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RescueMe: Self Rescue Application Using Smartphone

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Abstract: ***Recent ubiquitous earthquakes have been leading to mass destruction of electrical power and cellular infrastructures, and deprive the innocent lives across the world. Due to the wide-area earthquake disaster, unavailable power and communication infrastructure, limited man-power and resources, traditional rescue operations and equipment are inefficient and time-consuming, leading to the golden hours missed. With the increasing proliferation of powerful wireless devices, like smartphones, it can be assumed to be abundantly available among the disaster victims and can act as valuable resources to coordinate disaster rescue operations. A smartphone-based self-rescue system also referred to as RescueMe, to assist the operations of disaster rescue and relief. RescueMe is that a set of smart phones carries by survivors trapped or buried under the collapsed infrastructure forms into a one-hop network and sends out distress signal in an energy-efficient manner to nearby rescue crews to assist rescue operation. The location and alert message is sent to the rescue crew.***

Keywords: RescueMe, survivors trapped, smartphone, innocent lives

1. Introduction

Unexpected natural disasters such as tornadoes, earthquakes, hurricanes, and tsunamis have been rising dramatically in recent years. In particular, earthquakes tremendously kill innocent lives and damage the environment around the globe, and the epicenter of an earthquake can occur anywhere and now no place would be safe from ubiquitous earthquakes. For example, as reported by Ansari (2016) a 5.6-magnitude earthquake struck Oklahoma and impacted six neighboring states in the U. S. on September 04, 2016. As reported by Karimi and Ansari (2016) the Ecuador earthquake (April 16, 2016) left a 272 death toll and more than 2, 500 injured. An earthquake often happens in a flash but has the potential to massively destruct the infrastructures, buildings, and homes in a short period of time. After the disaster, it was impossible for disaster victims to utilize their communication devices, such as smartphone, tablet, or laptop, to notify their families and friends of their safety and confirm the safety of their loved ones since the communication infrastructures were physically damaged or lacked the energy necessary to operate. More importantly, since many people could be trapped beneath the rubble and brick, the victims may have a large chance to survive if they are located and rescued within “Golden 72 Hours. ” If a severely injured person does not receive care or medical treatment quickly, the probability of survival rapidly decreases. Thus, in order to minimize casualties and save innocent lives across the world, it is essential to plan and conduct expedited disaster rescue operations. When an earthquake occurs, the rescue teams or planners of disaster rescue and relief mainly suffer from the following issues. First, since the current disaster situation of sudden earthquake may not be available, it is difficult to make a plan or decision on the priority of rescue operations in terms of the focused rescue areas, the distribution of rescue teams, or the allocation of equipment. Second, the impact areas are admittedly wide, ranging from a few miles to several U. S. states, but the number of rescue teams and man-power are very limited in reality. Third, due to the collapse of power and communication infrastructure, the impacted areas become a black spot where Wi-Fi and 4G-LTE services are not available and the affected area is cut off from the outside. Last but not least, most rescue teams still heavily rely on the traditional operations and equipment, such as detection dogs, video cameras, or sound sensors. In summary, the traditional rescue operations and equipment are inefficient and time-consuming, leading to the golden hour missed.

2. Literature Survey

2.1 C. PU, “Evacuation Assisting Strategies in Vehicular Ad-Hoc Networks” in IEEE Proc. UEMCON, November 2018

Recent natural and man-made disasters such as Sandy (2012) and Fukushima nuclear power plant (2011) make efficient evacuation route planning and routing more important than ever. Conventional sign-based evacuation route and its information are limited to use in a life-threatening environment. First investigate a least travel time based shortest path approach to minimize the evacuation time in a Vehicular Ad hoc Network (VANET). Since the travel time changes in the presence of time-varying traffic congestion, frequent and timely updates of the shortest path during the evacuation period are essential. Also investigate an evacuation assistant VANET to efficiently update the shortest path on wheel by using Vehicle-to-Infrastructure (V2I) and Vehicle-to-Vehicle (V2V) communications. Propose evacuation assisting schemes, V2RSU and V2RSU+V2V. Also implement the shortest path based schemes to work in VANETs, Lower bound and W/O Update. The performance of four schemes as a function of the number of congestions, sources, destinations, and vehicles and different network sizes. The simulation results indicate that the proposed schemes integrated with a VANET can reduce the evacuation time significantly.

