EmerSave: A Novel Crowdsourcing Emergency Response Application

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Introduction

With the exponential growth of human population and technology, more individuals access emergency medical services (EMS) for a plethora of reasons. In the early 1970s, 70% of EMS callers needed paramedic support, while today, only 35% of EMS callers request paramedic support (Fire Chief Contributor, 2013). Despite the decrease in paramedic requests, EMS is often inundated with calls; this leads to blocked telephone lines which would prevent others from accessing EMS. In most paramedic situations, it is imperative that a first-responder gets to the distressed individual within five minutes, or the chance of fatality dramatically increases (Blackwell, K., 2002). The role of EmerSave is to act as a supplement for EMS to reduce stress on the response system. This application has a wide range of potential users who can benefit from the application's unique voice-activated call system. Although many groups could benefit from the development of this app, including pedestrians, and individuals caught in natural disasters; the targeted demographic is the elderly. By acting as an alternative source for quick, non-life-threatening aid, EmerSave can help EMS focus on life-threatening scenarios while being a mode for other individuals to access –saving more lives and preventing a deadly catastrophe.

Target Audience

Elderly

A quick and efficient method of calling for help can aid many senior citizens. In a survey recently conducted by the Center for Disease Control (CDC) of 835,200 individuals in 2014, 21% of people living in residential care had fallen in the previous ninety days. In scenarios such as falls, it is imperative that a first-responder gets to elderly individuals as soon as possible, because delayed response time can result in their condition worsening.

There is a significant demand for an effective personal emergency response system (PERS). Currently, the percentage of people between the ages of 60 and 64 with a PERS is 18%. The percentage of people with a PERS is 38% for people between the ages of 75 and 79, and 46% for individuals between the ages of 80 and 84 (Link-age, 2013). These values are expected to increase rapidly, as demand for telehealth services, which are classified as healthcare through the use of phones, has significantly increased in recent years. In 2013, 350,000 people in the United States had bought some variation of a telehealth service, and by 2017, 3.84 million people had invested in PERS. The percentage of people with PERS in the United States is projected to almost double to 7 million by 2018 (HIS, n.d.). The rapidly increasing demand for PERS illustrates the need for a comprehensive and easy to use application to help the elderly access immediate assistance.

Global Positioning Systems (GPS)

GPS technology has revolutionized the methods people employ to provide location based services (LBS) to consumers. GPS technology is contingent upon a network of satellites identifying and communicating the location of an electronic device based on proximity to the satellites (National Park Service, n.d.). As the scope of such technology increases, individuals are looking to extend the use of GPS and mobile technology. H. H. Lee is an individual credited with developing a system in which mobile location is traced by GPS and exploting the capabilities of GPS and mobile networks to create a system in which the location of electronic devices can be precisely tracked (Roy, M. & Dutta, S. R., 2016). Over time, mobile tracking technology, like the line of sight technique, were developed. The line of sight technique provides the position of a mobile device through the means of a direct signal from a satellite to the mobile device; this is the most commonly exercised means of providing location among GPS providers (Fattepur, M. B. et al., 2016). This simplicity of this technique differentiates it from its adversaries such as the

multipath technique, which utilizes multiple signals distributed in different paths to identify the location of a mobile device (Fattepur, M. B. et al., 2016). While GPS technology does have minor flaws in rapid location identification, it is superior to other common methods such as the use of Wi-Fi and cellular radio signals, and is the best outdoor positioning technique to date (Garzon, S. R., 2016). Because GPS is more reliable and efficient than its competitors, it is the best technique for a mobile phone providing LBS.

Geofencing

Geofencing is a technique that utilizes GPS technology to track the movement of objects in and out of a set virtual fence (Fattepur, M. B., 2016). A geofence can be configured into any shape, but the most common configuration is a circular geofence around a specified center (Roy, M., 2016). After the geofence is created, objects such as smartphones can keep using GPS, and moving in or out of the geofence can trigger an action by an associated app (Garzon, S. R., 2016). For example, a Walmart store might be attempting to let people passing by their store know that there is a sale on an item. By creating a geofence around that store, they can push a notification about that sale to appear to all the phones of Walmart app holders within a mile of the store. Although geofencing is a relatively new field, many colleges and third-party companies attempting to create geofences with irregular shapes make the process of creating a geofence more user-friendly (Garzon, S. R., 2016).

