**Mobile Application for Calamity Response using Prescriptive Analytics**

# Chapter 1

## Introduction and Its Background

Tropical Cyclones also known as typhoons are one of the destructive natural calamity that the Philippines encounter because of its geographical location that is near at the Pacific Ring of Fire resulting to being a tropical country. Mostly, every year about twenty typhoons are entering the archipelago and five out of these typhoons were destructive (Asian Disaster Reduction Center Philippines, 2008). Northern Luzon is one of the areas that frequently hit by these typhoons. Because it is a natural disaster these events are not avoidable the local government takes its part to prevent or minimize the cost of damages and casualties by making organization that prepared and organized its responses before, during and after the calamities.

NDRRMC or National Disaster Risk Reduction and Management Council are in charge with the overall disaster preparedness, disaster operations and rehabilitation of the Philippines when a natural disaster appears.But the NDRRMC has also a small branches or levels which are: Municipal Disaster Risk Reduction and Management Council (MDRRMC) and Barangay Disaster Risk Reduction and Mangement Council (BDRRMC) this organizations also plans for the local imediate responses when a natural disasters occurs in their areas.

This study focus on the areas of the City of Los Baños on how the MDRRMC and BDRRMC can be more efficient and effective with the use of technology in emergency responses when there is a typhoon or tropical cyclones. The City of Los Baños has a land area of 56.5 square kilometers and boarded by south and southwest of Mt. Makiling and in the north area is the water mass which is the Laguna de Bay. The city is prone to flooding and also landslides. The city has 14 baranggays and has a population of 115,353 people. This people will be affected when a calamity strikes so that the planning and organizing a emergency response is important and will be a great help with our rescuers to have an application that will help them to execute a plan or actions.

This study aims to help the local emergency responders by using a prediction analysis and prescriptive analytics. Prediction and Prescriptive Analytics are some of the types of Data Analytics. Data Analytics is the study of analyzing a raw data to create a conclusion about a certain topic. Prediction analysis is one of the branches of data analytics which is used to create predictions about in uncertain events. Prescriptive analytics uses many techniques such as statistics modeling, machine learning and artificial intelligence to examine current data to make predictions about the future. Prescriptive analytics takes predictive analytics one step ahead by giving a specific and actionable step for how to solve the problems brought by the prediction analysis.

Using both predictive and prescriptive analysis these systems aims to establish a good to fair planning for typhoon emergencies. To give a good and fair data analyzation to create a plan for quick responses and helpful planning strategy.

## Research Problem

Over the years, City of Los Baños have encounter and experience such typhoons were in they experience flash floods, landslide, storm surges and road blocks. With these experiences the local municipalities have created and planned their quick responses when calamity occurs. The researchers think how the response teams will response quickly with the help of advance technology to have a better and precise plan and responses.

Though, there are only few mobile applications that are intended for calamity responses. However, these applications are limited and difficult in terms of functionality. Creating a mobile application that is designed to calamity response will need a lot of time. Existing mobile application platforms are lacking in number. Predicting on what will happen during a calamity might be predictable but the accuracy is way more underestimated at this time. And prescribing an action takes time when a calamity happens. Though with the help of advance learning and using an application with predicting and prescribing in a situation may be a great help with the use of the gathered data or information.

## Research Objective

The general objective of the research project is to develop a mobile application for Calamity Response Integrating Kinematic Differential Global Positioning System. It aimed to:

1. Develop an application that will help MDRRMO to dispatch responders to a location that request aid in times of typhoon disaster.
2. Design an application that will utilize the algorithm of prescriptive analytics.

3. To prove then efficiency of the application in times of typhoon and the accuracy of the algorithm.

## Research Framework

**Theoretical Framework**

Login/Sign Up

Login/Sign Up

Show current GPS position

Check SOS w/ GPS position

Confirmation SOS

Send SOS Request w/ GPS position

Government USER

Local USER

Figure1. Theoretical Framework

Figure 1 shows the flow of the process of the mobile application. To define and breakdown each process: first, if you’re using the app as a Civilian User, you need to login or sign up by providing all the required information; second, the system will show the current position of the civilian user to check if the position is correct; lastly, sending a SOS request from the government user in order to send responders to the requested location. Using the mobile application as the government user: first is to login and sign up just like in Civilian User interface; second, the interface pops up a message with a pinpoint location of the civilian in the GPS; lastly, sending back a confirmation that the government official received their request and the government official will handle the dispatch of the responders to the designated location.

## Scope and Limitations of the Research

Typehoone is a mobile android based because this application will be created with the help of Android Studio. The application can be access through offline. The objective of the system is to predict a possible event that will happen when a calamity occurs and prescribe a best option to do for rescuers.

## Significance of the Research

**Local government unit**. The mobile application software will provide an alert for those whose current location is near an occurring calamity. This will help the local government for quick response to the affected areas.

**Local Community**. The mobile application software will help the local community by providing them a tool that helps them in times of emergency.

**Future researchers.** The mobile application aims to provide the future researchers a reference for their future reviews related to this study.

# Chapter 2

## Related Literature

The Philippines is known to have tropical and maritime climate. Philippines have a high temperature, humidity and abundant rainfall. High temperature, humidity and rainfall are the important elements of climate in our country. High temperature refers to the average or the annual temperature of the country which is 26.60c. The coolest month falls to January while the warmest occurs in May. Humidity is the moisture content of the atmosphere. Because Philippines are surrounded with the bodies of waters our country has a high humidity. The combination of warm, high temperature and pure humidity give high temperature throughout the archipelago. This may occurs during March to May. Rainfall is one of the most important elements of climate in the Philippines. The rainfall distribution changes from one region to another depending to the direction of the cold air mass and location or the landscape of the regions. The annual rainfall of the Philippines depended from 965 to 4,064 millimeters.