2.2 Nishiyama, H., Ito, M., & Kato, N. (2014). Relay-by-smartphone: realizing multihop device-to device

communications. IEEE Communications Magazine, 52 (4), 56-65.

The Great East Japan Earthquake and Tsunami drastically changed Japanese society, and the requirement for ICT was completely redefined. After the disaster, it was impossible for disaster victims to utilize their communication devices, such as cellular phones, tablet computers, or laptop computers, to notify their families and friends of their safety and confirm the safety of their loved ones since the communication infrastructures were physically damaged or lacked the energy necessary to operate. To realize the importance of device-to-device communications. With the recent increase in popularity of D2D communications, many research works are focusing their attention on a centralized network operated by network operators and neglect the importance of decentralized infrastructureless multihop communication, which is essential for disaster relief applications. The concept of multihop D2D communication network systems that are applicable to many different wireless technologies, and clarify requirements along with introducing open issues in such systems. The first generation prototype of relay by smartphone can deliver messages using only users' mobile devices, allowing us to send out emergency messages from disconnected areas as well as information sharing among people gathered in evacuation centers. The success of field experiments demonstrates steady advancement toward realizing user-driven networking powered by communication devices independent of operator networks.

2.3 Raj, M., Kant, K., & Das, S. K. (2014, August). E-darwin: Energy aware disaster recovery network using WiFi tethering. In Computer Communication and Networks (ICCCN), 2014 23rd International Conference on (pp.1-8). IEEE.

To propose a novel architecture called Energy Aware Disaster Recovery Network using Wi-Fi Tethering (E-DARWIN). The underlying idea is to make use of WiFi Tethering technology ubiquitously available on wireless devices, like smartphones and tablets, to set up an ad hoc network for data collection in disaster scenarios. To this end, design novel mechanisms, which aid in autonomous creation of the ad hoc network, distribution of data capturing task among the devices, and collection of data with minimum delay. Specifically, design and implement a distributed coalition formation game for distributing the data capturing task among wireless devices based on their capabilities, available energy, and network participation for higher network lifetime. Finally, evaluate the performance of the proposed architecture using a prototype application implemented on Android platform and large-scale simulations.

2.4 Ray, S. K., Sinha, R., & Ray, S. K. (2015, June). A smartphone-based post-disaster management mechanism using WiFi tethering. In Industrial Electronics and Applications (ICIEA), 2015 IEEE 10th Conference on (pp.966-971). IEEE.

Natural disasters often cause the breakdown of the power grid in the affected areas hampering telecommunication services. In the absence of electrical power undamaged cellular base stations switch to battle") backup to sustain communication. However, owing to the sudden substantial increase in voice and data traffic, base stations become over-congested fast and batter) backups quickly get exhausted. Propose a smartphone-based post-disaster management mechanism for managing traffic in the affected areas using the concept of WiFi tethering. Smart phones in the affected areas may turn themselves into temporary WiFi hotspots to provide internet connectivity and important communication abilities to nearby WiFi-enabled user devices. The hotspots can self-assess the number of new connections they can serve based on their leftover battery energy. Client devices approaching the affected areas, can also self-select the most suitable hotspot to connect to depending on their proximity and nature of motion with respect to individual hotspots. Long Term Evolution Advanced (LTE-A) underlying networks are considered for this work.

2.5 Luo, Y., Liu, J., Gao, Y., & Lu, Z. (2014, December). Smartphone-controlled robot snake for urban search and rescue. In International Conference on Intelligent Robotics and Applications (pp.352-363). Springer, Cham.

Search and rescue robots would benefit from versatile locomotion ability and hence cope with varying environments. Robot snakes, with hyper-redundant body and unique gaits, offer a promising solution to search and rescue applications. This paper presents a portable design of robot snakes that can be controlled from commercial mobile devices like the smartphones. The control results are validated and demonstrated using hardware prototypes.

3. System Analysis

A detailed appraisal of the existing system is explained. This appraisal includes how the system works and what it does. It also includes finding out in more detail-what are the problems with the system and what user requires from the new system or any new change in system. The output of this phase results in the detail model of the system. The model describes the system functions and data and system information flow. The phase also contains the detail set of user requirements and these requirements are used to set objectives for the new system.

