AN ANDROID BASED INTERACTIVE TRACKING AND SHORTEST PATH FINDING SYSTEM FOR CLUSTERED TRAVELLING USING DIJKSTRA'S ALGORITHM

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ABSTRACT

The need to belong is a strong need for all human beings. Friends, families and tourists go to unfamiliar or new places to unwind and relax. By doing so, the risk of getting lost and scammed increases. The system will track members of a party and display their location in a real – time map. It also has an Instant Messaging feature where a member can send pre – made messages to the party. The system will be using GPS to gather the location of each party member. It will then send all collected data to the cloud server. All processes will be done in the cloud server. The system will be implemented on the Android platform. By doing this study, the proponents hope to give a sense of security to the users and alleviate the hassle or burden of people in their everyday life, most especially as they travel across miles.

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CHAPTER 1
INTRODUCTION

1.1 Rationale of the Study

According to a study made by sociologists of University of Maryland in 2008 (Robinson & Martin, 2008), unhappy people watch more TV, while very happy people spend more time socializing. The need for belonging is an essential need for all human beings. If we lived in isolation we may end up feeling empty and depressed. Therefore, justifying people's need to socialize. In order to socialize and relieve stress, people go for an adventure or an outing.

In the Philippines, when people go for an adventure or an outing, they would normally go in groups. Either they travel together or just meet up in the destination. When they go out with their friends they would have a hard time in keeping track of each other's location and what has happened to them while they are travelling. Whether they are travelling on foot or by any means of transportation, they would have to constantly call or text each other to get an update on where they are, how far they are from each other and what has happened to them. This is also true for tourists who visit the country.

According to an article made by the Department of Tourism (Department of Tourism, 2015) the total number of tourist arrivals as of 2014 has increased from 4,681,307 to 4,833,368. The increasing number of tourists that enter the Philippines will also mean more and more tourists will become victims to opportunists that will take advantage.

Motorists who travel together usually have a hard time in keeping track of each other. Motorists have to keep on checking their companion through their rear view mirror or sometimes they have to try very hard to keep up with their companion in front. This becomes a hassle because the driver gets distracted. Distracted driving is one of the causes of road accidents such as hitting a person, hitting another vehicle and the like. Sometimes, when motorists travel together

they could cause traffic jams because the leading motorist would tend to slow down and wait for the other motorists thus affecting other vehicles in the process.

The number of smartphone users in this country is skyrocketing. Prices of smartphones are going down. A recent study in 2014 shows that as the prices of smartphones in the country are going down, more and more people are changing their feature phones for a more functional and advanced smartphone (Rivera, 2014). People purchase a smartphone whether it is for communicating, social networking or surfing the net. These days, having a smartphone is a convenience. Smartphones are becoming more advanced; most of them are GPS ready.

Over the years, GPS technology has become a part of the growing number of features in a smartphone. Smartphones that have GPS can calculate accurate location, speed and time information. GPS tracking enables a central tracking centre to identify the current location of vehicles or people without having the need to transmit the information explicitly. GPS technology has become a revolutionary tool that can be used in navigating and tracking.

Cloud computing makes the development of mobile applications easier and faster. The cloud provides rapid access to flexible and low cost IT resources. With cloud computing applications, the need to install applications in smartphones will be lessen. Cloud computing becomes a step towards applications being hosted over the Internet.

The research aims to develop a party tracking system. The system will display the real – time location of the members in the party in an interactive map. The system will be able to calculate an estimated distance and route between each member and the desired destination. Global Positioning Satellite (GPS) will be used to gather the members' location. In addition, the server will be stored in the cloud and the processes will be done in the cloud as well.

1.2 Statement of the Problem

1.2.1 General Objective

The main objective of this study is to develop an interactive android smartphone party – tracking system for clustered travelling using GPS and cloud computing.

1.2.2 Specific Objectives

This research aims to:

1. develop an interactive and real – time map showing all members of the party;
2. develop a module that will calculate and show the shortest possible route from the user's current location to the desired destination using Dijkstra's algorithm;
3. develop a module that will calculate the distance of a member – pair;
4. develop a party management module;
5. develop a customizable instant messaging module;
6. develop a module for saving and retrieving historical data of past events;
7. integrate the modules to create a tracking system; and
8. test and evaluate the system.

1.3 Significance of the Study

In the Philippines, there are lots of places where people go to for a good time. Spending these moment with friends, colleagues or family would make the experience better. There are many ways on how to go to the destination of the vacation. The mostly used way in doing this is to set a meeting place and travel together. The research will benefit the following:

Tourists. When a group of tourists visit the Philippines they usually take a taxi or other public transportation to get to a certain place. Keeping track of each other becomes a serious matter because they are most likely to get lost and there are many opportunists who take advantage of tourists for money. By using the system the tourists can get directions to tourist destinations and keep track of each other.

Motorists. When motorists travel together they usually have to constantly worry if the other motorists are not lost or if they, themselves are not lost. The proposed system would aid the motorists in the directions to the desired location and constantly give the motorist updates regarding the other motorists he/she is travelling with.

Parents. Parents will always worry about their children. The proposed system will benefit parents by providing them a means to track their children.

Teenagers. Most teenagers have adventures or outings in an unfamiliar place. They would normally meet up in an agreed place to travel together to the destination or just meet up in the outing location. By using our system, they can get directions on how to get to their destination and keep track of their companions.

Future developers and researchers. This research will benefit the future developers by giving them an idea how to use the technologies the proponents used such as GPS and cloud computing. It will also provide the future developers with new algorithms.

GPS and Cloud Computing Field. This research will give the GPS and Cloud Computing field a new perspective on how to use GPS and cloud computing technologies.

1.4 Scope and Limitation

The study will create and develop a tracking system through an Android application that uses GPS to retrieve the location of the party members, and Dijkstra's algorithm to get the shortest possible path to the destination. The range of the application is dependent on the coverage of the Cellular Service Provider and GPS satellites. Only members of the party are able to track each other. All computations will be done in the cloud server. The security of the party member will be his/her own responsibility. The system's power consumption optimization will not be a part of the research. Testing of the system will be done in the Cebu City area. The map that will be used will be from the Google Maps API.