Current Uses

Geofencing is commonly associated with providing LBS for commercial uses, yet many applications created in recent years demonstrate the potential of geofencing in emergency situations. One example, created in Japan, gets information about active natural disasters and creates geofences around dangerous areas. Once an individual enters this geofence, they are

warned of the danger and are urged to exit the danger zone. Once the natural disaster is over, the geofence around the previously designated danger zone is disassembled. Through thorough testing, researchers have determined that this app does correctly detect the entrance into a geofence, but it is not accurate at detecting when a user leaves the geofence (Suyama, A., 2016). While this app has its flaws, it is still a revolutionary example of the multitude of uses for geofencing. An example of geofencing in the medical field is an app called Alzimio, which uses activity recognition and geofencing to help people with Dementia, Autism, and Alzheimer's. This app utilizes geofencing to set up a designated safe zone such as the boundaries of a house. Once patients leave the safe zone, he or she, and other selected contacts, are alerted to move the patient back into the safe zone (Helmy, J., & Helmy, A., 2016). These applications show examples of how geofencing can be used to assist people with personalized safety.

Why Geofences are Not Efficient

Although geofencing is the optimal technology to use for certain products, it has many flaws. While geofencing technology has improved significantly, one flaw that remains is its impact on battery life. Not only is it required for smartphones to constantly monitor geofences, but they must also constantly send data to a server, causing excessive battery drain (Garzon, S. R., 2016). Another major issue with geofencing is low accuracy. Many experiments and studies have shown that geofencing applications must choose between optimizing accuracy and battery life, and even if accuracy is optimized, geofencing technology is not developed enough to predict when a smartphone enters or exits the geofence without error (Garzon, S. R., 2016). Moreover, the complexity and the cost required to maintain a geofence can exceed the financial or computational resources an organization can provide (Garzon, S.R., 2016). Finally, even if one were to overlook the aforementioned problems, Android Studio only allows an app to create 20 geofences, which

limits the number of users who can benefit from this app (Android Studio, n.d.). Due to the many pitfalls associated with geofencing, a similar, simpler technique of calculating distance by the means of using latitude and longitude coordinates would be a better method of distance computation.

Voice Recognition

Unlike many other technologies in development, voice recognition has quickly integrated into many different sectors due to its versatility. One of the leading companies in the field of voice recognition is Google. The principal purpose of voice recognition is to generate a world in which all technology is voice-activated, reducing the direct interaction between humans and technology (Wesley, J. A., 1991). Voice recognition software primarily utilizes artificial intelligence (AI) and analytics to ascertain speech (Walker, C., 2017). By 2016, Google's voice recognition software could analyze over 90% of over 5 million words: an amount which is still expected to increase dramatically (Walker, C., 2017). Furthermore, many leading companies such as Google have also recently developed context awareness for voice recognition software, granting the software the ability to determine the context of a command based on location or previous commands (Walker, C., 2017). Despite the benefits of voice recognition, it still presents one significant flaw: security (Walker, C., 2017). Once the security issue is nullified, hardware equipped with voice recognition software will be the best mode of interaction between humans and smart-technology.

Mobile Phones

One of the premier platforms for software development is mobile technology, more specifically, smartphone technology. The pretext for this statement is the growing popularity of the smartphone ever since its inception: between 2016 and 2020, the number of smartphone users is expected to increase from 2.1 billion to 2.87 billion (eMarketer, n.d.). The amount of time

millennials spend on smartphones is also significant, as the average millennial spends approximately three hours and five minutes on his or her phone every day (GlobalWebIndex, n.d.). With a vast pool of smartphone users, it is the methodical choice to focus on smartphone technology as a main platform for mobile development.