3.1 Existing System

In the existing system, the application is developed a mechanism to enable the device to discover their neighbors autonomously and transmit data of disaster-affected area by different network to WiFi access points using a smartphone-based WiFi tethering technique. It will send information only through network using in smartphones. To set up an ad hoc network for data collection in disaster scenarios. The monitoring is done by fixing tags in different location for identifying the exact position. The android terminal is connected to Bluetooth and wireless LAN and it is limited to shorter distance. The proposed system has no boundary limits. The communication link to the management server is managed by wireless LAN which is relatively slow when compared to the 3G network. The network is more complex and it is not reliable. The message is transferred through wireless LAN and it is not secure.

3.1.1 Disadvantages

- Here the message or information data can be transferred only when the network is on use.
- The computational cost is very high.
- It leads to higher complexity.

3.2 Proposed System

A smartphone-based self-rescue system, also referred to as RescueMe, to assist the operations of disaster rescue and relief in the disaster area. Different functions have been implemented for the new generation monitoring system such as telephone manager to track outgoing call and SMS. Android mobile terminal is connected to high speed 4G network for effective data transfer. Monitoring can be made at a very high speed without any distortion in the network. This proposed system makes use of the cloud technology to store and retrieve telephony information using SOAP protocol. Global Positioning System, shortly known as GPS System, is the system that enables you to know the location of the victim. In this application, survivors can share their location, send alert message to the persons they want and also predicts pedometer count. This information can transfer only after the mobile get shake for mean time.

3.2.1 Advantages

- It is user friendly.
- It can transfer data on a time to multiple members.
- This application computational cost is low and it provides service efficiently.
- It took less processing time because of wireless LAN connection.
- GPS cover all the locations.

4. System Design

4.1 System Architecture

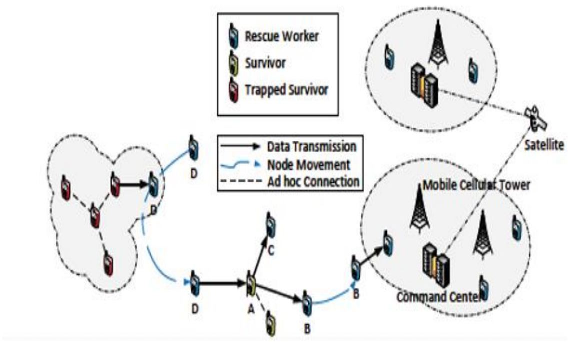

Figure 4.1.1: Data Transmission

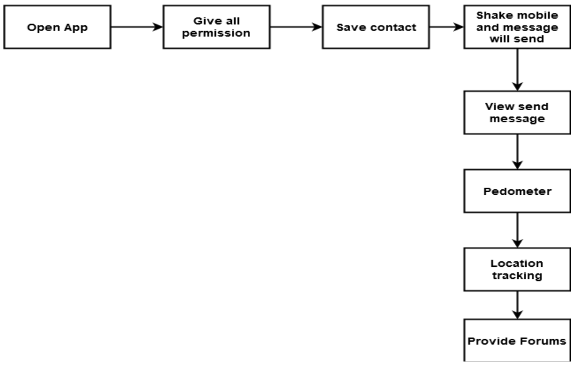

Figure 4.1.2: Data Movements

4.2 UML Diagram

4.2.1 Use Case Diagram

Use case diagrams model behavior within a system and helps the developers understand of what the user require. The stick man represents what's called an actor. Use case diagram can be useful for getting an overall view of the system and clarifying that can do and more importantly what they can't do. Use case diagram consists of use cases and actors and shows the interaction between the use case and actors.

- The purpose is to show the interactions between the use case and actor.
- To represent the system requirements from user's perspective.
- An actor could be the end-user of the system or an external system.

