Mobile Emergency Notification System Based on Geographical Information System

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Abstract - Unpleasant situations such as fire outbreaks, road accidents, and various forms of security threats are highly unpredictable and thus could happen anytime and anywhere. This has brought about the creation of various agencies by the governments or organizations to respond and combat such emergencies on time. Inaccurate communication of a distress call to the corresponding agency could hinder or sabotage the work of these agencies thereby leading to further damage or loss of lives. There is the need to develop an android mobile Emergency Notification System to effectively and accurately communicate with the corresponding agencies during unpleasant situations. The system was developed using android studio and SQLite database. Three emergency response management agencies – Hospitals, Security, and Fire Station were incorporated into the prototype system. However, sending distress calls without mobile data will be a good modification to this work.

Keywords - Emergency Notification System, Geographical Information System, Global Positioning System, Mobile Notification System.

I. INTRODUCTION

We move about our daily activities with lots of uncertainties. Inferno of varying degrees, road accidents, and various forms of security threats are common emergencies that occur in almost any part of the world. Trying to call toll free or emergency lines of corresponding agencies responsible for emergencies might prove abortive not because of network issues but at times due to lack of proper communication during unpleasant incidence such as the timely and accurate location of the incidence. These most times misguide the agencies while trying to salvage the situation. An Emergency Notification System (ENS) is a method of broadcasting messages to one or numerous gathering of individuals cautioning them on a pending or existing crisis.

Geographical Information System (GIS) can be defined as a type of information system developed to store, capture, and display geographical information [1]. It helps to capture, store, check, and display data related to various positions on the earth's surface. One's location can be expressed as latitude and longitude, regular address, or a zip code [2]. Overtime, GIS has been attached to various operations and numerous applications spanning the

engineering, management, logistic, telecommunication industry, and so on [3]. Emergency management involves five phases which include mitigation, preparation, communication, response, and recovery [4]. This research work focuses on the communication phase which involves the dissemination of accurate and timely information to the right authorities through which could be achieved through a one-click.

In recent times, applications for mobile devices especially smartphones have been designed to improve the quality of living and also to make life easier. Communication of accurate and timely information during unpleasant incidents is very crucial to both the service agents and the victim since the most crucial activity of a disaster is to deliver help to the victim. Hence, there is a need to effectively handle the communication process through the development of a mobile application that sends distress signals alongside the accurate and real-time location of incidence to the corresponding agencies through the help of the GIS technology. To effectively achieve this, SQLite was used to develop the database to track, store, and ease future retrievals of records. An android application was developed with the help of the android studio to send timely and accurate information. Only three emergency management agencies – Hospitals, Security, and Fire Station were incorporated into the prototype system. More emergency response units as so desired by the adopting state or community can be incorporated. The development of this research work will reduce the destruction of lives and properties during an emergency and unpleasant situation because the emergency response team can adequately locate and track scene of incidence.

II. LITERATURE REVIEW

Emergency System is the collection of components that work together to add in the management of emergency within the society. Emergency response can be defined as the services carried out by emergency agencies, it refers to the action that is taken to respond to a sudden and life-threatening incidence in other to remove or reduce the impact on the people in such a situation. The One-Click Notification application is an illustration of a technique for clicking one button inside a mobile application or crisis

warning stage to start the spread of a message. Emergency management aims to ensure the protection from all hazardous occurrences for the individuals, properties, and government organizations in the environment [5]. The major phases of Emergency Management are:

1. **Mitigation Phase:** The mitigation phase is in charge of the prevention of future emergencies and reducing their effects. It also involves any activities that will prevent and decrease the chances of an emergency occurring.

2. **PreparednessPhase:**This phase handles emergencies, it includes the plans and preparation made to minimize loss of lives and to help respond to these occurrences.

3. **Response Phase:** Quick and fast response to an emergency is basically what this phase is all about.

4. **Recovery Phase:** This entails the things to be done after an emergency has occurred.

