilizes data-driven decision making appears to be a promising strategy.

## 1.3 Research Objectives

- To study the way of identifying key parameters for UMP Centralized Emergency Respond and Disaster Assistance System (CERDAS)

- To develop a dashboard to analyse the collected emergency and disaster data.

- To evaluate the effectiveness of developed dashboard on analysing emergency and disaster data.

## 1.4 Research Question

- What type of campus emergencies and disasters occurred?
- How significant is an online dashboard for emergency and disaster situations on campus?
- Which visualization techniques are critical and effective for emergency responses on campus?

## 1.5 Scope

- This research is focus on emergency and disaster cases that occur inside Universiti Malaysia Pahang, Pekan Campus.
- The system is intended for use by every UMP community.

## 1.6 Thesis Organization

This thesis consists of five chapters.

Chapter 1 discusses the introduction to the project which include the justification for project problem statement, its objective and scope.

Chapter 2 explains and discusses the literature review, which examines and compares similar current systems based on their characteristics, benefits, and drawbacks.

Chapter 3 discusses the project's general methodology. This chapter briefly justifies the methodology employed during the project's development. In addition, this chapter describes the methodologies, software, and hardware employed.

Chapter 4 discusses the project's implementation. This chapter will describe the development and implementation of the dashboard.

Chapter 5 would be a summary of the project's findings as well as a discussion of future dashboard enhancements that could be implemented.

# CHAPTER 2

# TECHNICAL AND FORMATTING SPECIFICATIONS

## 2.1 Introduction

Various researchers have developed approaches and instruments to promote the development of emergency and disaster support systems. In order to have a better knowledge of how the system was established by others, an analysis of the existing emergency response and disaster assistance system has been conducted to identify the system's features, benefits, and drawbacks.

## 2.2 Existing System/ Works

Three research-proposed existing systems have been chosen for examination in the establishment of an emergency response and disaster aid system.

### 2.2.1 RescueMark: Visual Analytics of Social Media for Guiding Emergency Response in Disaster Situations

According to (Jeitler et al., 2019), RescueMark, a web-based visual analytics instrument for analysing disaster scenarios and directing emergency action. In emergency scenarios, operators must make prompt and effective judgments to resolve important problems. RescueMark delivers geographical, topical, and temporal event analysis to enable resource allocation decisions and the identification of damaged metropolitan regions. The author presents the social media data analysis and visualisation process used to retrieve pertinent information. The visualisation is based on a high-level aggregation of the data, which enables its depiction in a clearly classified way and aids emergency responders in making decisions.

The first stage is to do data pre-processing and analysis by identifying the essential data attributes, which are: time, location, account name, and message, in order to avoid noisy data containing misspelt words, words other than English, and irrelevant messages. This work defines an analytical pipeline to clean and mine data in order to extract meaningful messages from a dataset in order to perform the data pre-processing and analysis step. These measures are:

i. Use a spell-checking algorithm to correct words not in the dictionary

ii. Filter irrelevant data (mainly the advertisement messages).

iii. Transform messages into word embedding with the fastText technique and apply k-means clustering to eliminate clusters of irrelevant messages from the dataset.

Next, in order to characterise the condition and allocate resources, the data is separated into disaster-related and non-disaster-related messages. Then, using the Latent Dirichlet Allocation (LDA) algorithm to extract subject term, disaster-related messages are classified into ten groups. As query words for message retrieval in fastText vector space, the 24 most heavily weighted subject terms from the top 20 topics were picked. Thus, the communications were categorised according to ten resource classifications. The final stage was to extract only those messages that expressed a "need" for a certain resource. Using both pattern matching and human annotation, this was accomplished. The author performed a burst analysis on the tiny dataset using Klein-burst burg's detection technique to identify instances of an upsurge in messages mentioning a particular disaster.

Further, using RescueMark, all pertinent information is shown in a single dashboard in Figure 2.1 , in which it separated into five sections: Social Navigation Bar, Interactive City Map, Events, Timeline, and Need for Resources-Trend Topics.

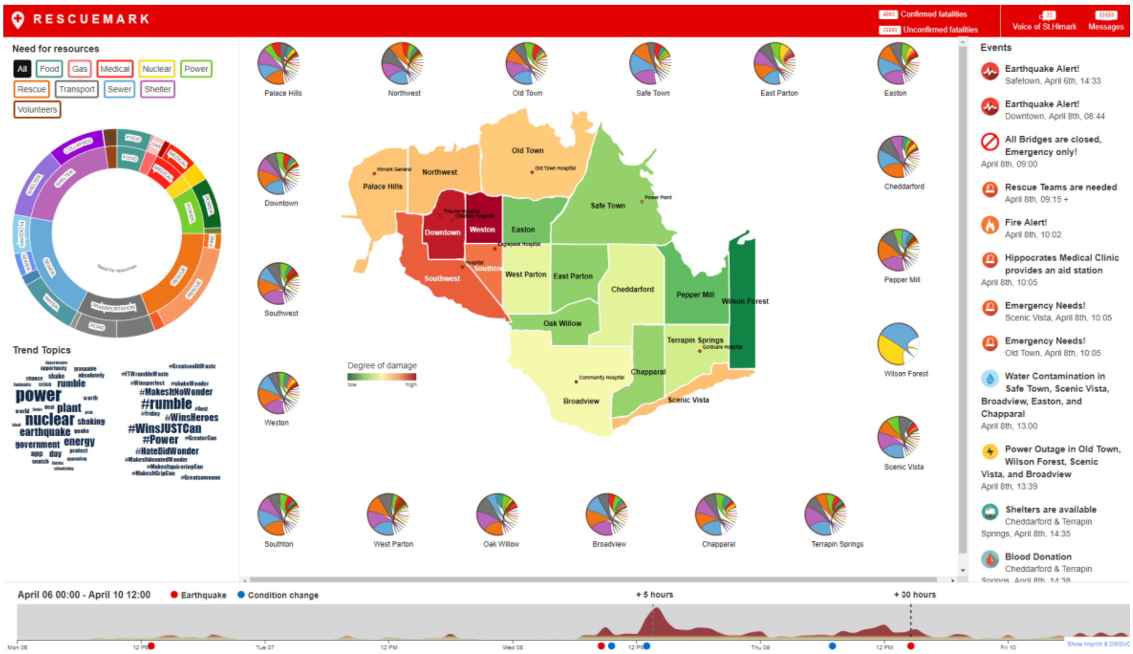



Figure 2.1: RescueMark - Dashboard Overview

### 2.2.1.1 Interactive City Map

The damage per district is depicted on a linear scale on the interactive city map as shown in Figure 2.2. Depending on the set time period, users can identify earthquake-damaged locations.

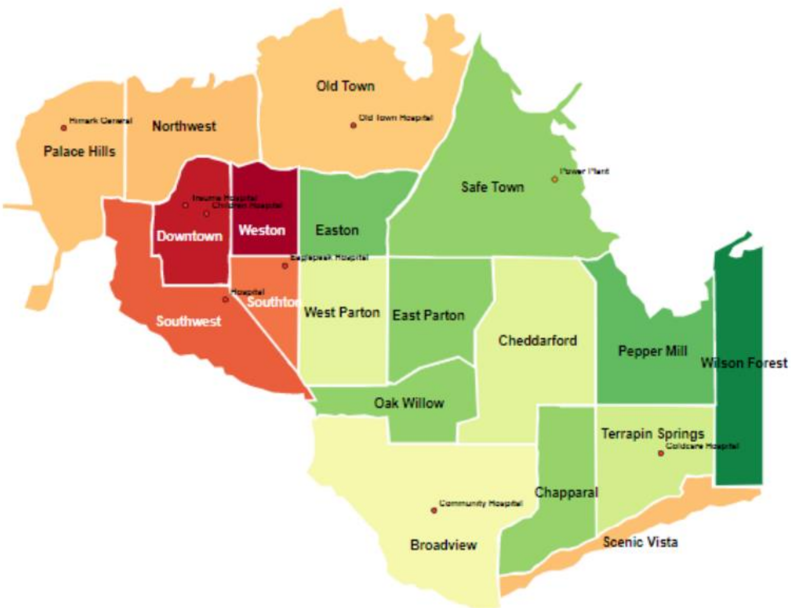



Figure 2.2: Degree of Damage per District

2.2.1.2 Need for Resources and Trend Topic

By selecting a certain resource from the resource menu as shown in Figure 2.3, the data displayed on the interactive city map can be altered to illustrate the need for a particular resource in each district as shown in Figure 2.4.


Figure 2.3: Resource Menu

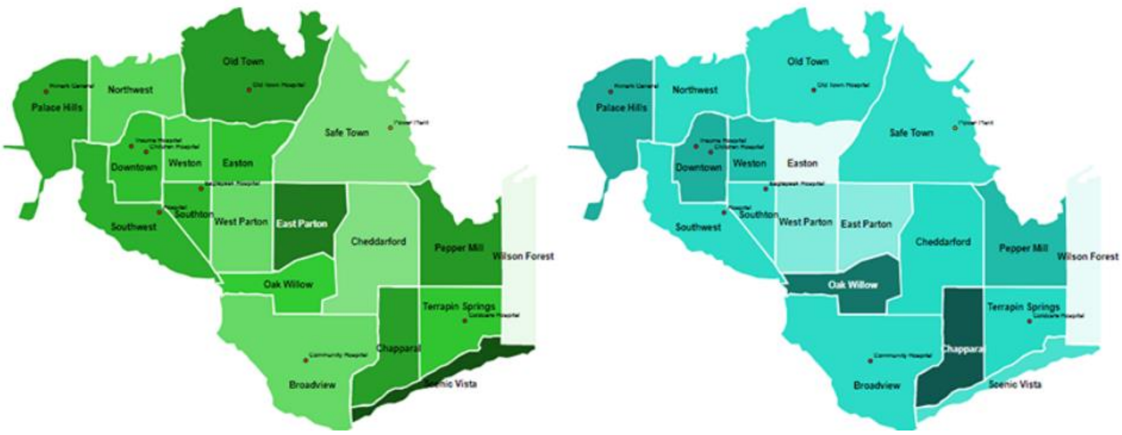



Figure 2.4: Need for Resource View on City Map Power (Left) and Food (Right)

2.2.1.3 Events and Decision Maker Announcement

The "Events" list contains the significant situations requiring official notification as shown in Figure 2.5. These events can be used to determine the appropriate time interval and rapidly characterise the event's circumstances.

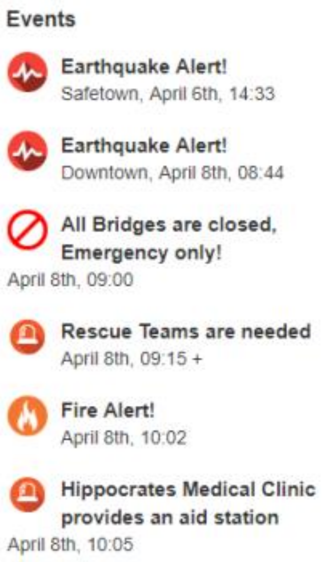



Figure 2.5: Events and Decision Maker Announcement

2.2.1.4 Social Navigation Bar

This function assists operators in comprehending how to dispatch rescue and medical support teams. The deaths section indicates the uncertainty or certainty of the data during a certain time period. Meanwhile, the displayed subset of messages is divided into two sections: social media communications and crisis messages as shown in Figure 2.6.

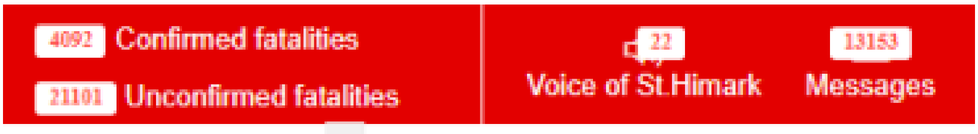



Figure 2.6: Social Navigation Bar

The RescueMark decision dashboard incorporates resource needs, decision marker announcements, critical events, and mortality data in a single view and gives user-interaction tools to focus on particular spatiotemporal units using a time slider and interactive map. This paper describes how a combination of data mining and visual analytics techniques could be used to solve the problem, how word embeddings and clustering could be used to extract relevant crisis-related resource needs-related messages from a noisy dataset, and how event detection could be used to identify changes in resource allocation conditions. In addition, we demonstrated that a combination of pattern-matching analysis and contextual information may be used to extract reliable text messages from fatality reports.

### 2.2.2 Public Behaviour Response Analysis in Disaster Events Utilizing Visual Analytics of Microblog Data

According to (Chae et al., 2014), Twitter messages were analysed to determine people's mobility habits during a crisis during Hurricane Sandy and a short-lived tornado. To analyse such social media data, our system provides the analysts with an interactive visual spatiotemporal analysis and spatial decision support environment that assists in evacuation planning and disaster management. The collected data was represented using a heatmap, which assisted analysts in understanding how people react to various events by comparing the spatial-temporal patterns under atypical conditions (Kwon & Kang, 2016). The paper's process flow is shown in Figure 2.7.

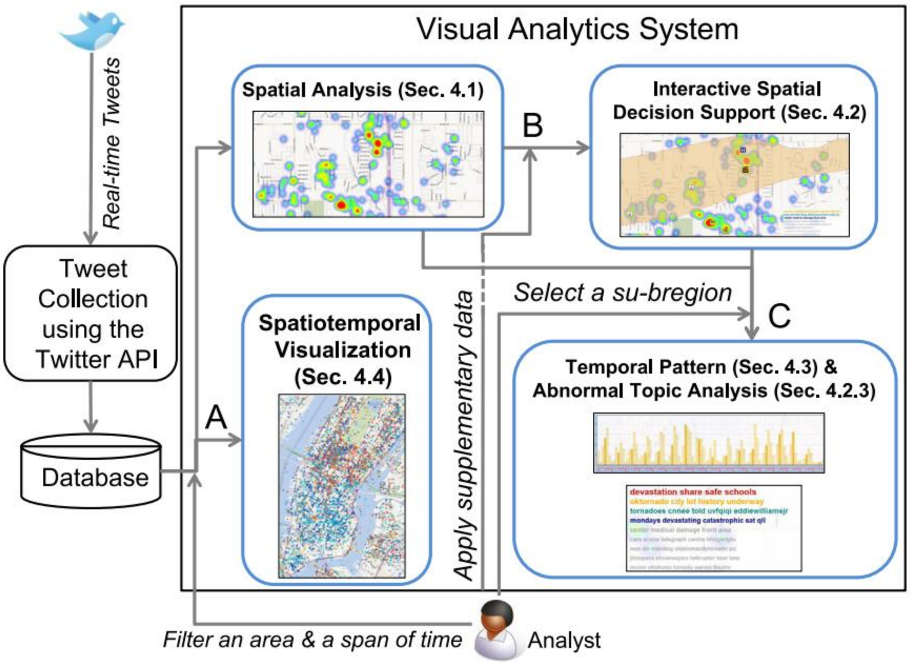



Figure 2.7: Overview of Interactive Analysis Schema for Public Behaviours Analysis Using Social Media Data

2.2.2.1 Spatiotemporal Analysis

Spatial analysis is used to investigate the distribution of Twitter users as social media Incorporating geo-location data into the data is incredibly valuable for evaluating location-based public behaviour. Therefore, such geographical analysis is essential for managing and preparing plans for catastrophe and emergency situations. For certain time intervals, the spatial distribution of users is analysed. A Geospatial heatmap was helpful for gaining an overview of the spatial distribution and estimating trends. To avoid any confusion between the colour scheme of the desaturated colormap of the backdrop map and the colour scheme used to generate the heatmap, saturated colours are applied for the data distribution in the heatmap as show in Figure 2.8.

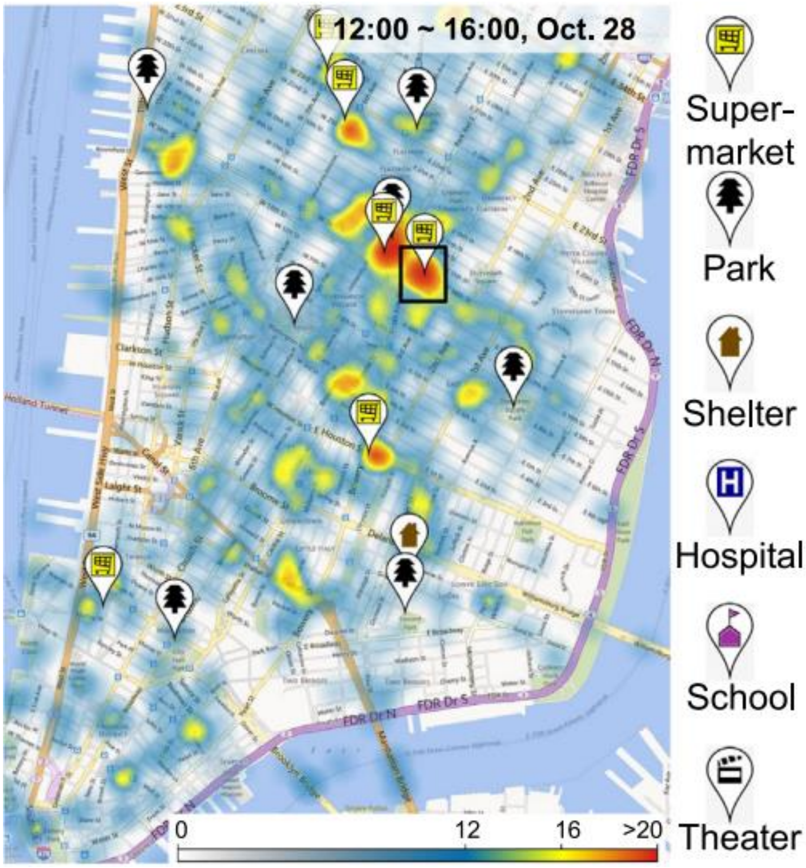



Figure 2.8: Spatial User Twitter Distribution after Execution Oder

2.2.2.2 Spatiotemporal Visualization

Spatiotemporal visualization is the modest visualization technique that enables analysts to study both space and time in a single view. In the visual depiction, analysts can depict the general spatiotemporal patterns of people's movements during a crisis as shown in Figure 2.9.

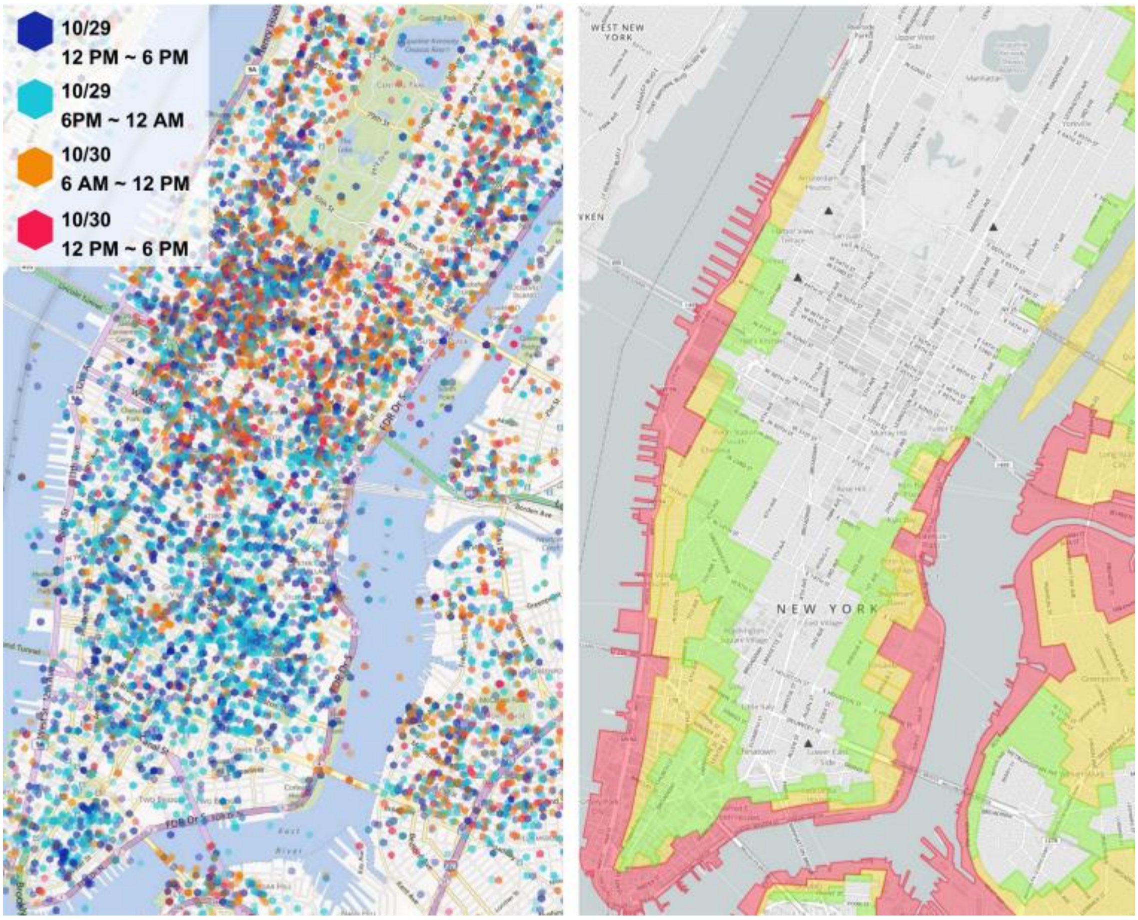



Figure 2.9: Visualization for Spatiotemporal Social Media Data

2.2.3 Designing Multimodal Interactive Dashboard of Disaster Management System

This study focuses on developing user-friendly multimodal disaster data dashboards to enhance human-to-system interactions during emergency response by providing useable forms of interactive dashboards to display multimodal catastrophe data. The author investigates social media data and metadata for elicitation and analysis purposes as the initial stage. These specifications are then utilised to create interactive, multimodal dashboards that communicate complex disaster information in an approachable manner. The author performed a heuristic evaluation in order to validate the multimodal dashboard designs. The suggested interactive multimodal dashboards supplement the existing methodologies for gathering textual, image, audio, and video emergency information and classifying it for user-friendly presentation (Alabdulaali et al., 2022). The framework for multimodal data visualisation is shown in Figure 2.10. The dashboard interface is shown in Figure 2.11, Figure 2.12, Figure 2.13.

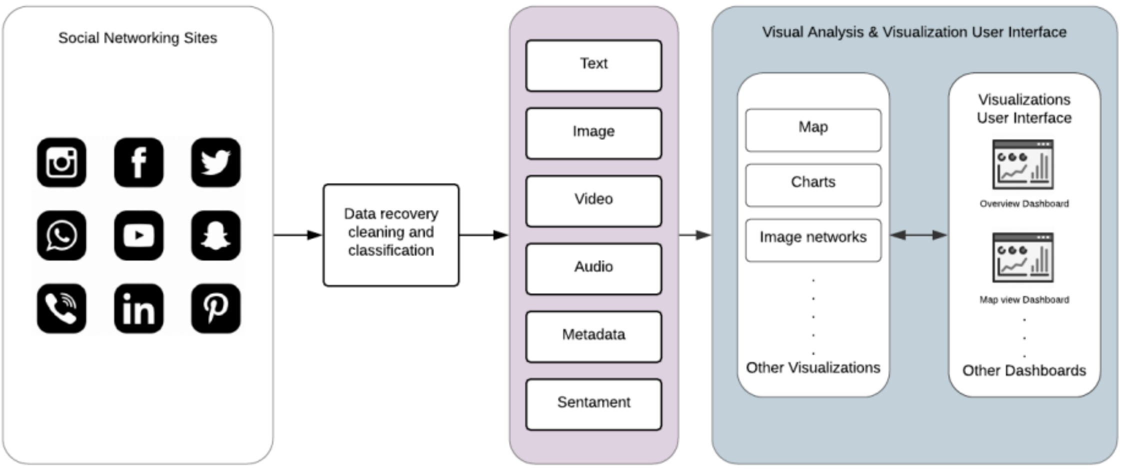



Figure 2.10: Multimodal Data Visualization Framework

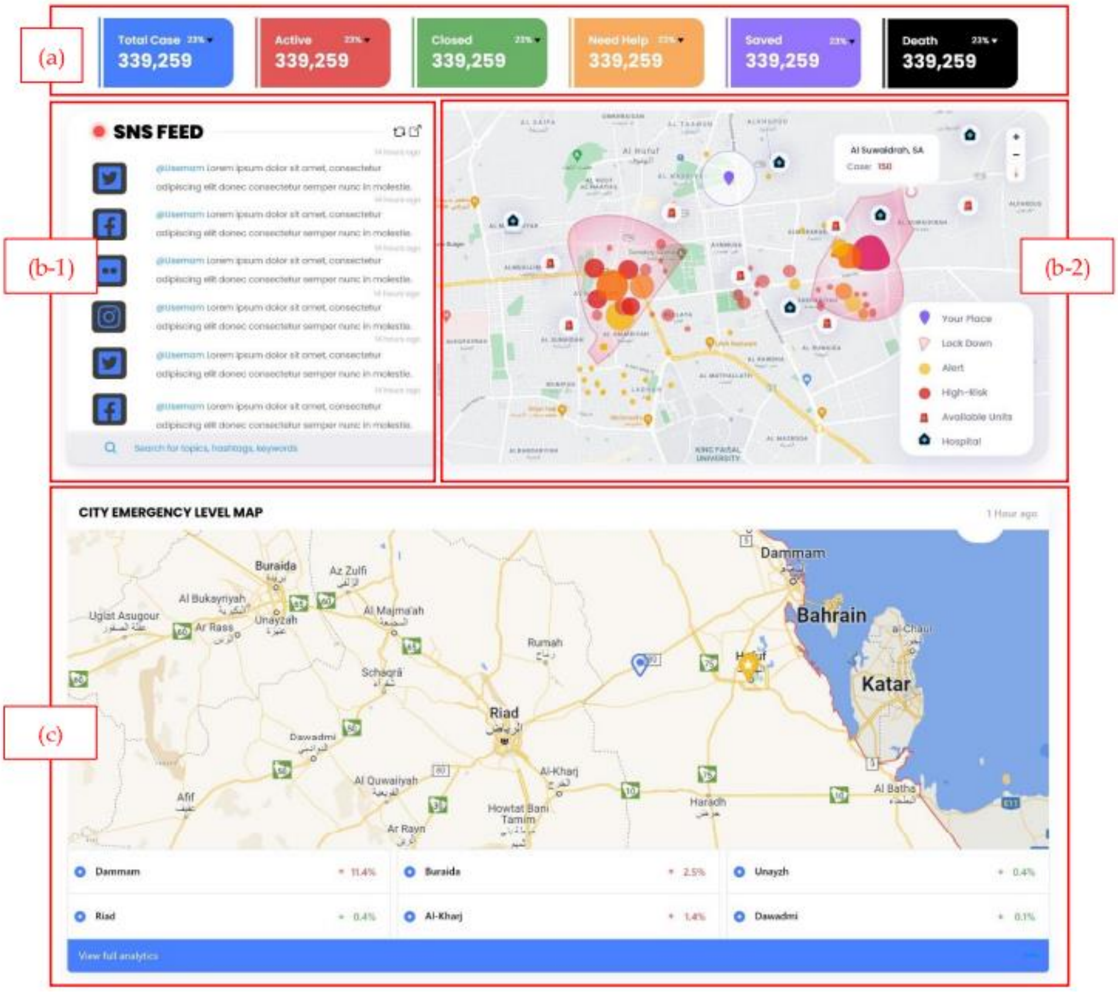



Figure 2.11: The dashboard displays the following parts of multi-monitor visual analytics: (a) overall case statistics; (b-1) a live SNS feed; (b-2) a heatmap; and (c) a city emergency map

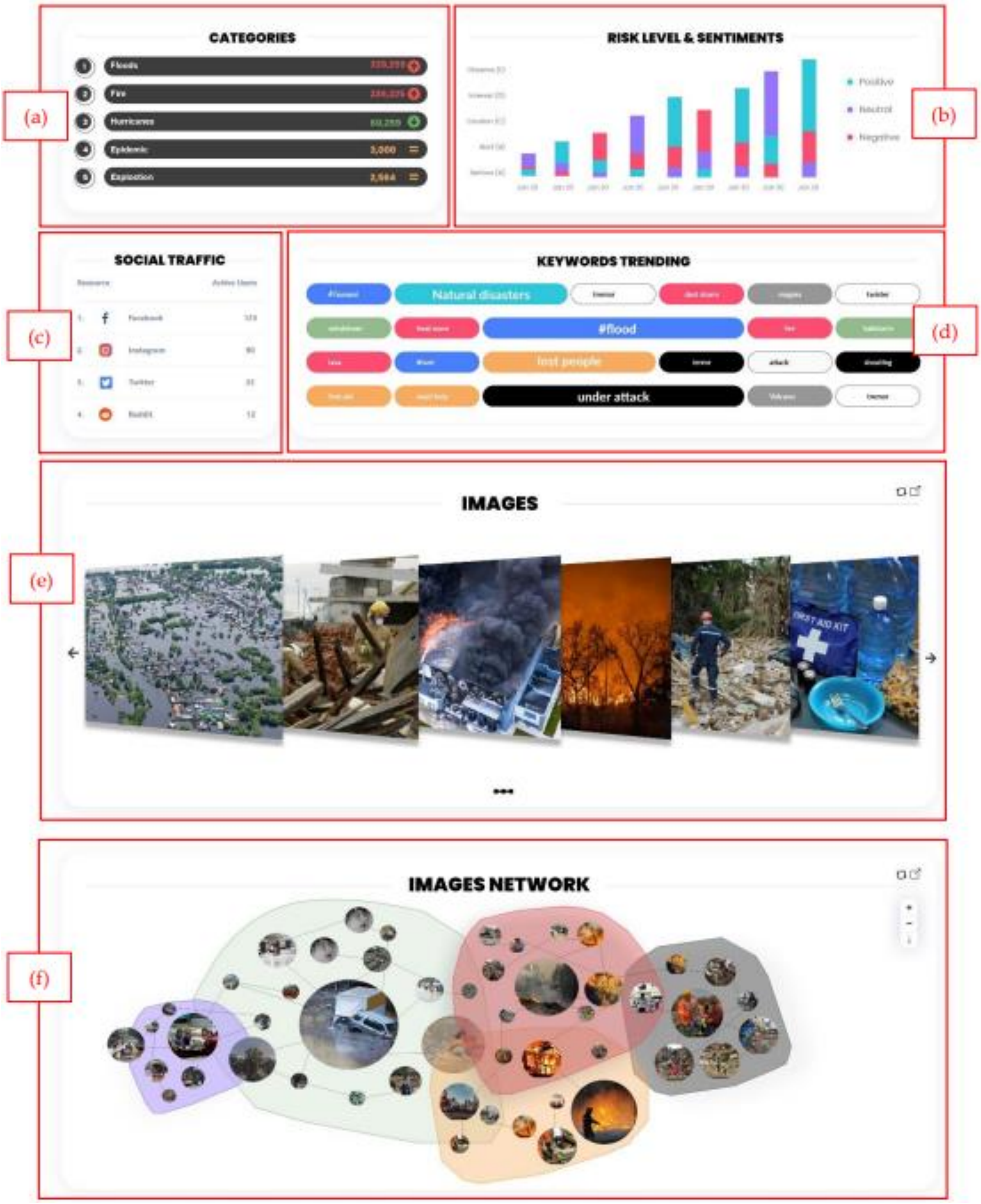



Figure 2.12: The dashboard displays the following part of multi-monitor visual analytics: (a) crisis category ranking; (b) risk and sentimental levels bar chart; (c) social traffic ranking; (d) keyword word cloud; (e) picture gallery; (f) image network

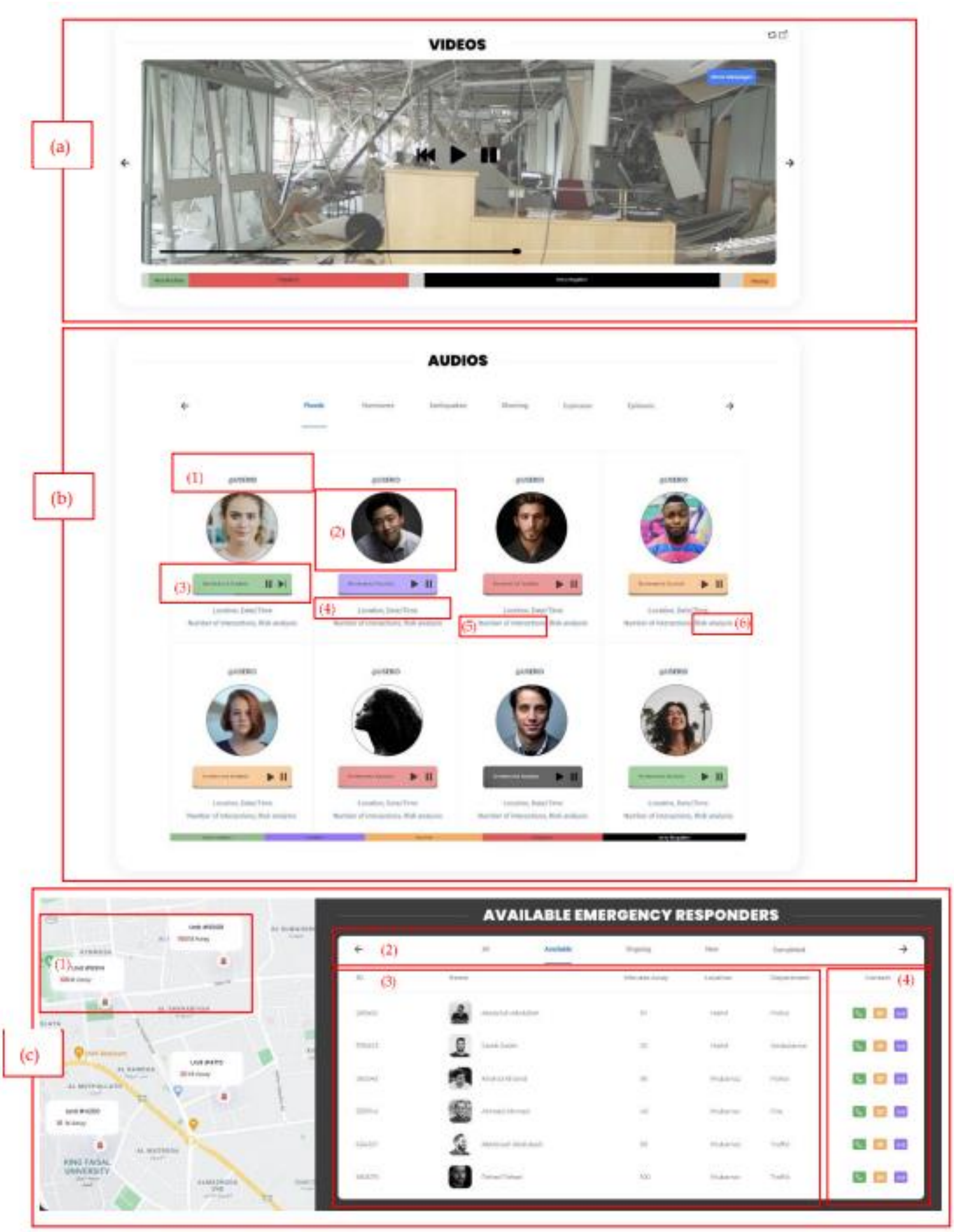



Figure 2.13The dashboard displays the following part of multi-monitor visual analytics: (a) video sentimental analysis; (b) audio map that includes: (1) username, (2) user display picture, (3) audio player; (4)metadata, (5) number of interactions, and (6) the risk.

## 2.3 Analysis/ Comparison of Existing System

Astrik et al. (Jeitler et al., 2019) have proposed RescueMark, which purpose is to analyse disaster situations and guide emergency response. Their methodology of data processing include using spell-checking algorithm to repair misspelt terms in several messages; using fastText algorithm to minimize distortions by transforming the message into word embeddings, using k-means clustering is applied to remove clusters of unrelated messages from the dataset; using LDA algorithm to extract theme terms from message and using Kleinberg's burst detection algorithm to find times when earthquake mentioning message increase. The collected data have then been visualized using social navigation bar, interactive city map etc in a single dashboard.