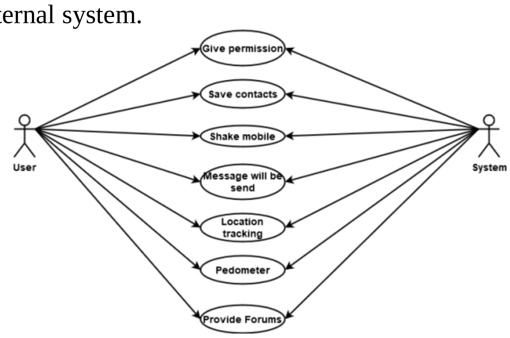

Figure 4.2.1: Use Case Diagram

4.2.2 Class Diagram

- Class is nothing but a structure that contains both variables and methods. The Class Diagram shows a set of classes, interfaces, and collaborations and their relating ships. There is most common diagram in modeling the object oriented systems and are used to give the static view of a system. It shows the dependency between the classes that can be used in our system.
- The interactions between the modules or classes of our projects are shown below. Each block contains Class Name, Variables and Methods.

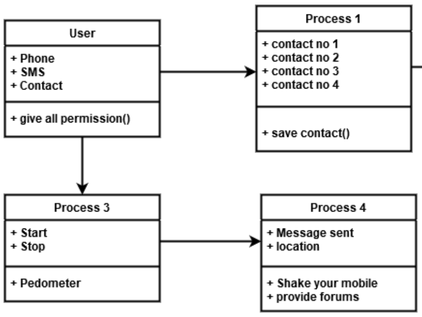

Figure 4.2.2: Class Diagram

4.2.3 Activity Diagram

Activity diagrams are graphical representations of workflows of stepwise activities and actions with support for choice, iteration and concurrency. In the Unified Modeling Language, activity diagrams can be used to describe the business and operational step-by-step workflows of components in a system. An activity diagram shows the overall flow of control.

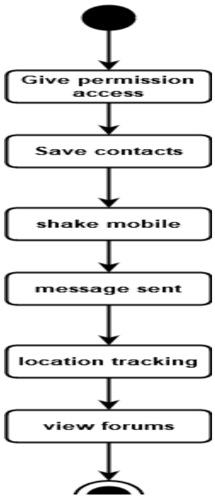

Figure 4.2.3: Activity Diagram

5. System Implementation

Implementation is the stage of the project when the theoretical design is turned out into a working system. Thus it can be considered to be the most critical stage in achieving a successful new system and in giving the user, confidence that the new system will work and be effective. The implementation stage involves careful planning, investigation of the existing system and it's constraints on implementation, designing of methods to achieve changeover and evaluation of changeover methods.

5.1 System Modules

A module is a part of a program. Programs are composed of one or more independently developed modules that are not combined until the program is linked. A single module can contain one or several routines.

The modules are
1) Messaging System
2) Self-Rescue System
3) Add Contact Module
4) SMS alert Module
5) GPS Module
6) Pedometer Module