DEFINITION OF TERMS

Clustered Travelling – is travelling with two or more small groups

Instant messaging – sending electronic pre – made message templates through buttons

Party – is a group of people travelling togther

Tracking – is following the movements of a party member and identifying the distance of other party members

CHAPTER 2
REVIEW OF RELATED LITERATURE

Tracking

According to Sabawi, a vehicle tracking system consists of an electronic device installed on a vehicle so that it could be tracked. Most of the vehicle tracking systems, today already use Global Positioning System (GPS) to get a more accurate reading of the vehicle's position. Cellular (GSM) and satellite transmitters are combined to transmit the vehicle's current position to a remote user. They transmitted data can be viewed by using a software on a computer (Sabawi, 2009).

A real – time transit tracking system requires an in – vehicle device (sometimes referred to as an Automatic Vehicle Locator Unit or AVL unit) and a back – office component. The in – vehicle device is used to determine the vehicle's current location using Global Positioning System (GPS) technology and communicates this via a wireless link either through satellite of cellular service to the back – office component. The back – office component consists of multiple computers that serve as a central server. The central server processes the time – ordered sequences of locations (location traces) and provides a live – tracking site and status monitoring for the users (Biagioni et al, n. d.).

Global Positioning System (GPS)

A GPS receiver receives the signals from the GPS satellites high above the Earth. It calculates its position by precisely timing the signals it receives from the satellites. Each GPS satellite continually transmits messages that include the time the message was transmitted, precise orbital information, and the general system health and rough orbits of all GPS satellites (T. Mahalingam et al, 2013).

Space has three dimensions. Therefore, three satellites might seem enough to solve for a position near the Earth's surface. However, even with a

small clock of error multiplied by the very large speed of light, the speed at which satellite signals propagate, results in a large positional error. Thus, GPS receivers use four or more satellites to solve for the receiver's location and time. Most GPS applications hide the accurately computed time and use only the calculated location. However, a few specialized GPS applications use the time and other data transmitted by the satellite.

Cloud Computing

Cloud Computing has recently emerged as a technology making a huge impact in all sectors through low cost of entry and high interoperability (Alazawi et al, 2011). The technology allows developing reliable, incrementally deployable and scalable systems with low cost and on demand-base access of large shared resources (Bernstein et al, 2010).

In concept, cloud computing makes the users utilize the information services when they are connected to the Internet, even if they do not completely understand the complex information service structure and possess any professional knowledge. In 1990s, cloud computing borrows from the techniques of Grid Computing and Utility Computing. In the 21st century, based on the improvement of network techniques the related network services vigorously developed.

Cloud Computing system comprises components that are being offered as services such as Software as a Service (SaaS), Platform as a Service (PaaS) containing hardware, software and data services and Infrastructure as a Service (IaaS) with computational resources, storage and communication services (Youseff et al, 2008). Cloud computing has a potential to radically affect road transportation systems (Alazawi, 2011) which suffer from large – scale traffic data handling problems like scalable computation and management, real-time processing and retrieval of traffic data problems.

Cloud Computing is the delivery of computing as a service rather than a product, whereby shared resources, software, and information are provided to computers and other devices as a metered service over a network (typically the Internet) (T. Mahalingam et al, 2013).

Cloud computing is the combination of computing as a utility and software as a service (Vogels, 2008). The applications are delivered as a service over the Internet and the hardware and systems in data centers provide those services. The concept of cloud computing is to transfer computation processes to remote resource providers. This is the key strength so cloud computing can be described in terms of the services offered by cloud service providers: software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS) (Carolan et al, 2009).

Aepona (Aepona, 2010) describes Mobile Cloud Computing (MCC) as a new paradigm for mobile applications whereby the data processing and storage are moved from the mobile device to powerful and centralized computing platforms located in clouds. These platforms are then accessed through a wireless connection based on a thin native client on the mobile devices.

MCC can also be defined as a combination of mobile web and cloud computing (Christenen, 2009)(Liu, 2011), which are the tools favored by majority of the users. All the complicated computing modules can be processed in the clouds therefore, smartphones do not need a very powerful configuration. MCC provides the users with bigger data storage and computing power.

Cloud computing is Internet – based computing, whereby shared resources, software, and information are provided to computers and other devices on demand. An authorized user can access the cloud information via a web portal.

The users of the system have his/her own username and password making the manipulation of other users' data very less and the security is high.

The user is able to retrieve the information real time. The cloud server is using Best Fit Algorithm for storing the data (Alexe, Ezhilarasie, 2011).

Cloud Computing refers to a computing system in which tasks are assigned through a combination of connections, service and software over a network. Cloud provides the logical and physical infrastructure to store the data. Only the authorized person can access the data from cloud environments (Alexe, Ezhilarasie, 2011).

With all these various ideas and concepts combined, the research will create an interactive and real – time tracking system that uses GPS for requesting the location and cloud computing for translating the gathered data from the GPS and interpret that gathered information for the party members.

CHAPTER 3
TECHNICAL BACKGROUND

Over the years, Smartphone usage has radically increased. Many people in this country have gone accustomed to having their smartphones part of their daily lives. According to the study made by Juniper Research, by 2014 the entire market for cloud – based mobile applications will rise to $9.5 billion (S. Perez, 2010). Mobile Computing can provide an effective tool needed by the user irrespective of user movement thus being location independent. Mobility is one of the characteristics of a ubiquitous computing environment where users can continue their work regardless of where they are (M. Satyanarayanan, 1996).

In Mahalingam et, al.'s study they stated that there were more than 400, 000 apps available for Android, and the estimated number of applications downloaded from the Android Market exceeded 10 billion in 2011 (T. Mahalingam et al, 2013).

