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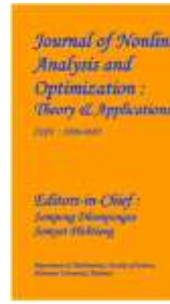

SMART SENSORS BASED ALARMING SYSTEM TO RESCUE FROM DISASTERS

THIPPALURU ISWARYA., Assistant Professor, aish.tippaluru@gmail.com
VARADA DEEPTHI, Assistant Professor, varadadeepthi@gmail.com
ASONDI SREEPRADHA, Assistant Professor, sreepradha5217@gmail.com
Dept of Computer Science and Engineering, Sri Venkateswara Institute of Technology, N.H 44, Hampapuram, Rapthadu, Anantapuramu, Andhra Pradesh 515722

Abstract:
As a consequence of the continued changes in the global climate, natural catastrophes have recently become increasingly common. A major problem with disaster relief efforts, particularly rescue operations, is the difficulty in locating and communicating with survivors at catastrophe sites. In order to facilitate precise and rapid rescue operations in the event of a catastrophe, this article builds a platform that facilitates direct communication on smart handheld devices using wireless networks like Wi-Fi and Bluetooth. Our goal is to create a decentralised application-layer ad hoc network that can communicate with smart devices in place of traditional cellular networks and wireless access points. In order to accomplish disaster rescue goals efficiently, this research also uses a mobile location algorithm. First, to pinpoint where survivors are, second, to aid rescuers in their search for victims, and third, to reduce computational overheads for smart device power savings. In comparison to prior research, this study presents simulation and implementation findings that validate the suggested strategy.

Keywords:
Mobile disaster response, localization, ad hoc networks, device-to-device communication,

I. INTRODUCTION

Persistent climate change is increasing the likelihood of natural catastrophes occurring throughout the globe. In recent decades, weather-related calamities have become far more costly and have claimed more lives. The development of frameworks to overcome the obstacles of catastrophe rescue operations has been the focus of several research efforts in response. A major problem with disaster relief efforts, particularly rescue operations, is the difficulty in locating and communicating with survivors at catastrophe sites. When natural disasters like tornadoes or earthquakes hit, there is a high probability that several individuals may get trapped under the rubble of collapsed buildings and bridges. Here, those who have managed to stay alive will likely attempt to contact outside aid and signal their whereabouts using their smart handheld gadgets. However, survivors may probably forget about getting a signal at all because to the widespread outage of traditional network infrastructure including cellular networks and Figure 1 also shows that Wi-Fi APs might be harmed. This problem has recently attracted the attention of several scholars. They are taking use of 5G cellular networks' device-to-device (D2D) service and/or Wi-Fi Direct7 to replace broken infrastructures[1-6]. The absence of dedicated hardware components that make up the network's backbone is what defines a wireless ad hoc network. Rather, client devices, such smart handhelds, serve as nodes in both the client and backbone networks. Because no preexisting infrastructure is required to govern communication in such an ad hoc network, it is considered decentralised.

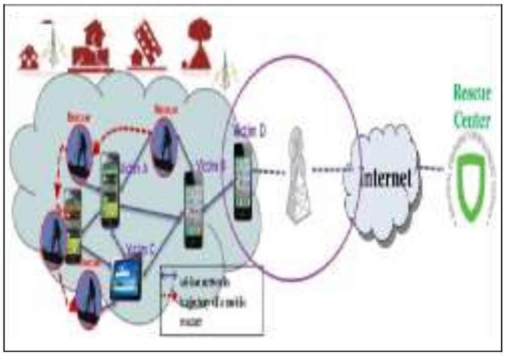

Figure 1. The intended outcome is for a rescuer to look for victims while they are all connected to ad hoc networks, which lack both infrastructure networks and GPS. So far, several indoor localization