Analysis of public behaviour plays a significant role in crisis management, disaster response, and evacuation planning, according to Chae et al. (Chae et al., 2014). Unfortunately, acquiring relevant data can be expensive, and locating useful information for analysis can be difficult. Their technology provides analysts with an interactive visual spatiotemporal analysis and spatial decision support environment that aids in evacuation planning and catastrophe management in order to evaluate social media data. Their suggested approach to visual analytics offers several analytical techniques, including spatial analysis, spatial decision support, temporal pattern analysis, aberrant topic analysis, and interactive spatiotemporal visualisation. The Tweet collection component collects around 2.2 million geotagged Tweets every day from the United States using the Twitter API. In general, the needed geocoordinate precision for spatial analysis relies on the required level of location granularity. The data, however, is generated using GPS and software that are extremely dependable. Two distinct analytics components can reflect the initially selected spatiotemporal environment of Tweets: spatial analysis and spatiotemporal visualisation. Spatial analysis enables analysts to evaluate the global distribution of Twitter users and identify regions where a disproportionate number of Twitter users submit Tweets. Analysts can add supplementary information (infrastructure locations, tornado paths) to current information representing outcomes in order to better comprehend events and increase situational awareness; can select a sub-region within the initial area in order to analyse temporal patterns of the number of Twitter users and extract abnormal topics from text messages in the selected region. Moreover, their interactive spatiotemporal visual analytics gives a single view representation for the simultaneous examination of spatial and temporal properties of Tweets.

Abeer et al. (Alabdulaali et al., 2022) has discovered a gap between the data processing approach and the development of a user-friendly multimodal catastrophe data dashboard. To address this issue, they propose a practical design for an interactive dashboard that displays multimodal disaster information. For the required elicitation and analysis, they have investigated social media data and metadata for this aim. These criteria are then used to develop dashboards. To evaluate the multimodal dashboard design, they conducted a heuristics evaluation with a customised set of heuristics, which yielded positive evaluation results. This researcher prefers to present more information for the user to view the most crucial facts, as compared to the prior work. This dashboard is comprised of four pages, with three pages presenting multi-monitor visual analytics features and the remaining page displaying the one-page flow visualisation user interface for text, image, audio, and video disaster data.

This article outlines the fundamental requirements for disaster-related dashboards. Various data pre-processing techniques, including LDA, the fastText algorithm, and others, have been introduced. In addition, different dashboard design criteria have been presented in this study in order to construct high-level disaster-related dashboards to aid emergency response workers in preventing substantial damage.

The comparison of three existing system is describe in Table 2.1.

Table 2.1: Comparison on Existing System

| | **System One** | **System Two** | **System Three** |
|---|---|---|---|
| **Author** | (Jeitler et al., 2019) | (Chae et al., 2014) | (Alabdulaali et al., 2022) |
| **Project title** | RescueMark: Visual Analytics of Social Media Data for Guiding Emergency Response in Disaster Situations: Award for Skilful Integration of Language Model | Public Behaviour Response Analysis in Disaster Events Utilizing Visual Analytics of Microblog Data | Designing Multimodal Interactive Dashboard of Disaster Management Systems |
| **Technology/ method/ algorithm used** | Analysis Pipeline, Spell-Checking Algorithm, fastText algorithm, k-means clustering, Latent Dirichlet Allocation (LDA) Algorithm, Kleinberg's burst Detection Algorithm | Visual Spatiotemporal Analysis, Spatial Analysis, Spatial Decision Support, Temporal Pattern Analysis, Abnormal Topic Analysis | Disaster categorized, Sentimental Analysis, Risk Analysis, Image Classification, Damage Security Level, Videos Classification |
| **Data Source** | Social Media | Twitter | Twitter, Facebook, Flickr |
| **Data Types** | Text | Text | Text, Images, Audio, Video Data |
| **Required data** | Time, Location, Account Name, Message | - Time-stamped, Geo-located Data,<br>- Microblog Data: Twitter Messages.<br>- Infrastructure Data: Location<br>- Disaster Event Data: Weather Condition | - User information: user handle, display picture, number of followers/ following, number of posts.<br>- Geolocation: profile location, tagger location, mentioned location, geocodes, geotags.<br>- Date and Time: post date and time.<br>- Number of Interaction: Number of replies/ comments, retweets and quote-retweets, likes and reviews. |
| **Data visualization technique** | Social Navigation Bar, Interactive City Map, Events, Timeline, and Need for Resources Trend Topics | Heatmap, Bar Chart, Spatiotemporal Visualization, Glyph-based Visualization, | Total Case Statistics, Live SNS Feed, Heatmap, City Emergency Level Map, Crisis Categorized Ranking, Risk and Sentimental Level Bar Chat, SNS Traffic Ranking, Keywords Word Cloud, |

| | | | |
|---|---|---|---|
| | | | Image Gallery, Image Network, Video Sentimental Analysis, Audio Map, Collaboration Board |
| **Number of dashboards** | One | Four | Two |
| **Platform** | Web | Web | Web |
| **Advantages** | - User friendly interface.<br>- Interactive visualization<br>- Possess a visualization of geographical data.<br>- Have topic identification<br>- Contains events and decision-maker announcements, which the other existing system lacks. | - User friendly interface<br>- Interactive visualization.<br>- Possess a visualization of geographical data<br>- Real-time visualization<br>- Have topic identification | - User friendly interface<br>- Interactive visualization.<br>- Possess a visualization of geographical data<br>- Real-time visualization<br>- Have topic identification<br>- Include multiple types of data, including text, photos, audio, and video. |
| **Disadvantages** | - Text data only; no other data types are involved.<br>- Unclear the relationship between data and pie chart.<br>- Does not have real-time visualization | - Text data only; no other data types are involved. | - Information overloaded. |

## 2.4 Summary

Ultimately, the comparative summary of existing systems will serve as the foundation for the development of the UMP Centralized Emergency Response and Disaster Assistance System (CERDAS). The key finding of this chapter is that all existing systems have used powerful tools and techniques to develop their dashboards, with the majority of them collecting data from Twitter, one of the world's leading social media platforms. As our research is limited to UMP Pekan students, we are not required to collect data from social platforms.

# CHAPTER 3

# METHODOLOGY

## 3.1 Introduction

This chapter will also describe the obtained data type, sampling designs, data collection methods, and data analysis strategies. In order to construct a dashboard, it is necessary to collect a set of data. Since our research focuses on emergency and disaster data, we will employ a mixed-method methodology that combines qualitative and quantitative data collection techniques and also implemented Design & Development Research methodology. This project will collect data from Universiti Malaysia Pahang, Faculty of Computer students through a survey with a list of designed question.

## 3.2 Project Management Methodology

Data-driven emergency response in the campus involves the use of data analytics and real-time information to improve emergency preparedness and response. With the availability of various data sources, such as sensors, social media, and other digital platforms, it is possible to collect and analyse data to detect early warning signs of potential emergencies, track the spread of an ongoing crisis, and inform decision-making during and after the emergency. It has become an increasingly important strategy for improving emergency preparedness and response efforts. According to a report by the United Nations Global Pulse initiative, data-driven decision making can help emergency responders and disaster relief organizations gain real-time situational awareness and make more informed decisions during emergencies(Emmanuel Letouzé, 2012) . By leveraging data from a variety of sources, including social media, sensors, and other data streams, emergency response teams can gain insights into the situation on the ground and take actions more quickly and effectively.

One of data-driven emergency response model that frequently adopted in research is Decision-Making Trial and Evaluation Laboratory (DEMATEL). DEMATEL uses a multi-criteria decision-making approach to evaluate different factors and their interrelationships in order to make informed decisions(Gabus & Fontela, 1972). The method involves constructing a matrix of the relationships between different criteria or factors, and then using that matrix to identify the most important factors and the causal relationships between them. Studies has shown the applicability of DEMATEL in the context of emergency management(Song et al., 2022; Zhou et al., 2017). One limitation of DEMATEL is that it relies heavily on the availability and quality of data to construct the interrelationship matrix. The accuracy and usefulness of the final results of a DEMATEL analysis depend on the quality of the data used in the matrix construction. Here are a few specific issues related to data acquisition that may limit the effectiveness of DEMATEL:

1. Incomplete data: If there is missing data for some of the criteria or factors being evaluated, it can be difficult or impossible to construct a complete interrelationship matrix. This can lead to inaccurate or incomplete results.
2. Biased data: The accuracy of the interrelationship matrix depends on the quality and objectivity of the data used to construct it. If the data is biased or incomplete, it can lead to incorrect or incomplete results.
3. Data collection costs: Acquiring and processing data can be a time-consuming and costly process. Collecting and processing data may require significant resources and expertise, which may not always be available.
4. Data complexity: The data used in DEMATEL can be complex and difficult to obtain. In some cases, the data may be proprietary or confidential, making it difficult to access or use in a DEMATEL analysis.

All the issues mentioned are related to data. Whether it is incomplete, biased, costly or complex, the first and foremost step is to make the data available or acquiring data in a cost-effective manner. Therefore, this study proposes a cloud-based with low-code software development approach for developing the emergency response system in campus environment.

The reason of selecting the Decision-Making Trial and Evaluation Laboratory (DEMATEL) method in this project on data-driven emergency response in a campus environment is based on several reasons:

i. Multi-criteria decision-making approach: DEMATEL is designed to handle multi-criteria decision-making problems, which are common in emergency response situations. In an emergency response scenario, there are multiple factors to consider, such as response time, resource allocation, risk assessment, and communication effectiveness. DEMATEL enables researcher to assess and prioritize these factors based on their interrelationships, providing a comprehensive evaluation framework.

ii. Structured decision-making process: DEMATEL provides a structured and systematic approach to decision-making. It helps to identify the cause-and-effect relationships between different factors, enabling researcher to understand the complex interactions within the emergency response system. By following the DEMATEL process, researcher can ensure a logical and transparent decision-making process that is based on data and analysis.

## 3.3 Project Requirement

Table 3.1: Project Requirement

| **Features** | **Description** |
|---|---|
| **Input** | The project's inputs include date & time, location, emergency/ disaster type, emergency description, injured option, number of injured persons, injured level and emergency image. |
| **Output** | The project's deliverable is an interactive visualisation dashboard. |
| **Process Description** | 1. Data Collection<br>We adopt JotForm for data collection process. Using JotForm to create an emergency report form with closed-ended, open-ended, short-form, and extended-form questions that respondents can fill out on their |

| | |
|---|---|
| | mobile phones by scanning a QR code at a safe point. The form collects data such as the date, time, location, emergency type, number of people injured, injury condition, and an image related to the emergency incident. The data is stored in JotForm and integrated with Google Sheets.<br><br>2. Data pre-processing<br>As part of the date pre-processing process, the uploaded image URL is transformed into a functional image URL that can be displayed in Google Looker Studio as a visual representation of emergency cases.<br><br>3. Data Mapping<br>Google Looker Studio is a valuable tool for developing dashboards, which can be used to visualize data collected from various sources, including Google Sheets. For this research, location data was essential, and the longitude and latitude of each location were imported into Google Looker Studio as data sources. To provide a geographic context for the data, a bubble map visualization was used to pinpoint the selected locations on the map. The size of the bubble represents the number of incidents that have occurred at each location, with different colours used to differentiate between locations. The Time Series Chart exhibits various types of emergencies and disasters that occurred between 0:00 and 24:00, with distinct line colours representing each type of event. |
| **Constraints** | - |
| **Limitation** | - |
| **Case Study** | When user clicks on the dashboard, it can view all the relevant information in the dashboards. The interaction possibilities at the user's disposal are for the singular purpose of zooming into the data to focus on the certain points. The dashboard is divided into two pages which contains scorecard, dropdown list, date range control, button, bubble map, pie chart, stacked column chart, time series chart, table and image |

## 3.4 Design Solution

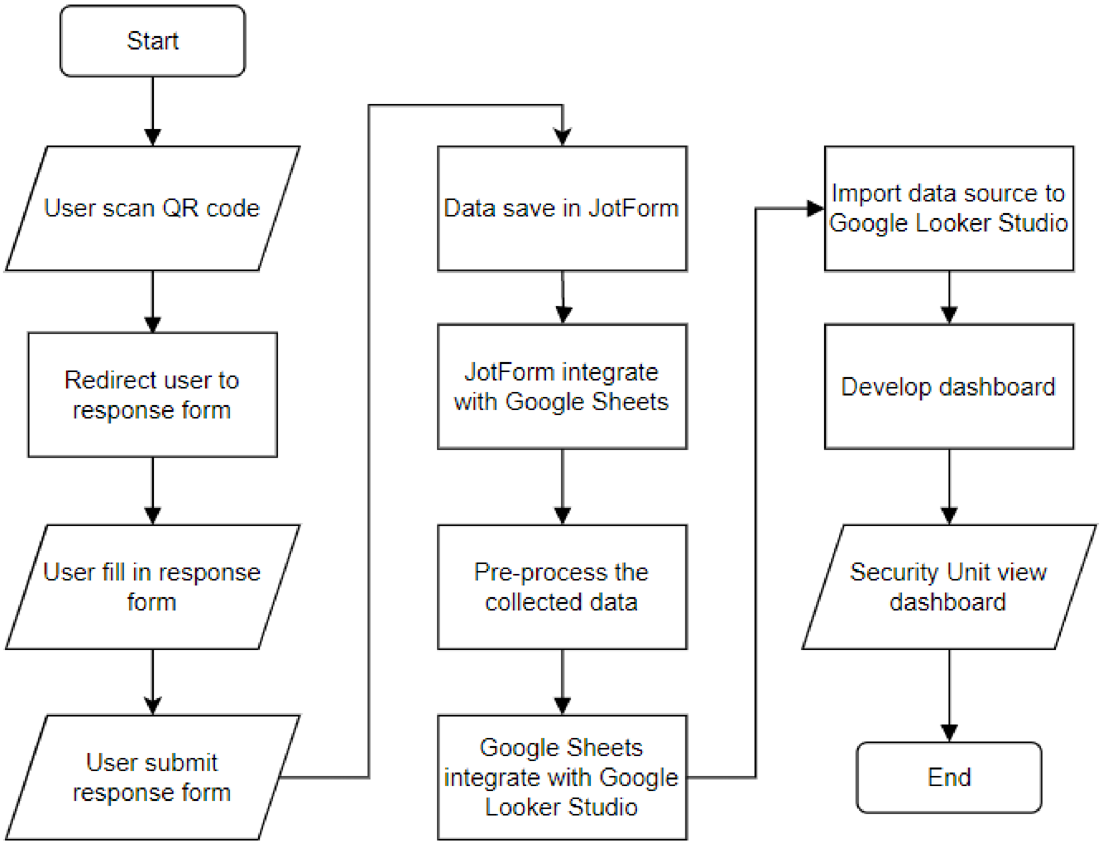



Figure 3.1: Flowchart for Proposed Design

## 3.5 Data Design

### 3.5.1 Dataset Description

| Field Name | Description |
|---|---|
| Date & Time | This field captures the date and time when the emergency or disaster occurred. It provides temporal information for each event. |
| Location | This field records the specific location where the emergency or disaster took place. It may include details such as building names, areas, or coordinates to identify the geographical context. |
| Emergency/ Disaster Type | This field categorizes the type of emergency or disaster that occurred. It could include categories such as fire, car accident, food poisoning, medical emergency, hazardous material incident, etc. This information helps in understanding the nature of the events. |
| Emergency Description | This field provides a textual description of the emergency or disaster. It includes relevant details about the situation, and any other pertinent information. |
| Injured Option | This field indicates whether there were any injured individuals involved in the emergency. It serves as a binary indicator, with options such as "Yes" or "No." |
| Number of Injured Persons | This field quantifies the number of individuals who sustained injuries in the emergency. It provides a numerical value indicating the count of injured persons. |
| Injured Level | This field assesses the severity or level of injuries sustained by individuals. It may include categories such as "Minor", "Moderate", "Serious, Not Life Threatening", "Severe, Life Threatening, Survival Probable", "Critical, Survival Uncertain", "Unsurvivable", enabling a better understanding of the impact of the emergency on individuals. |

| | |
|---|---|
| Emergency Image | This field contains an image related to the emergency or disaster. It could be a photograph capturing the scene, visuals of damages, or any other relevant imagery that aids in visualizing the event. |

### 3.5.2 Context Diagram

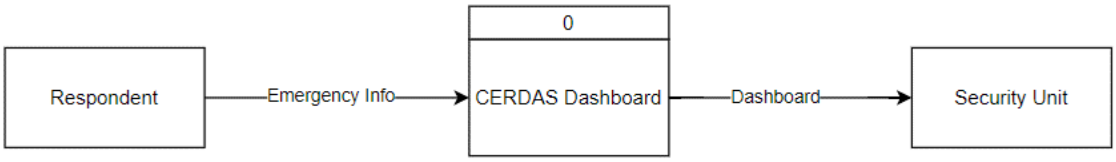



Figure 3.2: Context Diagram

### 3.5.3 ERD Diagram

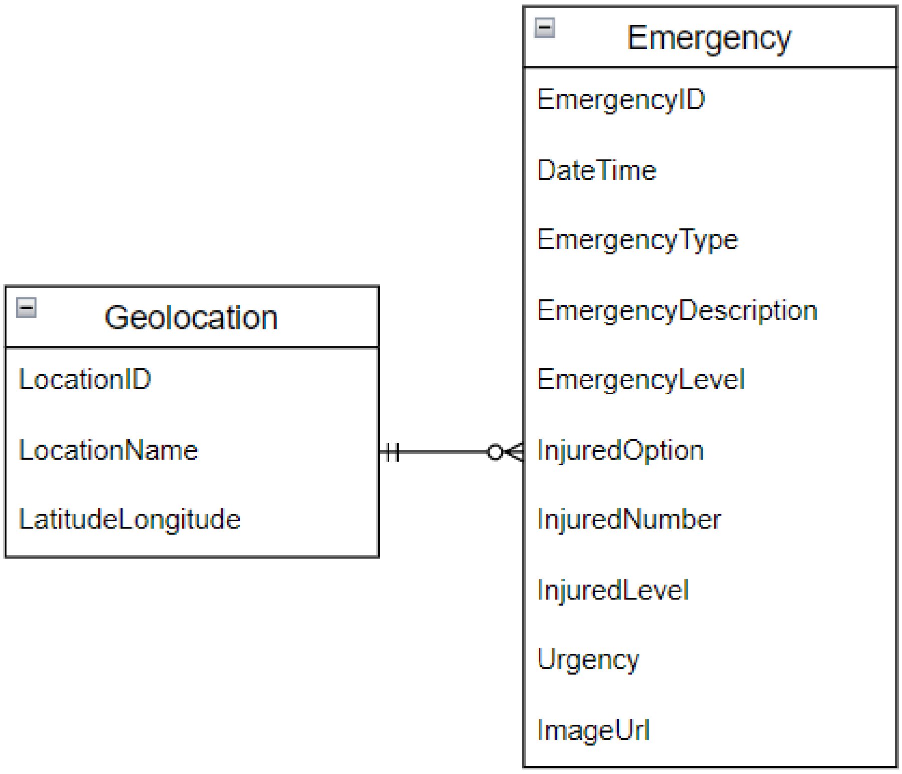



Figure 3.3: ERD Diagram

### 3.6 Proof of Initial Concept

In order to gain a better understanding of the obstacles students face when attempting to contact the security department, a survey using JotForm was conducted to collect student feedback on the emergency response and disaster assistance system at UMP. The survey is distributed randomly using convenience sampling, in which respondents are selected based on one ‘s convenience in terms of availability, reach, and accessibility, in order to collect the response quickly and without placing any additional strain on the available resources. The proof of initial concept is attached in Appendix A. Ten responses to the survey have been collected. The collected responses have been analysed.

The data analysis reveals that 9 of the respondents believe that safety is essential to their lives and that they felt frustrated and powerless in the face of emergency or disaster. In addition, seven out of ten respondents are aware of whom to contact in the event of an emergency or natural disaster. In the meantime, all respondents believe that UMP lacks an emergency response and disaster assistance system, and they plan to use the Centralized Emergency Response and Disaster Assistance System (CERDAS) in the future in the event of an emergency or disaster. Seven out of ten respondents have encountered one emergency and disaster situation during their UMP learning journey, while three respondents have encountered two emergency and disaster situations. Among the emergency and disaster situation the respondents have encountered are flooding and water damage (13%), roaming of wild animal (13%), spirit possession (13%), student/ people in crisis (13%), elevators malfunctioning (9%), hostage situation (9%), medical emergency (9%), power outage/ downed power of lines (9%), emergency/ closing down UMP (4%), fire emergency (4%) and robbery/ shoplifting/ theft situation (4%).

Therefore, a system that analyses emergency and disaster data that occurs on the University Malaysia Pahang, Pekan Campus has been proposed in order to provide the responsible authority with a comprehensive view of the occurrence of emergency and disaster data in UMP. This is crucial for the responsible authority to comprehend because emergency and disaster cases not only affect the injured person, but also pose a threat to all UMP students. If emergencies and disasters persist for an extended period of time, the consequences will be far-reaching and detrimental to future standards of living.

Consequently, with the aid of emergency and disaster visual analytic solution, the UMP security department and other responsible departments can be alerted to the emergence of emergencies and disasters and take immediate action to ensure people's safety, increase people's trust in university departments and the efficiency of their operations, and enhance the university's reputation.

## 3.7 Testing

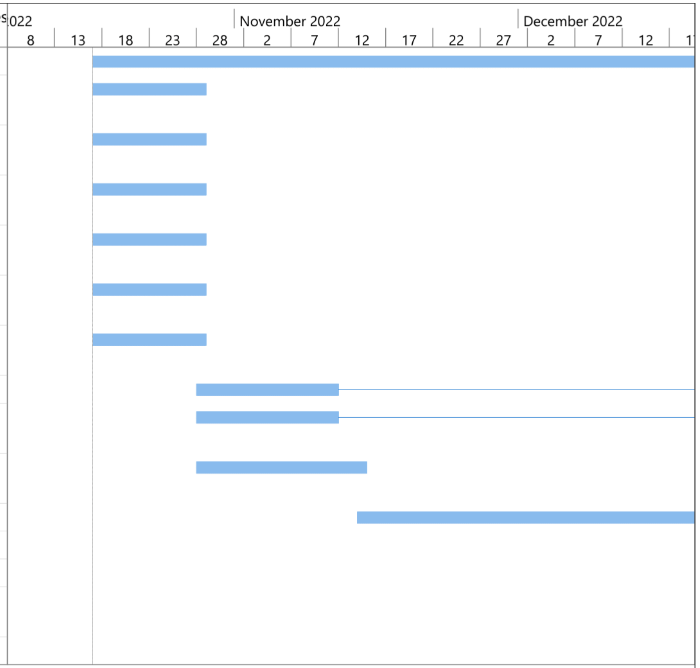
The purpose of the UAT form is to evaluate the performance of the dashboard in real-world situations, as depicted in Appendix E. Besides, the Evaluation Form for Safety Unit personnel who utilize the dashboard is presented in Appendix F. This form is utilized to gather user feedback, which is taken into consideration when making any enhancements or modifications to the dashboard, as well as assessing its effectiveness.

## 3.8 Potential Use of Proposed Solution

This finding of the study will redound to the social’s benefit, considering that visual analytics play an important role in saving lives when it comes to disasters and emergency situation is very critical not only in the higher education institution but also in village, office, restaurant, mountain and etc. For instance, if someone is climbing a mountain and twists his or her toe, he or she or a buddy can scan the QR code to notify the rescue crew. When the data is shown in the dashboard, the rescue team is able to take action and plan for the future in order to avoid cases from occurring. Therefore, institutions of higher education that use the approach advised by this study will increase campus safety and security. Respond team such as safety department and clinic department will be guided on how to use the developed dashboard to enhance the respond time in saving student, staff and other people lives.

## 3.9 Gantt Chart

| ID | Task Mode | Task Name | Duration | Start | Finish | Predecessors |
|---|---|---|---|---|---|---|
| 1 | | **Phase 1: Analysis** | 55 days | Mon 17/10/2 | Fri 30/12/22 | |
| 2 | | Analyze Stakeholder's | 10 days | Mon 17/10/22 | Fri 28/10/22 | |
| 3 | | Analyze Background Study | 10 days | Mon 17/10/22 | Fri 28/10/22 | |
| 4 | | Analyze Problem Statement | 10 days | Mon 17/10/22 | Fri 28/10/22 | |
| 5 | | Analyze Research Objectives | 10 days | Mon 17/10/22 | Fri 28/10/22 | |
| 6 | | Analyze Expected Outcome | 10 days | Mon 17/10/22 | Fri 28/10/22 | |
| 7 | | Analyze Research Duration | 10 days | Mon 17/10/22 | Fri 28/10/22 | |
| 8 | | Analyze Data Model | 11 days | Fri 28/10/22 | Fri 11/11/22 | |
| 9 | | Analyze System Architecture | 11 days? | Fri 28/10/22 | Fri 11/11/22 | |
| 10 | | Analyze Methodoology Used | 12 days? | Fri 28/10/22 | Mon 14/11/22 | |
| 11 | | Analyze Tools Used | 34 days? | Mon 14/11/2 | Thu 29/12/22 | |
| 12 | | **Phase 2: Design** | 14 days? | Mon 2/1/23 | Thu 19/1/23 | 1 |
| 13 | | Design Data Model | 14 days? | Mon 2/1/23 | Thu 19/1/23 | 8 |
| 14 | | Design System Architecture | 14 days? | Mon 2/1/23 | Thu 19/1/23 | 9 |
| 15 | | Design Survey Questi | 14 days? | Mon 2/1/23 | Thu 19/1/23 | 8,11 |

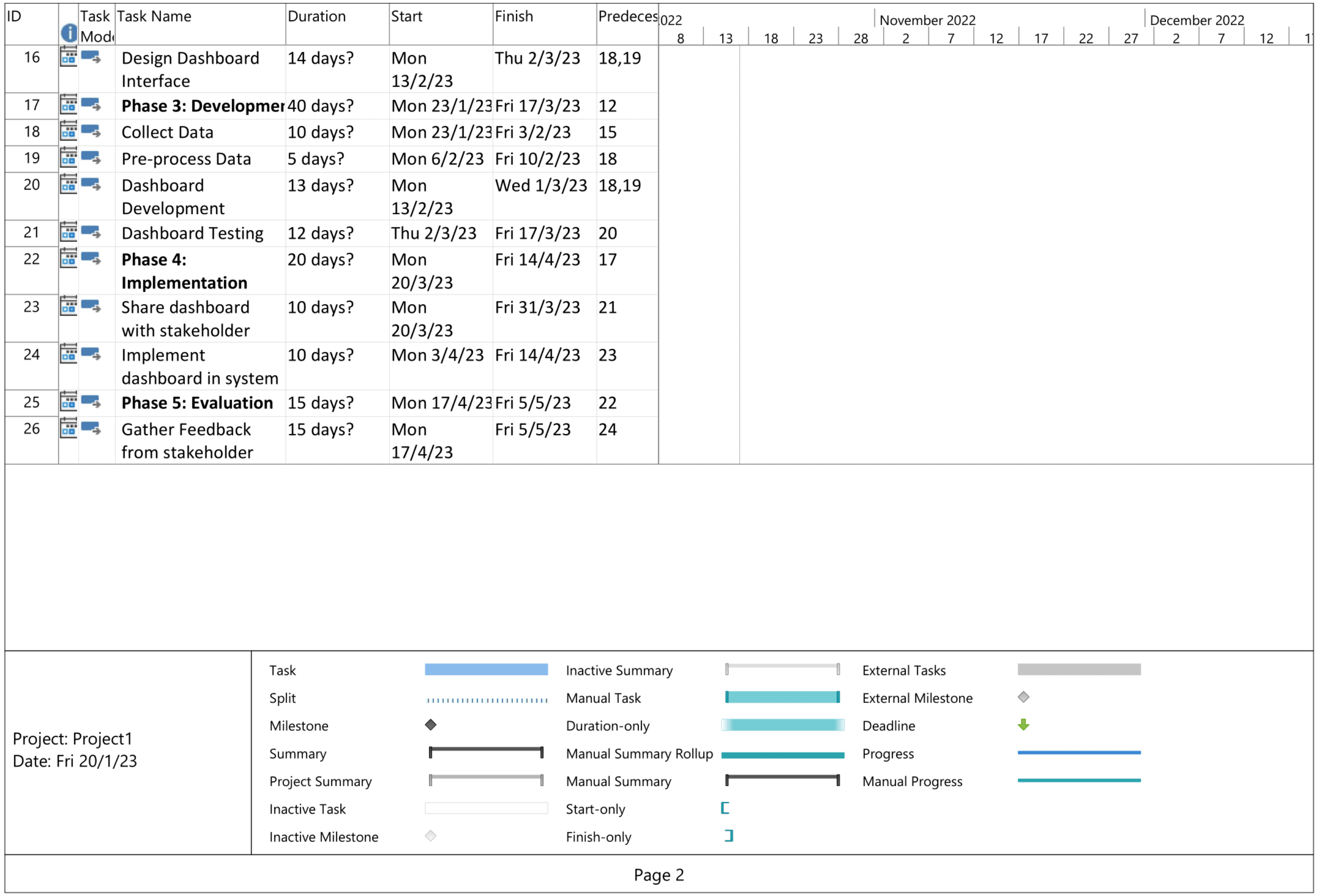



Project: Project1
Date: Fri 20/1/23

| | | | | | |
|---|---|---|---|---|---|
| Task | | Inactive Summary | | External Tasks | |
| Split | | Manual Task | | External Milestone | |
| Milestone | | Duration-only | | Deadline | |
| Summary | | Manual Summary Rollup | | Progress | |
| Project Summary | | Manual Summary | | Manual Progress | |
| Inactive Task | | Start-only | | | |
| Inactive Milestone | | Finish-only | | | |

Page 1

Figure 3.4: Gantt Chart (1)



| ID | | Task Mode | Task Name | Duration | Start | Finish | Predeces |
|---|---|---|---|---|---|---|---|
| 16 | | | Design Dashboard Interface | 14 days? | Mon 13/2/23 | Thu 2/3/23 | 18,19 |
| 17 | | | **Phase 3: Developmer** | 40 days? | Mon 23/1/23 | Fri 17/3/23 | 12 |
| 18 | | | Collect Data | 10 days? | Mon 23/1/23 | Fri 3/2/23 | 15 |
| 19 | | | Pre-process Data | 5 days? | Mon 6/2/23 | Fri 10/2/23 | 18 |
| 20 | | | Dashboard Development | 13 days? | Mon 13/2/23 | Wed 1/3/23 | 18,19 |
| 21 | | | Dashboard Testing | 12 days? | Thu 2/3/23 | Fri 17/3/23 | 20 |
| 22 | | | **Phase 4: Implementation** | 20 days? | Mon 20/3/23 | Fri 14/4/23 | 17 |
| 23 | | | Share dashboard with stakeholder | 10 days? | Mon 20/3/23 | Fri 31/3/23 | 21 |
| 24 | | | Implement dashboard in system | 10 days? | Mon 3/4/23 | Fri 14/4/23 | 23 |
| 25 | | | **Phase 5: Evaluation** | 15 days? | Mon 17/4/23 | Fri 5/5/23 | 22 |
| 26 | | | Gather Feedback from stakeholder | 15 days? | Mon 17/4/23 | Fri 5/5/23 | 24 |



Figure 3.5: Gantt Chart (2)

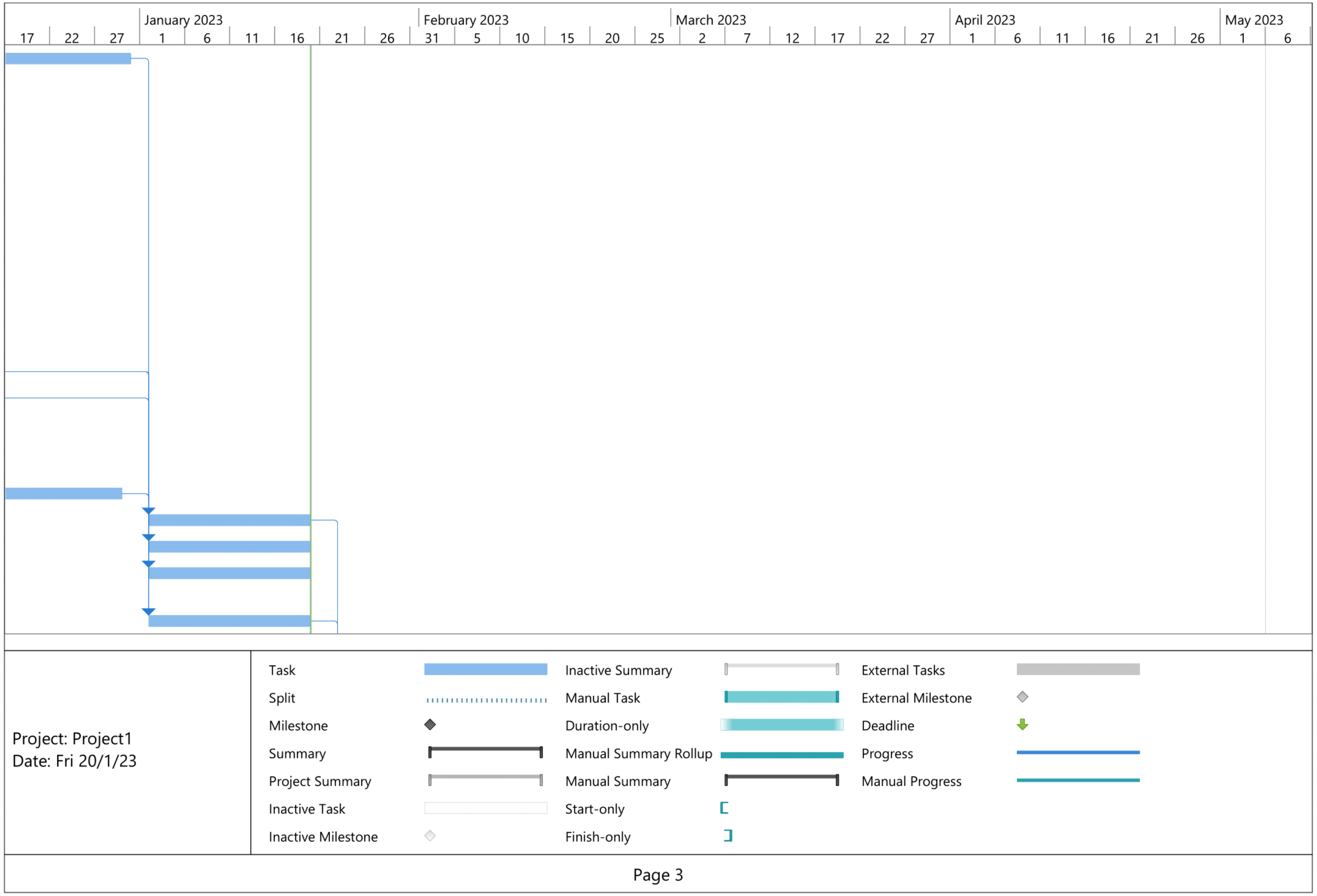



Figure 3.6: Gantt Chart (3)

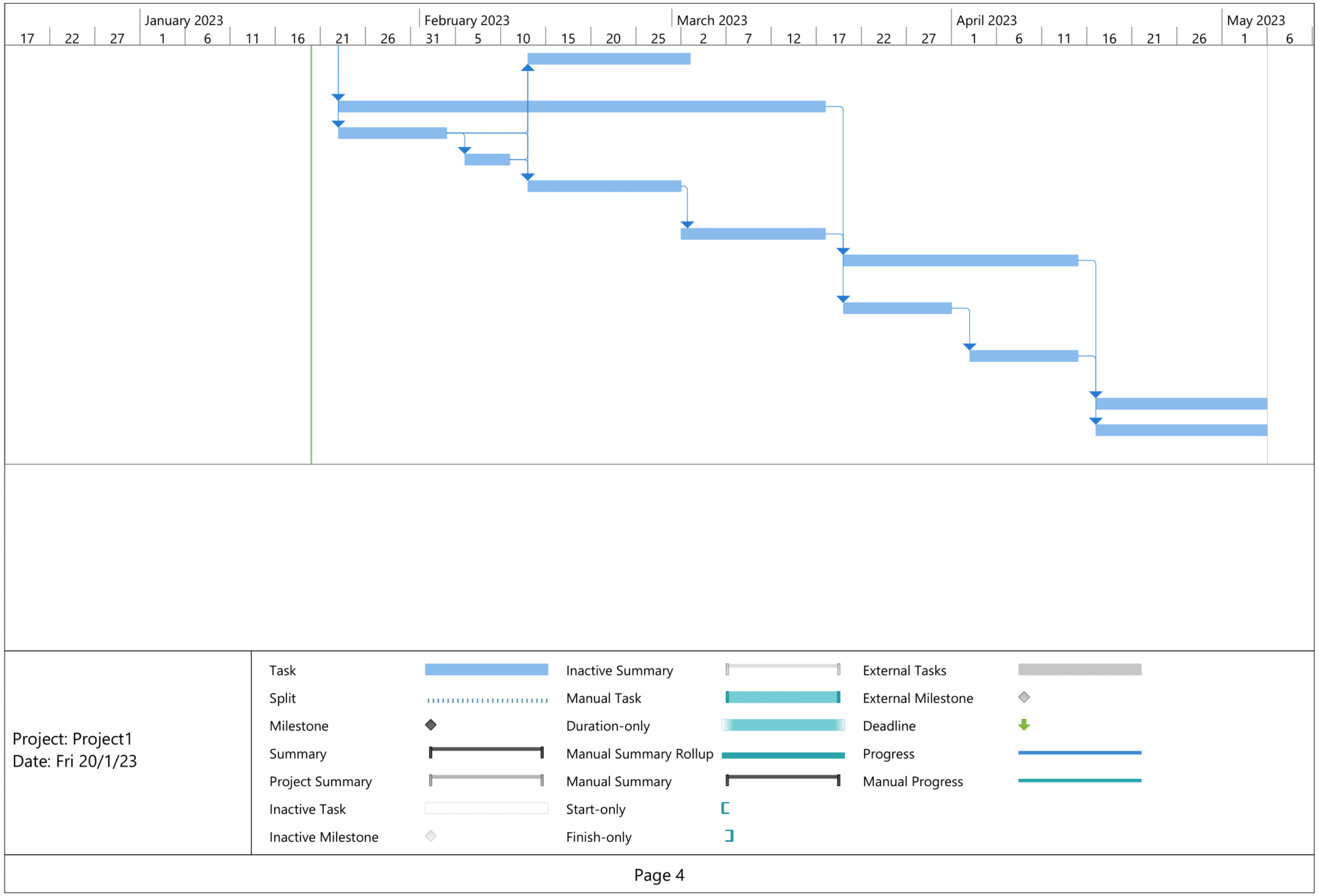



Figure 3.7: Gantt Chart (4)

# CHAPTER 4

# IMPLEMENTATION, RESULTS AND DISCUSSION

## 4.1 Introduction

Chapter 4 covers the development, implementation, and evaluation of the CERDAS dashboard, which is implement to the Security Unit of Universiti Malaysia Pahang's (UMP) Pekan campus to be used in cases of emergencies or disasters. The testing process was conducted to identify any potential errors and resolve them promptly.