Notification systems are an attempt to send important and current information to the due location effectively and efficiently. The use of notification systems includes the obtainability of important information rapidly to the rightful area at a particular time [6]. The first GIS was introduced by Roger Tomlinson in the early 1960s [7]. GIS is perceived as a basic device in the readiness for, reaction to, and recuperation from calamities and crisis occasions. It is an automated mapping innovation that takes into account the show and investigation of the general surroundings by showing a guide in form of a Common Operating Picture so crisis responders know about the extent of the catastrophe, where imperative regions of concern are, the place activities are situated and also giving harm appraisal data and the area and status of Critical Infrastructure.

Review of Related Works

Lots of research have been conducted relating to emergency management in general, but few have implemented the uses of GIS-based on emergency management.

[8] Designed an ambulance management system using a geographical information system. The area in question is Hyderabad, which is one of the largest cities in India. The objective of the system was to helps hasten the process of emergency response by aiding the ambulance to reach its destination without any delay due to congestion on the road network. One of the most important actors in emergency response is the ambulance as it plays a major role in the hastened recovery of the accident victims. A GIS/GPS/GSM based prototype system was designed for routing ambulances on road networks. The prototype was designed such that it finds the accident location on the road network and locates the nearest ambulance to the incident point using real-time technologies (GPS and GSM). The researcher achieved this using the ArcGIS version 9.1, Arc GIS extension network analyst, and Visual Basic 6.0 programming language. The Design of a fire emergency management system using GIS was further developed by [9], the research focused on Joshua Tree National Park in California where a fire outbreak lasted for hours before a service agency responded to the emergency. The goal was designed to help National park fire station to assess fire incidents by developing a web-based application to assist them with rapid response to fire incidents using GIS and to reduce the response time for fire emergencies. Spiral development which combines the features of prototyping and waterfall model, the model also facilitates a high level of risk analysis, ArcGIS 9.3.1 was used to program sequence algorithms while the Flex API was adopted in the development of the web application.

[10] designed an emergency response management and information system using a geographical information system. In this article, the problem addressed was the lack of efficient transportation of the patient to the hospital during emergencies. Data were taken from different sources, such as a survey of India, corporation of Madurai, station wise fire accident records for the years 2004 to 2008, office of the divisional fire office, and Madurai office of the police commissioner. This research study aimed to develop an emergency response management based on a geographical information system to improve the response time and the fastest route to the appropriate hospital. The proposed system was developed using VB.Net programming. The system is not easily accessible to users because it was not designed for mobile devices. [11] designed a geographical information system based on fire emergency response for the Ghana National Fire Service (GNFS). The objective was to develop a system that helps the GNFS track the optimal route from their respective location to the fire incident to the nearest healthcenter. The proposed system was designed by using the introduced Topographical region digitized map with data capture and processing. The gap of this system is that it is restricted to only fire incidents.

From the reviewed literature, the researchers came up with ways to accurately track scenes of accidents as well as other emergencies and also accessing the scene through the fastest route. However, the proposed solutions were tailored to a particular form of emergencies (fire, road accident and so on), also the solutions were designed for a particular district, state or country which is not suitable and adoptable in other countries or area and above all the solutions are not mobile-friendly. It is therefore evident that there is the need to develop a universal emergency notification system where communication and distress

signals can be sent with just a button in case the victim is   under duress or a life-threatening situation.