In particular, device-to-device communication is a cutting-edge innovation in 5G cellular networks. D2D allows mobile devices to communicate directly with one another, without the need for a central eNodeB. Because it is Peer-to-Peer (P2P), mobile devices may easily connect to one another and form a reliable network at any time and in any location. It is well-suited for use in rescue and catastrophe situations because of this characteristic. One of the most widely used peer-to-peer protocols is Wi-Fi Direct [7]. Most smart devices utilise Wi-Fi to connect to wireless access points, and this is the foundation of Wi-Fi Direct. In theory, any Wi-Fi Direct smart device may act as an AP since it has a "software AP" loaded on it. This smart gadget supports Wi-Fi Direct, allowing other devices with Wi-Fi capability to connect directly to it. This article draws on a wireless ad hoc network that utilises smart devices to conduct efficient search and rescue operations at disaster sites, inspired by this insight. Our primary goal is to facilitate the rapid localization and rescue of survivors by allowing both rescuers and victims to connect to an ad hoc network. In particular, this piece suggests RescueTalk as a means for survivors to converse with one another and even

A. Among the frameworks that combine infrastructure and wireless ad hoc networks is disaster rescueCodeBlue. Disaster victims

might be able to talk to outside of the disaster site to ask for help. Over this ad hoc network, this article also proposes a localization method which is customized to search-and- rescue operation in disaster sites with no GPS service and no infrastructure.

approaches have been suggested, one of which is our own [8]. Unfortunately, these works aren't fit to assist a catastrophe rescue situation since most of them rely on handheld devices that also include other modules, such ultrasonic, for daily use.

II RELATED WORK

may get health care services via it. Paramedics and emergency technicians in the area get patient vitals reports. Furthermore, by using the received signal strength from infrastructure like Wi-Fi APs, the whereabouts of both rescuers and victims may be determined. Nevertheless, traditional infrastructure is prone to damage and malfunction in many crisis scenarios. Therefore, there are restrictions on the actual deployment of these infrastructure-dependent systems. Some research does not make use of the standard infrastructure. Some of the heterogeneous networks set up by DistressNet [4] are specifically for disaster management; these networks include 802.11, 802.15.4, and IPv6. Unfortunately, most smart gadgets cannot accommodate such a platform since it requires the installation of extra network modules.

Nevertheless, a rescue framework that requires little new infrastructures is designed by the RescueMe project [5]. The structure

uses standard infrastructure to safely gather the whereabouts of typical internet users via their everyday networking activities. It can set up ad hoc networks and share the whereabouts of those who were able to escape before a tragedy strikes. But it's handling the "prior" sites, those that were in existence before the catastrophe. If a natural catastrophe occurs

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within a structure without GPS service for an extended period of time, and victims are in motion, the results will be inaccurate.

A. Location service

Numerous academics have put up different iterations of algorithms for localization. Two main types of localization algorithms exist: those that rely on anchors and those that do not. Algorithms that rely on anchors assume a network of nodes whose locations are known using GPS or other infrastructure-assisted techniques. Algorithms use this data about anchors to determine the positions of unknown nodes [9–13]. One distributed technique that is comparable to distance vector routing is the ad hoc positioning system (APS) suggested by Niculescu and Nath [9]. Having said that, this approach is only effective when there is a lot of communication between the nodes. For situations when there is no direct line of sight (NLOS), many research have suggested indoor localization techniques. These include Horiba et al. (2010) and Kim et al. (2011). There have been several multilateration algorithms, or MLAT, suggested, for example, [12], [13]. MLAT approaches primarily rely on the location data of the distant anchor node. This approach uses Kalman filters to avoid the buildup of errors and least square estimate to refine the location. But this approach has its limits, such as inaccurate computation results when there aren't enough anchor nodes in the network or when the positions of the nodes have error factors. Here, we exhibit

characteristics in the assessment part contrasted with our suggested approach.

Many researchers have started using machine learning techniques to get around these constraints of NLOS recently.

One such system that uses a combination of Bluetooth and ultrasound signals and applies machine learning algorithms to the received signals is the acoustic location processing system (ALPS) system [14]. Even Xiao et al. [5] made use of comparable learning techniques. Nevertheless, as a result of machine learning systems' intrinsic limitations, the performance of the learning-based systems mentioned before may be highly reliant on learning parameters. Additionally, in some real-life catastrophe circumstances, the map-based approach may not be appropriate since it needs pre-processing of the target region.