## 4.2 Implementation Process

The implementation process is to record all steps in developing CERDAS dashboard. The method of developing the CERDAS dashboard in this research is illustrated in Figure 4.1.

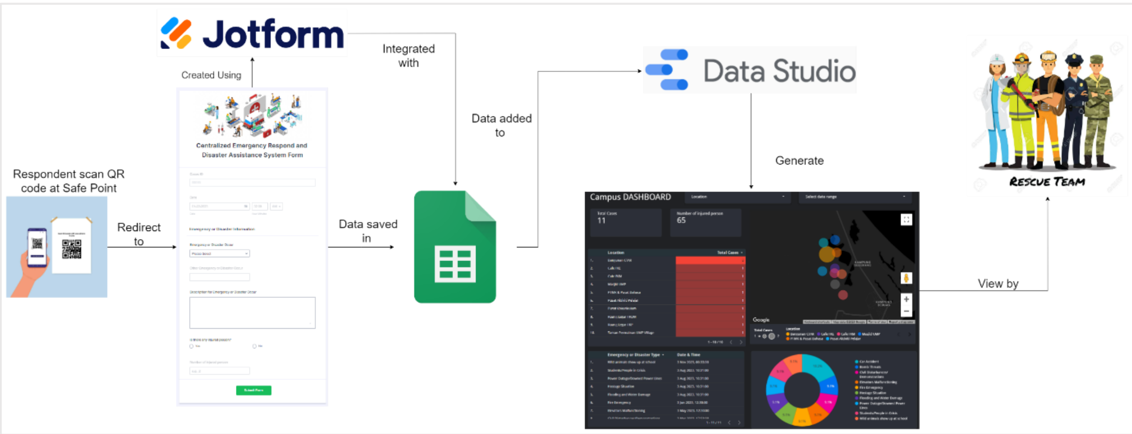



Figure 4.1: Method for Developing Emergency Response System

Step 1: Data acquisition with cloud-based form creator

There are various types and service providers that provide cloud-based form creation with low-code approach. In this study, we adopt the service from JotForm. It is an online form builder that allows users to create custom forms for a variety of purposes. The platform offers a wide range of form fields and customization options, making it easy for users to create forms that match their branding and meet their specific needs. Using JotForm to create an emergency report form with closed-ended, open-ended, short-form, and extended-form questions that respondents can fill out on their mobile phones by scanning a QR code at a safe point. The form collects data such as the date, time, location, emergency type, number of people injured, injury condition, and an image related to the emergency incident (see Appendix B). The data is stored in JotForm and integrated with Google Sheets.

Step 2: Data visualization with cloud-based dashboard creator

There are many types of software that can be used for creating dashboards. Google Looker Studio is a valuable tool for developing dashboards, which can be used to visualize data collected from various sources, including Google Sheets. For this research, location data was essential, and the longitude and latitude of each location were imported into Google Looker Studio as data sources. To provide a geographic context for the data, a bubble map visualization was used to pinpoint the selected locations on the map. The size of the bubble represents the number of incidents that have occurred at each location, with different colours used to differentiate between locations. The Time Series Chart exhibits various types of emergencies and disasters that occurred between 0:00 and 24:00, with distinct line colours representing each type of event. The overview of the dashboard used in English version for this research is attached in Appendix C and the Malay version is attached in Appendix D.

## 4.3 Testing and Result Discussion

### 4.3.1 Testing

Upon completion of the development phase, the testing phase is initiated to assess the dashboard's usability and efficacy. The User Acceptance Form (UAT) (see Appendix E) and Evaluation Form (see Appendix F) is employed to ensure the application is thoroughly tested. Appendix G displays the User Acceptance Test (UAT) results collected from the users. A personal device, specifically an Acer Aspire Vero, is provided to users for testing the application. Five Security Unit staff members participated in the testing process, and a feedback survey was administered to gather their thoughts on the dashboard (see Appendix H).

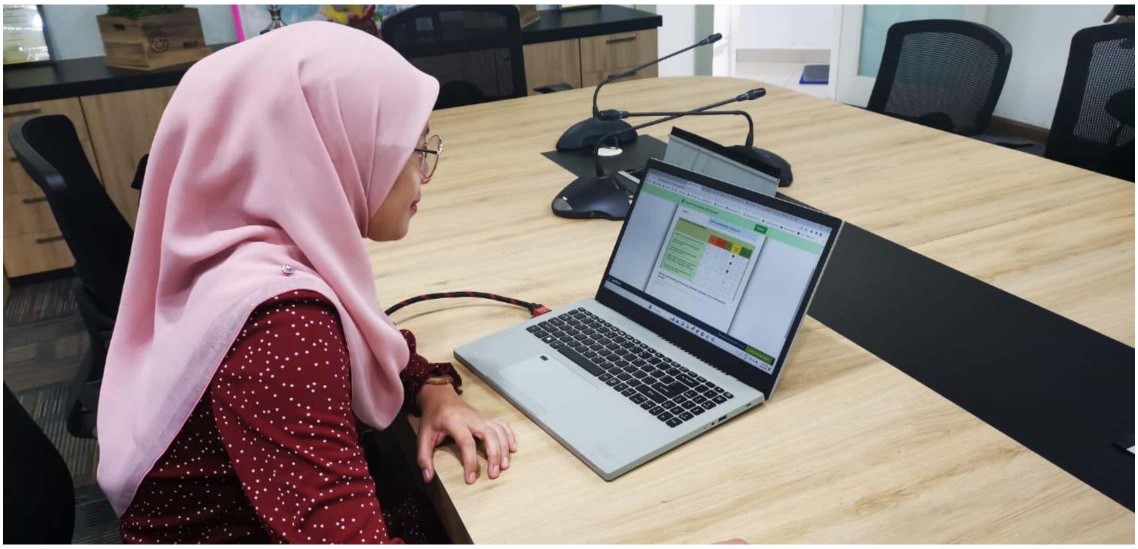


Figure 4.2: Respondent (Security Unit Staff) 1 Doing UAT and Evaluation Test

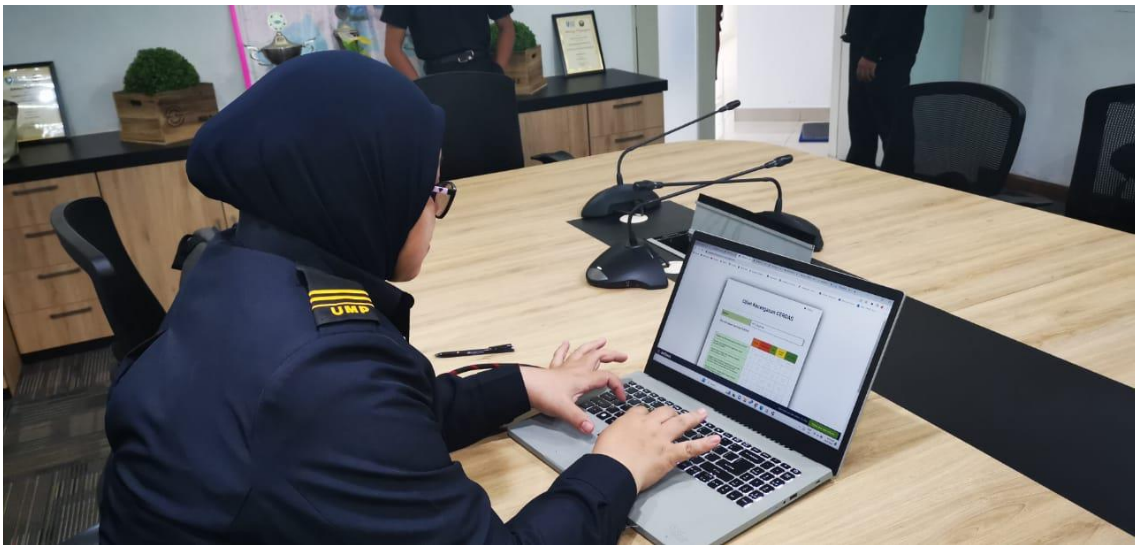


Figure 4.3: Respondent (Security Unit Staff) 2 Doing UAT and Evaluation Test

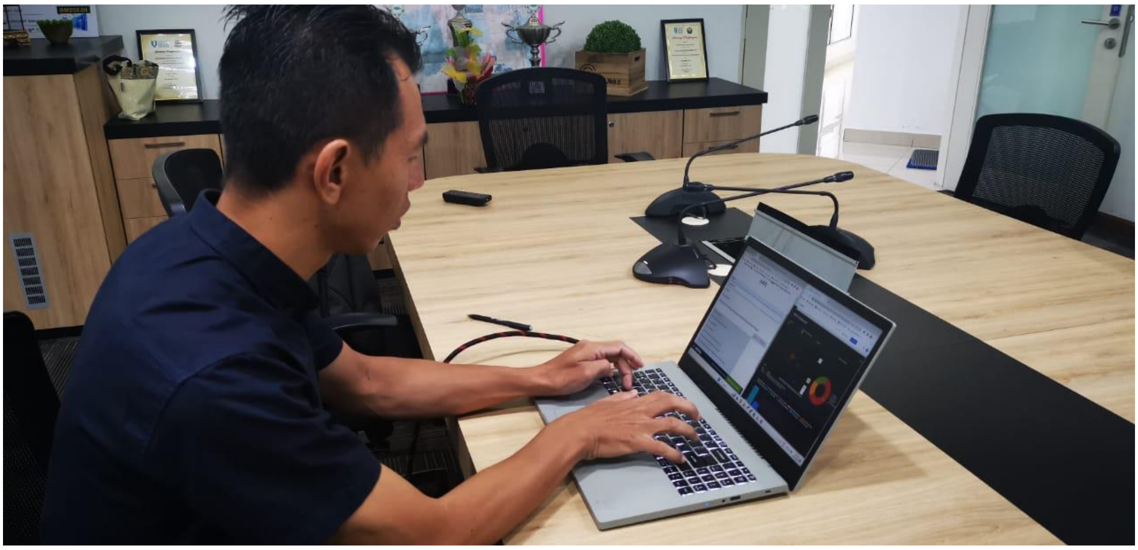


Figure 4.4: Respondent (Security Unit Staff) 3 Doing UAT and Evaluation Test

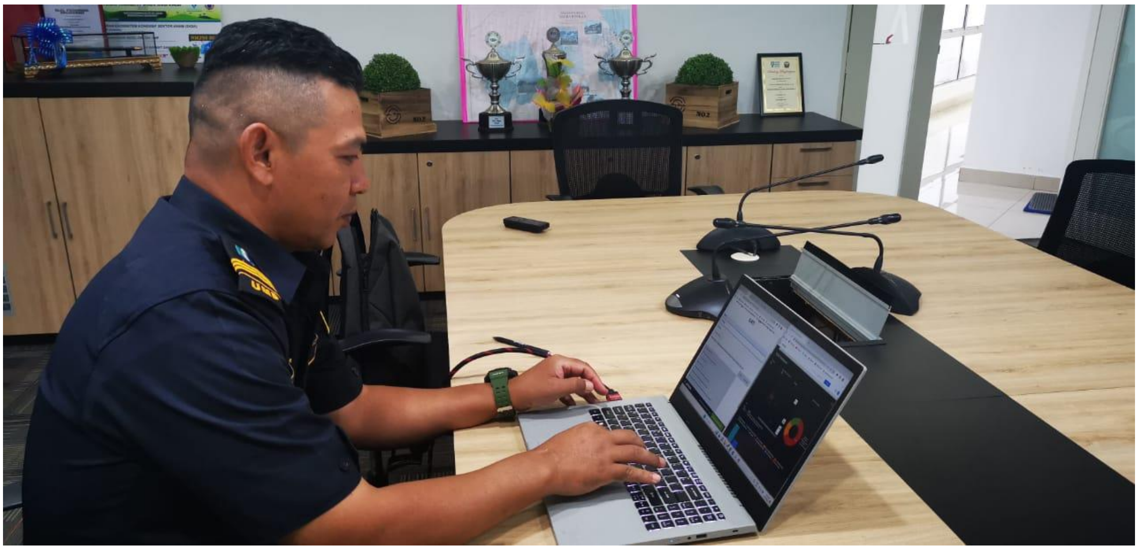


Figure 4.5: Respondent (Security Unit Staff) 4 Doing UAT and Evaluation Test

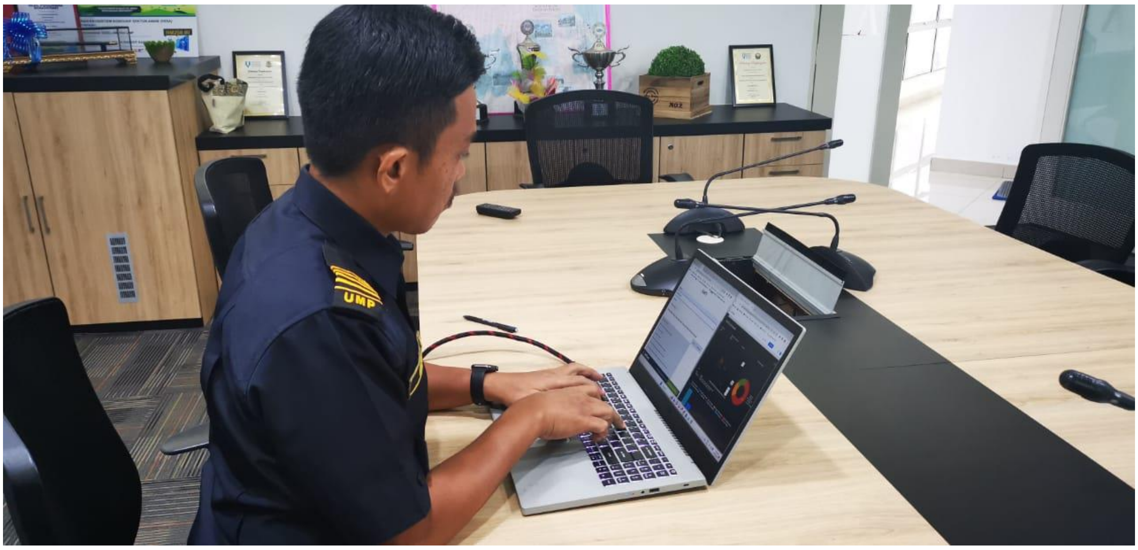


Figure 4.6: Respondent (Security Unit Staff) 5 Doing UAT and Evaluation Test

Figure 4.7: Respondent (Security Unit Staff) 6 Doing UAT and Evaluation Test

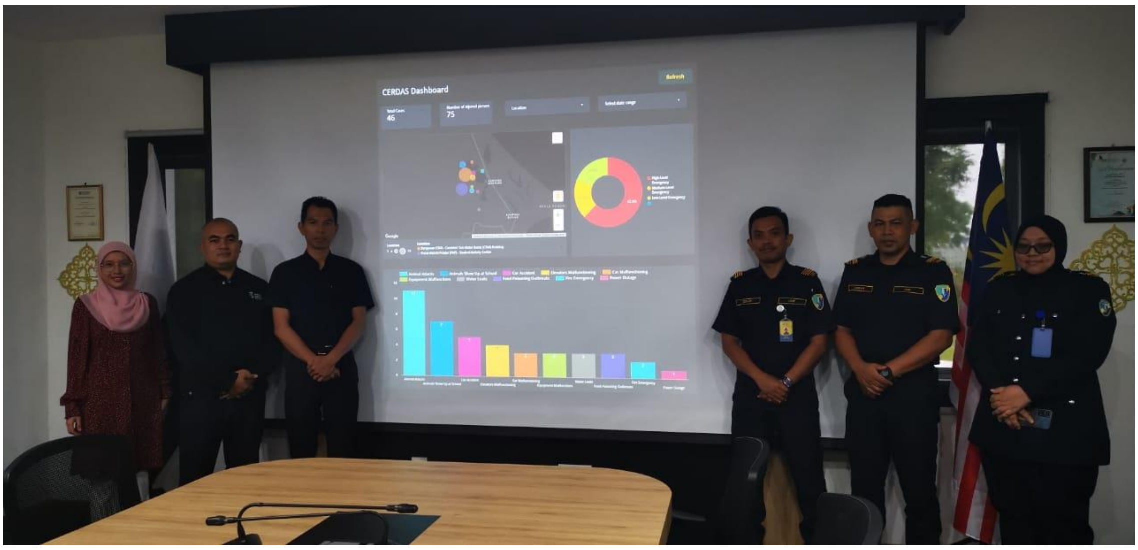



Figure 4.8: Respondent (All Security Unit Staff) Group Photo

### 4.3.2 Result

Based on the User Acceptance Testing (UAT) conducted, it can be concluded that all the functions of the CERDAS dashboard, including the Scorecard, Dropdown list, Date range control, Refresh button, Bubble map, Pie chart, Stacked Column Chart, Table, and Image, worked correctly without any errors. The UAT respondents unanimously selected "Comply" when testing these functions, indicating their successful execution.

Furthermore, the Evaluation Test revealed positive feedback from the respondents. All five respondents (100%) expressed their liking for the CERDAS dashboard, while four respondents (80%) reported enjoying its use. Additionally, four respondents (80%) acknowledged gaining valuable insights from the dashboard, and the same number of respondents (80%) believed that the CERDAS dashboard could assist in making decisions during emergency situations. Notably, four respondents (80%) expressed their intention to use the CERDAS dashboard in the future. Importantly, no comments or suggestions for dashboard improvements were provided by any of the respondents.

Based on the UAT and Evaluation Test results, it can be concluded that the CERDAS dashboard successfully performs its functions without errors, and it has received positive feedback from the users, who expressed satisfaction, enjoyment, insightfulness, and a willingness to utilize the dashboard in the future. The absence of comments or suggestions for improvements suggests that the dashboard has effectively met the users' needs and expectations.

The findings from this study are organized based on the research questions as follow: -

1. How significant is an online dashboard for emergency and disaster situations on campus?

   An online dashboard for emergency and disaster situations on campus is a significant tool in data-driven emergency response. By utilizing data analytics and real-time information, the dashboard provides critical information for stakeholders to make informed decisions and take appropriate actions. It offers situational awareness by indicating the level of emergency and urgency for each emergency type and helps identify those who may be affected, enabling emergency responders to deploy resources more effectively and efficiently. Additionally, the dashboard displays the suggested required personnel for the University Health Centre and Emergency

Department, as well as the number of available personnel for both departments. Inclusion of the level of emergency and urgency for each emergency type, along with personnel information, can further enhance the overall response to emergency and disaster situations on campus. Therefore, an online dashboard is an essential tool for effective data-driven emergency response on campus.

2. Which visualization techniques are critical and effective for emergency responses on campus?

   There are several visualization techniques that emergency responders can use to effectively respond to incidents on campus. Real-time dashboards are one such technique, providing stakeholders with critical information about the incident, such as the level of emergency and urgency, and the number of available personnel for responding to the situation. With real-time updates on the situation, these dashboards can help emergency responders deploy resources more effectively and efficiently. Another critical and effective visualization technique is the bubble map. A bubble map displays data using circles or bubbles of different sizes, colors, and positions on a map to represent specific values. It is an effective tool for visualizing spatial patterns and relationships between data points, such as the location and severity of incidents. By using longitude and latitude coordinates, emergency responders can quickly identify the location of the incident and determine the severity of the situation based on the size and colour of the bubble. This visualization technique provides a quick and intuitive way for emergency responders to understand the situation and make informed decisions. Additionally, the bubble map can be used to visualize other relevant data, such as the distribution of emergency resources, to help responders allocate resources effectively. Overall, both the real-time dashboard and bubble map are critical and effective tools for emergency responses on campus.

Part of the significant outcome derived from this study has been successfully reported and presented at the ICRES conference. Please refer to Appendix I for more details on this achievement.

### 4.3.3 Discussion


Figure 4.9: Dashboard with Label (1)

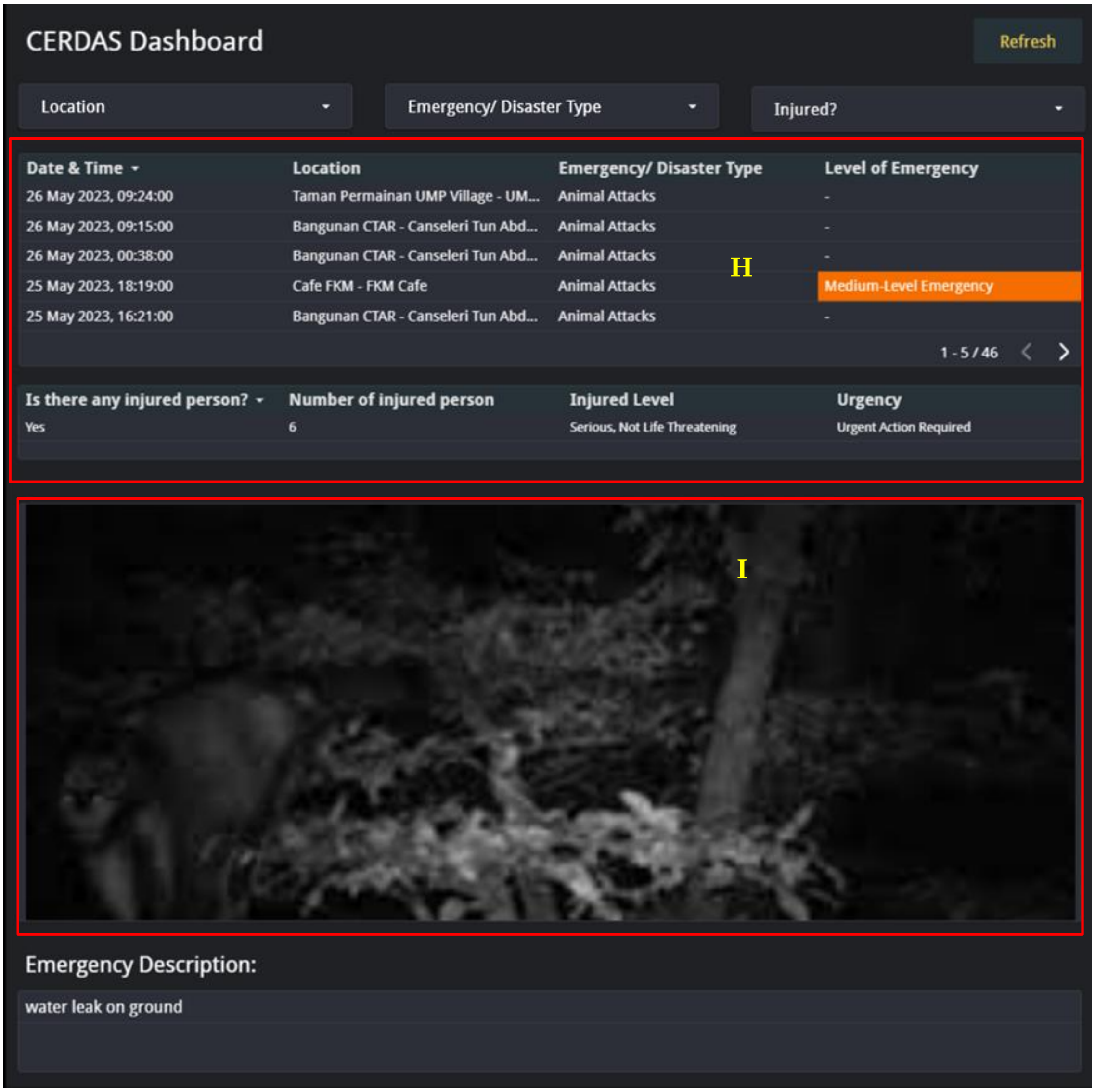



Figure 4.10: Dashboard with Label (2)

Based on Figure 4.9 and Figure 4.10, the dashboard contains a scorecard, dropdown list, date range control, button, bubble map, pie chart, stacked column chart, time series chart, table and image. The combination of the mention elements can be an effective collection of tools for showing and analysing data in a dashboard, such that: -

A. Scorecard: The Scorecard, labelled as A, gives a succinct total case happen and total number of people injured, allowing users to quickly determine the level of safety on the campus.
B. Dropdown list: The Dropdown list, labelled as B, enables users to filter data based on a selected location. This can assist users in focusing on the data that is most

pertinent to their needs and make it easier to compare data across regions.

C. Date range control: The Date range control, labelled as C, enables users to customize the time period during which data is displayed. This is especially useful for tracking trends over time and assessing data changes across multiple time periods.

D. Refresh button: The Refresh button, labelled as D, is set to reset filter actions, allows users to update the displayed data and restore default filter settings. This feature is especially advantageous when working with real-time data, as it enables users to view the most recent information while preserving the dashboard's original filtering configuration.

E. Bubble map: The Bubble map, labelled as E, displays data spatially, using bubbles or markers to indicate the position and magnitude of cases. This is very effective for illustrating spatial trends in data.

F. Pie chart: The Pie chart, labelled as F, displays the relative proportions of emergency type categories. This can be helpful for rapidly determining the most significant or pertinent categories.

G. Stacked Column Chart: The Stacked Column Chart, labelled as G, displays the various types of emergencies that occurred at each location, with distinct colours indicating each type of event. The horizontal axis represents the locations, while the vertical axis represents the number of cases that occurred. This chart aids in identifying the locations with the highest number of emergency cases and determining which types of emergencies are most prevalent in each location.

H. Table: Table, labelled as I, shows the date and time, location, emergency/ disaster type, level of emergency, injured option, injured level and urgency data in a tabular fashion, with rows and columns that facilitate data sorting and filtering.

I. Image: Image, labelled as J, is set to display one row per page, serves as a visual representation of the emergency and response system. This feature enables security unit to quickly identify key elements of the system. The image function simplifies the navigation process, making it easier for users to access critical information during an emergency.

The potential impacts of using a dashboard in emergency and catastrophe situations are significant and can extend to multiple sectors, including:

1. Society: Society 5.0 recognizes the importance of leveraging technology to improve safety, security, and quality of life for all members of society (Deguchi et al., 2020) The use of a dashboard in emergency and disaster response, such as the Community-based Disaster Risk Management (CBDRM) initiative proposed by Yayasan PETRONAS (YP), exemplifies how technology can be used to achieve these goals. By providing the public with real-time updates and accurate information, the dashboard can help minimize panic and misinformation, while also ensuring that individuals take appropriate safety measures. In the case of CBDRM, the dashboard can provide communities with critical information about potential disasters, evacuation routes, and emergency services, empowering them to make informed decisions and actively participate in disaster risk reduction efforts.
2. Government: The use of a dashboard in emergency and catastrophe situations is an example of how digital government can be leveraged to improve the delivery of public services. Digital government refers to the use of digital technologies, such as online platforms and data analytics, to enhance the efficiency, effectiveness, and transparency of government operations (Misuraca et al., 2020). In the context of CBDRM, the dashboard can serve as a central hub for government agencies and local authorities to coordinate their efforts, share information, and collaborate with communities. It enables real-time monitoring of the situation, facilitates data-driven decision-making, and allows for the efficient allocation of resources to affected areas.
3. Industry: A dashboard can be an invaluable tool for protecting critical infrastructure and facilities during emergencies or natural disasters. By utilizing data-driven decision-making in emergency response systems, it becomes possible to identify potential threats and deploy necessary resources to secure vital infrastructure and facilities with a preventive management approach for the long term. This approach aligns with the global trend towards the fourth industrial revolution (Duan & Da Xu, 2021). For instance, in the CBDRM initiative, the dashboard can provide industry stakeholders with real-time information about the

status of infrastructure, supply chains, and logistics, enabling them to proactively respond to potential disruptions and minimize the impact on operations.

4. Environment: The efficiency gained from data-driven decision making has a significant impact on the environmental issue. Optimization of resource utilization is possible to be done when there is data available either for real-time action or future scenario planning especially on the logistic and resource planning. This somehow affect directly the environmental in term of carbon emission especially from fires (Wiedinmyer & Neff, 2007). In the case of CBDRM, the dashboard can integrate environmental data, such as weather patterns, flood levels, and landslide risks, to support decision-making that minimizes environmental impact. By using nature-based solutions (NBS) and ecosystem-based disaster risk reduction strategies, the dashboard can facilitate the implementation of environmentally sustainable measures to reduce the impact of climate hazards and promote resilience.
5. Academia: This study contributes a new insight into the body of knowledge for sustainable higher education itself. Greater attention can be made among scholars and academia on the importance of emergency response systems empowered with data analytics. For instance, the CBDRM initiative proposed by YP contributes to the body of knowledge for sustainable higher education itself. By implementing emergency response systems empowered with data analytics, academia can gain new insights into the effectiveness of CBDRM approaches and contribute to ongoing research and best practices. Greater attention can be given to the importance of data-driven decision-making and the role of technology in enhancing community resilience. Academia can collaborate with organizations like YP to conduct studies, evaluate the impact of CBDRM initiatives, and disseminate knowledge and findings to stakeholders in the field of disaster management and sustainable development.

# CHAPTER 5

# CONCLUSION

## 5.1 Introduction

Chapter 5 of this research study will delve into the findings related to the development of Visual Analytics for UMP Centralized Emergency Response and Disaster Assistance System (CERDAS), with the aim of achieving the stated objectives and addressing the identified problem. The findings of this study emphasize the significance of data-driven decision-making in emergency response and disaster management systems within higher education institutions. By utilizing cloud-based services such as online form creator and online dashboards, universities and communities can gather and analyze data to inform emergency response plans and improve the safety and security of individuals on campus. Furthermore, the study's emphasis on sustainable development goals underscores the need for emergency response systems that prioritize building resilience and preparedness for emergencies scenarios. As such, investing in smart campuses with robust emergency response systems can contribute to achieving these goals, making them an essential resource for decision-makers and stakeholders in emergency management and disaster preparedness. In summary, the link between campus emergencies and emergency response systems is clear. By implementing data-driven decision-making with cloud technologies, universities and communities can improve their emergency response and disaster management systems, ensuring the safety and security of individuals on campus while contributing to sustainable development goals

## 5.2 Research Constraint

In the context of developing an emergency response and disaster assistance system dashboard, it is crucial to acknowledge certain limitations that may impact the effectiveness of visual analytics and technology implementation in emergency situations. While the study offers valuable insights, it is important to consider the following factors:

1. Availability of Resources and Infrastructure:
- The successful implementation of visual analytics relies on the availability and accessibility of resources and infrastructure. In some regions or institutions, there may be limited access to stable internet connections, reliable power supply, or up-to-date technological devices. Without these essential resources, the effectiveness of the emergency response system could be compromised.

2. Stakeholders' Capacity:
- The effectiveness of any technology or system depends on the capacity of stakeholders to implement and utilize it efficiently. Emergency response and disaster management involve a wide range of stakeholders, including administrators, first responders, medical personnel, and individuals affected by the situation. Ensuring that all stakeholders are adequately trained and have the necessary skills to use the technology effectively is crucial. If stakeholders lack the knowledge or training required to utilize the system, its overall effectiveness may be diminished.

3. Dependence on Smartphone Usage:
- The study mentions that the use of smartphones is essential for lodging emergency reports. While smartphones have become ubiquitous in many societies, there are cases where individuals may not possess or have immediate access to smartphones during an emergency. For example, in situations where someone panics or loses consciousness, they may be unable to use the technology effectively, rendering the emergency reporting feature less reliable.

4. Accessibility and Usability:
- It is essential to ensure that the emergency response system dashboard is accessible and user-friendly to individuals with diverse backgrounds, abilities, and technological

literacy. Considerations should be given to factors such as language barriers, intuitive user interfaces, and accommodating individuals with disabilities. Failing to address these accessibility and usability issues could exclude certain segments of the population from effectively utilizing the system during emergencies.

## 5.3 Future Work

As for future research, findings and limitations from this study could provide the way how to explore additional questions related to emergencies and disasters in higher education. Some potential areas for further investigation are:

1. Factors that influence the occurrence of emergency and disaster cases could be examined in future research. For instance, this study revealed a significant incidence of elevator malfunctioning on campus, and further research could explore contributing factors such as mechanical failure or improper maintenance to reduce the frequency of lift malfunctions.
2. The relationship between emergency and disaster cases and their effects on mental health could be investigated in future research. This study did not explore this connection, and additional research could identify successful approaches for delivering psychosocial support and increasing mental health resilience in affected communities.
3. Prevent Fake Entries: To address the issue of fake entries by respondents in the CERDAS form, future work can focus on integrating AI technology as a preventive measure. Currently, there is no foolproof solution to completely eliminate fake entries, but leveraging AI can significantly reduce the occurrence of such entries. By incorporating AI technology into the CERDAS system, advanced algorithms can be employed to analyze respondent behavior, patterns, and data consistency, allowing the system to detect and flag suspicious or fraudulent entries. Machine learning models can be trained to identify anomalies in the data, such as inconsistent information or repeated patterns, which may indicate potential fake entries. Furthermore, an alternative approach could involve adding a confidential checkbox for respondents on the CERDAS form. By selecting this checkbox, the respondent acknowledges responsibility for the accuracy and authenticity of the entered data. This serves as a reminder to respondents that they are accountable for the information they provide, discouraging them from submitting false or misleading entries. It is

important to note that while AI integration and the confidential checkbox can act as preventive measures, they are not foolproof solutions. They can significantly reduce the likelihood of fake entries, but there is still a possibility of some slipping through the system. Regular monitoring, manual verification, and cross-referencing with other data sources may be necessary to ensure data integrity.