III.   PROPOSED METHODOLOGY

Fig. 1 shows a summary of the methodology of the ENS based on GIS technology as adapted from [8].
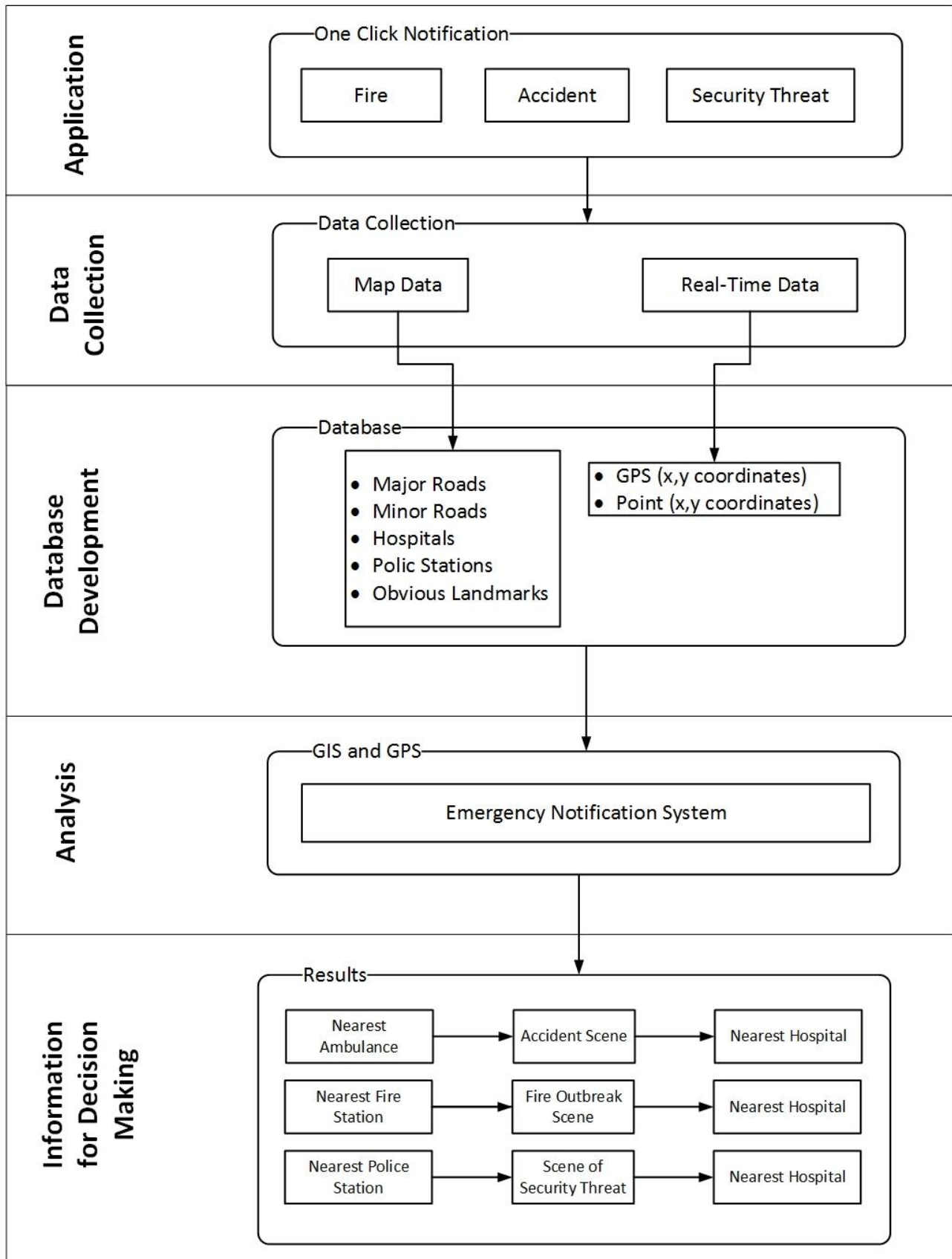

Fig.1. Methodology for Mobile Emergency Notification System

Application

The application is android based that can be installed on android smart devices. upon installation, the user registers by entering the location such as an address, state, and country. The application allows the user to send a distress call when the is a fire outbreak, road accident, or security threats such as a robbery attack, kidnapping, and so on.

Data Collection

The ENS receives data from three sources which are:

i. **Map Data:** This shows the major roads, minor roads, fire stations, hospitals, police stations, and other obvious landmarks. This data can be gotten from GIS professionals of the adopting region or states.

ii. **Real-Time Data:** This shows the real-time location of the scene from where the distress call was made. Real-Time Data: This shows the real-time location of the scene from where the distress call was made.

Database Development

Apart from the GIS database, an SQLite database was designed to store the GPS location of the scene of event as x-coordinate and y-coordinate. Also, the real-time location of the corresponding emergency response team is stored as point (x-coordinate and y-coordinate). This will help determine the response time.