Vehicle tracking systems is rooted in the shipping industry. The owners of the shipping industry needed a solution to the difficulty of keeping track of their vessels when it is in the vast expanses of the oceans. They needed a system that could determine where each vessel was at any given time and for how long it traveled. A real – time tracking system was needed where it could transmit the collected data about the vessel at regular intervals of time or at least it could transmit the data when the monitoring station asks for the data (T. Mahalingam et al, 2013).

The concept of satellite positioning system is calculating the distance between a satellite and the current position of the GPS unit. The location of each satellite is known. Using the calculated distance from three to four satellites, one can narrow the current position to exactly one place on surface of the earth. The accuracy of the positioning depends on how correctly the distance is measured and how precisely the position of the satellite is known.

The satellite communication technology is used to identify the vehicle locations. Vehicle tracking systems have also become a part of the day – to – day life of a common man. These days, more and more GPS fitted vehicles are becoming a preference for the people.

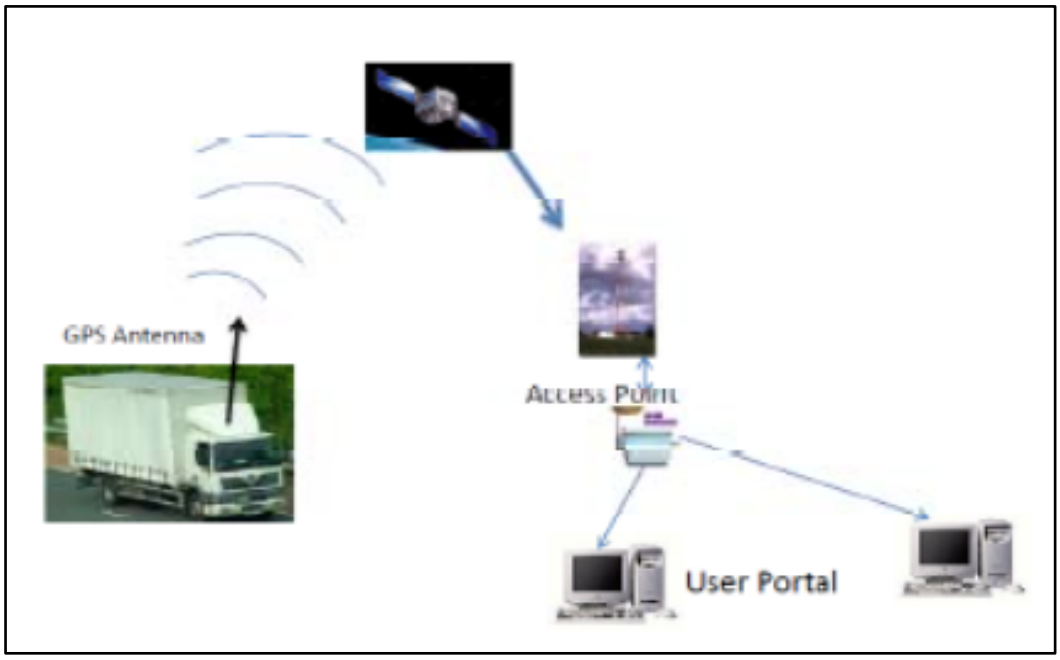

Figure 3.1 Old Concept of Tracking

Figure 3.1 shows the process of old systems of the GPS based tracking systems. Vehicles are equipped with GPS antenna, which is used to transfer the location signal to the GPS satellites. The satellites receives the signal transmit it to corresponding access point server. Access points are connected with GSM modem that is used to interface desktop computers to GPS data.

Caravan Track

Caravan Track was the winning project created by engineering students from a Ford – sponsored course in the University of Michigan. The application lets people share route and vehicle information and coordinate stops as they travel in groups of cars. With Caravan Track, users sign up online to join a trip with friends, much like joining a Facebook group. The leader of the trip supplies a

four-digit code that allows each participant to log in. Routes to all planned meeting points and the final destination are automatically generated for each car. Once on the road, all the participants can share data from each of their cars, such as speed, location and fuel level. Caravan Track can also provide information on nearby restaurants and gas stations with the click of a button.

Users can send text messages between the cars to coordinate activities. To make things easier, there are prepared messages, such as "We should stop at the next rest area," that can be initiated with one click and played over the speakers in the other cars. It is designed to be used by drivers and passengers together, and one of the aims of the project is to determine what is the type of interface to use.(Ciccone, Hawke, Park, & Phillips, 2012)

CHAPTER 4
DESIGN AND METHODOLOGY

The research will incorporate several scientific methods. The process method will be used when the proponents are learning the unfamiliar tools needed to develop the system. The research will also use the model method to better understand the different modules of the proposed system.

Lastly, the proponents will use the build method to develop and test the different modules as well as the proposed system itself.