Future research could be conducted to identify effective strategies for improving community readiness and resilience for emergency and disaster situations as well as implementing technology to prevent fake entry. Emergency preparedness and resilience are crucial for mitigating the effects of catastrophes and disasters.

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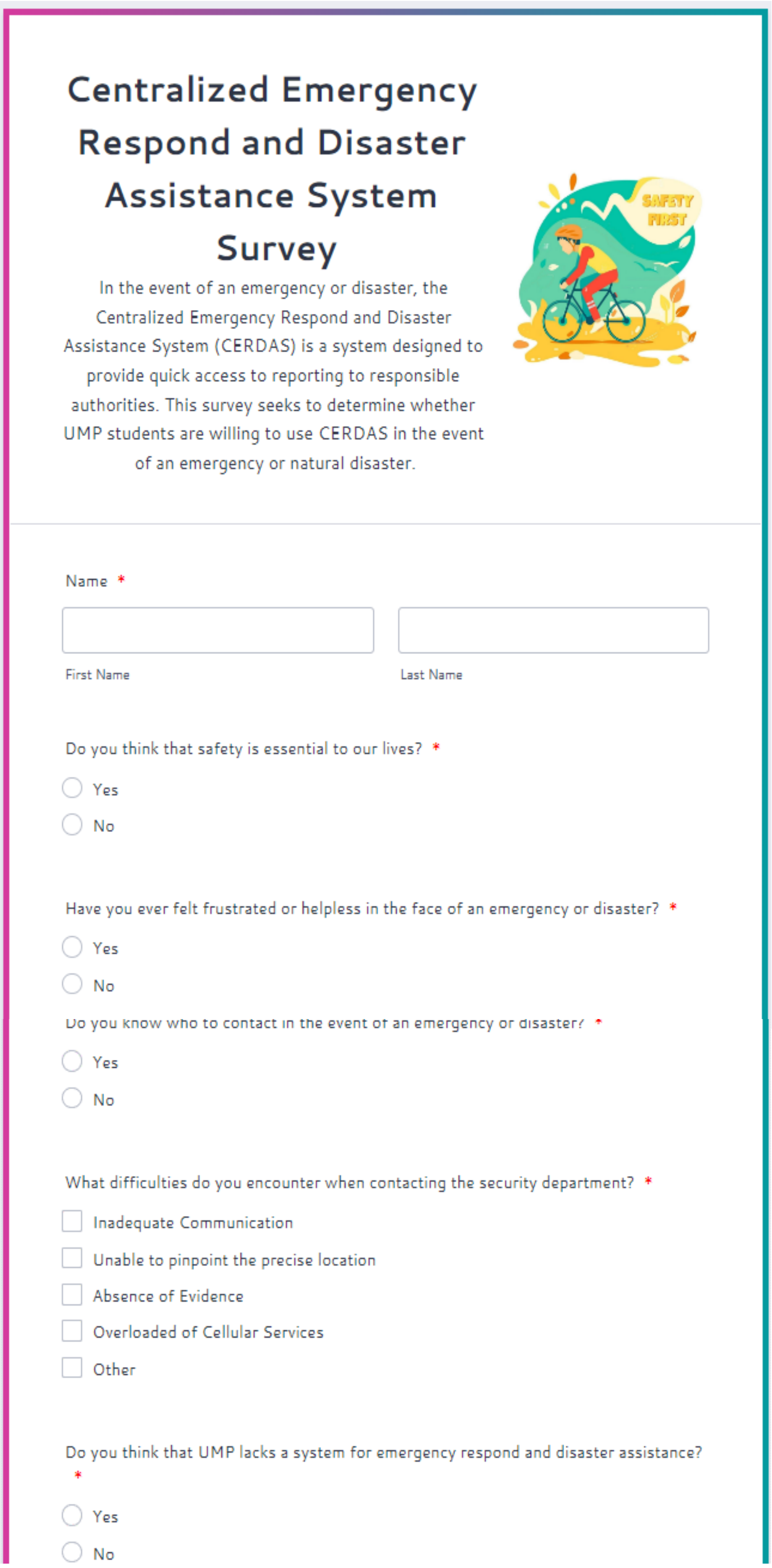
**APPENDIX A**
**PROOF OF CONCEPT**



## Centralized Emergency Respond and Disaster Assistance System Survey

In the event of an emergency or disaster, the Centralized Emergency Respond and Disaster Assistance System (CERDAS) is a system designed to provide quick access to reporting to responsible authorities. This survey seeks to determine whether UMP students are willing to use CERDAS in the event of an emergency or natural disaster.

SAFETY FIRST

Name *

First Name | Last Name

Do you think that safety is essential to our lives? *

- Yes
- No

Have you ever felt frustrated or helpless in the face of an emergency or disaster? *

- Yes
- No

Do you know who to contact in the event of an emergency or disaster? *

- Yes
- No

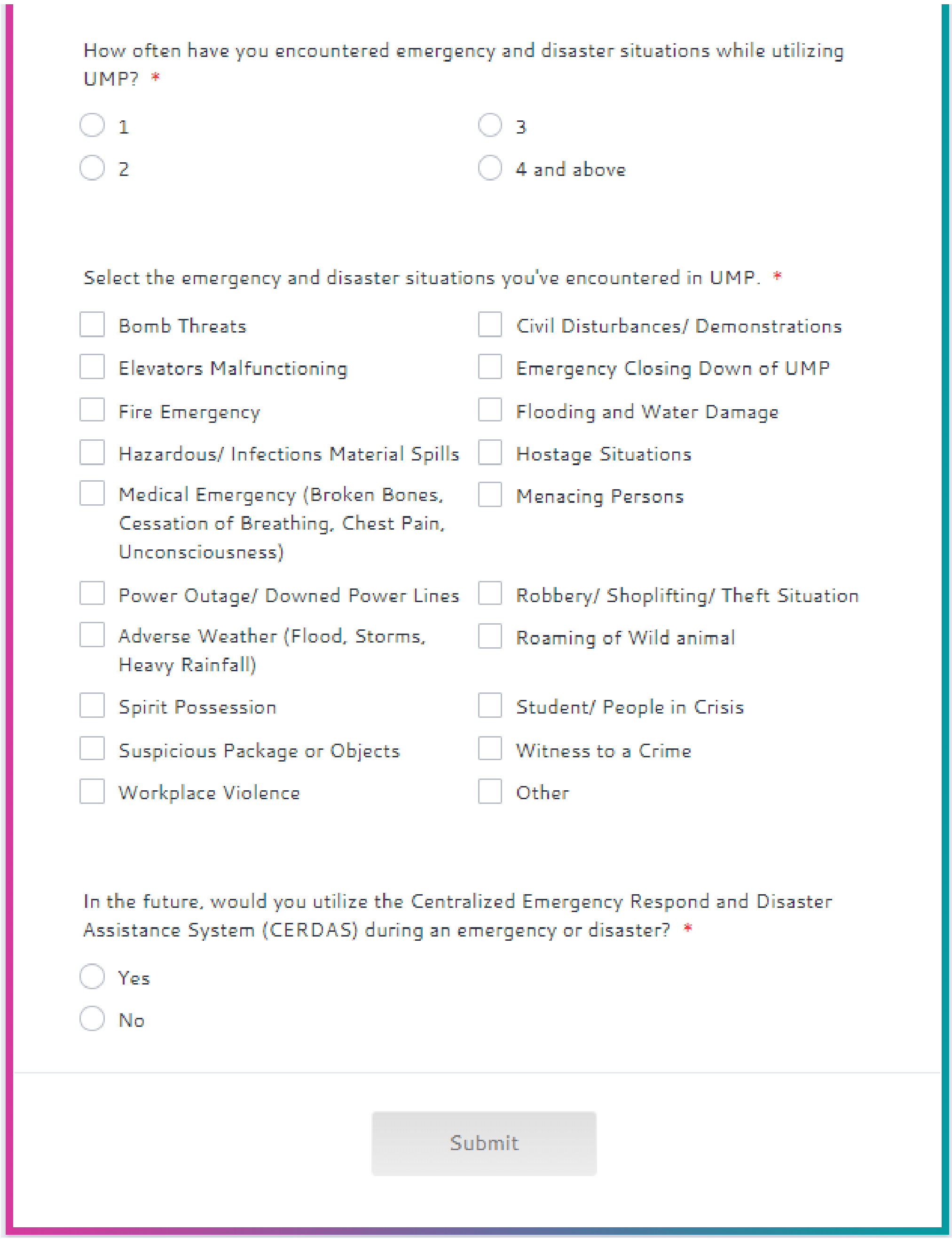
What difficulties do you encounter when contacting the security department? *

- Inadequate Communication
- Unable to pinpoint the precise location
- Absence of Evidence
- Overloaded of Cellular Services
- Other

Do you think that UMP lacks a system for emergency respond and disaster assistance? *

- Yes
- No

Figure 5.1: Survey's Question (1)



How often have you encountered emergency and disaster situations while utilizing UMP? *

- 1
- 2
- 3
- 4 and above

Select the emergency and disaster situations you've encountered in UMP. *

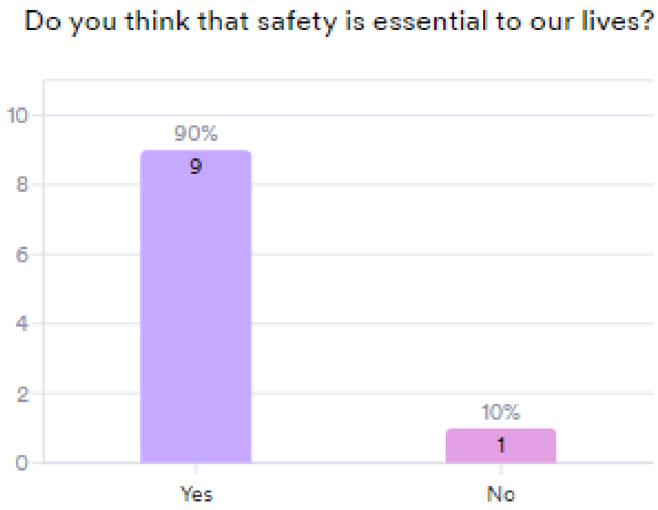
- Bomb Threats
- Civil Disturbances/ Demonstrations
- Elevators Malfunctioning
- Emergency Closing Down of UMP
- Fire Emergency
- Flooding and Water Damage
- Hazardous/ Infections Material Spills
- Hostage Situations
- Medical Emergency (Broken Bones, Cessation of Breathing, Chest Pain, Unconsciousness)
- Menacing Persons
- Power Outage/ Downed Power Lines
- Robbery/ Shoplifting/ Theft Situation
- Adverse Weather (Flood, Storms, Heavy Rainfall)
- Roaming of Wild animal
- Spirit Possession
- Student/ People in Crisis
- Suspicious Package or Objects
- Witness to a Crime
- Workplace Violence
- Other

In the future, would you utilize the Centralized Emergency Respond and Disaster Assistance System (CERDAS) during an emergency or disaster? *

- Yes
- No

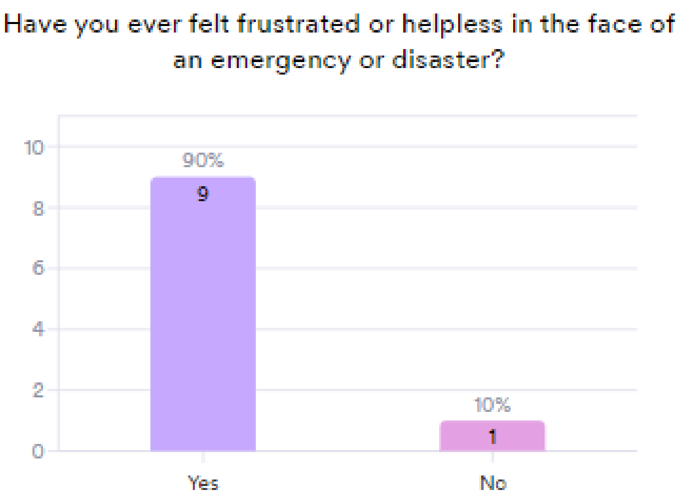
Submit

**Figure 5.2: Survey's Question (2)**



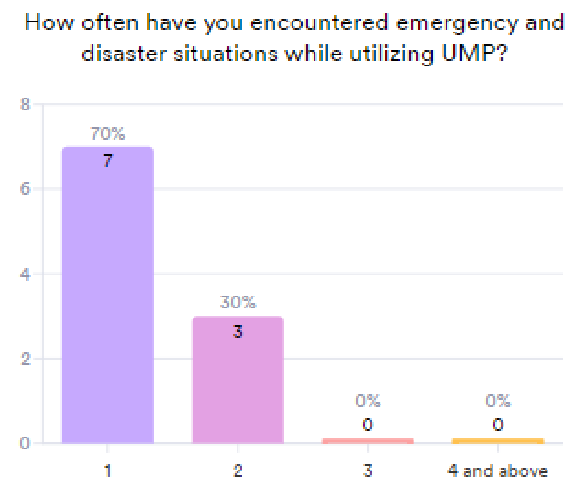

| Data | Response | % |
|---|---|---|
| Yes | 9 | 90% |
| No | 1 | 10% |

Figure 5.3: Analysis of Survey Response (1)




| Data | Response | % |
|---|---|---|
| Yes | 9 | 90% |
| No | 1 | 10% |

Figure 5.4: Analysis of Survey Response (2)

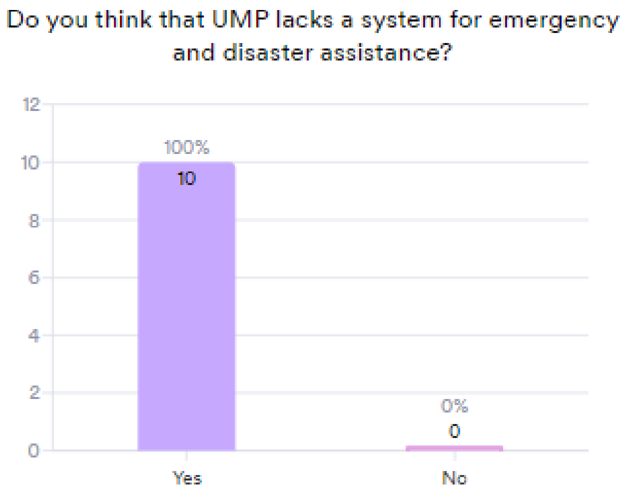



| Data | Response | % |
|---|---|---|
| 1 | 7 | 70% |
| 2 | 3 | 30% |
| 3 | 0 | 0% |
| 4 and above | 0 | 0% |

Figure 5.5: Analysis of Survey Response (3)

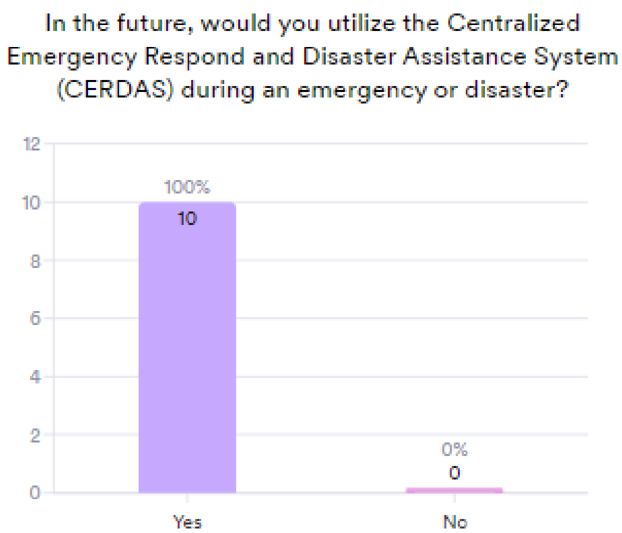

| Data | Response | % |
|---|---|---|
| No | 7 | 70% |
| Yes | 3 | 30% |

Figure 5.6: Analysis of Survey Response (4)



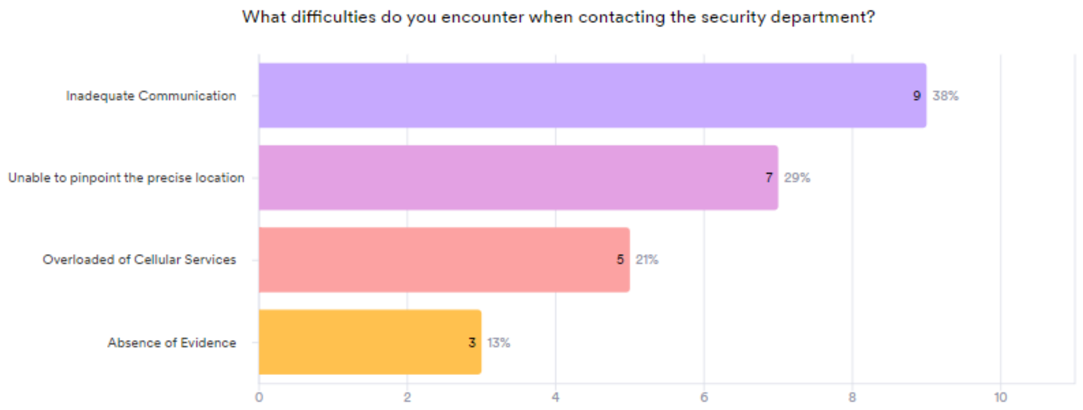

| Data | Response | % |
|---|---|---|
| Yes | 10 | 100% |
| No | 0 | 0% |

Figure 5.7: Analysis of Survey Response (5)



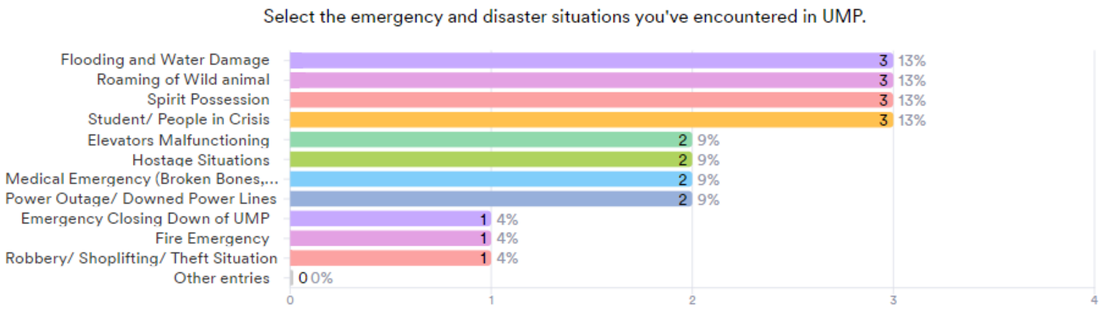

| Data | Response | % |
|---|---|---|
| Yes | 10 | 100% |
| No | 0 | 0% |

Figure 5.8: Analysis of Survey Response (6)




| Data | Response | % |
|---|---|---|
| Inadequate Communication | 9 | 38% |
| Unable to pinpoint the precise location | 7 | 29% |
| Overloaded of Cellular Services | 5 | 21% |
| Absence of Evidence | 3 | 13% |

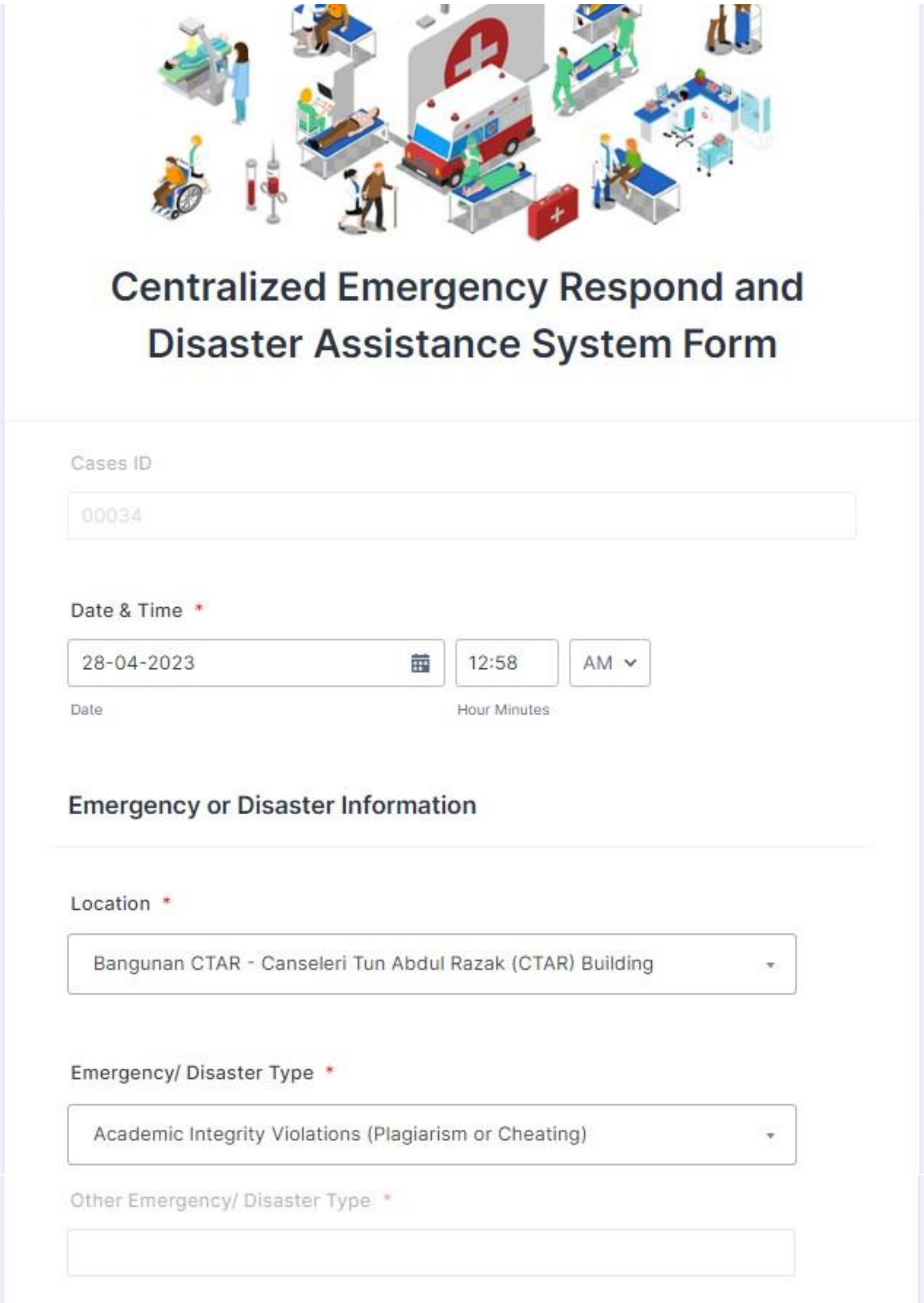
Figure 5.9: Analysis of Survey Response (7)




| Data | Response | % |
|---|---|---|
| Flooding and Water Damage | 3 | 13% |
| Roaming of Wild animal | 3 | 13% |
| Spirit Possession | 3 | 13% |
| Student/ People in Crisis | 3 | 13% |
| Elevators Malfunctioning | 2 | 9% |
| Hostage Situations | 2 | 9% |
| Medical Emergency (Broken Bones, Cessation of Breathing, Chest Pain, Unco... | 2 | 9% |
| Power Outage/ Downed Power Lines | 2 | 9% |
| Emergency Closing Down of UMP | 1 | 4% |
| Fire Emergency | 1 | 4% |
| Robbery/ Shoplifting/ Theft Situation | 1 | 4% |
| Other entries | 0 | 0% |

Figure 5.10: Analysis of Survey Response (8)

**APPENDIX B**
**EMERGENCY REPORT FORM**



Centralized Emergency Respond and Disaster Assistance System Form

Cases ID

00034

Date & Time *

28-04-2023 | 12:58 | AM

Date | Hour Minutes

Emergency or Disaster Information

Location *

Bangunan CTAR - Canseleri Tun Abdul Razak (CTAR) Building

Emergency/ Disaster Type *

Academic Integrity Violations (Plagiarism or Cheating)

Other Emergency/ Disaster Type *

Figure 5.11: Emergency Report Form (1)

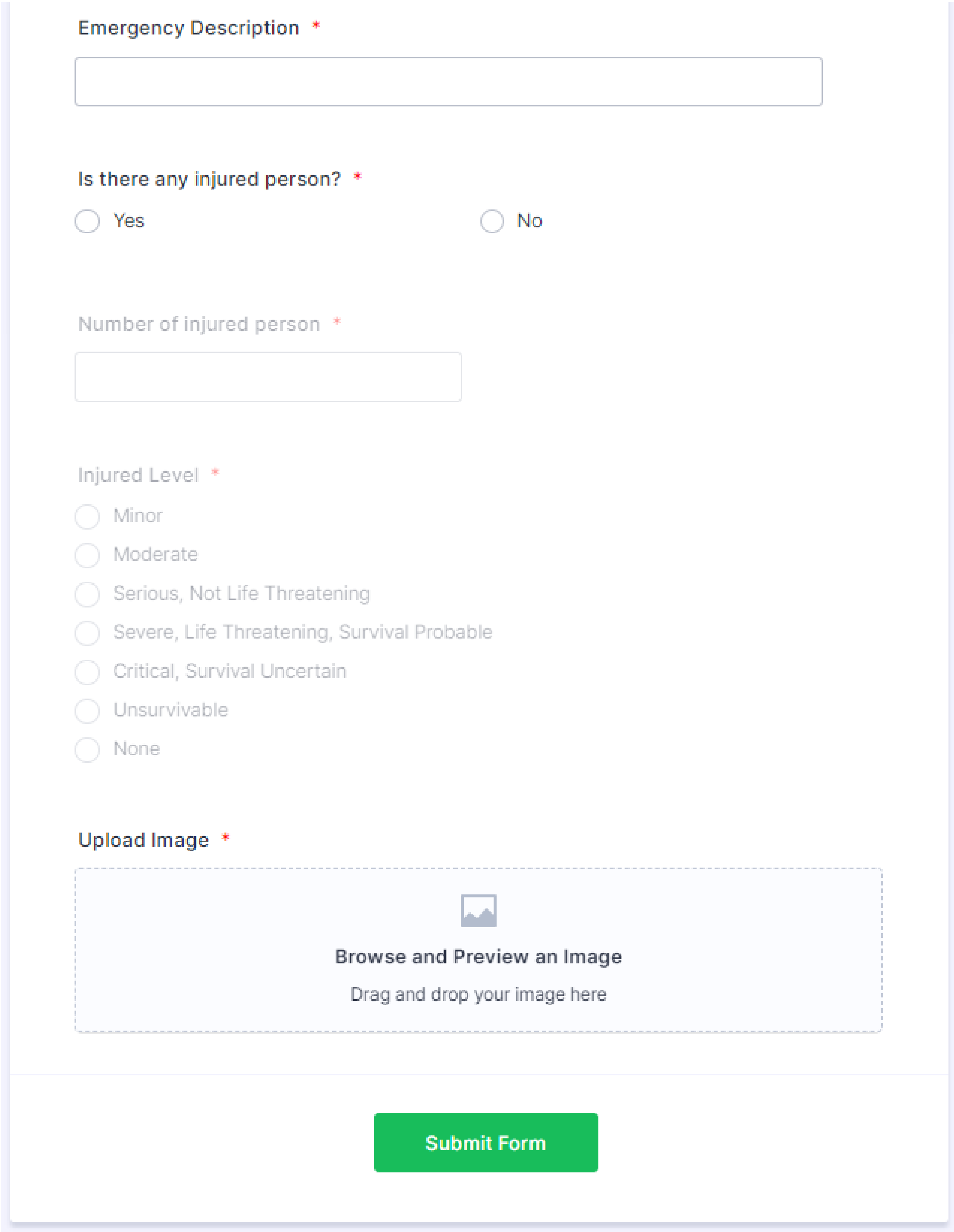



Figure 5.12: Emergency Report Form (2)

APPENDIX C
DASHBOARD (ENGLISH VERSION) OVERVIEW


Figure 5.13: Dashboard (English Version) Overview - CERDAS Overall

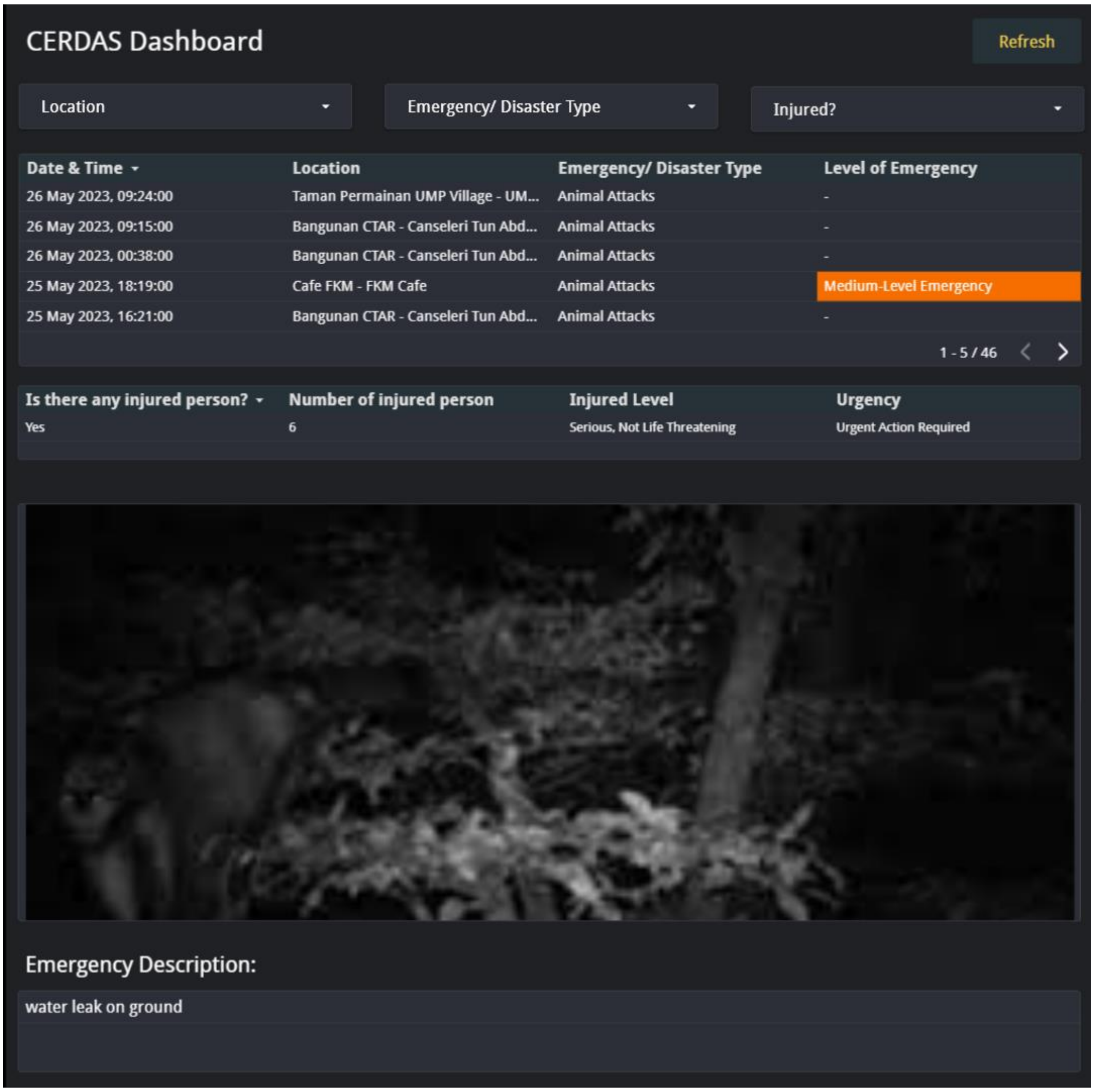



Figure 5.14: Dashboard (Malay Version) Overview - CERDAS Decision

## APPENDIX D
## DASHBOARD (MALAY VERSION) OVERVIEW


Figure 5.15: Dashboard (Malay Version) Overview - CERDAS Overall

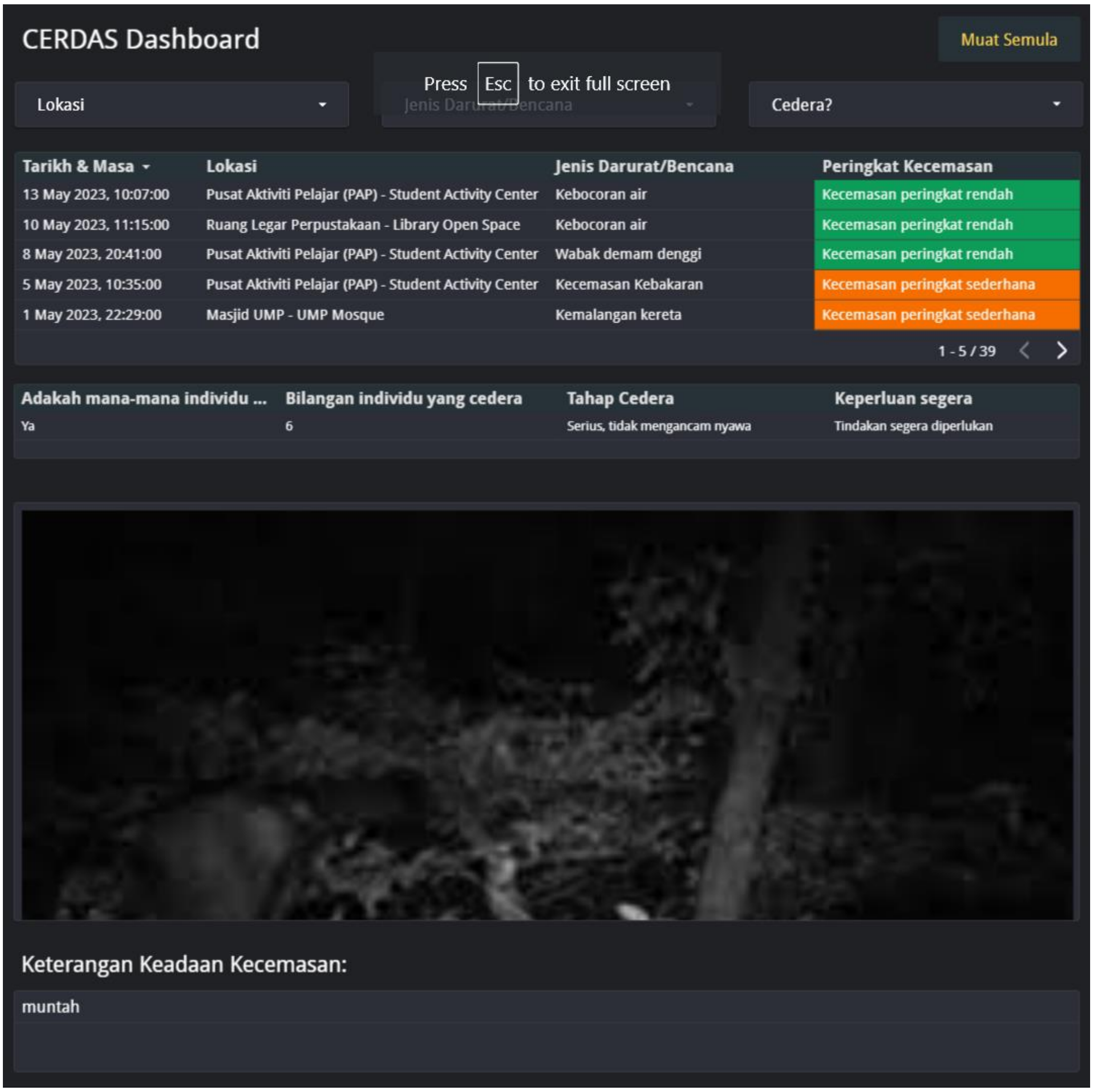
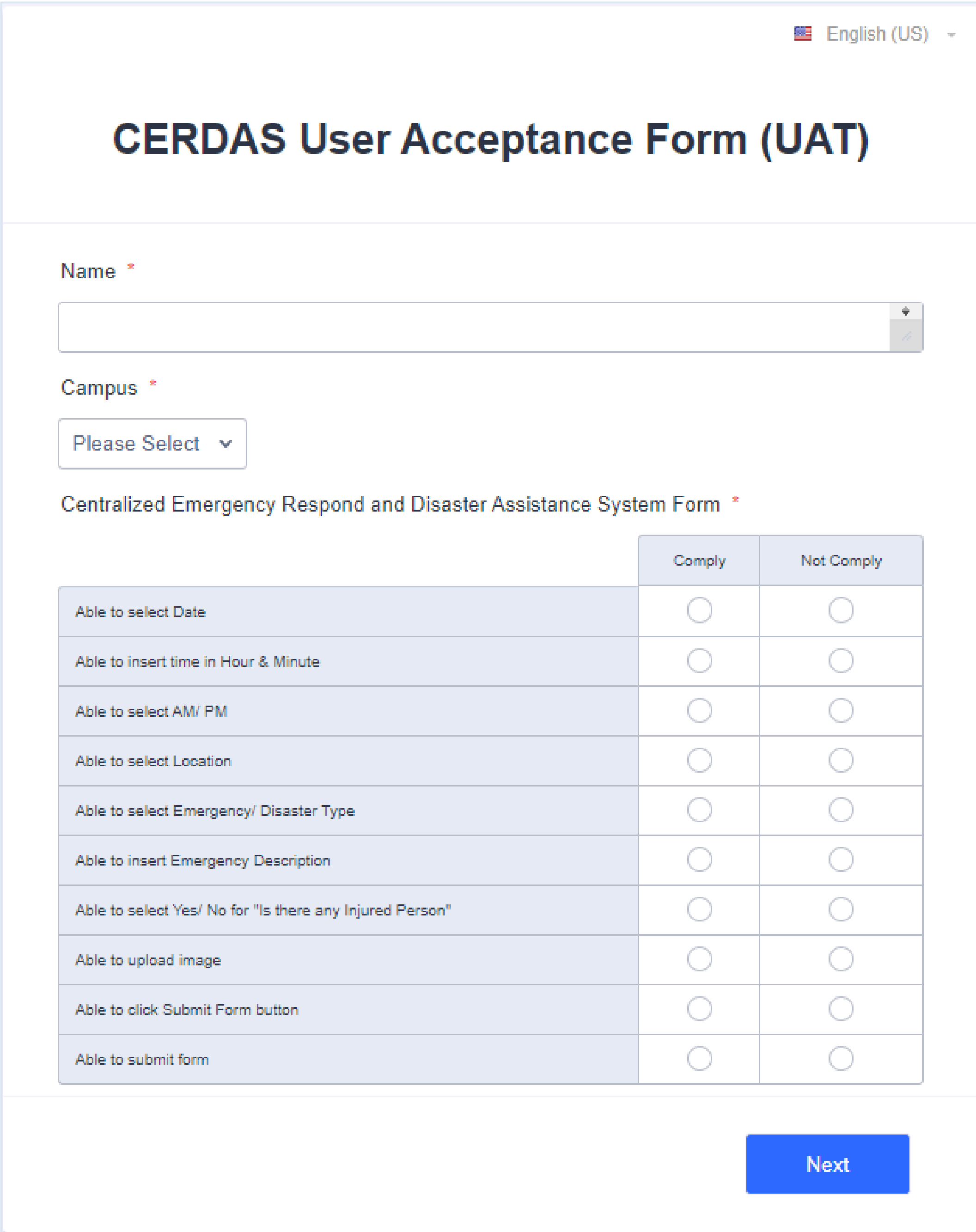