Analysis

The management of the ENS for a particular region or state will receive the distress call along with the details such as the real-time data, analyze the distress call to check and stop false alerts and send it to the respective emergency agency. Any form of communication can be adopted by each region or state depending on what is obtainable.

Information for Decision Making

Upon passing the information to the nearest relevant agencies, an informed decision can be made as regards the fastest route to take to the scene of incidence or the nearest hospital as the case may be.

IV.   ENS ARCHITECTURE

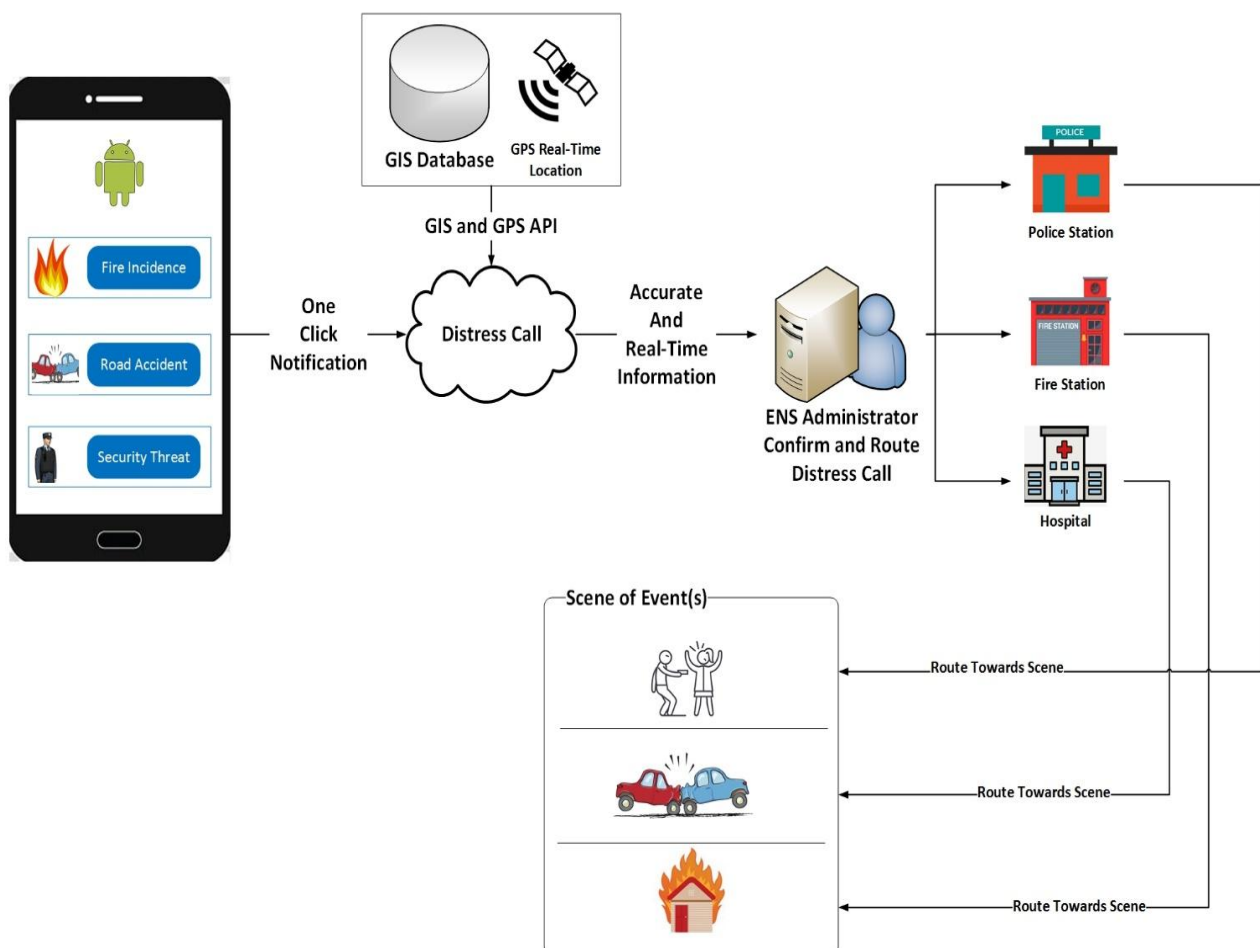Fig. 2 shows the android based ENS Framework.