Mobile beacon approaches have been suggested as an alternative to anchor-based localization. [6]An increase in the number of anchor nodes often results in a decrease in localization error. This finding was the basis for the localization method put forth by Sichitiu and Ramadurai16, who advocated using a single movable anchor and using each of its positions as an anchor. Although Sun and Guo proposed a probabilistic estimation-based localization approach, the movable anchor's trajectory is fixed to a helix trajectory. An approach that uses the characteristic of the circle and the perpendicular bisector of a chord to determine the node location was also proposed by Ssu et al. [8] and Yu et al. [9]. This algorithm uses the received signal strength indication (RSSI)-range circle to pick the anchor points. But these earlier efforts take the movable anchor's trajectory for granted, so we know where the mobile anchors will be. Due to these limitations, its implementation is challenging.

in the prospective rescue and catastrophe situation. In our ideal world, rescuers would enter catastrophe zones, where their paths would be constantly changing and their whereabouts would be unknown—just like the victims.

III METHODOLOGY

Victims of natural disasters like earthquakes, tornadoes, landslides, and the like are often ensnared in the rubble of collapsed buildings, bridges, and homes. The catastrophe locations would be scouted by rescuers in order to locate and save them. Normal contact between victims and rescuers is impossible beneath the rubble of destroyed buildings because network infrastructures including cellular networks and Wi-Fi access points are likely to be disrupted. Worse still,

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GPS isn't going to function well in disaster zones. In light of these findings, we provide an ad hoc network approach that aims to aid rescuers in such a catastrophe by precisely and quickly identifying survivors in the absence of GPS and infrastructure networks. The intended outcome of this piece is seen in Figure 1. In instance, we presume that every rescuer stationed at catastrophe locations is always on the move in search of victims. Aside from a node on the outskirts of the catastrophe location, like victim node D in Figure 1, the majority of rescuers and victims do not have access to any network infrastructure. A network connection to a location outside of the catastrophe site may be available to the edge node. Our goal is to construct an ad hoc network that victims may use to communicate with an external rescue centre by taking use of this edge node.

Incorporating a localization mechanism tailored to this particular catastrophe scenario, this article also includes such an ad hoc network. Take Figure 1 as an example; let's pretend the dotted lines show a rescuer's course. Given that

victim A may receive beacon frames from three separate places, allowing it to compute its own position, thanks to the rescuer's quick actions. That way, rescuers may find victims closest to them first. When victim A's position is sent to victims B and C over an ad hoc network, victim C is able to determine its own position by using the coordinates obtained from victim A. Ultimately, the whereabouts of victim B were discovered.

Challenges

In light of the catastrophe and rescue scenario discussed earlier, there are a number of obstacles, including:

• There is a lack of infrastructure. It is presumed that there is no centralised or infrastructural communication accessible at the catastrophe site, whether it be for rescuers or victims, in terms of cellular networks or an AP-based Wi-Fi network. The only way for them to communicate is via an ad hoc network. Therefore, it is quite probable that these networks are isolated and do not link to the outside world. We thus presume that there is no centralised command centre and that each rescuer and victim must make their own judgement.

• Garmin is not yet operational. Both the rescuers and the victims may experience GPS malfunctions in the specified catastrophe scenario.

The nodes may move around. It is quite probable that a rescuer will be in motion and not sedentary. Which is why the localization process has to take mobile nodes into account alongside static ones.

Restriction of power. The suggested solution should be power-efficient and have minimal power consumption since victims often have limited power resources, such as batteries.

level of difficulty. In particular, the suggested localization approach has to converge quickly in order to locate victims and rescue them without delay.

Platform for rescue operations: RescueTalk

An application-layer ad hoc network, RescueTalk, is designed and developed in this article. There are three components to the proposed platform:(1) creating ad hoc platforms, (2) identifying survivors, and (3) implementing ad hoc routing, What follows is an explanation of each of these three components.

IV ARCHITECTURE

The design of ad hoc networks

Using an open-source project as its foundation, this essay creates RescueTalk, an application-layer ad hoc network for use on smart devices. As shown in Figure 2, the development of the ad hoc network application begins with the creation of an application-layer protocol that is tailored to the specific needs of victims in terms of location and communication with rescuers. Using RescueTalk, rescuers and victims may connect and pinpoint each other when catastrophe sites have infrastructure like Wi-Fi and cellphone base stations.