Figure 5.16: Dashboard (Malay Version) Overview - CERDAS Decision

**APPENDIX E**

**USER ACCEPTANCE FORM (UAT) - QUESTION**



English (US)

# CERDAS User Acceptance Form (UAT)

Name *

Campus *

Please Select

Centralized Emergency Respond and Disaster Assistance System Form *

| | Comply | Not Comply |
|---|---|---|
| Able to select Date | | |
| Able to insert time in Hour & Minute | | |
| Able to select AM/ PM | | |
| Able to select Location | | |
| Able to select Emergency/ Disaster Type | | |
| Able to insert Emergency Description | | |
| Able to select Yes/ No for "Is there any Injured Person" | | |
| Able to upload image | | |
| Able to click Submit Form button | | |
| Able to submit form | | |

Next

Figure 5.17: UAT Question - Page 1

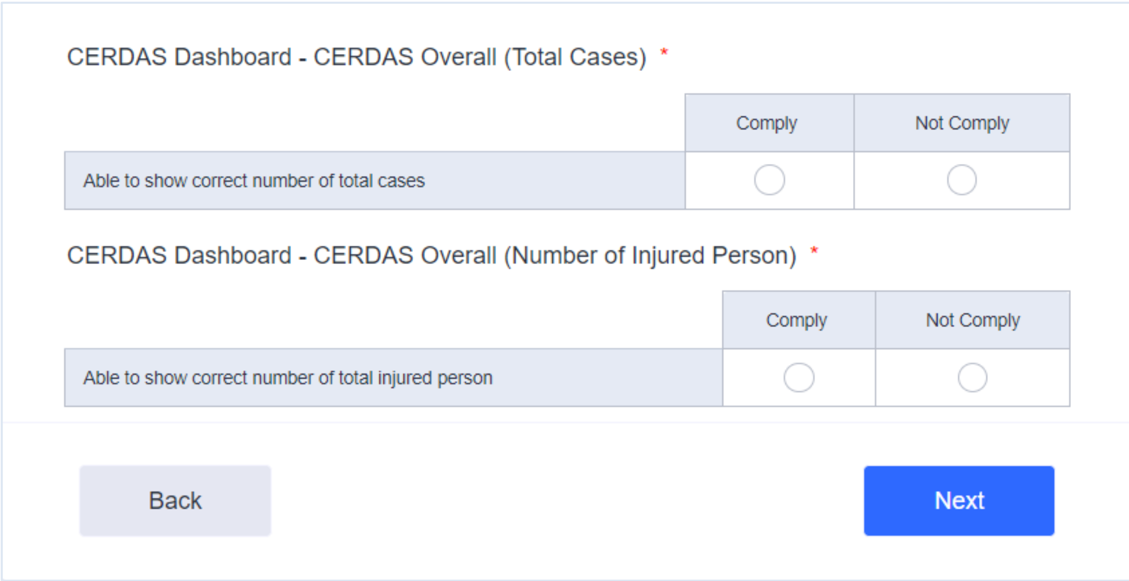



Figure 5.18: UAT Question – Page 2

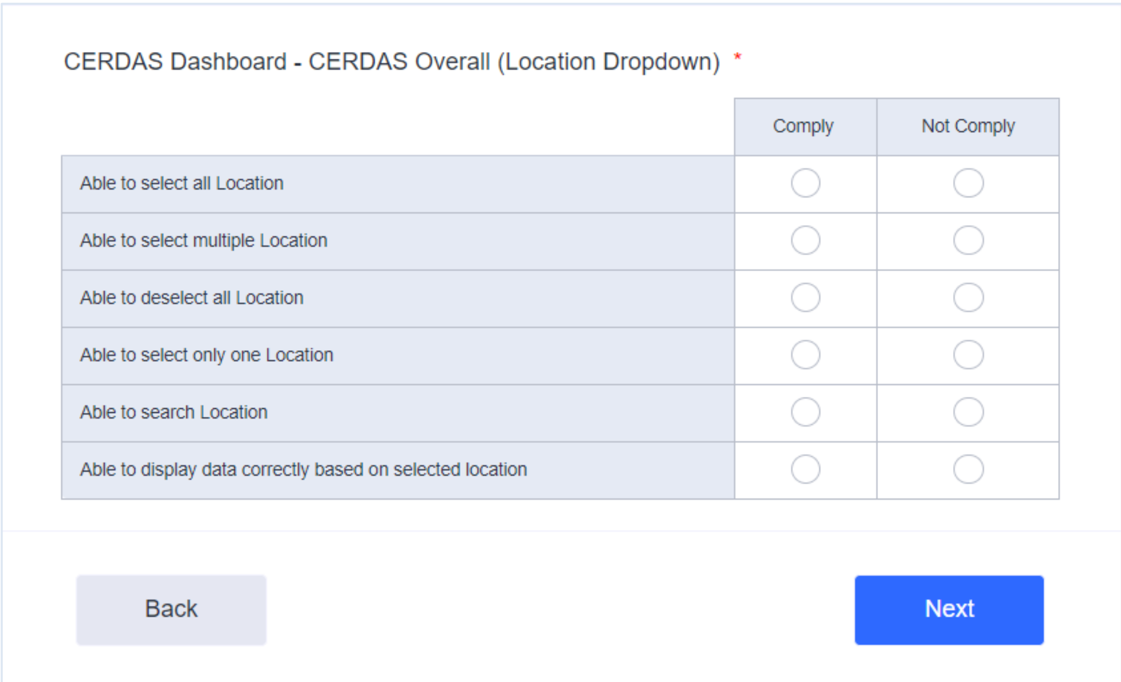
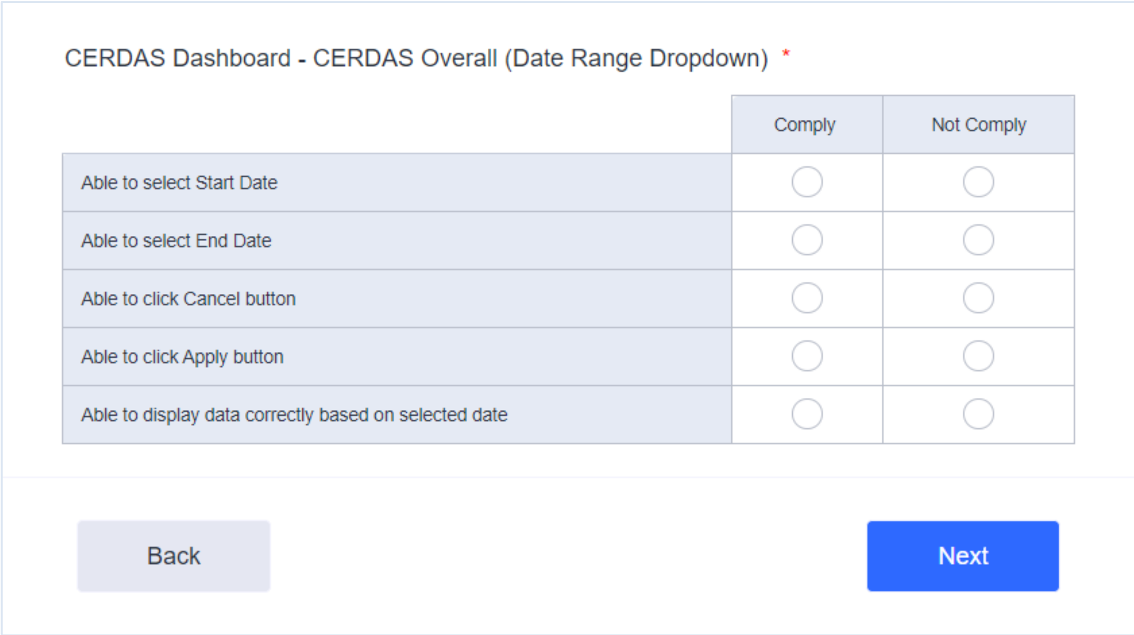


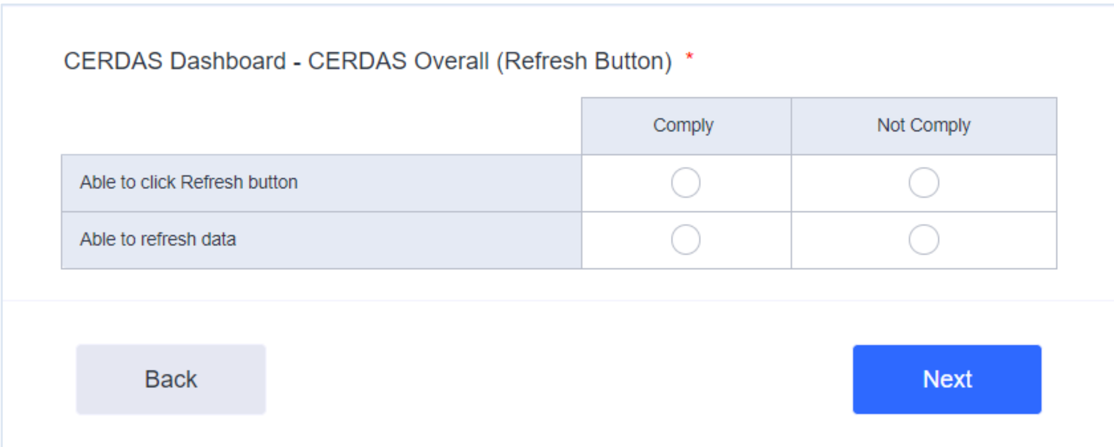

Figure 5.19: UAT Question - Page 3


CERDAS Dashboard - CERDAS Overall (Date Range Dropdown) *

| | Comply | Not Comply |
|---|---|---|
| Able to select Start Date | | |
| Able to select End Date | | |
| Able to click Cancel button | | |
| Able to click Apply button | | |
| Able to display data correctly based on selected date | | |

Back Next

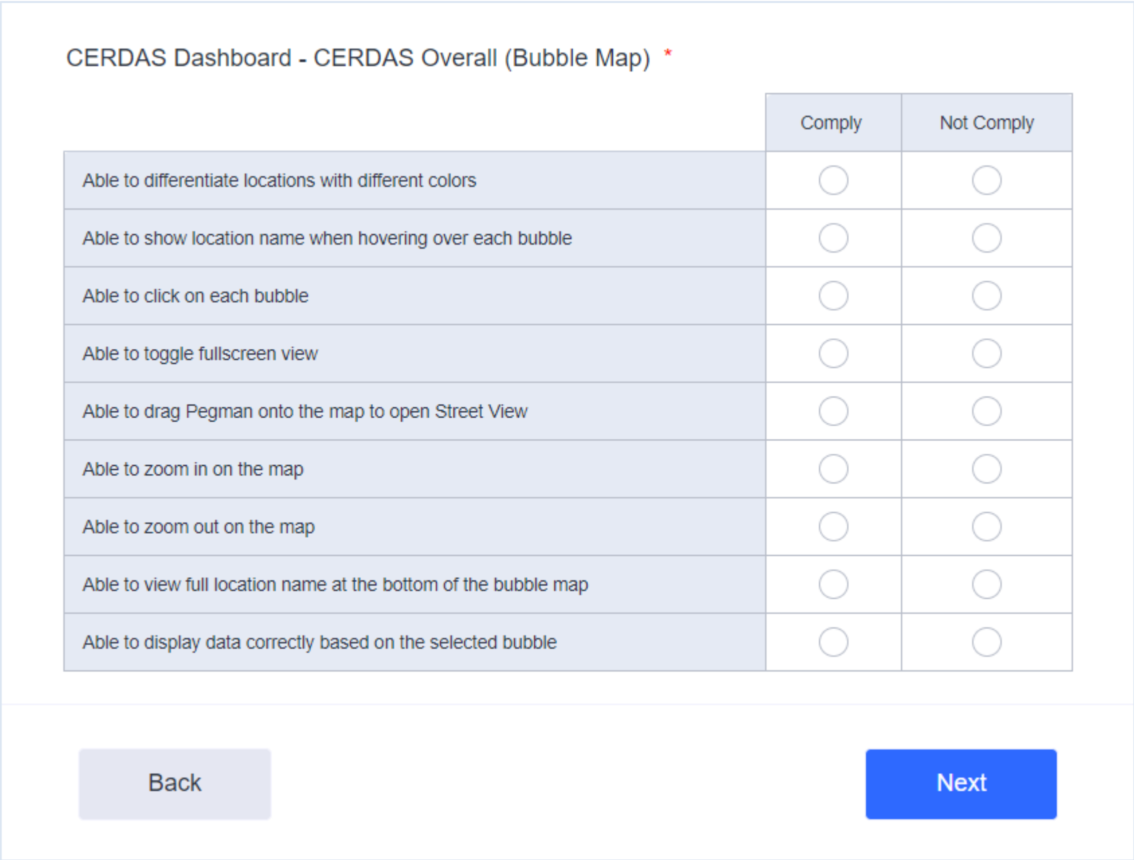
Figure 5.20: UAT Question - Page 4


CERDAS Dashboard - CERDAS Overall (Refresh Button) *

| | Comply | Not Comply |
|---|---|---|
| Able to click Refresh button | | |
| Able to refresh data | | |

Back Next

Figure 5.21: UAT Question - Page 5

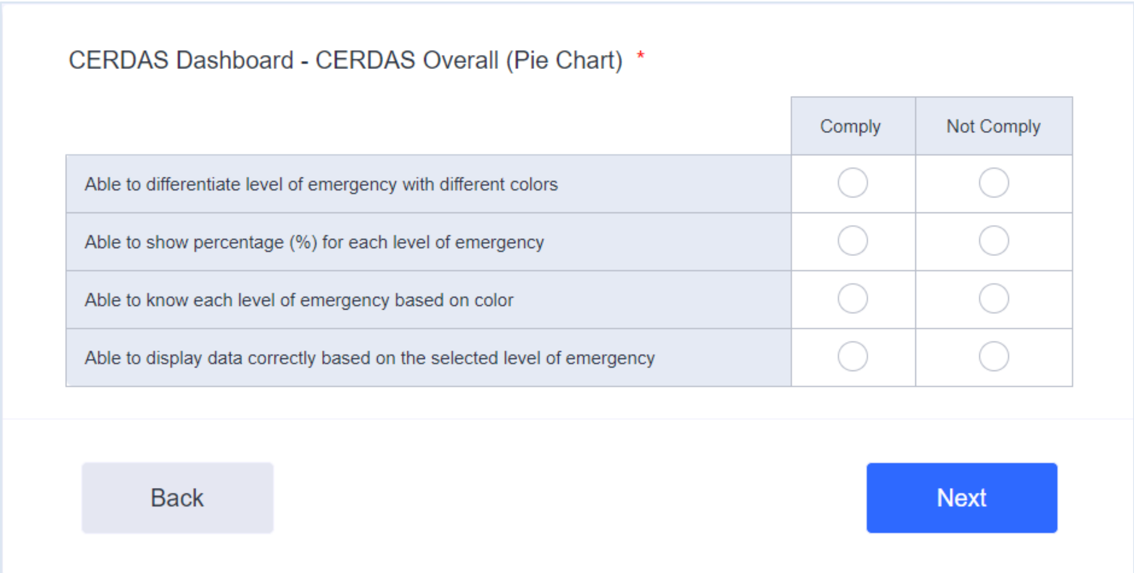


CERDAS Dashboard - CERDAS Overall (Bubble Map) *

| | Comply | Not Comply |
|---|---|---|
| Able to differentiate locations with different colors | | |
| Able to show location name when hovering over each bubble | | |
| Able to click on each bubble | | |
| Able to toggle fullscreen view | | |
| Able to drag Pegman onto the map to open Street View | | |
| Able to zoom in on the map | | |
| Able to zoom out on the map | | |
| Able to view full location name at the bottom of the bubble map | | |
| Able to display data correctly based on the selected bubble | | |

Back Next

Figure 5.22: UAT Question - Page 6



CERDAS Dashboard - CERDAS Overall (Pie Chart) *

| | Comply | Not Comply |
|---|---|---|
| Able to differentiate level of emergency with different colors | | |
| Able to show percentage (%) for each level of emergency | | |
| Able to know each level of emergency based on color | | |
| Able to display data correctly based on the selected level of emergency | | |

Back Next

Figure 5.23: UAT Question - Page 7

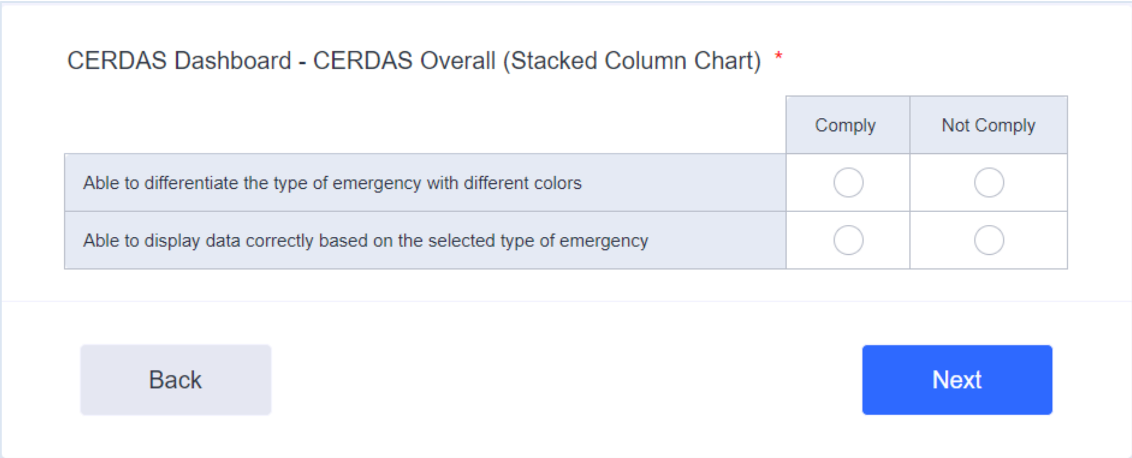



Figure 5.24: UAT Question - Page 8

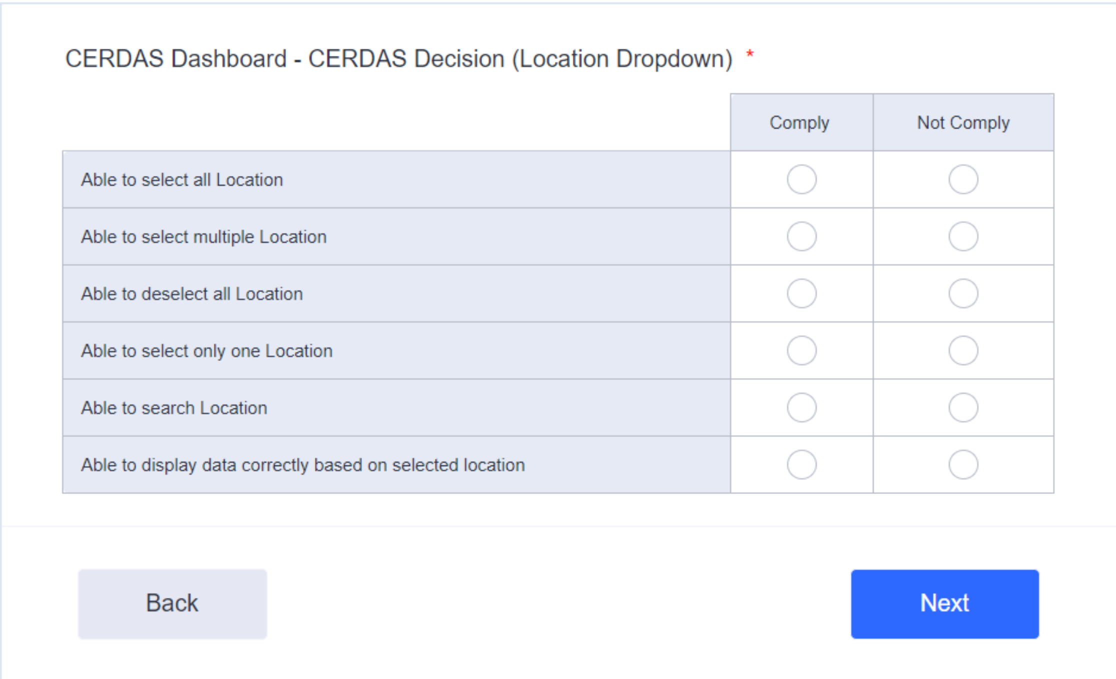



Figure 5.25: UAT Question - Page 9

CERDAS Dashboard - CERDAS Decision (Emergency/ Disaster Type Dropdown) *

| | Comply | Not Comply |
|---|---|---|
| Able to select all Emergency/ Disaster Type | | |
| Able to select multiple Emergency/ Disaster Type | | |
| Able to deselect all Emergency/ Disaster Type | | |
| Able to select only one Emergency/ Disaster Type | | |
| Able to search Emergency/ Disaster Type | | |
| Able to display data correctly based on selected Emergency/ Disaster Type | | |

Back Next

Figure 5.26: UAT Question - Page 10

CERDAS Dashboard - CERDAS Decision (Injured? Dropdown) *

| | Comply | Not Comply |
|---|---|---|
| Able to select Yes/No for Injured? | | |
| Able to select all Injured? | | |
| Able to deselect all Injured? | | |
| Able to select only one Injured? | | |
| Able to search Injured? | | |
| Able to display data correctly based on selected Injured? | | |

Back Next

Figure 5.27: UAT Question - Page 11

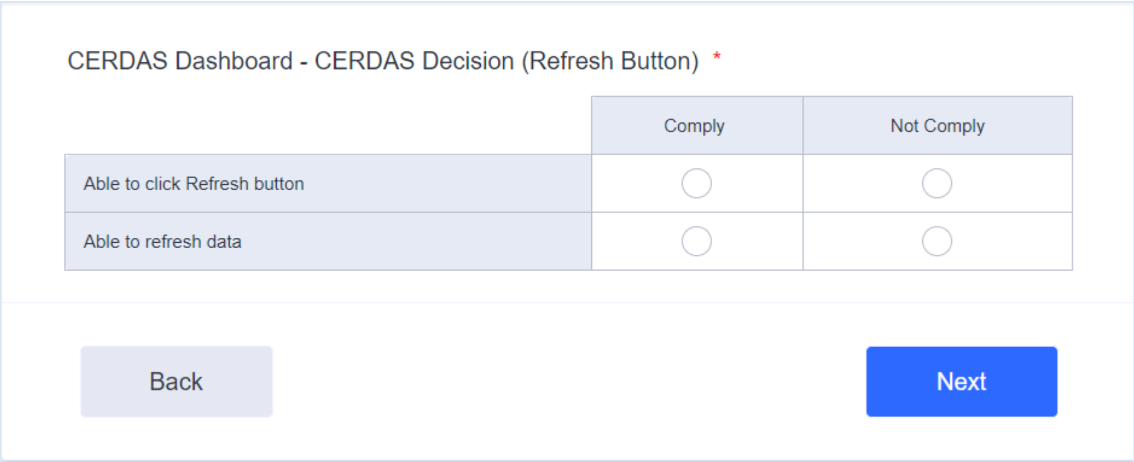



Figure 5.28: UAT Question - Page 12

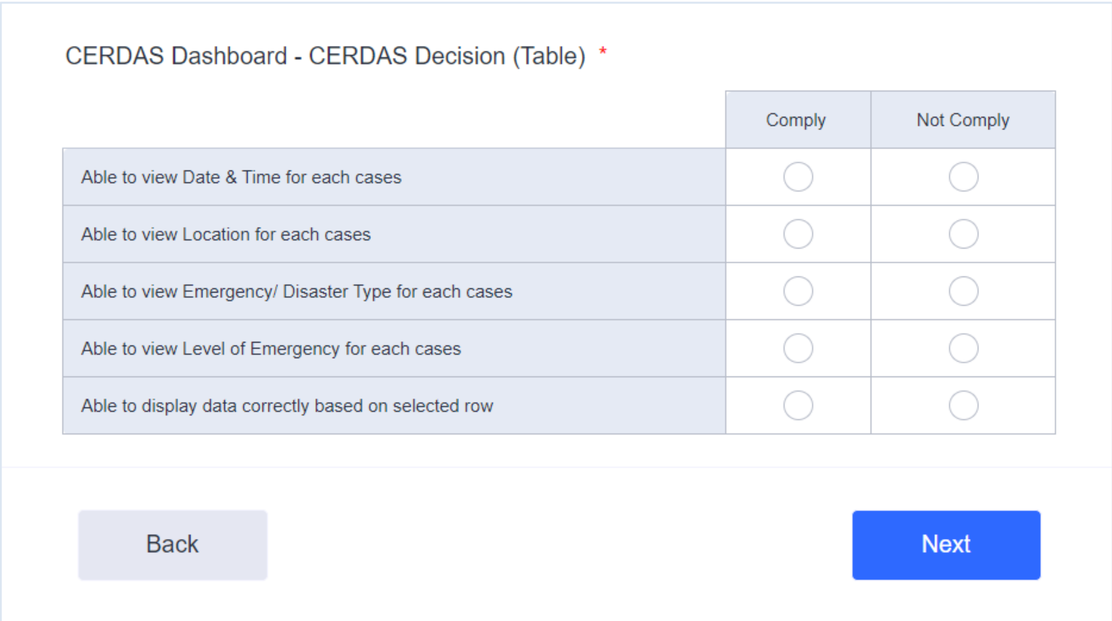
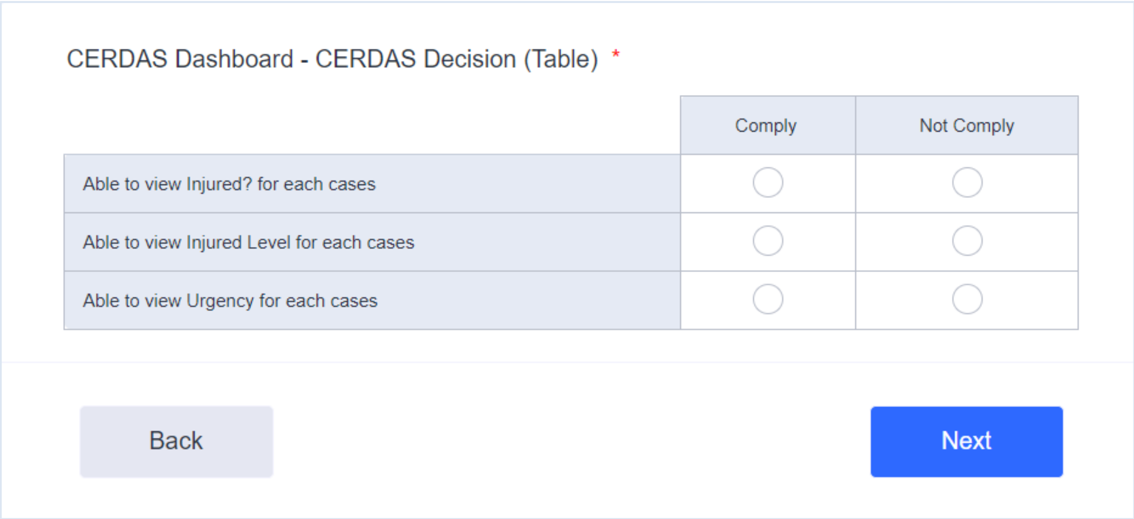



Figure 5.29: UAT Question - Page 13



CERDAS Dashboard - CERDAS Decision (Table) *

| | Comply | Not Comply |
|---|---|---|
| Able to view Injured? for each cases | | |
| Able to view Injured Level for each cases | | |
| Able to view Urgency for each cases | | |

Back

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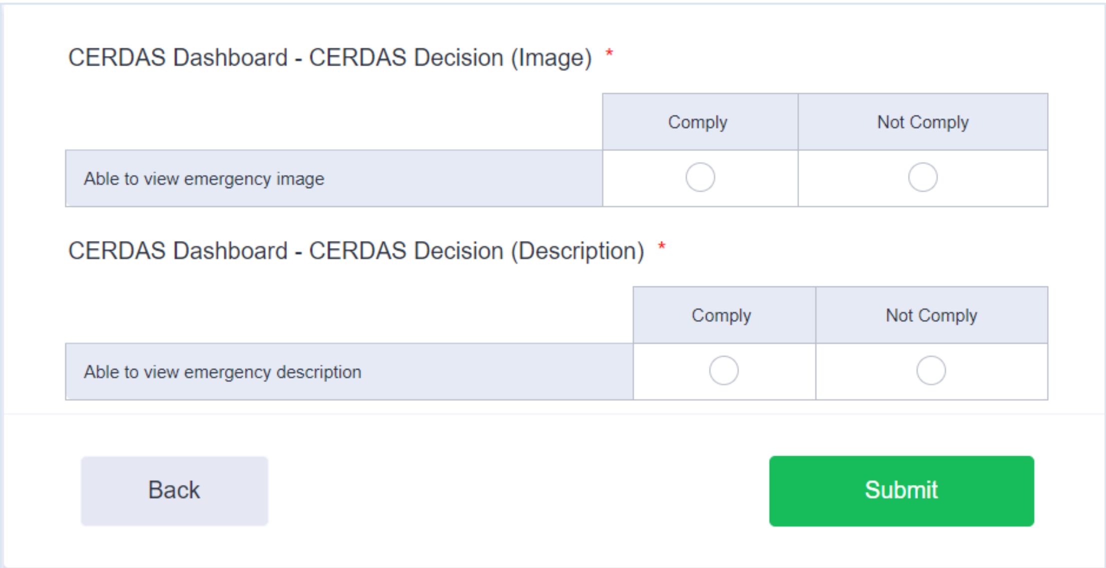
Figure 5.30: UAT Question - Page 14



CERDAS Dashboard - CERDAS Decision (Image) *

| | Comply | Not Comply |
|---|---|---|
| Able to view emergency image | | |

CERDAS Dashboard - CERDAS Decision (Description) *

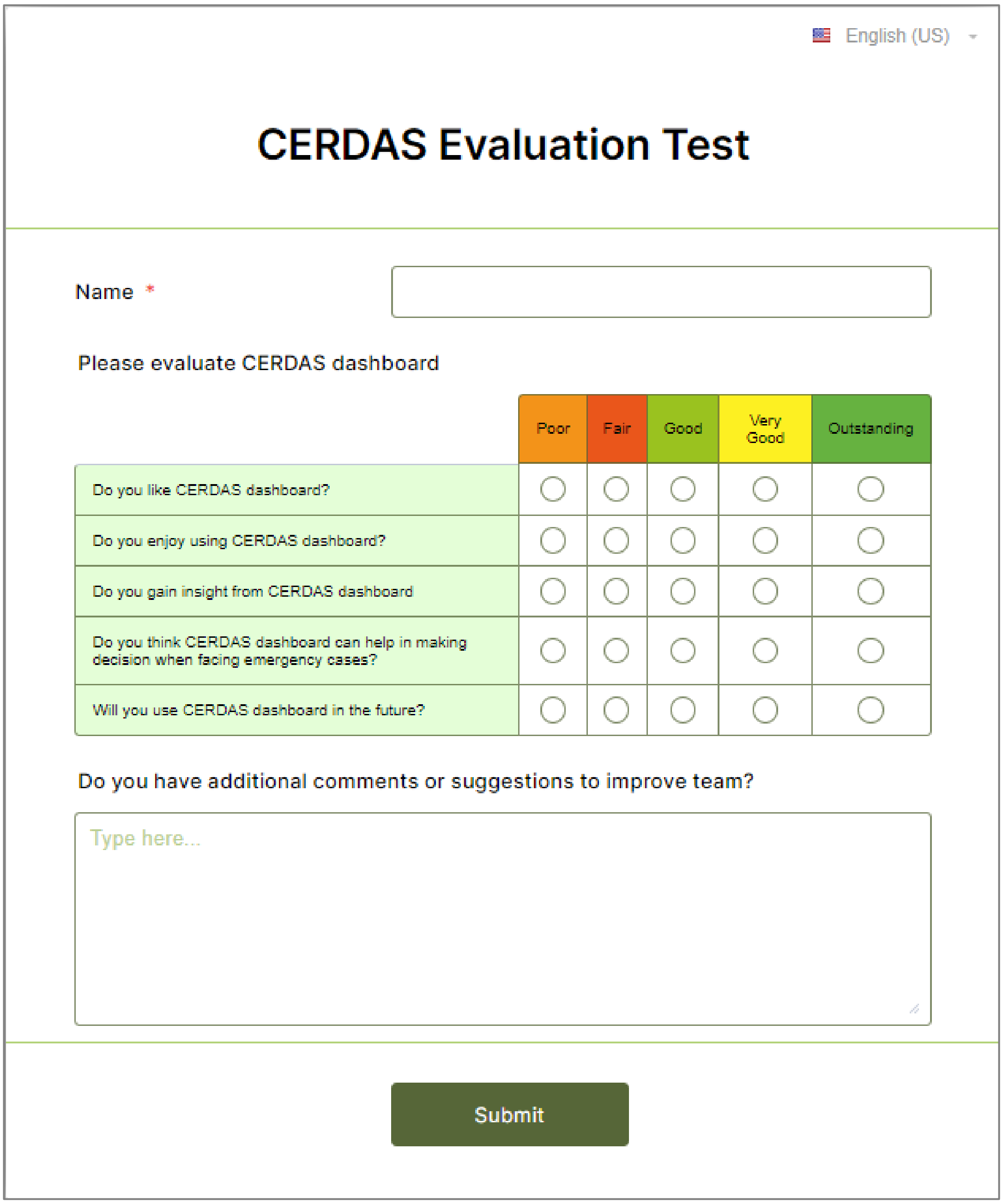
| | Comply | Not Comply |
|---|---|---|
| Able to view emergency description | | |

Back

Submit

Figure 5.31: UAT Question - Page 15

## APPENDIX F
## EVALUATION FORM – QUESTION



English (US)

# CERDAS Evaluation Test

Name *

Please evaluate CERDAS dashboard

| | Poor | Fair | Good | Very Good | Outstanding |
|---|---|---|---|---|---|
| Do you like CERDAS dashboard? | ○ | ○ | ○ | ○ | ○ |
| Do you enjoy using CERDAS dashboard? | ○ | ○ | ○ | ○ | ○ |
| Do you gain insight from CERDAS dashboard | ○ | ○ | ○ | ○ | ○ |
| Do you think CERDAS dashboard can help in making decision when facing emergency cases? | ○ | ○ | ○ | ○ | ○ |
| Will you use CERDAS dashboard in the future? | ○ | ○ | ○ | ○ | ○ |

Do you have additional comments or suggestions to improve team?