Fig. 2. Mobile Emergency Notification System (ENS) Architecture

Graphical User Interface of the Prototype System

The implemented system consists of the user module which shows the layout in which the user can login, register, update, and the homepage of the implemented system. The login interface accepts the registered email and password of the user as shown in figure 3, the registration interface allows new users to get enrolled into the database by accepting their name, email, mobile number, password as shown in figure 4. The home page is where users can click to send a distress call to any of the available emergency response teams as depicted in figure 5. The emergency response service agents' module is web-based such that service agents will be able to login to the application, view users, and view distress calls in the form of notifications. Lastly, the Administrator module enables the Admin to view emergency distress calls, view registered users, view and add emergency units.
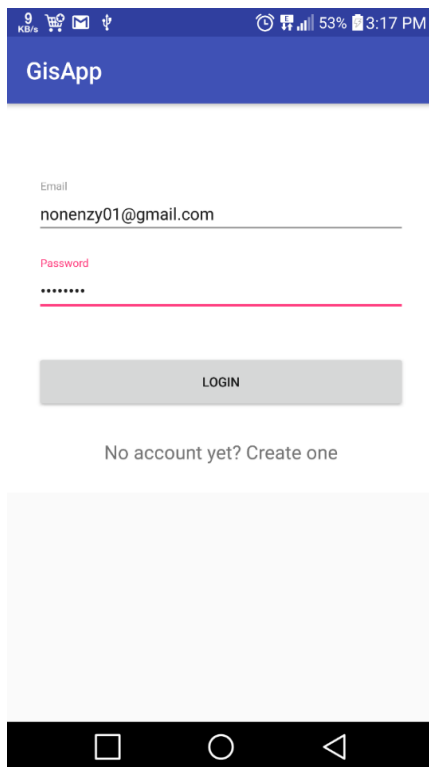

Fig. 3. User Login Interface

In this section author need to describe experimental/simulation results with graphs and appropriate tables.

V. CONCLUSION

This project achieved the development of an emergency notification system based on geographical information systems. The Emergency Notification System (ENS) is developed and implemented through the analysis of information. With the use of ENS, it is easier for the victim or eyewitness to call for help. The project Authors thought

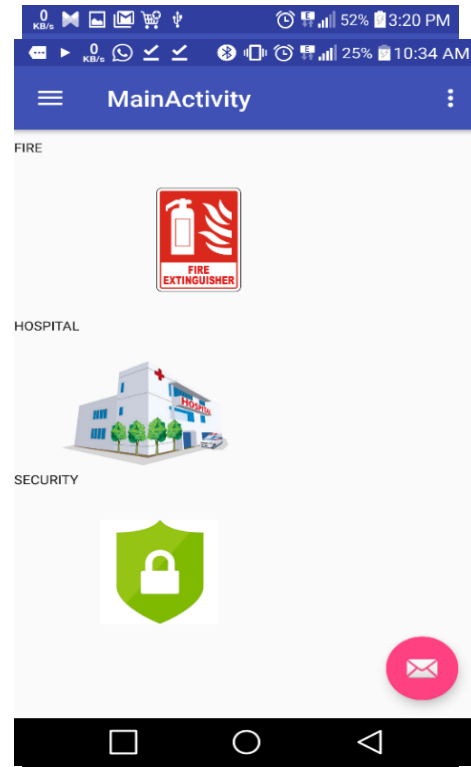Fig. 4. User Registration Interface

Fig. 5. User Home page To Trigger Distress Call

to make this system simple, efficient, and available to everyone every hour of the day as long as the mobile device is left on. This can be embraced by any region, state, or organization as it will go a long way in reducing the level of damage in the cause of unpleasant situations.

VI. FUTURE SCOPES

The ability to send distress calls without mobile data will be a good modification to this work.

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