Fig 3: System Architecture

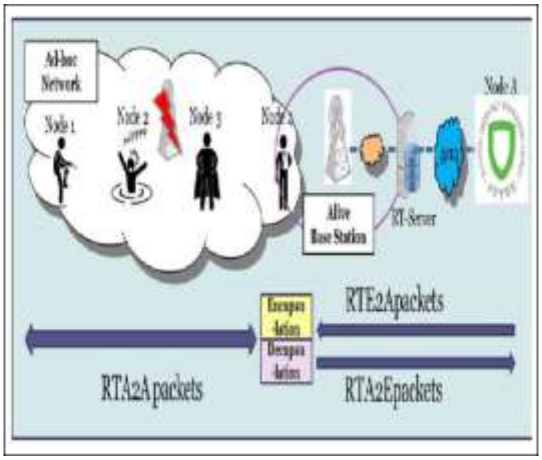

Fig 2: System Overview

Additionally, in cases when a node on the periphery maintaining connectivity to the crisis site (such as a rescuer node)

Upon receiving RescueTalk communications from a victim, it may transmit them to an external rescue centre for further steps in the rescue procedure (see Figure 2). To be more precise, the edge node encapsulates RescueTalk packets before sending them outside or decapsulates them before sending them into an ad hoc network. Figure 3 shows the RescueTalk communication formats and protocols that are designed in this article to make this situation achievable. Every node at the catastrophe site may talk to each other and send messages to a rescue centre outside the area using this application-layer protocol. Because the suggested platform is an application-layer ad hoc network, no changes to network infrastructures like base stations and Wi-Fi access points are required. In order to set up the platform, all we have to do is install software on each mobile device.

IMPLEMENTATION

Disaster Source:

Here, the data disaster source will initialise the nodes, explore the disaster data file, and choose

a hub and transmit it to the designated shelter, such as a hospital, flat, or cottage. After data sources upload their files to a routing server, the server chooses which nodes to transmit to certain end users based on how far apart they are. The data provider will get a response from the router after the successful reception is complete.

Router Server

Nodes A through F make up the Routing server in this module, which provides a data service. The number of nodes in the server is n. After receiving the data file from the source, the routing server will choose a node that is less distant and transmit it to the specific end user. If a router is compromised, the routing server will choose a less distant node to relay the user's data to. Node distance, node information, and attackers may all be seen in a routing server. All we have to do to assign distance is choose the node, input the new distance, and hit submit; the data will be saved in a routing server.

GPS Among the operations available in this module are seeing the assault destination and the route trajectory. By selecting "view path trajectory," we can see the whole path along with all of its associated metadata, including the name of the city, the current time and date, and more. The GPS system allows us to see the specifics of an attacker, including their name, city, Mac address, time and date, and other identifying information. Place of refuge (institution, home, or flat) A total of n end users (A, B, C, and D) are present in this module. The data file may be sent from the source to the end user using the routing server. The final recipient will get the file even if they don't edit the File Contents. Within the router, users may only receive certain data files.

Anyone altering the trajectory node's path is considered an attacker. Once the attacker has chosen a node, they will inject it with a phoney key. The attacker's information, including their name, city, IP address, time and date, and any tags they may have used, will be stored in the GPS and Routing Server after a successful attack.

V CONCLUSION

A mobile ad hoc network platform designed to seek for and rescue people in catastrophes more rapidly and accurately is the planned RescueTalk. Using application-layer techniques, RescueTalk takes use of underlying direct communications like D2D for 5G and Wi-Fi Direct. There are a number of advantages to the suggested strategy over previous research in this area. First, it demonstrates and puts into action a real-world platform for rescue operations via the efficient use of smart device-to-smart device connections. Infrastructure like GPS, cellular, and Wi-Fi access points are not necessary for it. In addition, the suggested platform is constructed on top of smart handheld devices at an application layer. This means that the current underlying protocols don't need to be changed much for the proposed protocol to work. In order to facilitate the easy location and rescue of survivors, this platform allows them to speak with one another and even send aid messages to an external rescue centre.

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