Type here...

Submit

Figure 5.32: Evaluation Form Question

# APPENDIX G
# USER ACCEPTANCE FORM – COLLECTED DATA

**1. Mohd Noorizwan Md Samad**
Updated at May 26, 2023

Submission Date
May 26, 2023

Centralized Emergency Respond and Disaster Assistance System Form

| | |
|---|---|
| Able to select Date | Comply |
| Able to insert time in Hour & Minute | Comply |
| Able to select AM/ PM | Comply |
| Able to select Location | Comply |
| Able to select Emergency/ Disaste... | Comply |
| Able to insert Emergency Descripti... | Comply |
| Able to select Yes/ No for "Is there... | Comply |
| Able to upload image | Comply |
| Able to click Submit Form button | Comply |
| Able to submit form | Comply |

CERDAS Dashboard - CERDAS Overall (Total Cases)

| | |
|---|---|
| Able to show correct number of to... | Comply |

CERDAS Dashboard - CERDAS Overall (Number of Injured Person)

| | |
|---|---|
| Able to show correct number of to... | Comply |

CERDAS Dashboard - CERDAS Overall (Location Dropdown)

| | |
|---|---|
| Able to select all Location | Comply |
| Able to select multiple Location | Comply |
| Able to deselect all Location | Comply |
| Able to select only one Location | Comply |
| Able to search Location | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Overall (Date Range Dropdown)

Figure 5.33: UAT SUBMISSION 1 - 1

| | |
|---|---|
| Able to select Start Date | Comply |
| Able to select End Date | Comply |
| Able to click Cancel button | Comply |
| Able to click Apply button | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Overall (Refresh Button)

| | |
|---|---|
| Able to click Refresh button | Comply |
| Able to refresh data | Comply |

CERDAS Dashboard - CERDAS Overall (Bubble Map)

| | |
|---|---|
| Able to differentiate locations with... | Comply |
| Able to show location name when ... | Comply |
| Able to click on each bubble | Comply |
| Able to toggle fullscreen view | Comply |
| Able to drag Pegman onto the map... | Comply |
| Able to zoom in on the map | Comply |
| Able to zoom out on the map | Comply |
| Able to view full location name at t... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Overall (Pie Chart)

| | |
|---|---|
| Able to differentiate level of emerg... | Comply |
| Able to show percentage (%) for e... | Comply |
| Able to know each level of emerge... | Comply |
| Able to display data correctly base... | Comply |

Name
Mohd Noorizwan Md Samad

Campus
Pekan

Figure 5.34: UAT SUBMISSION 1 - 2

CERDAS Dashboard - CERDAS Overall (Stacked Column Chart)

| | |
|---|---|
| Able to differentiate the type of e... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Location Dropdown)

| | |
|---|---|
| Able to select all Location | Comply |
| Able to select multiple Location | Comply |
| Able to deselect all Location | Comply |
| Able to select only one Location | Comply |
| Able to search Location | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Emergency/ Disaster Type Dropdown)

| | |
|---|---|
| Able to select all Emergency/ Disa... | Comply |
| Able to select multiple Emergency... | Comply |
| Able to deselect all Emergency/ Di... | Comply |
| Able to select only one Emergency... | Comply |
| Able to search Emergency/ Disast... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Injured? Dropdown)

| | |
|---|---|
| Able to select Yes/No for Injured? | Comply |
| Able to select all Injured? | Comply |
| Able to deselect all Injured? | Comply |
| Able to select only one Injured? | Comply |
| Able to search Injured? | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Refresh Button)

| | |
|---|---|
| Able to click Refresh button | Comply |
| Able to refresh data | Comply |

Figure 5.35: UAT SUBMISSION 1 - 3

CERDAS Dashboard - CERDAS Decision (Table)

| | |
|---|---|
| Able to view Date & Time for each ... | Comply |
| Able to view Location for each cases | Comply |
| Able to view Emergency/ Disaster ... | Comply |
| Able to view Level of Emergency f... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Table)

| | |
|---|---|
| Able to view Injured? for each cases | Comply |
| Able to view Injured Level for each... | Comply |
| Able to view Urgency for each cases | Comply |

CERDAS Dashboard - CERDAS Decision (Image)

| | |
|---|---|
| Able to view emergency image | Comply |

CERDAS Dashboard - CERDAS Decision (Description)

| | |
|---|---|
| Able to view emergency description | Comply |

Submission IP
103.53.32.27

Submission ID
5608730687221451017

Last Update Date

Figure 5.36: UAT SUBMISSION 1 - 4

## 2. Amran bin abdul razak

Updated at May 26, 2023

Submission Date

May 25, 2023

Centralized Emergency Respond and Disaster Assistance System Form

| | |
|---|---|
| Able to select Date | Comply |
| Able to insert time in Hour & Minute | Comply |
| Able to select AM/ PM | Comply |
| Able to select Location | Comply |
| Able to select Emergency/ Disaste... | Comply |
| Able to insert Emergency Descripti... | Comply |
| Able to select Yes/ No for "Is there... | Comply |
| Able to upload image | Comply |
| Able to click Submit Form button | Comply |
| Able to submit form | Comply |

CERDAS Dashboard - CERDAS Overall (Total Cases)

| | |
|---|---|
| Able to show correct number of to... | Comply |

CERDAS Dashboard - CERDAS Overall (Number of Injured Person)

| | |
|---|---|
| Able to show correct number of to... | Comply |

CERDAS Dashboard - CERDAS Overall (Location Dropdown)

| | |
|---|---|
| Able to select all Location | Comply |
| Able to select multiple Location | Comply |
| Able to deselect all Location | Comply |
| Able to select only one Location | Not Comply |
| Able to search Location | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Overall (Date Range Dropdown)

Figure 5.37: UAT SUBMISSION 2 - 1

| | |
|---|---|
| Able to select Start Date | Comply |
| Able to select End Date | Comply |
| Able to click Cancel button | Comply |
| Able to click Apply button | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Overall (Refresh Button)

| | |
|---|---|
| Able to click Refresh button | Comply |
| Able to refresh data | Comply |

CERDAS Dashboard - CERDAS Overall (Bubble Map)

| | |
|---|---|
| Able to differentiate locations with... | Comply |
| Able to show location name when ... | Comply |
| Able to click on each bubble | Comply |
| Able to toggle fullscreen view | Comply |
| Able to drag Pegman onto the map... | Comply |
| Able to zoom in on the map | Comply |
| Able to zoom out on the map | Comply |
| Able to view full location name at t... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Overall (Pie Chart)

| | |
|---|---|
| Able to differentiate level of emerg... | Comply |
| Able to show percentage (%) for e... | Comply |
| Able to know each level of emerge... | Comply |
| Able to display data correctly base... | Comply |

Name
Amran bin abdul razak

Campus
Pekan

Figure 5.38: UAT SUBMISSION 2 - 2

CERDAS Dashboard - CERDAS Overall (Stacked Column Chart)

| | |
|---|---|
| Able to differentiate the type of e... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Location Dropdown)

| | |
|---|---|
| Able to select all Location | Comply |
| Able to select multiple Location | Comply |
| Able to deselect all Location | Comply |
| Able to select only one Location | Comply |
| Able to search Location | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Emergency/ Disaster Type Dropdown)

| | |
|---|---|
| Able to select all Emergency/ Disa... | Comply |
| Able to select multiple Emergency... | Comply |
| Able to deselect all Emergency/ Di... | Comply |
| Able to select only one Emergency... | Comply |
| Able to search Emergency/ Disast... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Injured? Dropdown)

| | |
|---|---|
| Able to select Yes/No for Injured? | Comply |
| Able to select all Injured? | Comply |
| Able to deselect all Injured? | Comply |
| Able to select only one Injured? | Comply |
| Able to search Injured? | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Refresh Button)

| | |
|---|---|
| Able to click Refresh button | Comply |
| Able to refresh data | Comply |

Figure 5.39: UAT SUBMISSION 2 - 3

CERDAS Dashboard - CERDAS Decision (Table)

| | |
|---|---|
| Able to view Date & Time for each ... | Comply |
| Able to view Location for each cases | Comply |
| Able to view Emergency/ Disaster ... | Comply |
| Able to view Level of Emergency f... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Table)

| | |
|---|---|
| Able to view Injured? for each cases | Comply |
| Able to view Injured Level for each... | Comply |
| Able to view Urgency for each cases | Comply |

CERDAS Dashboard - CERDAS Decision (Image)

| | |
|---|---|
| Able to view emergency image | Comply |

CERDAS Dashboard - CERDAS Decision (Description)

| | |
|---|---|
| Able to view emergency description | Comply |

Submission IP
14.192.209.149

Submission ID
5608190019418743653

Last Update Date
May 26, 2023

Figure 5.40: UAT SUBMISSION 2 - 4

### 3. MOHAMAD NAJID BIN SAAT

Updated at May 25, 2023

Submission Date

May 25, 2023

Centralized Emergency Respond and Disaster Assistance System Form

| | |
|---|---|
| Able to select Date | Comply |
| Able to insert time in Hour & Minute | Comply |
| Able to select AM/ PM | Comply |
| Able to select Location | Comply |
| Able to select Emergency/ Disaste... | Comply |
| Able to insert Emergency Descripti... | Comply |
| Able to select Yes/ No for "Is there... | Comply |
| Able to upload image | Comply |
| Able to click Submit Form button | Comply |
| Able to submit form | Comply |

CERDAS Dashboard - CERDAS Overall (Total Cases)

| | |
|---|---|
| Able to show correct number of to... | Comply |

CERDAS Dashboard - CERDAS Overall (Number of Injured Person)

| | |
|---|---|
| Able to show correct number of to... | Comply |

CERDAS Dashboard - CERDAS Overall (Location Dropdown)

| | |
|---|---|
| Able to select all Location | Comply |
| Able to select multiple Location | Comply |
| Able to deselect all Location | Comply |
| Able to select only one Location | Comply |
| Able to search Location | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Overall (Date Range Dropdown)

Figure 5.41: UAT SUBMISSION 3 - 1

| | |
|---|---|
| Able to select Start Date | Comply |
| Able to select End Date | Comply |
| Able to click Cancel button | Comply |
| Able to click Apply button | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Overall (Refresh Button)

| | |
|---|---|
| Able to click Refresh button | Comply |
| Able to refresh data | Comply |

CERDAS Dashboard - CERDAS Overall (Bubble Map)

| | |
|---|---|
| Able to differentiate locations with... | Comply |
| Able to show location name when ... | Comply |
| Able to click on each bubble | Comply |
| Able to toggle fullscreen view | Comply |
| Able to drag Pegman onto the map... | Comply |
| Able to zoom in on the map | Comply |
| Able to zoom out on the map | Comply |
| Able to view full location name at t... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Overall (Pie Chart)

| | |
|---|---|
| Able to differentiate level of emerg... | Comply |
| Able to show percentage (%) for e... | Comply |
| Able to know each level of emerge... | Comply |
| Able to display data correctly base... | Comply |

Name
MOHAMAD NAJID BIN SAAT

Campus
Pekan

Figure 5.42: UAT SUBMISSION 3 - 2

CERDAS Dashboard - CERDAS Overall (Stacked Column Chart)

| | |
|---|---|
| Able to differentiate the type of e... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Location Dropdown)

| | |
|---|---|
| Able to select all Location | Comply |
| Able to select multiple Location | Comply |
| Able to deselect all Location | Comply |
| Able to select only one Location | Comply |
| Able to search Location | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Emergency/ Disaster Type Dropdown)

| | |
|---|---|
| Able to select all Emergency/ Disa... | Comply |
| Able to select multiple Emergency... | Comply |
| Able to deselect all Emergency/ Di... | Comply |
| Able to select only one Emergency... | Comply |
| Able to search Emergency/ Disast... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Injured? Dropdown)

| | |
|---|---|
| Able to select Yes/No for Injured? | Comply |
| Able to select all Injured? | Comply |
| Able to deselect all Injured? | Comply |
| Able to select only one Injured? | Comply |
| Able to search Injured? | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Refresh Button)

| | |
|---|---|
| Able to click Refresh button | Comply |
| Able to refresh data | Comply |

Figure 5.43: UAT SUBMISSION 3 - 3

CERDAS Dashboard - CERDAS Decision (Table)

| | |
|---|---|
| Able to view Date & Time for each ... | Comply |
| Able to view Location for each cases | Comply |
| Able to view Emergency/ Disaster ... | Comply |
| Able to view Level of Emergency f... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Table)

| | |
|---|---|
| Able to view Injured? for each cases | Comply |
| Able to view Injured Level for each... | Comply |
| Able to view Urgency for each cases | Comply |

CERDAS Dashboard - CERDAS Decision (Image)

| | |
|---|---|
| Able to view emergency image | Comply |

CERDAS Dashboard - CERDAS Decision (Description)

| | |
|---|---|
| Able to view emergency description | Comply |

Submission IP
103.53.32.18

Submission ID
5608122858122621593

Last Update Date

Figure 5.44: UAT SUBMISSION 3 - 4

## 4. MOHD SAID BIN MOHD SALIM

Updated at May 25, 2023

Submission Date

May 25, 2023

Centralized Emergency Respond and Disaster Assistance System Form

| | |
|---|---|
| Able to select Date | Comply |
| Able to insert time in Hour & Minute | Comply |
| Able to select AM/ PM | Comply |
| Able to select Location | Comply |
| Able to select Emergency/ Disaste... | Comply |
| Able to insert Emergency Descripti... | Comply |
| Able to select Yes/ No for "Is there... | Comply |
| Able to upload image | Comply |
| Able to click Submit Form button | Comply |
| Able to submit form | Comply |

CERDAS Dashboard - CERDAS Overall (Total Cases)

| | |
|---|---|
| Able to show correct number of to... | Comply |

CERDAS Dashboard - CERDAS Overall (Number of Injured Person)

| | |
|---|---|
| Able to show correct number of to... | Comply |

CERDAS Dashboard - CERDAS Overall (Location Dropdown)

| | |
|---|---|
| Able to select all Location | Comply |
| Able to select multiple Location | Comply |
| Able to deselect all Location | Comply |
| Able to select only one Location | Comply |
| Able to search Location | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Overall (Date Range Dropdown)

Figure 5.45: UAT SUBMISSION 4 - 1

| | |
|---|---|
| Able to select Start Date | Comply |
| Able to select End Date | Comply |
| Able to click Cancel button | Comply |
| Able to click Apply button | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Overall (Refresh Button)

| | |
|---|---|
| Able to click Refresh button | Comply |
| Able to refresh data | Comply |

CERDAS Dashboard - CERDAS Overall (Bubble Map)

| | |
|---|---|
| Able to differentiate locations with... | Comply |
| Able to show location name when ... | Comply |
| Able to click on each bubble | Comply |
| Able to toggle fullscreen view | Comply |
| Able to drag Pegman onto the map... | Comply |
| Able to zoom in on the map | Comply |
| Able to zoom out on the map | Comply |
| Able to view full location name at t... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Overall (Pie Chart)

| | |
|---|---|
| Able to differentiate level of emerg... | Comply |
| Able to show percentage (%) for e... | Comply |
| Able to know each level of emerge... | Comply |
| Able to display data correctly base... | Comply |

Name
MOHD SAID BIN MOHD SALIM

Campus
Pekan

Figure 5.46: UAT SUBMISSION 4 - 2

CERDAS Dashboard - CERDAS Overall (Stacked Column Chart)

| | |
|---|---|
| Able to differentiate the type of e... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Location Dropdown)

| | |
|---|---|
| Able to select all Location | Comply |
| Able to select multiple Location | Comply |
| Able to deselect all Location | Comply |
| Able to select only one Location | Comply |
| Able to search Location | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Emergency/ Disaster Type Dropdown)

| | |
|---|---|
| Able to select all Emergency/ Disa... | Comply |
| Able to select multiple Emergency... | Comply |
| Able to deselect all Emergency/ Di... | Comply |
| Able to select only one Emergency... | Comply |
| Able to search Emergency/ Disast... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Injured? Dropdown)

| | |
|---|---|
| Able to select Yes/No for Injured? | Comply |
| Able to select all Injured? | Comply |
| Able to deselect all Injured? | Comply |
| Able to select only one Injured? | Comply |
| Able to search Injured? | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Refresh Button)

| | |
|---|---|
| Able to click Refresh button | Comply |
| Able to refresh data | Comply |

Figure 5.47: UAT SUBMISSION 4 - 3

CERDAS Dashboard - CERDAS Decision (Table)

| | |
|---|---|
| Able to view Date & Time for each ... | Comply |
| Able to view Location for each cases | Comply |
| Able to view Emergency/ Disaster ... | Comply |
| Able to view Level of Emergency f... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Table)

| | |
|---|---|
| Able to view Injured? for each cases | Comply |
| Able to view Injured Level for each... | Comply |
| Able to view Urgency for each cases | Comply |

CERDAS Dashboard - CERDAS Decision (Image)

| | |
|---|---|
| Able to view emergency image | Comply |

CERDAS Dashboard - CERDAS Decision (Description)

| | |
|---|---|
| Able to view emergency description | Comply |

Submission IP
183.171.96.71

Submission ID
5608114341761097468

Last Update Date

Figure 5.48: UAT SUBMISSION 4 - 4

## 5. AHMAD FAUZI BIN AHMAD BAKTI

Updated at May 25, 2023

Submission Date

May 25, 2023

Centralized Emergency Respond and Disaster Assistance System Form

| | |
|---|---|
| Able to select Date | Comply |
| Able to insert time in Hour & Minute | Comply |
| Able to select AM/ PM | Comply |
| Able to select Location | Comply |
| Able to select Emergency/ Disaste... | Comply |
| Able to insert Emergency Descripti... | Comply |
| Able to select Yes/ No for "Is there... | Comply |
| Able to upload image | Comply |
| Able to click Submit Form button | Comply |
| Able to submit form | Comply |

CERDAS Dashboard - CERDAS Overall (Total Cases)

| | |
|---|---|
| Able to show correct number of to... | Comply |

CERDAS Dashboard - CERDAS Overall (Number of Injured Person)

| | |
|---|---|
| Able to show correct number of to... | Comply |

CERDAS Dashboard - CERDAS Overall (Location Dropdown)

| | |
|---|---|
| Able to select all Location | Comply |
| Able to select multiple Location | Comply |
| Able to deselect all Location | Comply |
| Able to select only one Location | Comply |
| Able to search Location | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Overall (Date Range Dropdown)

Figure 5.49: UAT SUBMISSION 5 - 1

| | |
|---|---|
| Able to select Start Date | Comply |
| Able to select End Date | Comply |
| Able to click Cancel button | Comply |
| Able to click Apply button | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Overall (Refresh Button)

| | |
|---|---|
| Able to click Refresh button | Comply |
| Able to refresh data | Comply |

CERDAS Dashboard - CERDAS Overall (Bubble Map)

| | |
|---|---|
| Able to differentiate locations with... | Comply |
| Able to show location name when ... | Comply |
| Able to click on each bubble | Comply |
| Able to toggle fullscreen view | Comply |
| Able to drag Pegman onto the map... | Comply |
| Able to zoom in on the map | Comply |
| Able to zoom out on the map | Comply |
| Able to view full location name at t... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Overall (Pie Chart)

| | |
|---|---|
| Able to differentiate level of emerg... | Comply |
| Able to show percentage (%) for e... | Comply |
| Able to know each level of emerge... | Comply |
| Able to display data correctly base... | Comply |

Name
AHMAD FAUZI BIN AHMAD BAKTI

Campus
Pekan

Figure 5.50: UAT SUBMISSION 5 - 2

CERDAS Dashboard - CERDAS Overall (Stacked Column Chart)

| | |
|---|---|
| Able to differentiate the type of e... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Location Dropdown)

| | |
|---|---|
| Able to select all Location | Comply |
| Able to select multiple Location | Comply |
| Able to deselect all Location | Comply |
| Able to select only one Location | Comply |
| Able to search Location | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Emergency/ Disaster Type Dropdown)

| | |
|---|---|
| Able to select all Emergency/ Disa... | Comply |
| Able to select multiple Emergency... | Comply |
| Able to deselect all Emergency/ Di... | Comply |
| Able to select only one Emergency... | Comply |
| Able to search Emergency/ Disast... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Injured? Dropdown)

| | |
|---|---|
| Able to select Yes/No for Injured? | Comply |
| Able to select all Injured? | Comply |
| Able to deselect all Injured? | Comply |
| Able to select only one Injured? | Comply |
| Able to search Injured? | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Refresh Button)

| | |
|---|---|
| Able to click Refresh button | Comply |
| Able to refresh data | Comply |

Figure 5.51: UAT SUBMISSION 5 - 3

CERDAS Dashboard - CERDAS Decision (Table)

| | |
|---|---|
| Able to view Date & Time for each ... | Comply |
| Able to view Location for each cases | Comply |
| Able to view Emergency/ Disaster ... | Comply |
| Able to view Level of Emergency f... | Comply |
| Able to display data correctly base... | Comply |

CERDAS Dashboard - CERDAS Decision (Table)

| | |
|---|---|
| Able to view Injured? for each cases | Comply |
| Able to view Injured Level for each... | Comply |
| Able to view Urgency for each cases | Comply |

CERDAS Dashboard - CERDAS Decision (Image)

| | |
|---|---|
| Able to view emergency image | Comply |

CERDAS Dashboard - CERDAS Decision (Description)