4.1 Concept

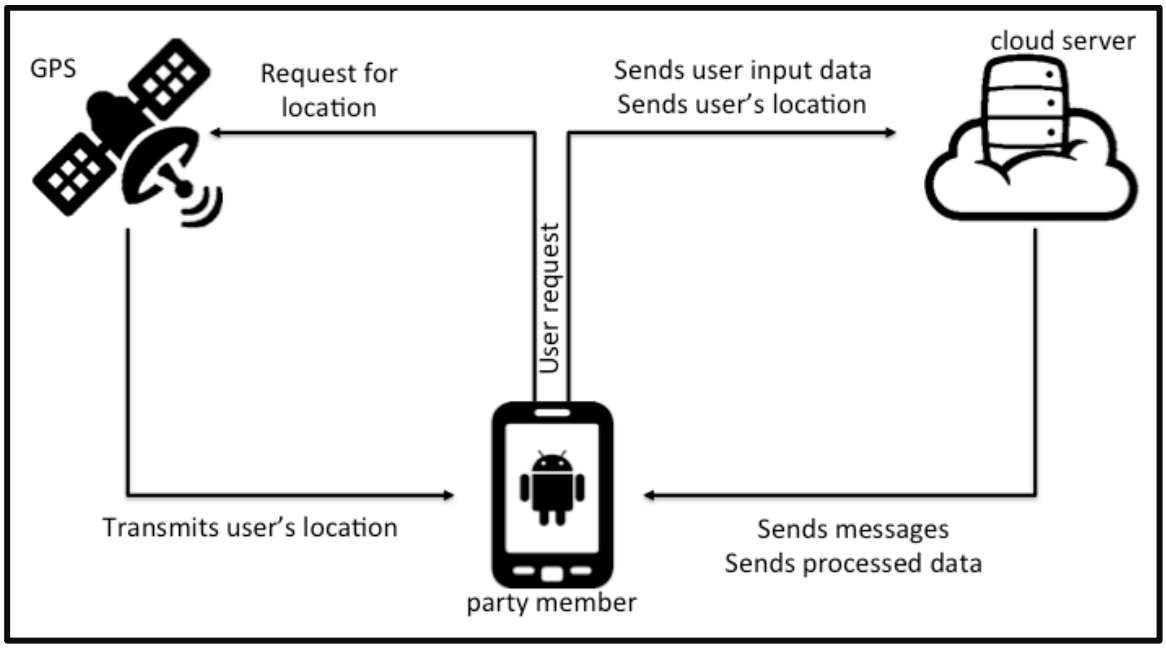

Figure 4.1 Conceptual Framework

In Figure 4.1, the system will request the party member's location from the GPS satellites. The system will then store the gathered data from the satellites into a cloud server. The server will then process these data, save it to the database and return the processed data to the party member.

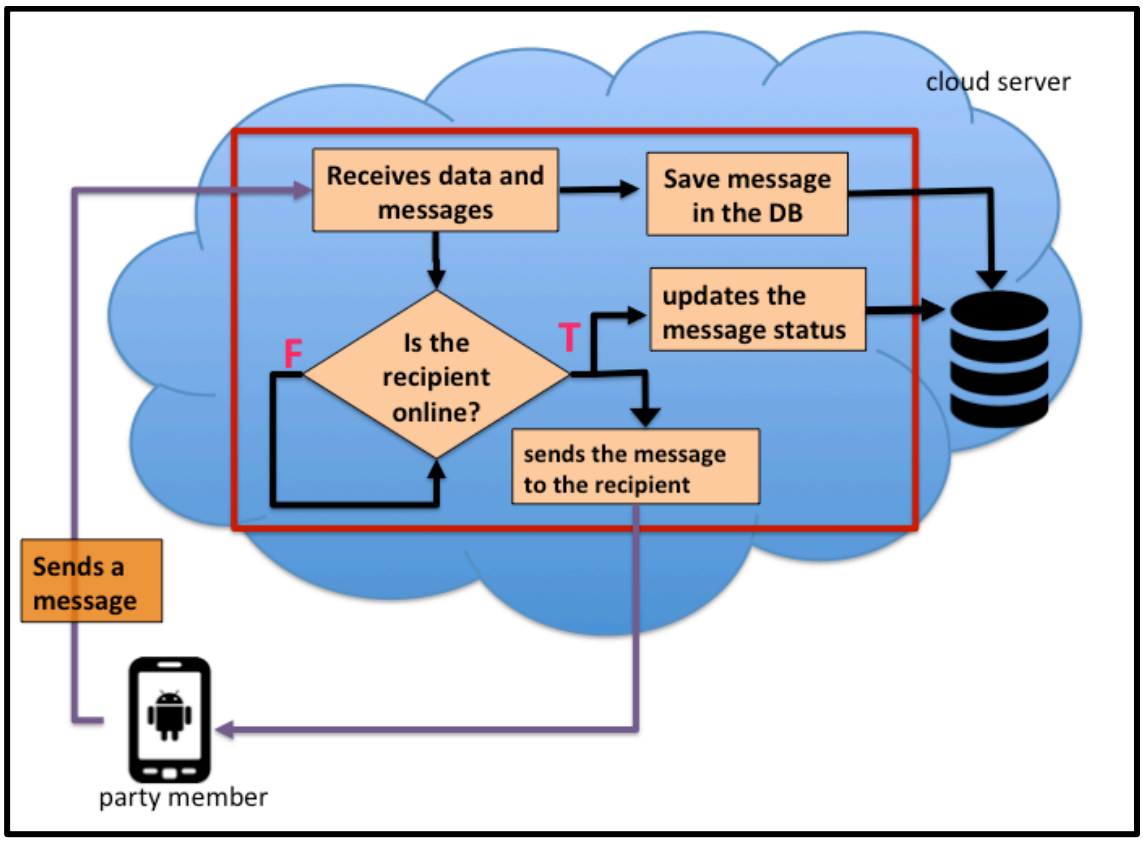

Figure 4.2 Conceptual Flow of the IM Module

When a party member sends a message to the party, the cloud server saves the message and date and time sent into the database. The server will then check if the recipients are online or not. If the party member is online the server will then send the message to the party member and update the status of the message sent.