5.2 Modules Description

5.2.1 Messaging System

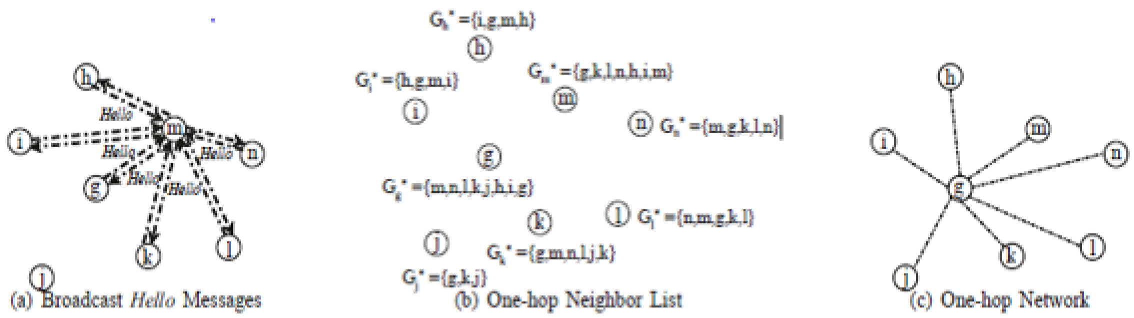

Figure 5.2.1: One-hop Network

- The three ways of message transmissions: through cellular connections, by ad-hoc communications and upon opportunistic contacts.
- First, each node broadcasts a one-time *Hello* message piggybacked with its node id, overhears *Hello* messages broadcasted by other nodes, and then build the one-hop neighbor list G^* .
- For example, nm broadcasts a *Hello* message, and overhears the *Hello* messages broadcasted by its adjacent nodes (e. g., nh, ni, ng, nk, nl, and nn).
- As a result, nm can build its one-hop neighbor list, $G^*_m = \{h, i, g, k, l, n\}$
- By using the same technique, other nodes also can build their one-hop neighbor list.
- In our project, each node also considers itself as a one-hop neighbor node and adds its id in the one-hop neighbor list. Thus, $G^*_m = \{h, i, g, k, l, n, m\}$.
- Each node then exchanges its one-hop neighbor list G^* with adjacent nodes, and identifies the *center node* who has the largest number of neighbor nodes and the G^* of

all other nodes is a subset of the center node's one-hop neighbor list.

- Then the center node builds a one-hop network, where every other node can directly communicate with the center node, vice versa.
- Second, the center node examines the received G∗ of all other nodes in the one-hop network, and groups the nodes that have the same subset of G∗ into a clique, where a direct connection exits between every two nodes and each node can cover all other nodes in a clique.
- Third, since the center node belongs to multiple cliques in the one-hop network, it will determine the schedule of broadcasting distress signal for all nodes across all the cliques.

5.2.2 Self-Rescue System

- Trapped survivors configure their smartphones as part of the self-rescue system and then the self-rescue system automatically sends out emergency messages when rescue workers or survivors are nearby.
- The battery life of smartphones must last as long as possible, since rescue operations may last for hours or even days.
- Therefore, the self-rescue system must be energy-efficient.
- Since trapped survivors are most likely difficult to discover, rescue crews may not infer the location of trapped survivors, even if they have received emergency messages from them.
- Thus, the emergency message should also provide location information to facilitate rescue operations.

5.2.3 Add Contact Module

The user needs to register the emergency contact numbers with the system which are stored in Register Contact Database. Users can add multiple people in the emergency contacts list. These are the people who will receive notifications or SMS in case of an emergency.

5.2.4 SMS Alert Module

When the user of the mobile is in danger, the user sends the initial message typed by the user, then the system sends the predefined alert message which is already typed and saved by the user as "I am in danger…. Rescue me". The location details are also sent with the alert message.

5.2.5 GPS Module

GPS find the location and send it to members which are included in contact list. Also it will capture the images of that location and send it with the message.

5.2.6 Pedometer Module

A Pedometer is a free tracking device usually portable and electronic or electromechanical, that counts each step a person takes by detecting the motion of the person's hand or hips. It is also called as a step counter. Pedometers may be less accurate for running or walking uphill, because of the stride change. It is used to ignore ordinary shaking, like a phone jiggling in a purse and it detects unique vibrations felt during the earthquake. If the magnitude is 5 or above then the phone detects an earthquake and it sends a message to a central server.

6. Results

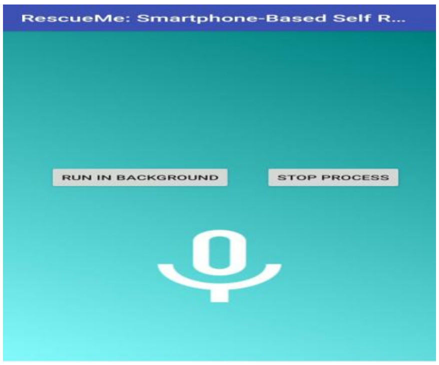

Figure 7.1: Home Page

After installation of application, the application provides two options as Run in Background and Stop Process. On clicking the run in background, it displays the new menu page. The stop process will not enter in any state and it just stays in the idle state.

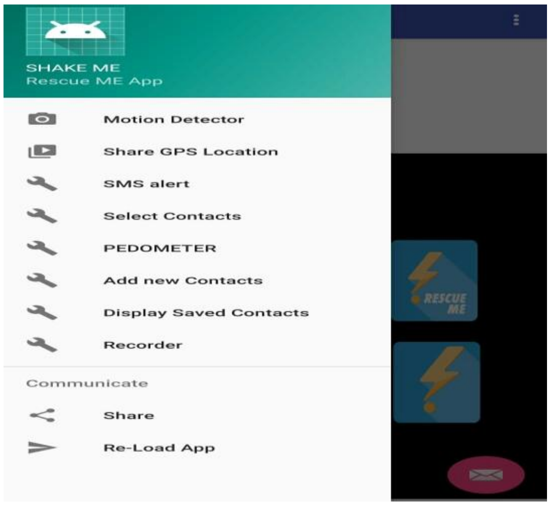

Figure 7.2: Settings

This page displays the number of options such as motion detector, share GPS location, SMS alert, select contacts, pedometer, add new contacts, display saved contacts, recorder and it also has two communicators like share and re-load app.