| | |
|---|---|
| Able to view emergency description | Comply |

Submission IP
103.53.32.17

Submission ID
5608104127121275593

Last Update Date

Figure 5.52: UAT SUBMISSION 5 – 4

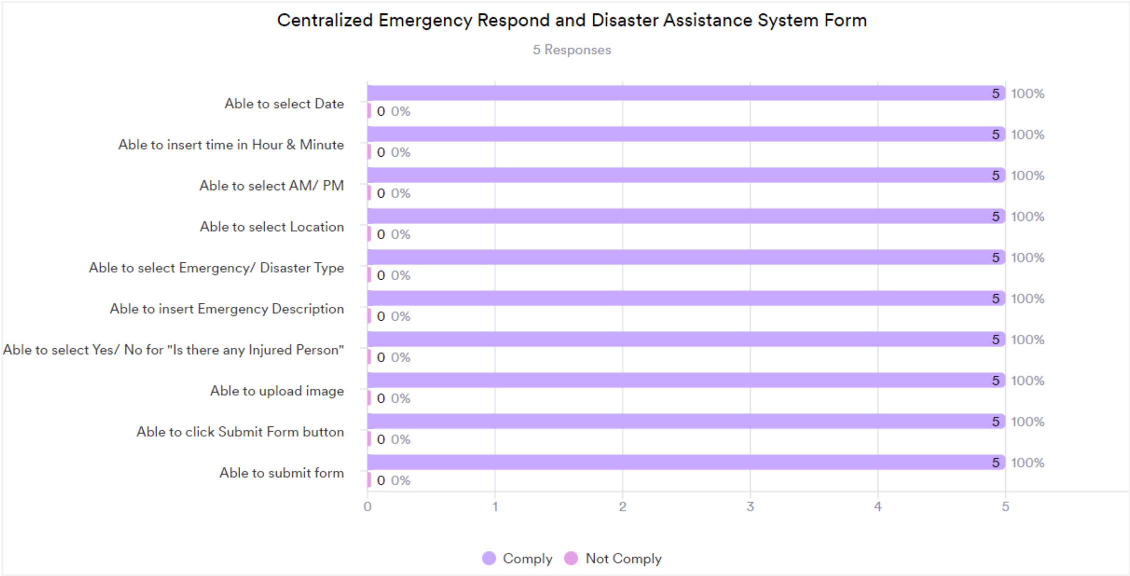



Figure 5.53: Analysis of UAT Data – 1

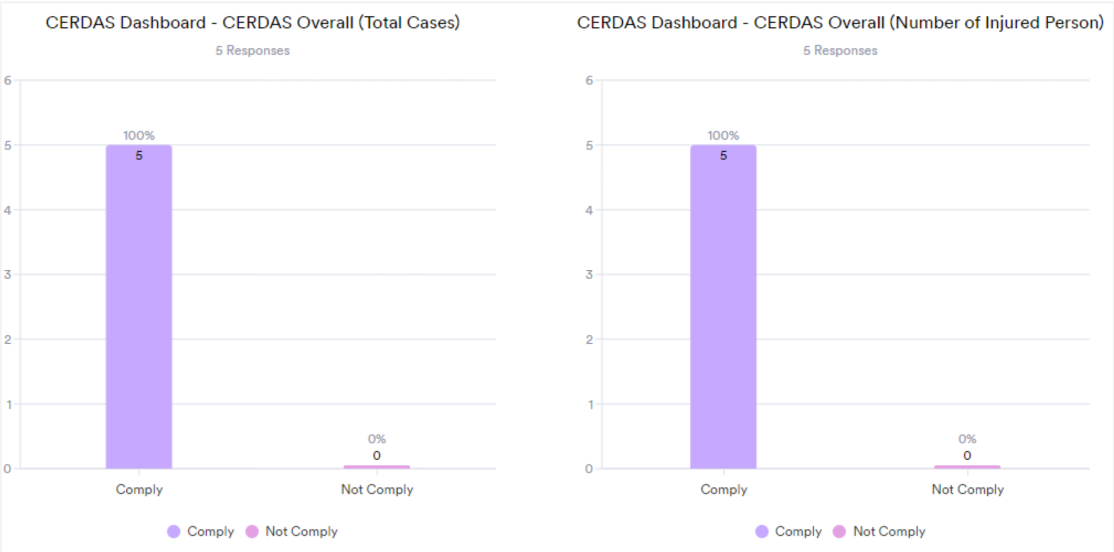



Figure 5.54: Analysis of UAT Data – 2

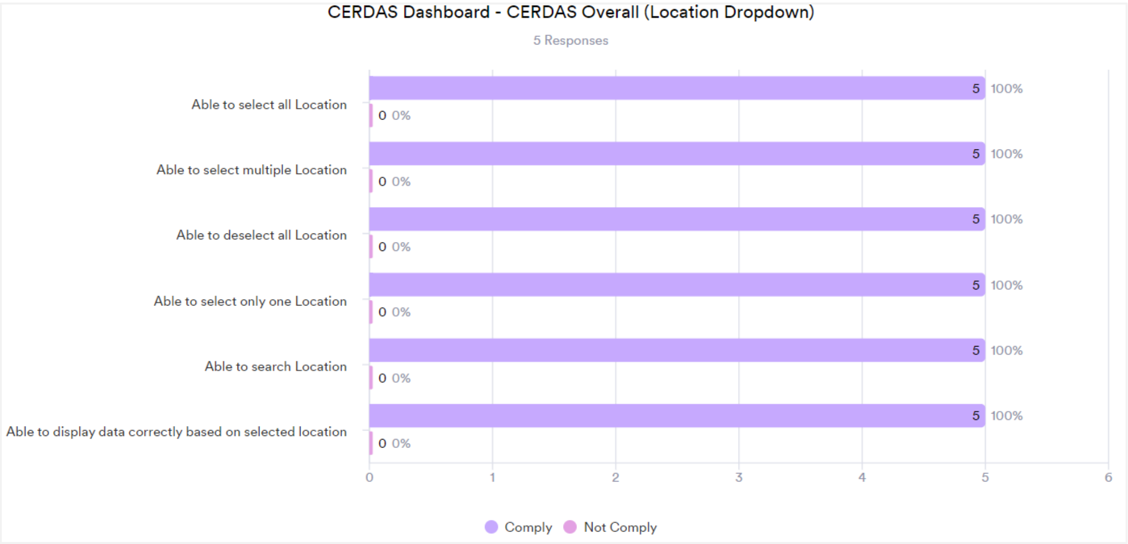



Figure 5.55: Analysis of UAT Data – 3

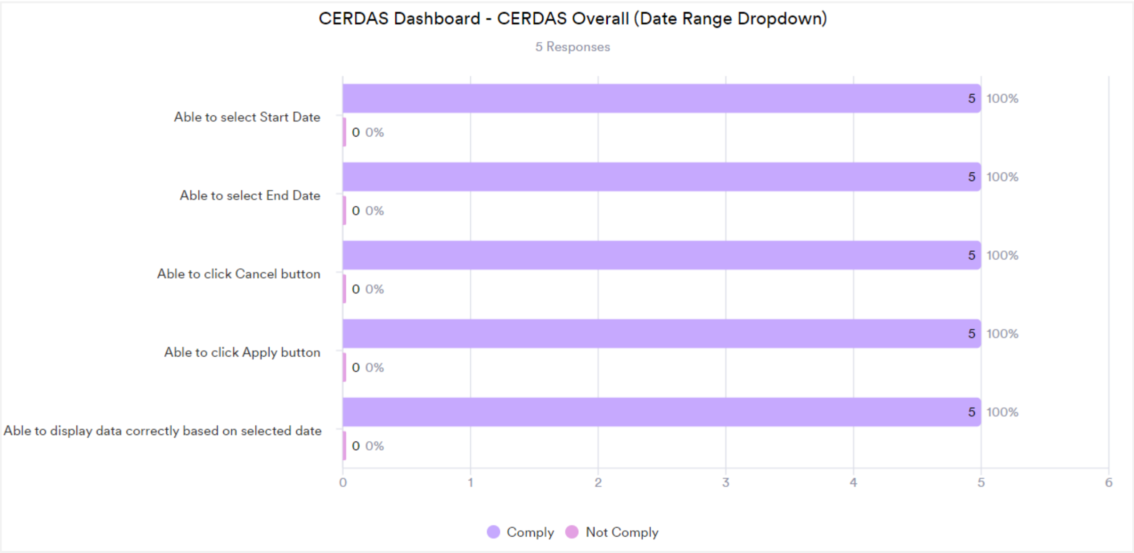



Figure 5.56: Analysis of UAT Data – 4

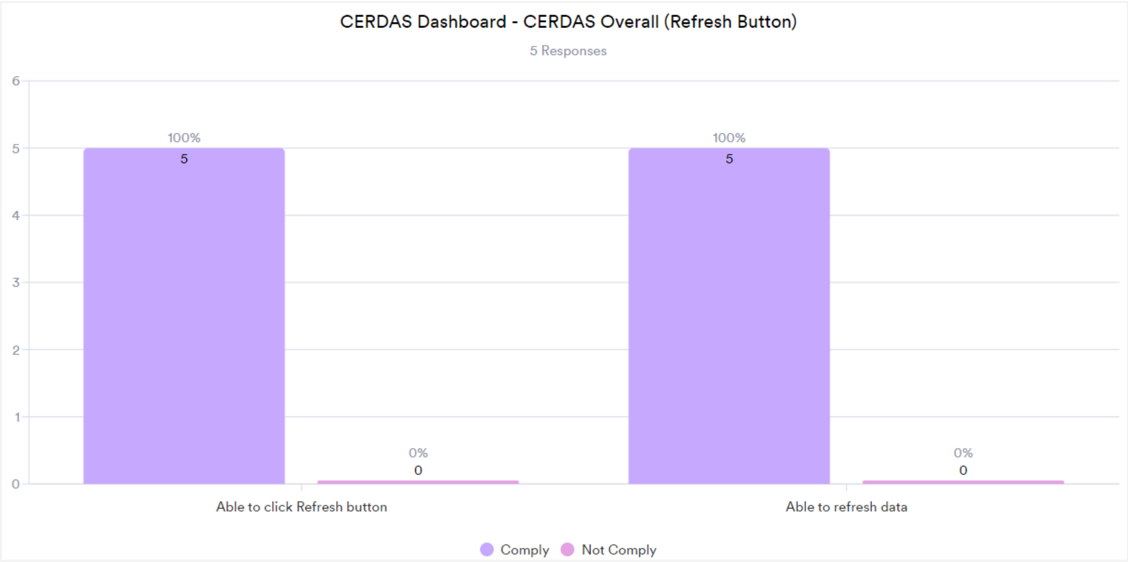



Figure 5.57: Analysis of UAT Data – 5

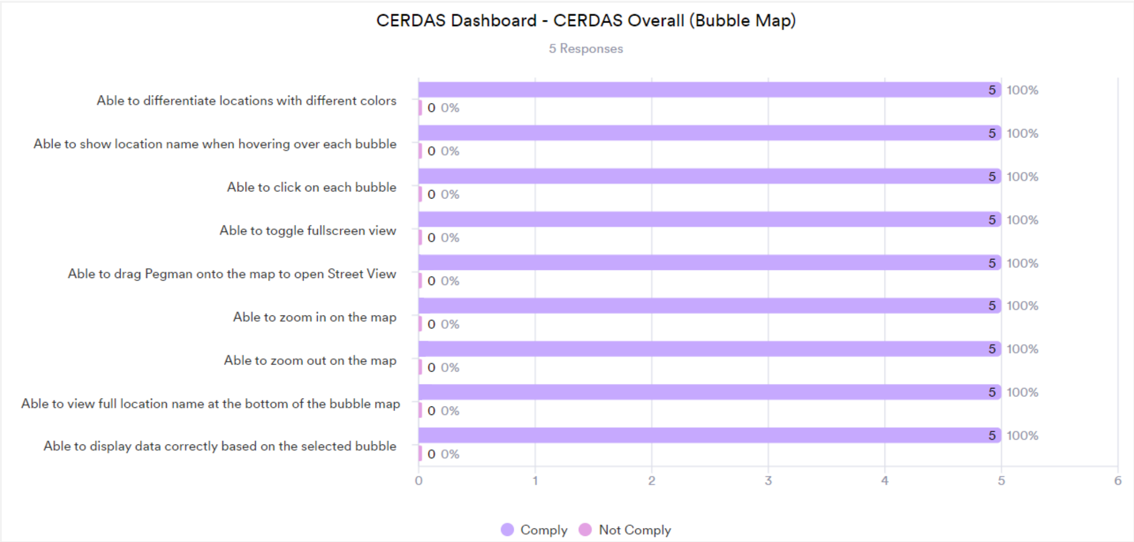



Figure 5.58: Analysis of UAT Data – 6

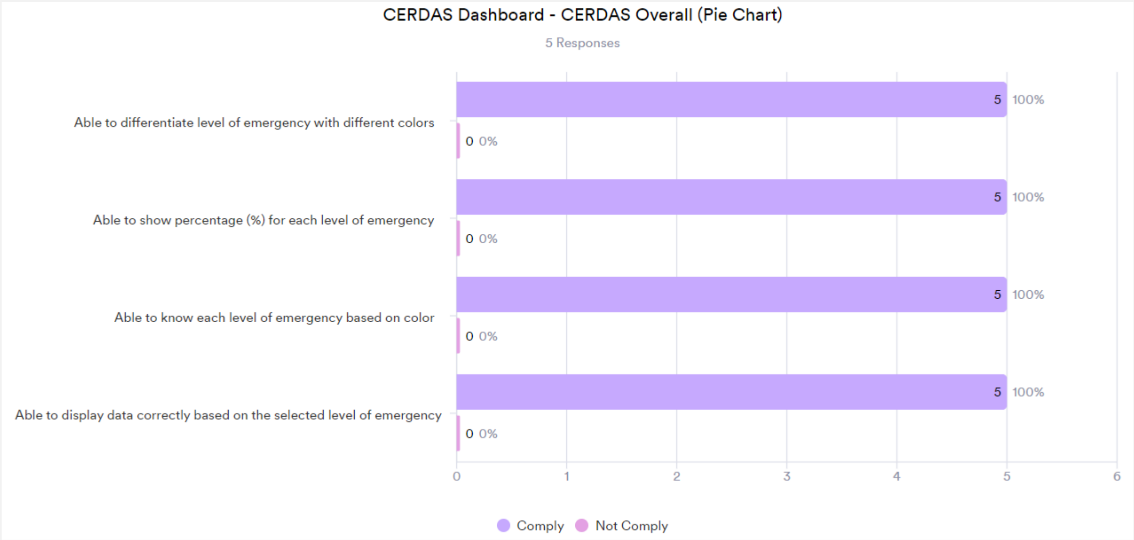



Figure 5.59: Analysis of UAT Data – 7

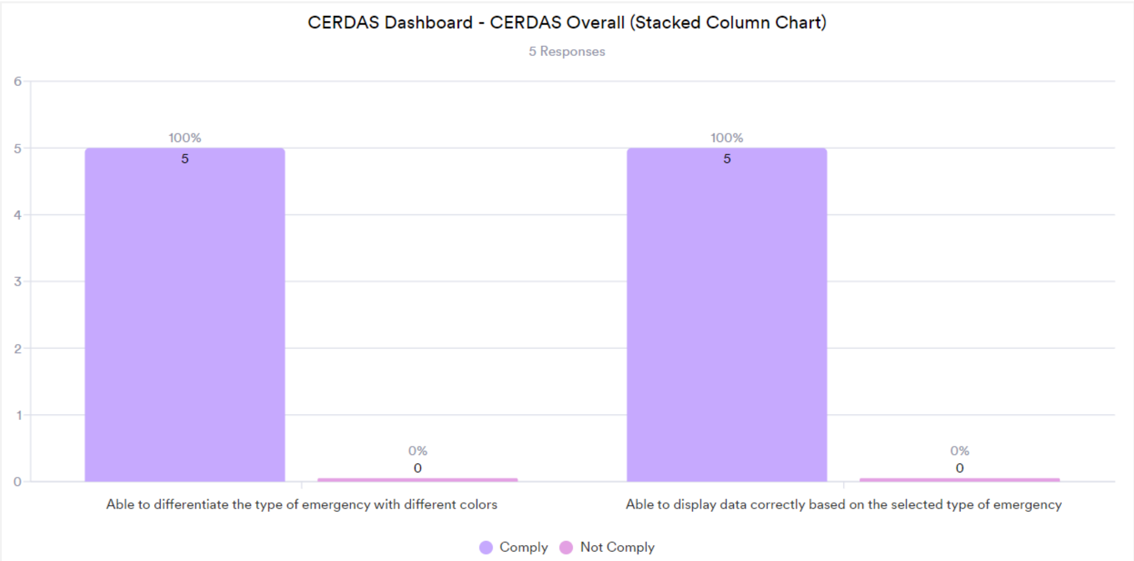



Figure 5.60: Analysis of UAT Data – 8

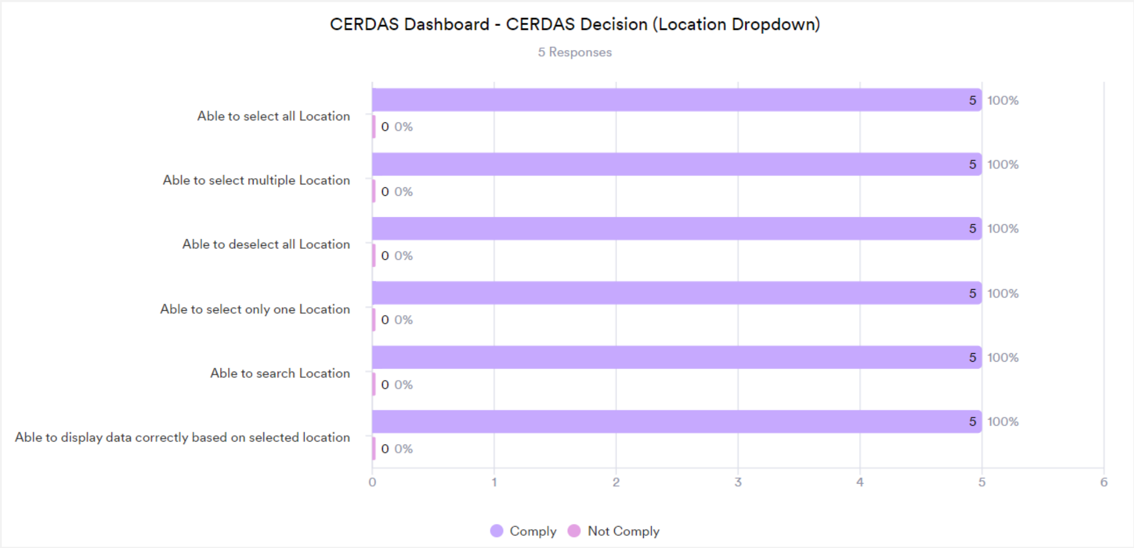



Figure 5.61: Analysis of UAT Data – 9

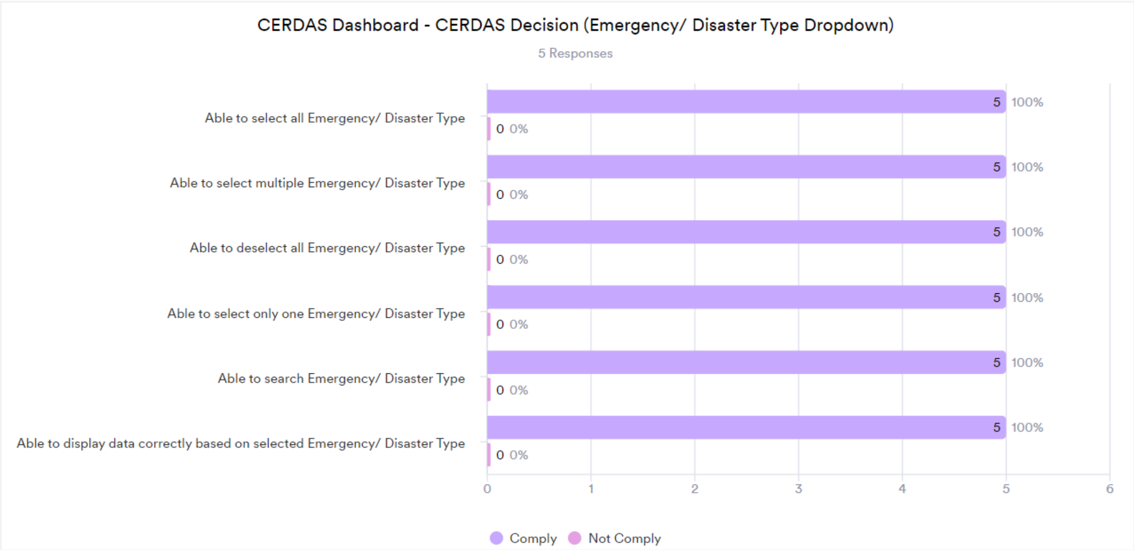



Figure 5.62: Analysis of UAT Data – 10

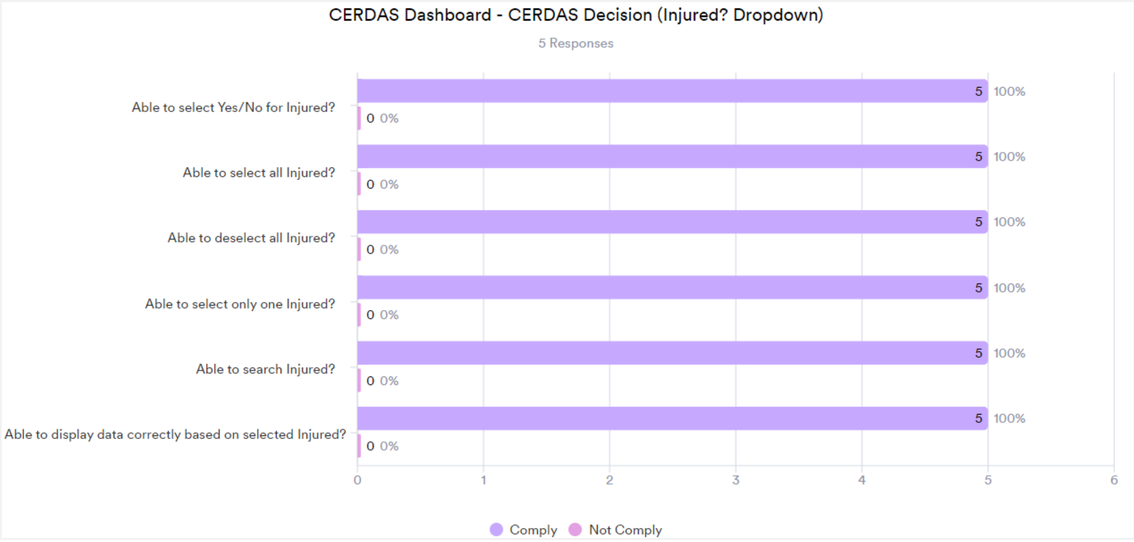



Figure 5.63: Analysis of UAT Data – 11

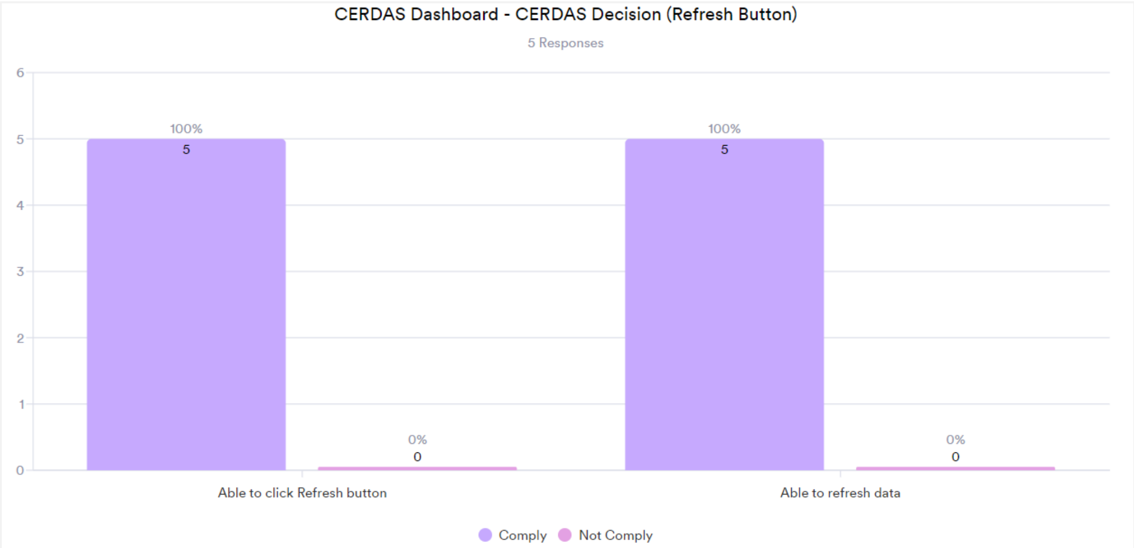



Figure 5.64: Analysis of UAT Data – 12

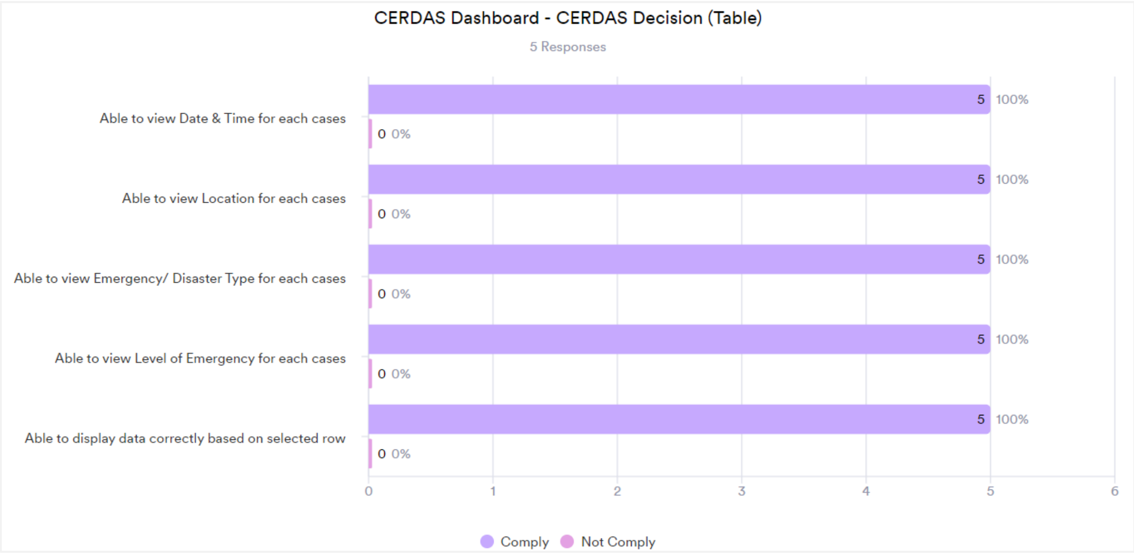



Figure 5.65: Analysis of UAT Data – 13

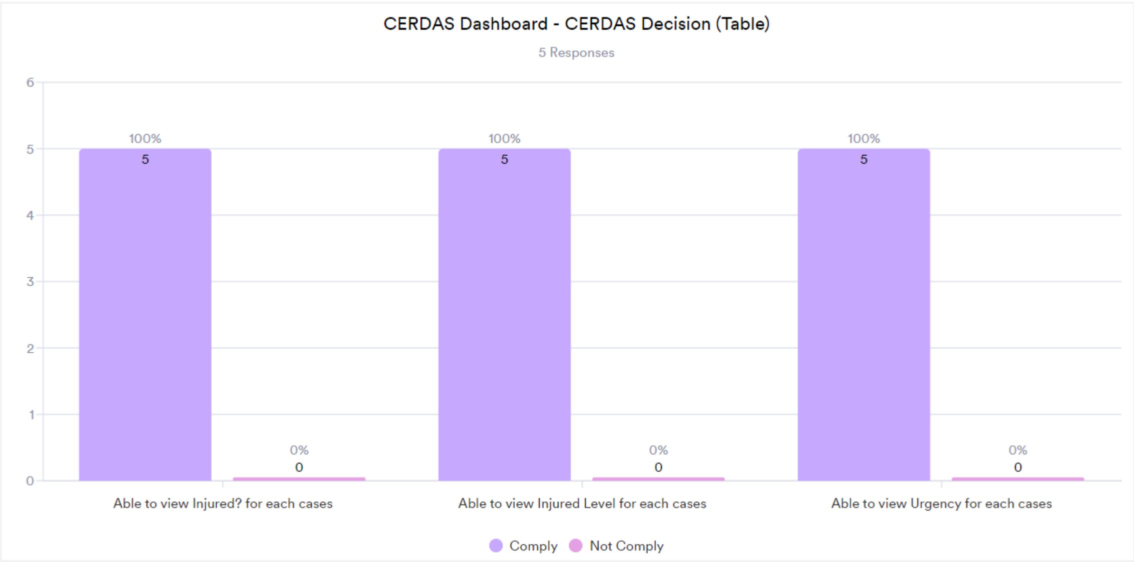



Figure 5.66: Analysis of UAT Data – 14

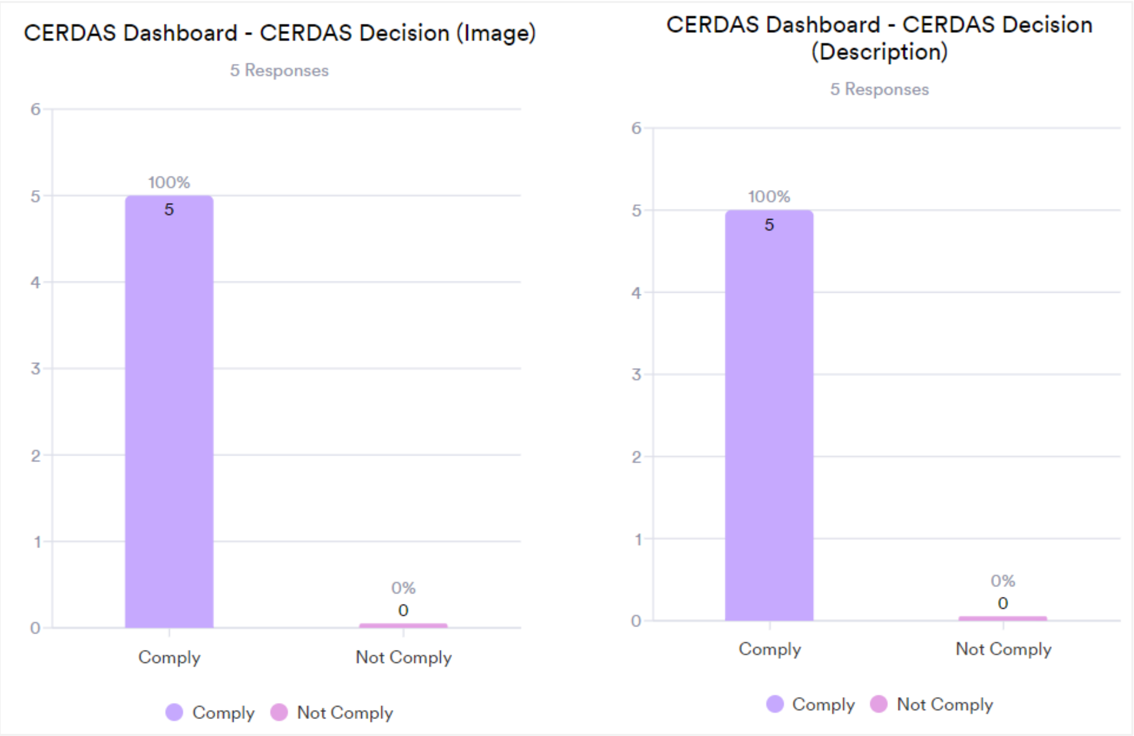
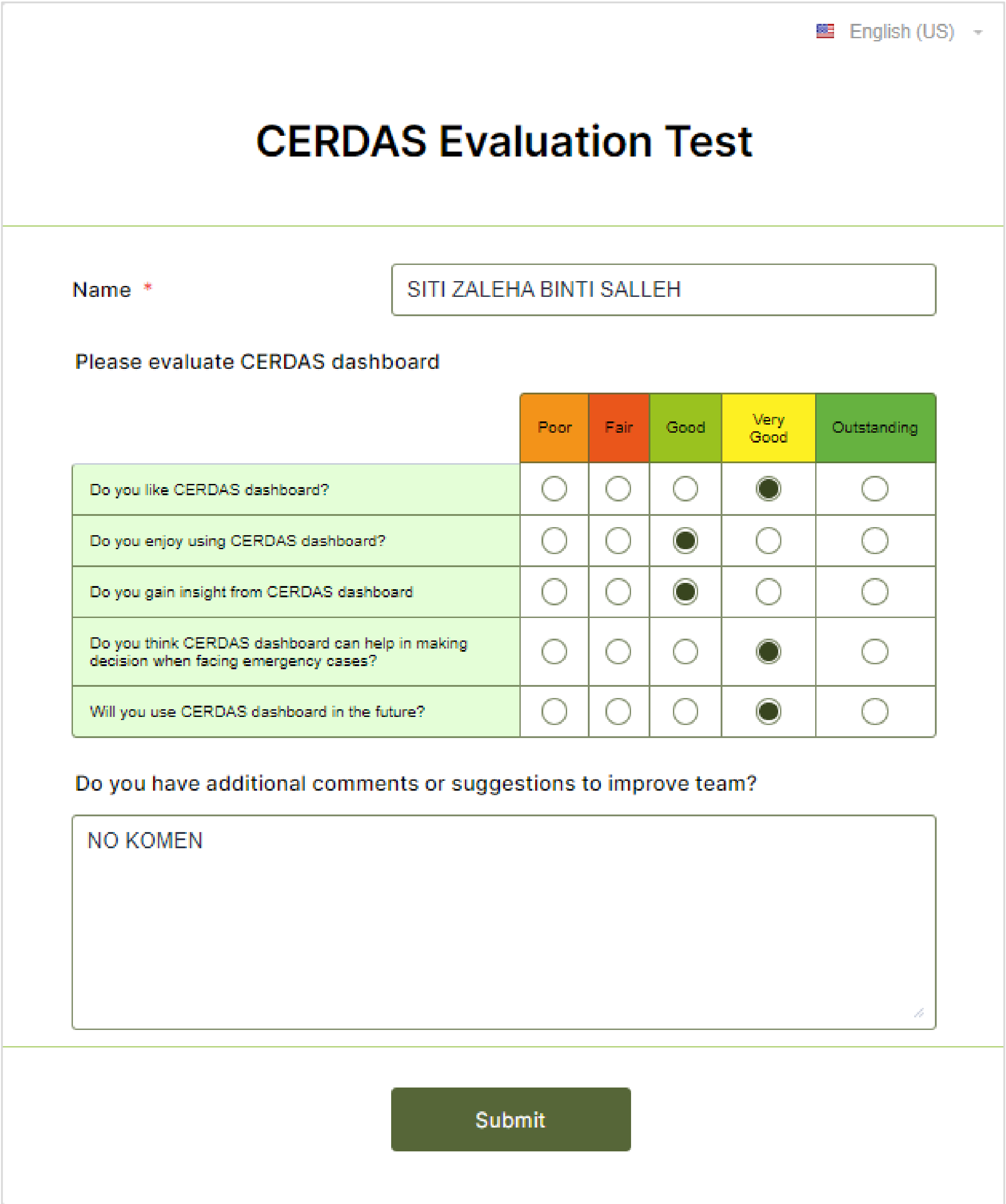



Figure 5.67: Analysis of UAT Data – 15

## APPENDIX H
## CERDAS EVALUATION FORM – COLLECTED DATA



English (US)

# CERDAS Evaluation Test

Name *

SITI ZALEHA BINTI SALLEH

Please evaluate CERDAS dashboard

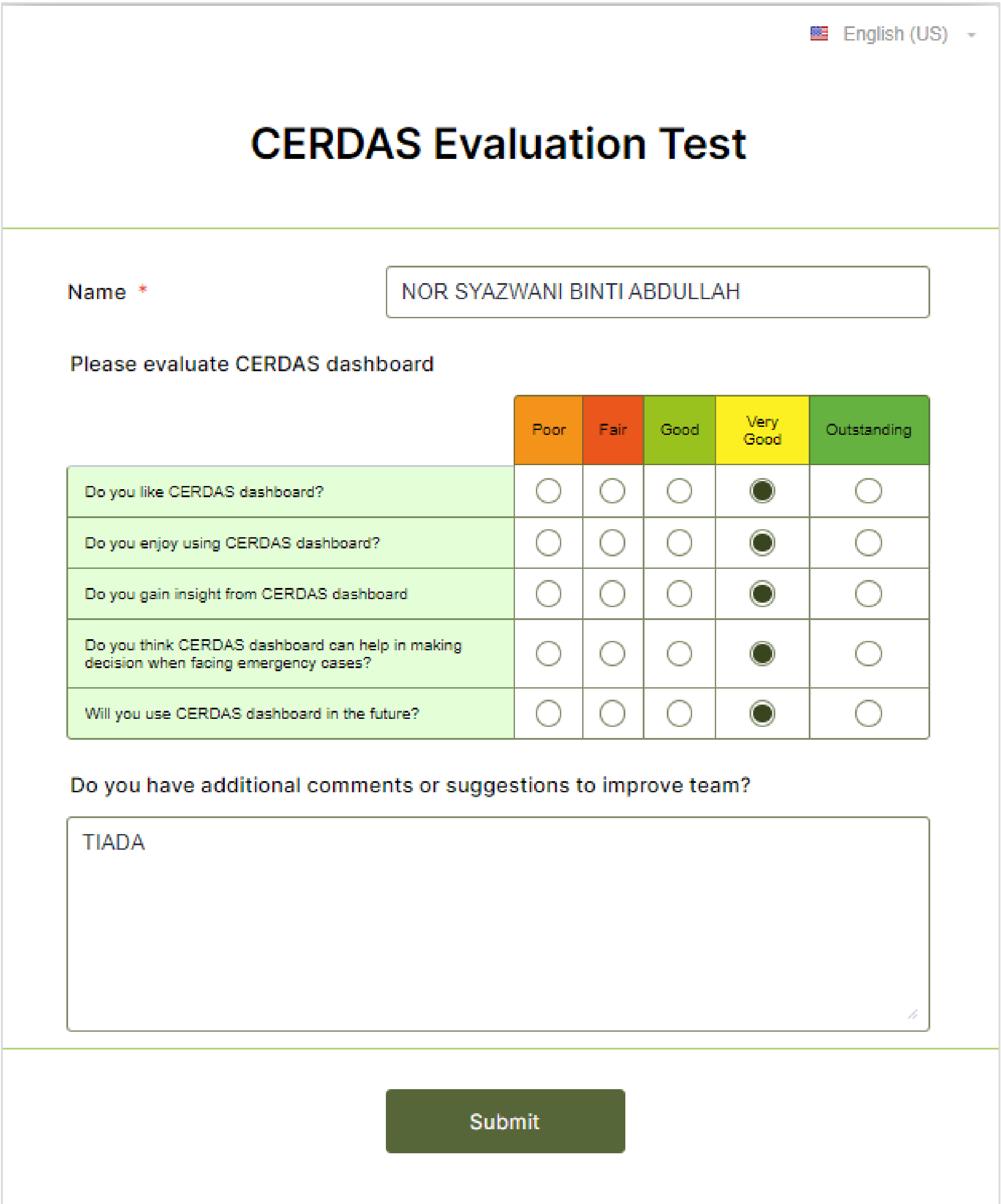
| | Poor | Fair | Good | Very Good | Outstanding |
|---|---|---|---|---|---|
| Do you like CERDAS dashboard? | ○ | ○ | ○ | ● | ○ |
| Do you enjoy using CERDAS dashboard? | ○ | ○ | ● | ○ | ○ |
| Do you gain insight from CERDAS dashboard | ○ | ○ | ● | ○ | ○ |
| Do you think CERDAS dashboard can help in making decision when facing emergency cases? | ○ | ○ | ○ | ● | ○ |
| Will you use CERDAS dashboard in the future? | ○ | ○ | ○ | ● | ○ |

Do you have additional comments or suggestions to improve team?

NO KOMEN

Submit

Figure 5.68: Evaluation Form Submission - 1



English (US)

# CERDAS Evaluation Test

Name *: NOR SYAZWANI BINTI ABDULLAH

Please evaluate CERDAS dashboard

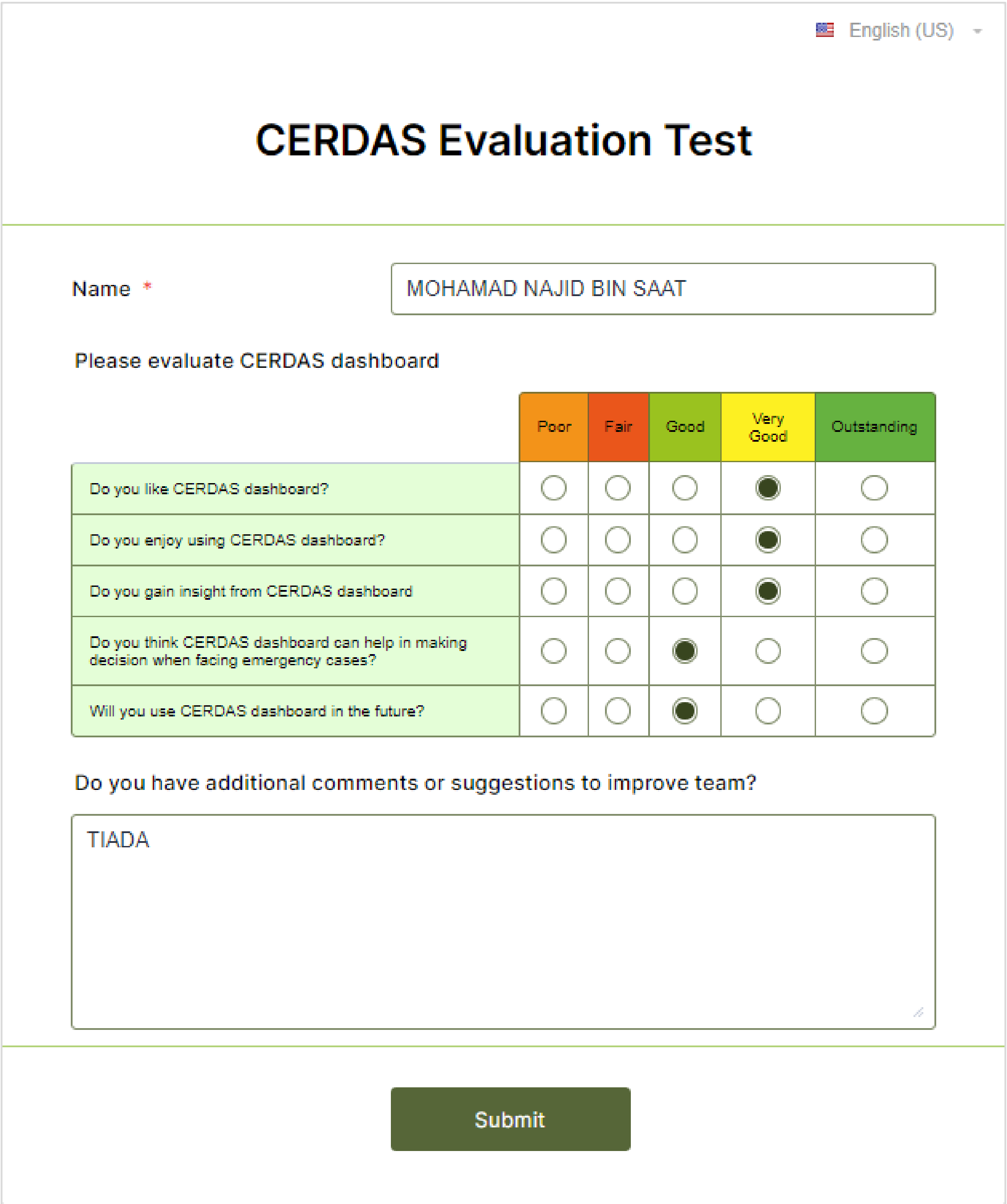
| | Poor | Fair | Good | Very Good | Outstanding |
|---|---|---|---|---|---|
| Do you like CERDAS dashboard? | ○ | ○ | ○ | ● | ○ |
| Do you enjoy using CERDAS dashboard? | ○ | ○ | ○ | ● | ○ |
| Do you gain insight from CERDAS dashboard | ○ | ○ | ○ | ● | ○ |
| Do you think CERDAS dashboard can help in making decision when facing emergency cases? | ○ | ○ | ○ | ● | ○ |
| Will you use CERDAS dashboard in the future? | ○ | ○ | ○ | ● | ○ |

Do you have additional comments or suggestions to improve team?

TIADA

Submit

Figure 5.69: Evaluation Form Submission – 2



English (US)

# CERDAS Evaluation Test

Name * MOHAMAD NAJID BIN SAAT

Please evaluate CERDAS dashboard

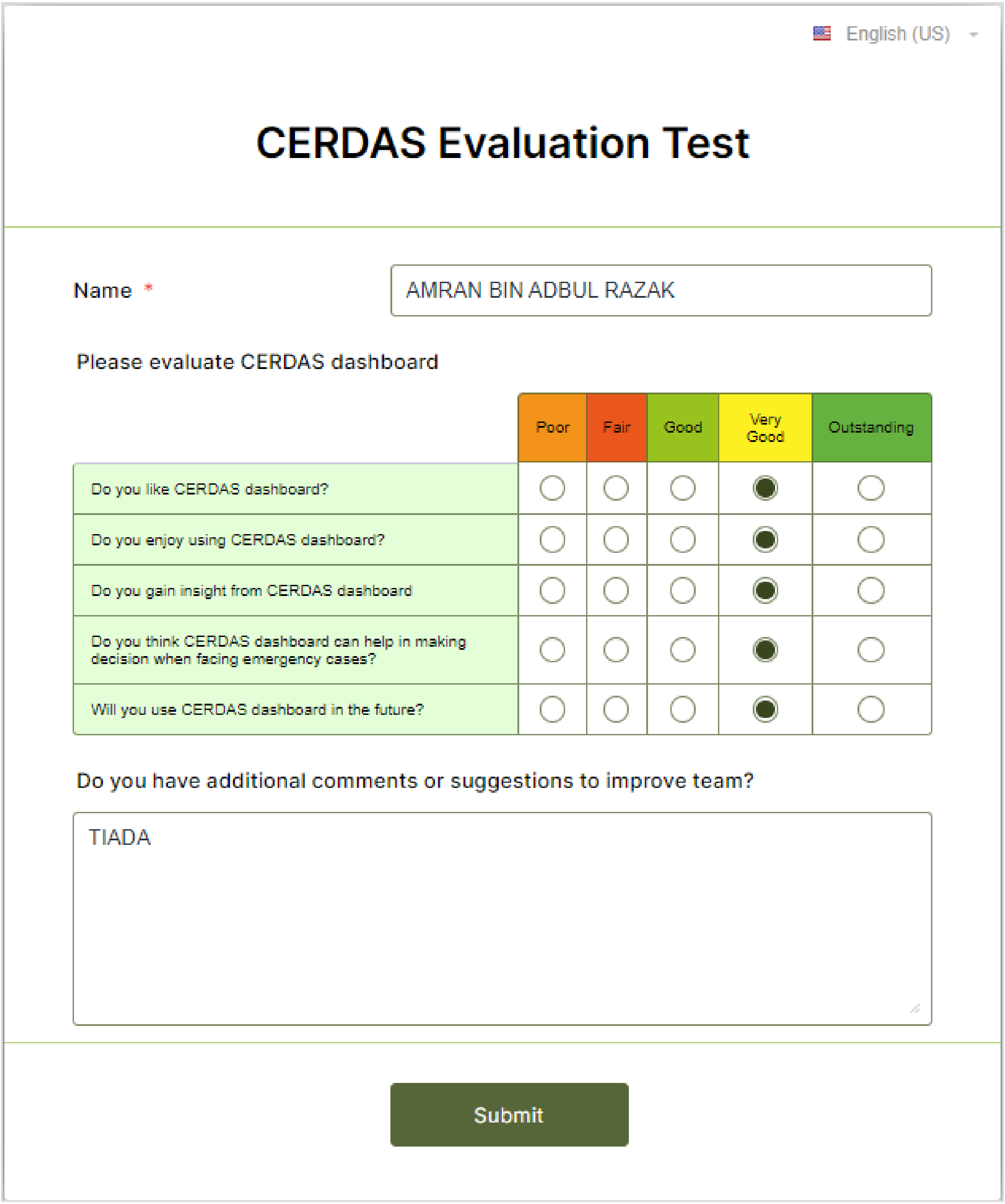
| | Poor | Fair | Good | Very Good | Outstanding |
|---|---|---|---|---|---|
| Do you like CERDAS dashboard? | ○ | ○ | ○ | ● | ○ |
| Do you enjoy using CERDAS dashboard? | ○ | ○ | ○ | ● | ○ |
| Do you gain insight from CERDAS dashboard | ○ | ○ | ○ | ● | ○ |
| Do you think CERDAS dashboard can help in making decision when facing emergency cases? | ○ | ○ | ● | ○ | ○ |
| Will you use CERDAS dashboard in the future? | ○ | ○ | ● | ○ | ○ |

Do you have additional comments or suggestions to improve team?