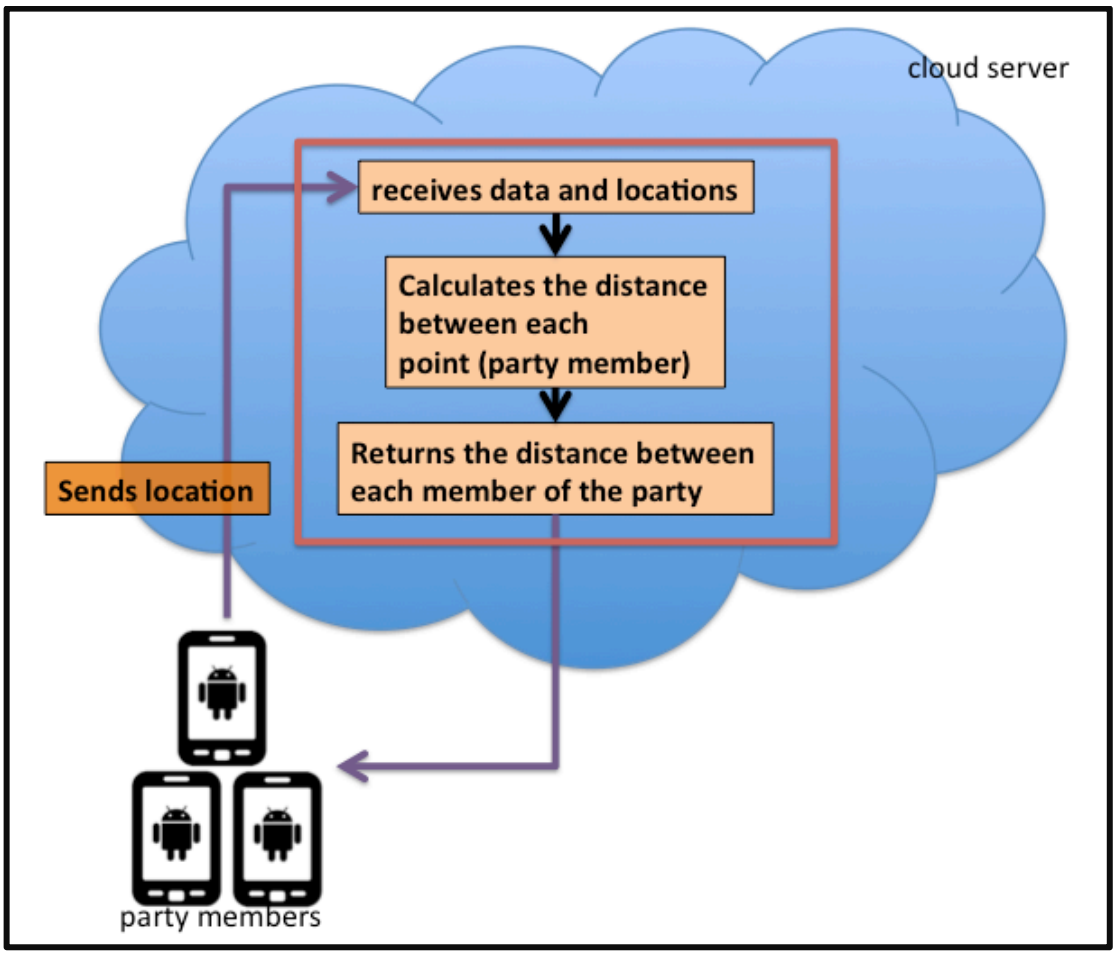

Figure 4.3 Conceptual Flow of the Distance Calculator Module

The server will collect each of the party member's location and save them to the database. The server will then calculate the distance between a pair of members. The calculated distance will then be sent to the party members.

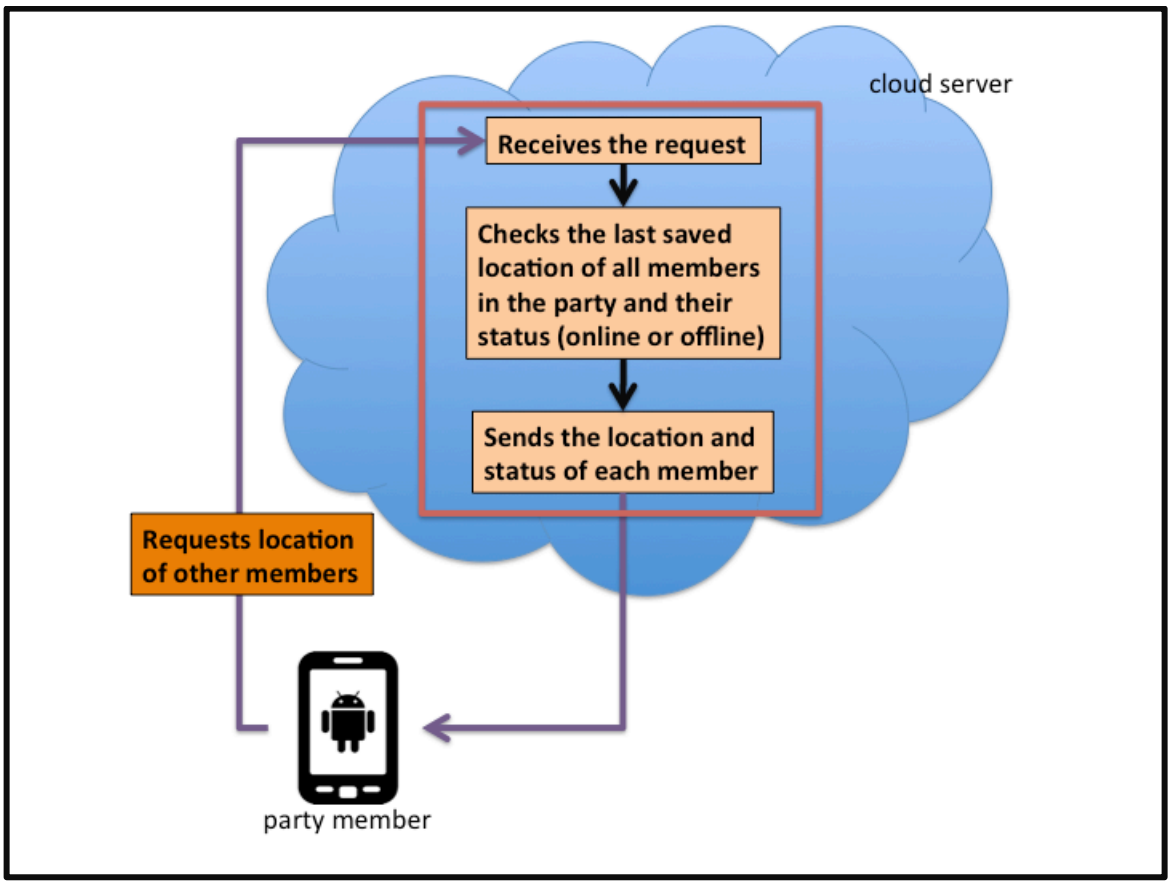

Figure 4.4 Conceptual Flow of the Tracking Module

A party member's smartphone will request for the location of all the members in the party. The cloud server will retrieve the last saved location and status (online or offline) of the party members. The server will then send the location and status of each member.