Based on the temperature and rainfall of the country the climate can be categorized in two major seasons which are the rainy season and the dry season. The rainy season occurs in June to November and the dry season starts in December to May (Philippine Atmospheric, Geophysical and Astronomical Services Administration, n.d.).

Philippines are known to be susceptible with tropical storms. According to (Asian Disaster Reduction Center Philippines, 2008), Philippines has an average of 20 typhoons per year wherein five of this typhoons where destructive. Some of these destructive typhoons that lands in Luzon are the Super Typhoon Rolly the year 2020 and Super Typhoon Lawin in 2016. Super typhoon Rolly that lands in the Bicol region according to (Office for the Coordination of Humanitarian Affairs, 2020), that around 25 people died when the super typhoon lands in and about 390 have been injured and 6 persons are still missing. While, the Super Typhoon Lawin lands in Cagayan and leaves about 18 deaths and 40 thousands of people were affected by the super typhoon.

According to (Philippine Atmospheric, Geophysical and Astronomical Service Administration, 2015) Philippines tropical cyclones derive their energy from the heat condensation which made them exist only over the oceans and die out rapidly on land. Tropical cyclones have five categories which are; Super Typhoon, Typhoon, Severe Tropical Storm, Tropical Storm and Tropical Depression. The strongest and mostly destructive in the category is the Super Typhoon it is a tropical cyclone with a maximum wind speed exceeding 220 kph or more than 120 knots. From 2016 to 2020 there are two super typhoons that lands in the Philippines which are the Super Typhoon Lawin and Super Typhoon Rolly. Next is, Typhoon it is a tropical cyclone with maximum wind speed of 118 to 220 kph or 64 to 120 knots.

For the past five years there are 32 typhoons that entered our Philippine Area of Responsibility or PAR. One of these is Typhoon Ambo which is the latest that lands in the region of Mindanao. Then, the Severe Tropical Storm is a tropical cyclone that has a maximum wind speed of 89 to 117 kph or 48 to 63 knots. And Tropical Storm has a maximum wind speed of 62 to 88 kph or 34 to 47 knots. And lastly and also the weakest in the category is Tropical Depression it is a tropical cyclone with maximum sustained winds of up to 61 kilometers per hour or less than 33 nautical miles per hour.

The effects of tropical cyclones are mainly strong winds, rainfall and flooding, and storm surge. Tornadoes can be one of the effects of tropical cyclone but from the past five years there is only one known tornado which is the Manila Tornado that rips many households’ roofs, trees are root out and damages power lines (Popioko, 2016).

As the researchers studies scope is in the City of Los Baños the researchers will focus on the effect of tropical cyclones in the city. Having strong winds when a calamity occurs may results in housing damages or casualties also the City of Los Baños are known to have a lot trees and it is near at the mountain of Maria Makiling and also it is near at the bodies of water which is the Laguna Lake. So that, when a calamity occurs Los Baños are prone to road blocks due to strong winds, landslide or soil erosion and flooding.

According to (Radbruch-Hall & Varnes, 1976) Landslide occurs when the ground on slope are unstable due to a manmade events or by a natural disasters. The unstable ground that collapses will flow down to the side of hills or mountains. This debris will surely affect if there is a community underneath or near the landslide area this will result to great damages also, rescuers should response quickly if there is a landslide and if this landslide covers a community or houses. Rescuers should act fast to get the trapped survivors. Flooding is also one of the major problems when a calamity happens this may causes road blocks and it can also damages the property and livestock of the community.

Flooding is the most often type of natural disaster and it occurs when an overflow of water immerse land that is usually dry. Floods are often caused by heavy rainfall, rapid snowmelt or a storm surge from a tropical cyclone or tsunami in coastal areas. There are three kinds of flood which are; pluvial floods or flash floods this are floods that result by an excessive and rapid rainfall that raises water heights quickly affecting roads, rivers, and streams. Fluvial Floods or river floods are floods that cause by a consistent rain that forces the river to overflow. While, Coastal Floods are cause by storm surges associated by a tropical cyclones and tsunamis.

The one of the most unforgettable flood that the City of Los Baños experience is when the typhoon Ondoy lands many of the agriculture in the city were damage and many of the houses are wreak or being drown in water floods.

The Tropical Storm Ondoy occurs in September 2009 were in many of the Lagunense suffered from extensive floods. This tropical storm leaves with a death of 23 people, 7 injured, 5 that are still missing. This typhoon has affected 179 barangays, 2 cities and 21 municipalities (Government of the Philippines, 2009).

Coastal and highland areas are likely prone to calamities and disasters. Responding to these calamities must be planned effectively and efficiently. Responders must gather facts about the incident or what type of crisis should be responded. This will create the response plan to the affected areas. The next phase will be putting the response plan in motion and starts working towards resolution. Members of the response team must be given necessary details of the incident and identify the affected parties involved.

According to (Frazzetto, Nielsen, Pedersen, & Šikšnys, 2016), prescriptive analytics is able to suggest the best decision options in order to take the advantage of the predicted future and illustrates the implications of each decision option. The prescriptive analytics incorporates analytic outputs and utilizes A.I. in order to provide optimal decisions.