TIADA

Submit

Figure 5.70: Evaluation Form Submission – 3



English (US)

# CERDAS Evaluation Test

Name *: AMRAN BIN ADBUL RAZAK

Please evaluate CERDAS dashboard

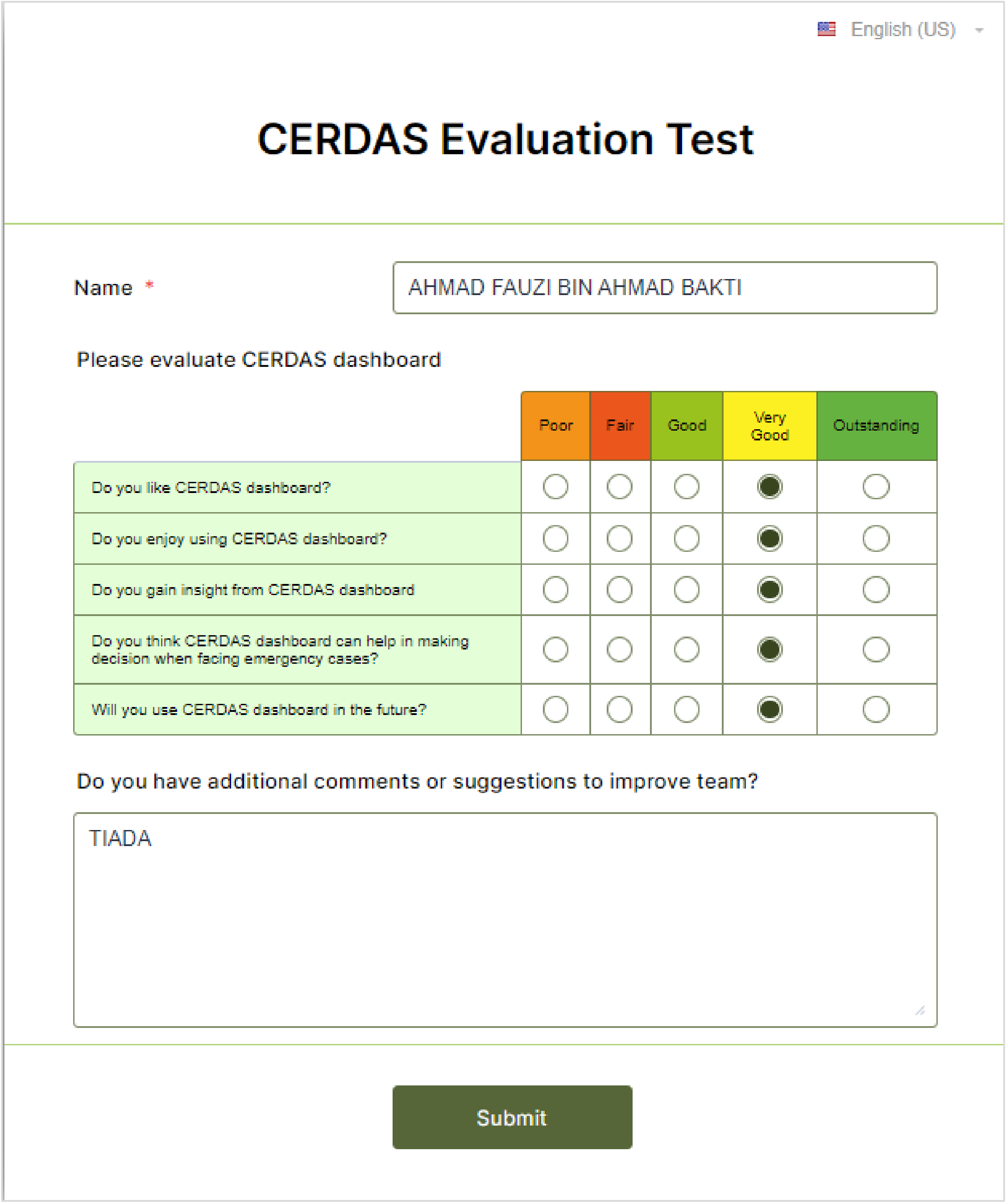
| | Poor | Fair | Good | Very Good | Outstanding |
|---|---|---|---|---|---|
| Do you like CERDAS dashboard? | ○ | ○ | ○ | ● | ○ |
| Do you enjoy using CERDAS dashboard? | ○ | ○ | ○ | ● | ○ |
| Do you gain insight from CERDAS dashboard | ○ | ○ | ○ | ● | ○ |
| Do you think CERDAS dashboard can help in making decision when facing emergency cases? | ○ | ○ | ○ | ● | ○ |
| Will you use CERDAS dashboard in the future? | ○ | ○ | ○ | ● | ○ |

Do you have additional comments or suggestions to improve team?

TIADA

Submit

Figure 5.71: Evaluation Form Submission – 4


English (US)

# CERDAS Evaluation Test

Name *

AHMAD FAUZI BIN AHMAD BAKTI

Please evaluate CERDAS dashboard

| | Poor | Fair | Good | Very Good | Outstanding |
|---|---|---|---|---|---|
| Do you like CERDAS dashboard? | ○ | ○ | ○ | ● | ○ |
| Do you enjoy using CERDAS dashboard? | ○ | ○ | ○ | ● | ○ |
| Do you gain insight from CERDAS dashboard | ○ | ○ | ○ | ● | ○ |
| Do you think CERDAS dashboard can help in making decision when facing emergency cases? | ○ | ○ | ○ | ● | ○ |
| Will you use CERDAS dashboard in the future? | ○ | ○ | ○ | ● | ○ |

Do you have additional comments or suggestions to improve team?

TIADA

Submit

Figure 5.72: Evaluation Form Submission – 5

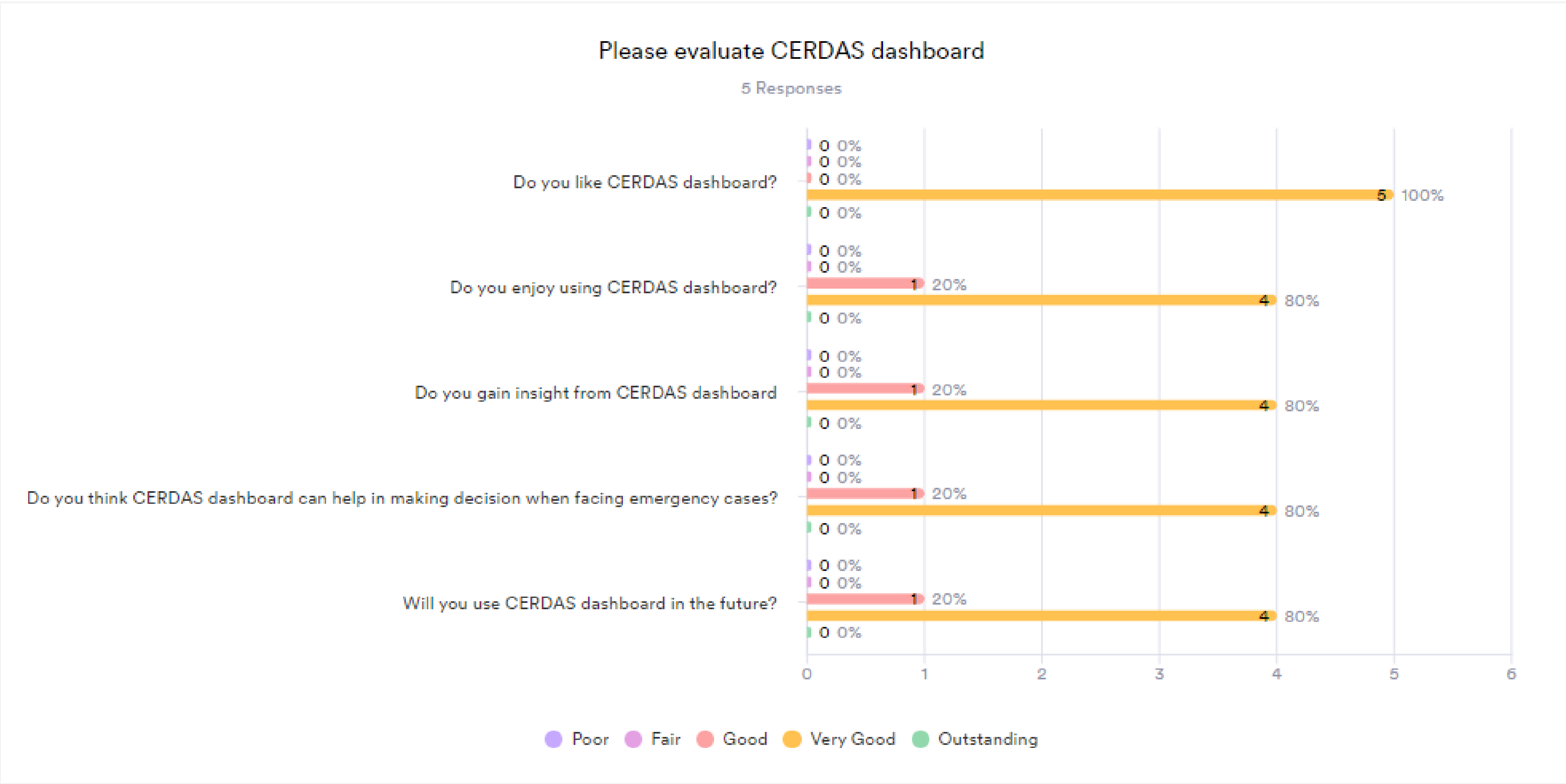



Figure 5.73: Analysis of Evaluation Form Data

**APPENDIX I**
**ICRES CONFERENCE – PAPER**

ICRES International Conference on Research in Education and Science istes Organization
www.icres.net May 18-21, 2023 Cappadocia, Turkiye www.istes.org

# Development of Visual Analytics for Campus Centralized Emergency Response and Disaster Assistance System

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**Abstract**: It is essential to save lives during emergencies not only in hospitals but also in colleges and universities. Failure to identify risks and take prompt action during catastrophes and emergency situations could result in the loss of life and property for the campus community. This research aims to explore the feasibility of using data analytics to mitigate the risks associated with disasters and emergencies on campus. A prototype of an online reporting system was developed using cloud services to collect relevant data, analyze it, and present the information in an online dashboard for stakeholders to make informed decisions. The study shows that the use of dashboards has a high potential for effectively mitigating risks and identifying appropriate intervention strategies. This research contributes to the ongoing efforts to improve emergency response planning and management in higher education institutions and can be applied to other universities and large community groups to enhance their disaster and emergency response preparedness.

**Keywords:** emergency response system, campus safety, higher education, data analytics

## Introduction

Some higher education institutions possess specialized physical facilities, making them distinctive. They serve both teaching and research purposes, generate employment and economic benefits within their local and regional communities, and offer essential services like medical care and laboratory functions. In essence, universities operate as self-sufficient communities that provide various amenities, including housing facilities, food services, small businesses (such as retail stores and printing presses), and even hospitals(Ayanian & Weissman, 2002). However, they are also vulnerable to emergencies like natural disasters and man-made crises, which can impact their ability to function effectively such as earthquakes(Koshiba & Nakayama, 2021) and flood(Ke et al., 2023), chemical explosion(Balla et al., 2021) and cyber-attacks(Kassem et al., 2019). In addition, health emergencies such as pandemics and outbreaks of contagious diseases can also pose significant risks to campus communities(Bokszczanin et al., 2023; Schmitt et al., 2021; Xiong et al., 2020). One of the significant challenges is the need to communicate effectively during emergencies. Higher education institutions may have large and diverse populations, including students, faculty, staff, and visitors, which can make communication challenging. Effective emergency response in higher education requires a multi-faceted approach that includes comprehensive planning, training, and resources(Song et al., 2022). Educational institutions should have clear and regularly reviewed emergency plans in place, as well as robust communication protocols and systems. In addition, there should be adequate resources dedicated to emergency response, including personnel, equipment, funding and technology.

This research aims to explore the feasibility of using data analytics to mitigate the risks associated with disasters and emergencies on campus. To achieve the research aims, this study is guided by the following research questions:

1. What type of campus emergencies and disasters occurred?
2. How significant is an online dashboard for emergency and disaster situations on campus?
3. Which visualization techniques are critical and effective for emergency responses on campus?

## Literature Review

### Campus Emergencies and Disasters

An emergency can be defined as a sudden, unforeseen, and typically dangerous situation that poses an immediate threat to health, life, property, or the environment and necessitates prompt action(Sarwar, 2018). Campus emergencies, ranging from natural disasters to man-made crises, can severely affect the safety and well-being of students, faculty, and staff. Natural disasters like floods, earthquakes, tornadoes, and wildfires can cause significant damage to buildings and infrastructure, leading to transportation disruptions, power outages, and water shortages(Toya & Skidmore, 2007). They can also result in serious injury and loss of life if people are not prepared or evacuated in time. In the context of students, transportation disruptions during floods can have a significant impact on their ability to access food. If food distribution channels are limited or supply chains are disrupted, it can make it difficult for students to purchase affordable and nutritious food. As a result, they may have to resort to eating less nutritious or more expensive food, or even go without food altogether. Furthermore, if transportation disruptions prevent emergency food aid from reaching affected areas, students who are already facing food insecurity may be at an even greater risk of going hungry. This can have a significant impact on their physical and mental health(Othman et al., 2022), as well as their overall wellbeing.

Man-made disasters, such as accidents, acts of terrorism, or violence, can also cause harm to people and property, and immediate emergency response measures may be required(Park, 2011). Examples of such disasters include chemical explosions(Morshidi et al., 2018; Mulcahy et al., 2013), mass shootings(Kowalski et al., 2021), and cyber-attacks(Ramim & Levy, 1 C.E.). Furthermore, the call for digital transformation of higher education has increased the vulnerability to cyber-attacks as universities become more reliant on technology especially for academic operation. As a result, universities have experienced significant data breaches involving the personal information of students, staff, and alumni. For example, in 2018, a hack of the University of Yale in the United States put the personal information, including social security numbers and addresses, of 119,000 students and staff at risk(Hailey Fuchs, 2018). Such cyberthreats not only disrupt educational processes and create barriers to learning, but are highly potent to cause significant emotional distress and trauma. This can affect their academic performance, mental health, and overall sense of student's wellbeing.

Hybrid disasters, which are a combination of natural and man-made disasters, can have compounded effects and are more complex to respond to. Covid-19 can be considered a type of hybrid disaster because it has both natural and human-made elements. On the one hand, it is caused by a natural virus that originated in animals and spread to humans(A. Zhu et al., 2023). On the other hand, its impact has been intensified by human activities such as international travel(Hohlfeld et al., 2022) and the lack of effective public health measures(Ullah & Harrigan, 2022) in some areas. Furthermore, the pandemic has led to various other disasters, such as economic downturns (Hyman et al., 2021) and social unrest(Warsame & Price, 2021), which are also man-made disasters extending the critical impact on higher education. The pandemic has also created significant mental health challenges for students. The stress and uncertainty of the pandemic, coupled with the social isolation and disruption to routine, have led to an increase in anxiety, depression, and other mental health issues(Bokszczanin et al., 2023). The impact of campus emergencies' events can be severe and long-lasting. Some of the other consequences include:

1. Loss of life and injury: Emergencies can cause injuries and loss of life, particularly if individuals are not properly prepared, treated or evacuated. For example, three students in China die in laboratory explosion (Zhuang Pinghui, 2018).
2. Property damage: Emergencies can cause significant damage to buildings and infrastructure, leading to disruptions in transportation, power outages, and water shortages. For example, Tropical Storm Allison caused 10 million gallons of water inundated the UTHSC-H Medical School basement, resulting in over 1 million gross square feet of space being unusable for several months(Goodwin & Donaho, 2010).
3. Reputation damage: Emergencies can damage the reputation of the institution and negatively impact the enrollment of future students.
4. Legal liabilities: Emergencies can lead to legal liabilities, such as lawsuits from individuals who were harmed or injured during the event.

Higher education institutions should prioritize the safety and wellbeing of their communities, recognizing that human life is priceless and that recovery from injuries can take a significant amount of time. Even though structures and objects can be reconstructed or replaced, the loss of life or the impact of an injury can have a long-lasting effect on the individuals involved and their loved ones. Therefore, it is crucial to invest in emergency response systems that can provide a swift response to emergency situations on campus.

**Emergency response system**

An emergency response system in higher education refers to a comprehensive set of policies, procedures, and resources put in place to address emergency situations on a college or university campus. These systems are designed to provide a rapid response to emergency situations, including natural disasters, medical emergencies, and violent incidents, with the goal of ensuring the safety and security of students, faculty, staff, and visitors. The significance of an emergency response system in higher education cannot be overstated since environment in campuses are dynamic with thousands of people living, learning, and working in close proximity to each other(R. Zhu et al., 2020).

There are several challenges remaining in the emergency response and disaster assistance system. The process of collecting data for emergency response and disaster assistance generates a massive amount of information, including reports, images, videos, and audio that cover various aspects of emergency and disaster situations(Pettet et al., 2022). Unfortunately, the sheer volume of this data often overwhelms emergency agents who lack the necessary tools to filter or refine it for future use. As a result, they may struggle to identify trends or patterns in the data, leading to delays in decision-making or even misinterpretation. In addition to the challenges mentioned earlier, the continued use of conventional and paper-based reporting systems as a primary practice in emergency response and disaster assistance can compound existing issues. Although these approach practically workable and less relying on technologies, these methods of data collection and reporting can be time-consuming and prone to errors, further exacerbating the challenges faced by emergency agents, personnel and victim. This can result in further delays in decision-making and potentially cause critical information to be lost or misinterpreted. There are several issues that can arise in emergency response systems:

1. Communication failures: Communication failures between emergency responders and victims or between different agencies can hinder the effectiveness of emergency response efforts.
2. Resource allocation: Emergency response efforts require the allocation of resources such as personnel, equipment, and supplies. Inadequate resource allocation can lead to delays or insufficient response efforts.
3. Inadequate training: Emergency responders must have adequate training to respond effectively to different types of emergencies. Inadequate training can lead to mistakes and ineffective response efforts.
4. Coordination difficulties: Emergency response efforts often involve multiple agencies and organizations, and coordinating their efforts can be challenging. Lack of coordination can result in duplication of efforts or conflicting response strategies.
5. Limited accessibility: People with disabilities or limited mobility may have difficulty accessing emergency services or evacuating during emergencies. Emergency response systems must be accessible to all members of the community.
6. Technological limitations: Emergency response systems rely heavily on technology, and technical failures or limitations can hinder their effectiveness. It is essential to have backup systems and contingency plans in place to address technical issues.

It is therefore crucial to develop and adopt modern and efficient systems for data collection, analysis, and reporting to improve emergency response and disaster assistance. To achieve the goal of improving emergency response and disaster assistance, implementing an information system that utilizes data-driven decision making appears to be a promising strategy.

**Data-driven Emergency Response**

Data-driven emergency response in the campus involves the use of data analytics and real-time information to improve emergency preparedness and response. With the availability of various data sources, such as sensors, social media, and other digital platforms, it is possible to collect and analyze data to detect early warning signs of potential emergencies, track the spread of an ongoing crisis, and inform decision-making during and after the emergency. It has become an increasingly important strategy for improving emergency preparedness and response efforts. According to a report by the United Nations Global Pulse initiative, data-driven decision making can help emergency responders and disaster relief organizations gain real-time situational awareness and make more informed decisions during emergencies(Emmanuel Letouzé, 2012) . By leveraging data from a variety of sources, including social media, sensors, and other data streams, emergency response teams can gain insights into the situation on the ground and take actions more quickly and effectively.

One of data-driven emergency response model that frequently adopted in research is Decision-Making Trial and Evaluation Laboratory (DEMATEL). DEMATEL uses a multi-criteria decision-making approach to evaluate different factors and their interrelationships in order to make informed decisions(Gabus & Fontela, 1972). The method involves constructing a matrix of the relationships between different criteria or factors, and then using that matrix to identify the most important factors and the causal relationships between them. Studies has shown the applicability of DEMATEL in the context of emergency management(Song et al., 2022; Zhou et al., 2017). One limitation of DEMATEL is that it relies heavily on the availability and quality of data to construct the interrelationship matrix. The accuracy and usefulness of the final results of a DEMATEL analysis depend on the quality of the data used in the matrix construction. Here are a few specific issues related to data acquisition that may limit the effectiveness of DEMATEL:

1. Incomplete data: If there is missing data for some of the criteria or factors being evaluated, it can be difficult or impossible to construct a complete interrelationship matrix. This can lead to inaccurate or incomplete results.
2. Biased data: The accuracy of the interrelationship matrix depends on the quality and objectivity of the data used to construct it. If the data is biased or incomplete, it can lead to incorrect or incomplete results.
3. Data collection costs: Acquiring and processing data can be a time-consuming and costly process. Collecting and processing data may require significant resources and expertise, which may not always be available.
4. Data complexity: The data used in DEMATEL can be complex and difficult to obtain. In some cases, the data may be proprietary or confidential, making it difficult to access or

use in a DEMATEL analysis.

All the issues mentioned are related to data. Whether it is incomplete, biased, costly or complex, the first and foremost step is to make the data available or acquiring data in a cost-effective manner. Therefore, this study proposes a cloud-based with low-code software development approach for developing the emergency response system in campus environment.

## Method

The method for developing the emergency response system in this research is illustrated in Figure 5.74.

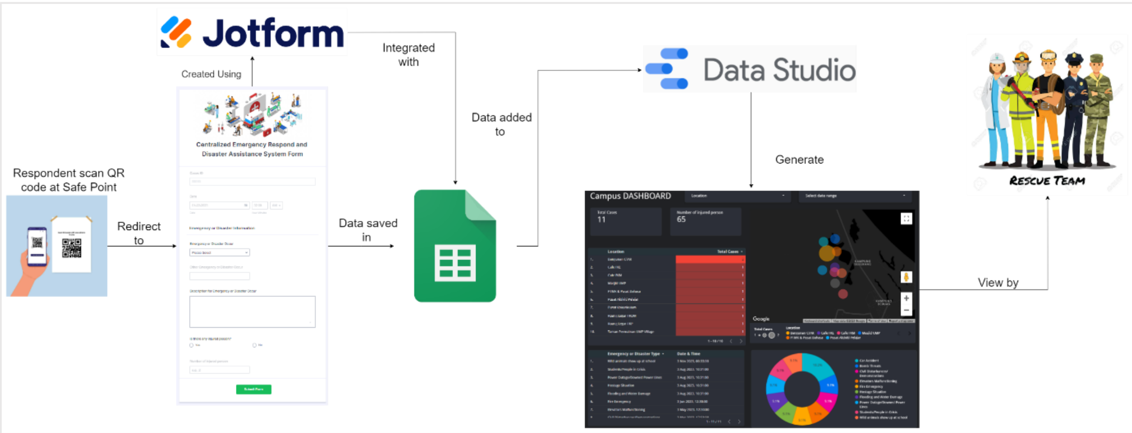


Figure 5.74: Method for Developing Emergency Response System

Step 1: Data acquisition with cloud-based form creator

There are various types and service providers that provide cloud-based form creation with low-code approach. In this study, we adopt the service from JotForm. It is an online form builder that allows users to create custom forms for a variety of purposes. The platform offers a wide range of form fields and customization options, making it easy for users to create forms that match their branding and meet their specific needs. Using JotForm to create an emergency report form with closed-ended, open-ended, short-form, and extended-form questions that respondents can fill out on their mobile phones by scanning a QR code at a safe point. The form collects data such as the date, time, location, emergency type, number of people injured, injury condition, and an image related to the emergency incident. The data is stored in JotForm and integrated with Google Sheets.

Step 2: Data visualization with cloud-based dashboard creator

There are many types of software that can be used for creating dashboards. Google Looker Studio is a valuable tool for developing dashboards, which can be used to visualize data collected from various sources, including Google Sheets. For this research, location data was essential, and the longitude and latitude of each location were imported into Google Looker Studio as data sources. To provide a geographic context for the data, a bubble map visualization was used to pinpoint the selected locations on the map. The size of the bubble represents the number of incidents that have occurred at each location, with different colors used to differentiate between locations. Additionally, a table with a heatmap was utilized to display the overall number of occurrences at each location, with lighter colors indicating a higher incidence rate. Figure 5.74 provides an overview of the dashboard used for this research.

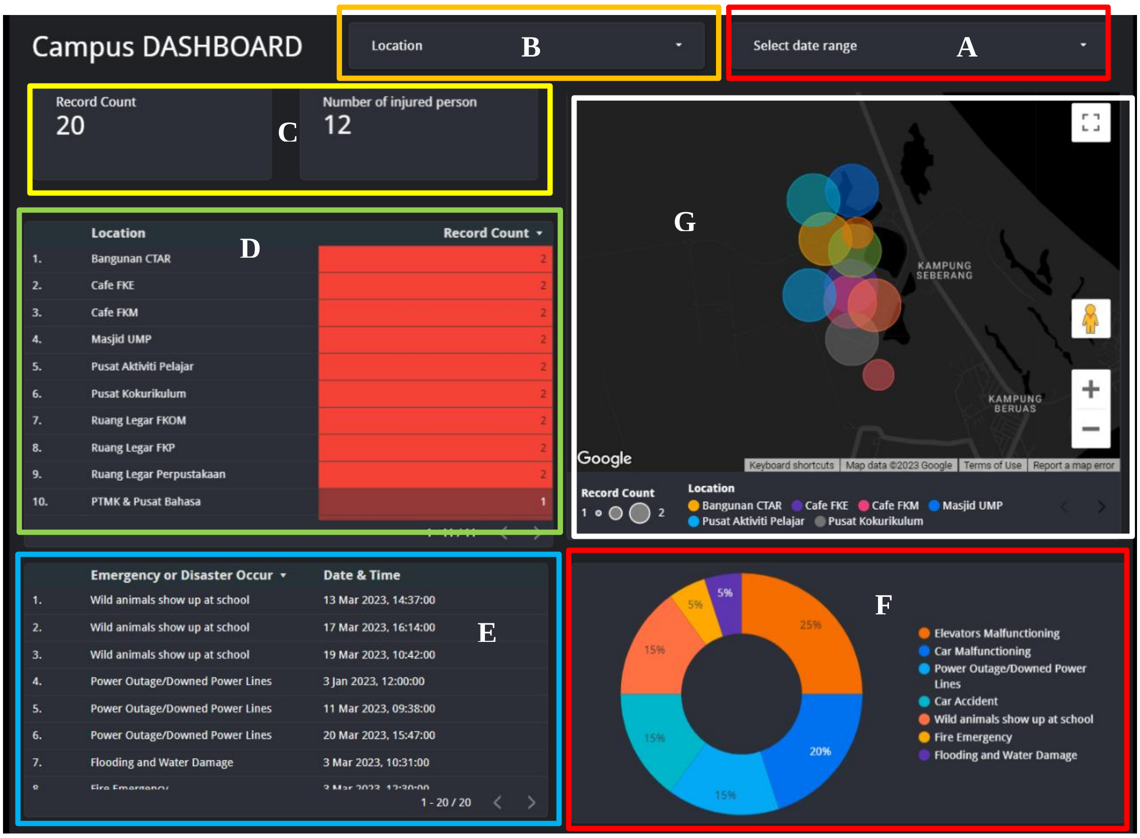

Figure 5.75: Method for Developing Emergency Response System

## Results

The findings from this study are organized based on the research questions as follow: -

1. How significant is an online dashboard for emergency and disaster situations on campus?

   An online dashboard for emergency and disaster situations on campus is a significant tool in data-driven emergency response. By utilizing data analytics and real-time information, the dashboard provides critical information for stakeholders to make informed decisions and take appropriate actions. It offers situational awareness by indicating the level of emergency and urgency for each emergency type and helps identify those who may be affected, enabling emergency responders to deploy resources more effectively and efficiently. Additionally, the dashboard displays the suggested required personnel for the University Health Centre and Emergency Department, as well as the number of available personnel for both departments. Inclusion of the level of emergency and urgency for each emergency type, along with personnel information, can further enhance the overall response to emergency and disaster situations on campus. Therefore, an online dashboard is an essential tool for effective data-driven emergency response on campus.

2. Which visualization techniques are critical and effective for emergency responses on campus?

   There are several visualization techniques that emergency responders can use to effectively respond to incidents on campus. Real-time dashboards are one such technique, providing stakeholders with critical information about the incident, such as the level of emergency and urgency, and the number of available personnel for responding to the situation. With real-time updates on the situation, these dashboards can help emergency responders deploy resources more effectively and efficiently. Another critical and effective visualization technique is the bubble map. A bubble map displays data using circles or bubbles of different sizes, colors, and positions on a map to represent specific values. It is an effective tool for visualizing spatial patterns and relationships between data points, such as the location and severity of incidents. By using longitude and latitude coordinates, emergency responders can quickly identify the location of the incident and determine the severity of the situation based on the size and color of the bubble. This visualization technique provides a quick and intuitive way for emergency responders to understand the situation and make informed decisions. Additionally, the bubble map can be used to visualize other relevant data, such as the distribution of emergency resources, to help responders allocate resources effectively. Overall, both the real-time dashboard and bubble map are critical and effective tools for emergency responses on campus.

## Discussion

Based on Figure 5.75, the dashboard contains a dropdown list, date range control, scorecard, table with heatmap, bubble map, table, and pie chart. The combination of the mention elements can be an effective collection of tools for showing and analyzing data in a dashboard, such that: -

A. Date range control: Date range control which label with the label A enables users to customize the time period during which data is displayed. This is especially useful for tracking trends over time and assessing data changes across multiple time periods.
B. Dropdown list: Dropdown list which label with the label B enables users to filter data based on a selected location. This can assist users in focusing on the data that is most pertinent to their needs and make it easier to compare data across regions.
C. Scorecard: Scorecard which label with the label C gives a succinct total case happen and total number of people injured, allowing users to quickly determine the level of safety on the campus.
D. Table with heatmap: Table with heatmap which label with the label D shows data in a tabular fashion, with color-coded cells indicating the relative significance or value of each data item. This can help users see trends and patterns in the data more quickly.
E. Table: Table which label with the label E shows the emergency type, date and time data in a tabular fashion, with rows and columns that facilitate data sorting and filtering.
F. Pie chart: Pie chart which label with the label F displays the relative proportions of emergency type categories. This can be helpful for rapidly determining the most significant or pertinent categories.
G. Bubble map: Bubble map which label with the label G displays data spatially, using bubbles or markers to indicate the position and magnitude of cases. This is very effective for illustrating spatial trends in data.

The potential impacts of using a dashboard in emergency and catastrophe situations are significant and can extend to multiple sectors, including:

1. Society: Society 5.0 recognizes the importance of leveraging technology to improve safety, security, and quality of life for all members of society (Deguchi et al., 2020) The use of a dashboard in emergency and disaster response is a prime example of how technology can be used to achieve these goals. By providing the public with real-time updates and accurate information, the dashboard can help to minimize panic and misinformation, while also ensuring that individuals take appropriate safety measures.
2. Government: The use of a dashboard in emergency and catastrophe situations is an

example of how digital government can be leveraged to improve the delivery of public services. Digital government refers to the use of digital technologies, such as online platforms and data analytics, to enhance the efficiency, effectiveness, and transparency of government operations (Misuraca et al., 2020).

3. Industry: A dashboard can be an invaluable tool for protecting critical infrastructure and facilities during emergencies or natural disasters. By utilizing data-driven decision-making in emergency response systems, it becomes possible to identify potential threats and deploy necessary resources to secure vital infrastructure and facilities with a preventive management approach for the long term. This approach aligns with the global trend towards the fourth industrial revolution (Duan & Da Xu, 2021).
4. Environment: The efficiency gained from data-driven decision making has a significant impact on the environmental issue. Optimization of resource utilization is possible to be done when there is data available either for real-time action or future scenario planning especially on the logistic and resource planning. This somehow affect directly the environmental in term of carbon emission especially from fires (Wiedinmyer & Neff, 2007).
5. Academia: This study contributes a new insight into the body of knowledge for sustainable higher education itself. Greater attention can be made among scholars and academia on the importance of emergency response systems empowered with data analytics.

## Conclusion

The findings of this study highlight the importance of data-driven decision-making in emergency response and disaster management systems at higher education. By utilizing cloud-based services such as online form creator and online dashboards, universities and communities can gather and analyze data to inform emergency response plans and improve the safety and security of individuals on campus. Furthermore, the study's emphasis on sustainable development goals underscores the need for emergency response systems that prioritize building resilience and preparedness for emergencies scenarios. As such, investing in smart campuses with robust emergency response systems can contribute to achieving these goals, making them an essential resource for decision-makers and stakeholders in emergency management and disaster preparedness. In summary, the link between campus emergencies and emergency response systems is clear. By implementing data-driven decision-making with cloud technologies, universities and communities can improve their emergency response and disaster management systems, ensuring the safety and security of individuals on campus while contributing to sustainable development goals.

### Limitation and Recommendations

While this study offers important insights into emergencies and disasters in higher education, it is also subject to certain limitations. The effectiveness of visual analytics on emergency response and disaster management depends on factors such as the availability of resources and infrastructure, as well as the capacity of stakeholders to implement and use these technologies effectively. For example, the use of smartphone is essential to lodge an emergency report. In certain emergency cases where a person panics or passes out, there is a high possibility the person will be unable to use the technology effectively. As for future research, findings and limitations from this study could provide the way how to explore additional questions related to emergencies and disasters in higher education. Some potential areas for further investigation are:

4. Factors that influence the occurrence of emergency and disaster cases could be examined in future research. For instance, this study revealed a significant incidence of elevator malfunctioning on campus, and further research could explore contributing factors such as mechanical failure or improper maintenance to reduce the frequency of lift malfunctions.
5. The relationship between emergency and disaster cases and their effects on mental health could be investigated in future research. This study did not explore this connection, and additional research could identify successful approaches for delivering psychosocial support and increasing mental health resilience in affected communities.
6. Future research could be conducted to identify effective strategies for improving community readiness and resilience for emergency and disaster situations. Emergency preparedness and resilience are crucial for mitigating the effects of catastrophes and disasters.

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# APPENDIX J
# ICRES CONFERENCE – CERTIFICATION OF PRESENTATION


ICRES2023

May 18-21, 2023 Cappadocia/TURKEY

Certificate of Presentation

This is to certify that

**Lecturer Aziman Abdullah**

presented the **"DEVELOPMENT OF VISUAL ANALYTICS FOR CAMPUS CENTRALIZED EMERGENCY RESPONSE AND DISASTER ASSISTANCE SYSTEM"** as an **oral** presentation and attended International Conference on Research in Education and Science (ICRES) held on May 18-21, 2023 in Cappadocia/Turkey.

Mack C. Shelley II

***Prof. Dr. Mack Shelley***
*Chair of Conference Organizing Committee*

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Figure 5.76: ICRES Conference - Certification of Presentation