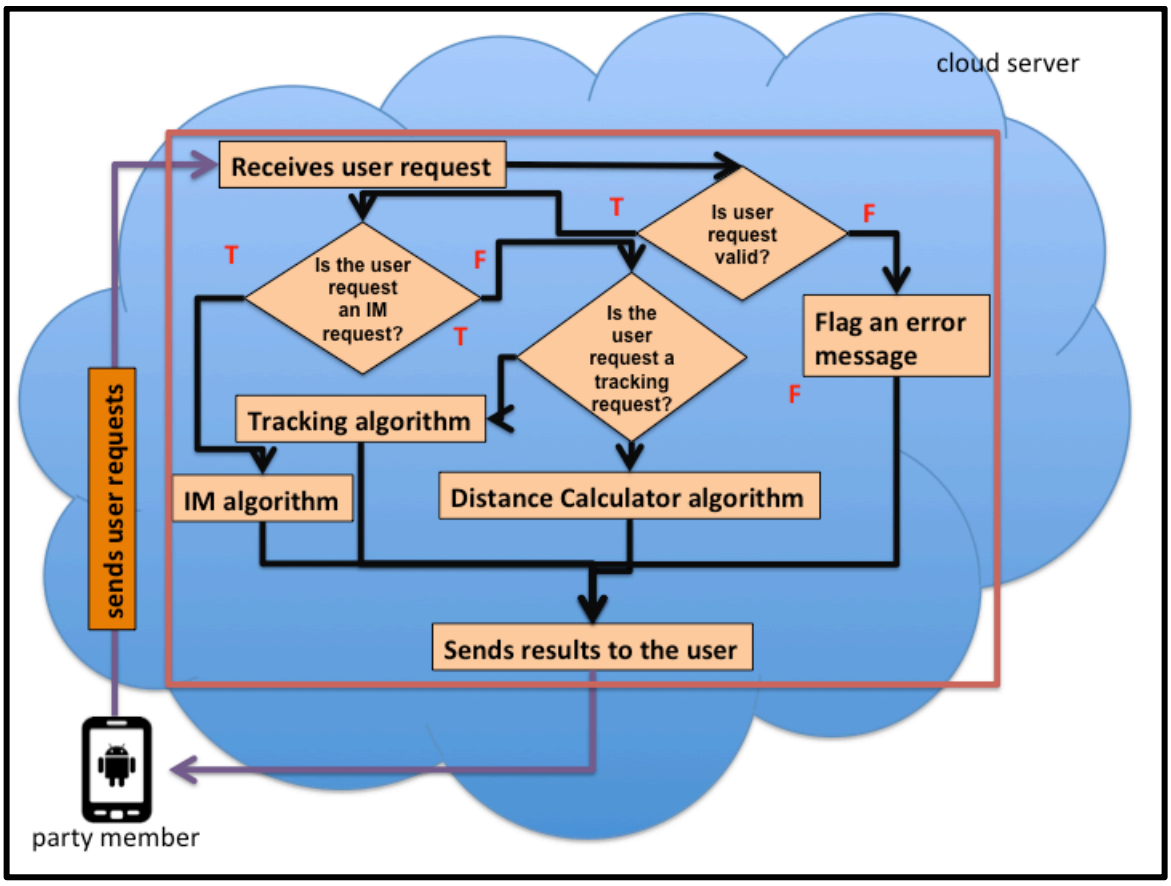

Figure 4.5 Conceptual Flow of the Integrated Modules

The system will be comprised of the different modules. The server will check the kind of user request that was sent by the party members. After checking, the server will then execute the respective algorithm of the request.

4.2 Analysis and Design

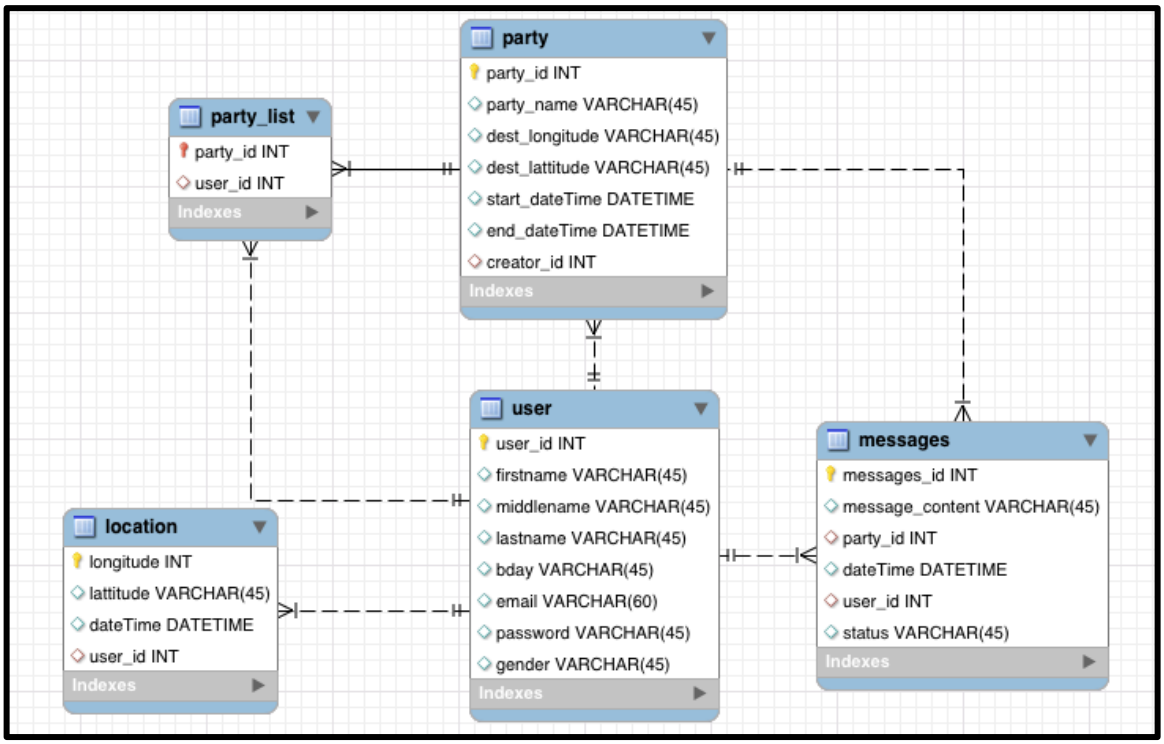

Figure 4.6 Basic ERD

The user table will contain all the party member's details. The party table will contain all the details related to each party. The message table will contain the details of the message sent by every party member. The location table will store all the locations of the members and its corresponding date and time of saving.