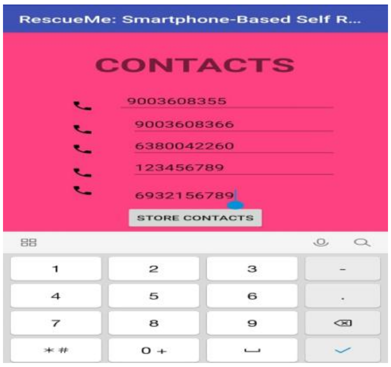

Figure 7.3: Add contact details

The user can store the emergency contact numbers with the systems in Register Contact Database. Users can add multiple contact numbers in the contact list. The saved contact list will receive notifications or SMS in case of an emergency.

Figure 7.4: SMS alert module

When the user of the mobile is in danger, the initial message is typed by the user and it is sent, then the system sends the predefined alert message which is already typed and saved by the user as "I am in danger…. Rescue me". The location details are also sent with the alert message.

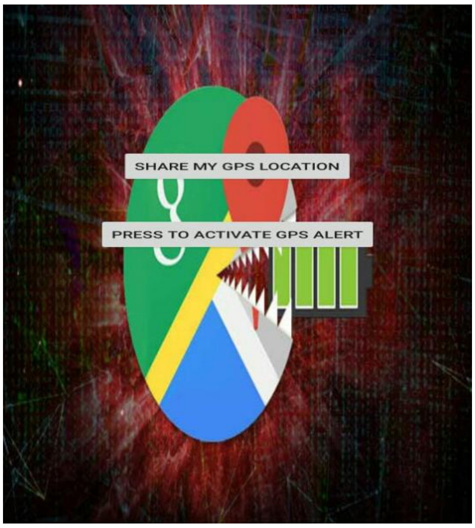

Figure 7.5: GPS location module

GPS find the location and send it to members which are included in contact list. Also it will capture the images of that location and send it with the message.

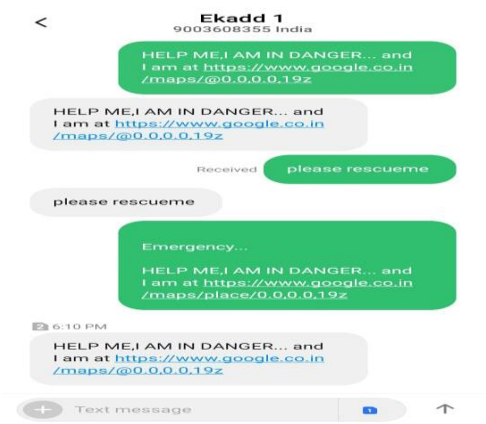

Figure 7.6 Halting process

The resultant messages are sent to the rescue crew that has been saved in the contact list. The rescue help message is sent along with the location.

7. Conclusion

For survivals trapped in earthquake ruins, time means life. Therefore, that people in disaster area actively carry out mutual aid in the earthquake zone is the foremost part in the emergency rescue. In this application, survivors can share their location, send alert message to the persons they want and also predicts pedometer count. This information can transfer only after the mobile get shake for mean time. Implementing real time application and a device, we can solve the problems to an extent. With further research and innovation, this project is used as a small wearable device like watch, pendent etc. The simulation results show that the proposed approach can significantly reduce the schedule vacancy of broadcasting distress signal and improve the discovery probability with very little sacrifice of network lifetime and indicate a potentially viable approach to expedite disaster rescue and relief operations.

This mobile application is helpful in future when any problem arises in travelling or any kind of situations. As the technology emerges, it is possible to upgrade the system and can be adaptable to desired environment. Because it is based on object-oriented design, any further changes can be easily adaptable. Based on the future security issues, security can be improved using emerging technologies.

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