4.3 Development Model

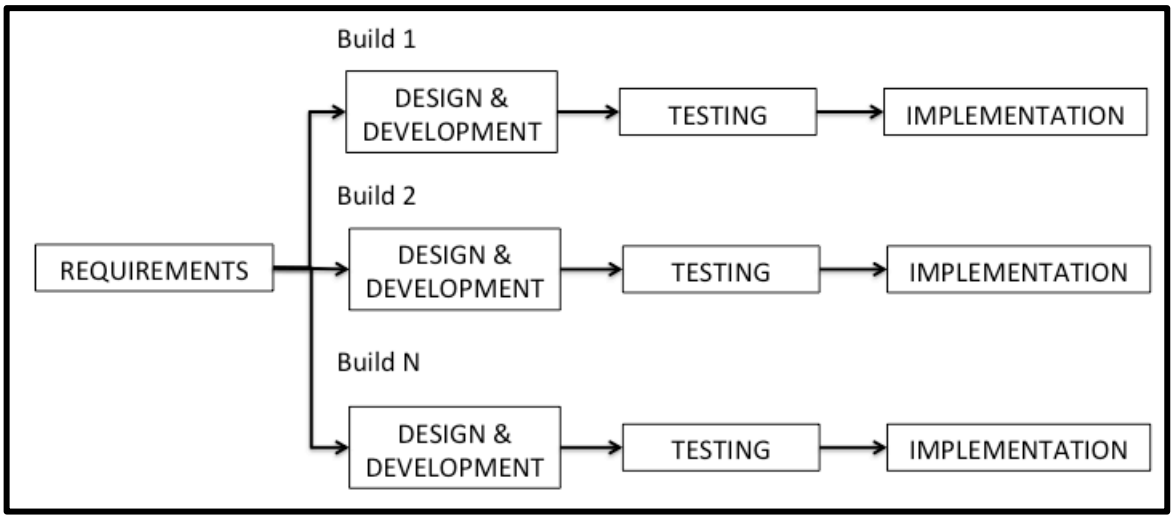

Figure 4.7 Incremental Prototyping

4.4 Development Approaches

Bottom – up approach is the kind of approach where members also have a voice in the decision-making. In this study, both proponents will be equally deciding for the outcome of this study.

4.5 Software Development Tools

Table 4.1 Software Development Tools

Software	Version	Source	Use
Android Studio	1.2	http://developer.android.com/	To develop and simulate the application before deployment
Android Software Development Kit (SDK)	24.0.2	http://developer.android.com/	To create the Android application
Java Development Kit (JDK)	8	http://www.oracle.com/	To run the Java code
Adobe Photoshop	14	http://www.adobe.com/	To make the UI components

Android Studio is an Integrated Development Environment (IDE) used in developing Android applications. It is a free software under the Apache License 2.0. It is compatible in Windows, Mac, and Linux.

Android Software Development Kit is a development kit used in creating Android applications. It is the most widely used platform by mobile developers.

Adobe Photoshop is a software used to create or manipulate images. It is a licensed software. It is a cross – platform software.

Java Development Kit is needed to develop the system. It is a free software under the Sun License.

4.6 Project Management

Schedule and Timeline

Table 4.2 WBS

Task	Hours
Learning period	42
Develop the interactive and real-time map module	16
Test and debug the interactive and real-time map module	12
Document the process and results	8
Develop the shortest path and distance calculator module	20
Test and debug the shortest path calculator module	16
Document the process and results	8
Develop the party management module	16
Test and debug the party management module	12
Document the process and results	8
Develop the customizable instant messaging module	16
Test and debug the customizable instant messaging module	12
Document the process and results	8
Develop the historical data module	16
Test and debug the historical data module	12
Document the process and results	8
Integrate the modules to create the system	20
Testing and debugging	16
Polishing of thesis documents	12

Responsibilities

Table 4.3 Responsibilities

Task	Proponent 1	Proponent 2
Development testing and documentation of the interactive and real - time tracking map	X	
Development, testing and documentation of the shortest path and distance calculator module		X
Development, testing and documentation of the party management module	X	
Documentation of the distance calculator module		X
Development, testing and documentationof the customizable instant messaging module	X	
Development, testing and documentation of the historical data module		X
Integration of the modules to create the system	X	X
Testing and Debugging the system	X	X
Finalization of Thesis Document	X	X

Budget and Cost Management

Table 4.4 Summary of Proposed Expenses

Cost description	Cost
Android Smartphones (at least 3)	₱10,000.00
Printing and Binding of Final Document	₱2,000.00
Miscellaneous	₱400.00
Cloud Server	₱5,000.00
Contingency Cost	₱1,000.00
Total	**₱18,400.00**

4.7 Verification, Validation and Testing

The proponents will constantly keep in touch and meet regularly to deliberate on what has been done and check whether the development is making progress. The proponents will use the Trello application for project management and to track the progress of the development.

At least three Android Smartphones will be used to test the system. The testing will only be done in the Cebu City area. The first test case will be creating a party and inviting a members. This test case will involve making a party name, destination, start date and time and a end date and time. The second test case will be tracking the location of the party members and getting the shortest path to the destination using Dijkstra's algorithm. There will be 2 – 3 party members in the event and they will be positioned in different places. The third test case will be the message sending and receiving test. Members of the same party will be simultaneously sending messages to the party.

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APENDICES

APPENDIX A SOFTWARE REQUIREMENTS SPECIFICATION (SRS)

SCOPE

The system will only get the real – time location of a party member when he/she is online. If the party member is offline the last saved location will be retrieved and displayed along with an offline status. A shortest possible route to the destination will be suggested by the system using the Dijkstra's Algorithm. It will be able to display the distance between the party member and the destination. The distance between members in the party will also be displayed.

In Instant Messaging, the system will have default messages and user – defined messages. The messages that can be sent from a party member to the party will only be the pre – made messages. The system will also save historical data of the previous events. The system will not be able to optimize the power consumption.

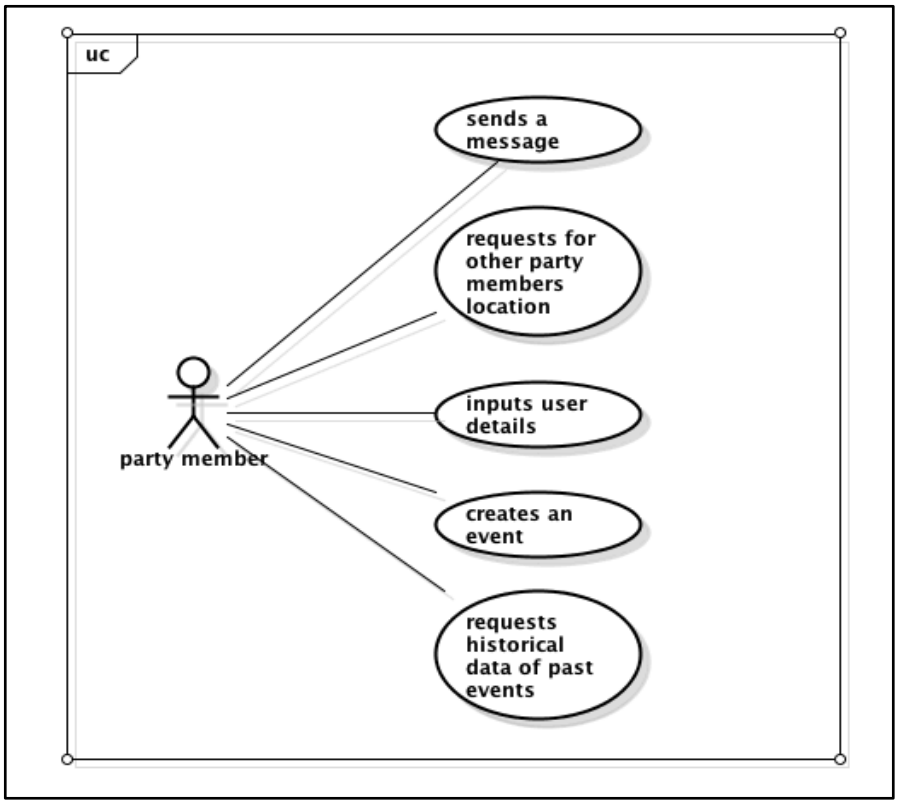
PRODUCT PERSPECTIVE

The system will be an application on an Android platform. It will need an Android device that has WIFI or Cellular Data connectivity and GPS capability. The Android device will be used to gather the necessary information that will be sent to the server. The user is responsible in launching the application and inputting the necessary data. The system will be unable to perform in case of hardware malfunctions.

ASSUMPTIONS & DEPENDECIES

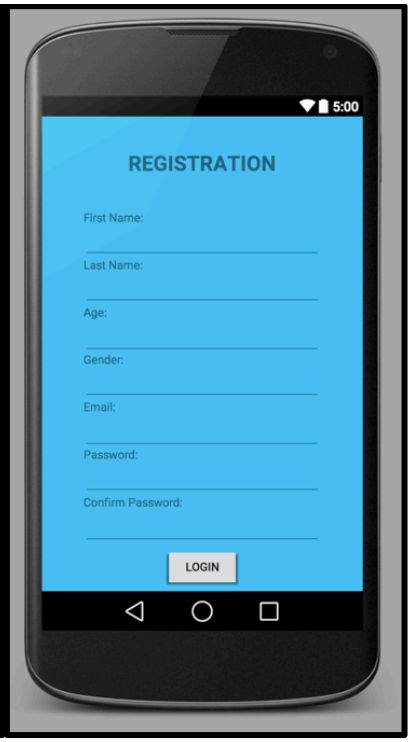
The hardware and software to be used in this research will be depend on the availability of the software or the resource.

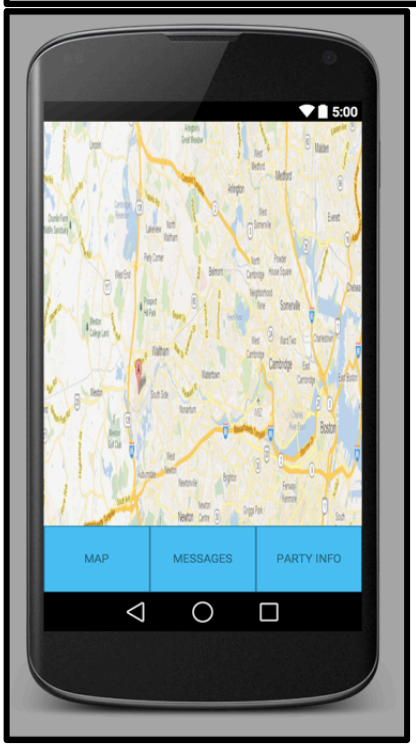
USER CHARACTERISTIC



MOCK UI


5:00
APP NAME AND LOGO
Username:
Password:
LOGIN


5:00
REGISTRATION
First Name:
Last Name:
Age:
Gender:
Email:
Password:
Confirm Password:
LOGIN


5:00
MAP
MESSAGES
PARTY INFO

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Secondary Level (2008 - 2012)

Saint Benedict Childhood Education Centre

Primary Level (2003 - 2008)

TECHNICAL SKILLS

C Programmer

Java Programmer

Basic Android Programming

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Bario Luz Elementary School

Primary Level (2003 – 2008)

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C Programmer

Basic Web Development