Play Store and App Store

Applications developed for smartphones are often purchased on application stores which house apps compatible with the operating system of the smartphone. The two preeminent application stores are the Google Play Store and Apple's App Store. In 2016, the Play Store offered 2.8 million applications to download, while the App Store offered 2.2 million applications to download (Android et. al., 2017). Furthermore, users have a greater confidence in applications developed on these platforms, as this indicates that an application is credible. This credibility is derived from quality tests performed by Google and Apple. These platforms also permit users to download free, useful applications, assisting them in completing tasks sans expensive hardware.

Programs

The purpose of this research is to develop a comprehensive application to aid people in emergencies, so it is essential to develop it using libraries and preexisting software which will give it the best opportunity to succeed. The software described below was chosen based on four main criteria: popularity, ease of use, reliability, and cost.

Android Studio

As this app is expected to be released on is the Google Play Store, the platform used to develop the application should be one which supports Android applications. In order to develop an application for the Google Play Store, an application development platform must support android; the two most premier development programs to do so are Android Studio and MIT's App

Inventor 2, which are both incredibly popular and free to use. App Inventor 2 is easier to use, as it utilizes drag and drop block programming. However, App Inventor, due to its intended simplicity, does not have many of the advanced features that Android Studio offers. Due to its use of block programming, App Inventor does not allow the developer to view source code and requires more processing time as the block code must be converted to byte code and compiled by a third-party compiler. Complications caused by the compiler include the application resulting in a much larger application size than an identical app written with the same number of lines of code in Android Studio. Another reason why applications developed in Android Studio are better than their counterparts developed in App Inventor 2 is that they offer better intra-app communication. One of the major setbacks of utilizing App Inventor 2 is that it only can communicate with other applications developed with App Inventor 2, whereas Android Studio allows communication with apps developed from various platforms. Moreover, the transmission time for a message between apps created with Android Studio was found to be much faster than the time for a message to travel between two apps created with App Inventor 2. It is due to Android Studio's many advanced features to aid in app development and its ability to develop efficient intraplatform and intra-operating-system applications that Android Studio is considered to be the best platform to develop an android application (Allison, L. & Fuad, M. M., 2016).

Firebase

Firebase is a Google mobile platform that of establishes an all-in-one platform for application developers to develop, test, analyze, and distribute their applications. Firebase also provides a real-time database for effortless integration with popular development platforms including iOS, Android, Unity, and the Web. Furthermore, the database supports development by multiple individuals with the aid of its valuable synchronization feature. Firebase also possesses

the ability to offer various external services on account of its development by Google; these services comprise of, but are not restricted to, cloud storage, ad-mob, analytics, and virtual devices. Security features such as user authentication are accorded as well.

Firebase functions rudimentarily to facilitate application developers of varying experience. The platform provides the intrinsic code required to integrate Firebase into a mobile application and allows the developer to install the files required to successfully run Firebase on mobile platforms. The data stored in the real-time database is stored in JavaScript Object Notation (JSON) format which allows maximized readability in a methodical format. It is due to its multitude of available tools and its effortless integration that Firebase is the most appropriate database for an emergency response mobile application (Irani, R., 2017).

Existing Systems

EMS

Existing products developed to fulfill a niche similar to those fulfilled by an application containing the aforementioned features have various issues. The purpose of this system is to function as a complement to emergency medical services (EMS). Since its introduction, emergency medical services have been an integral facet of public and private health services around the world. In the United States alone, approximately 240 million calls are made to 9-1-1 every year, with 80% of these calls made with the aid of a mobile device (NENA, 2017). Although 9-1-1 proves to be an effective method of delivering emergency services, there are still flaws which can hinder its effectiveness. One area where issues may arise are in emergency situations with the impaired or elderly. For instance, individuals who are deaf and hard of hearing require a teletypewriter to communicate with 9-1-1; these devices are arduous to operate and result in a prolonged communication time between emergency medical services and the endangered

individual. The area in which 9-1-1 is activated factors into the performance of the service as well. Large cities receive more than ten million emergency calls per year, and this volume often results in the overload of the call centers. Issues also persist with rural areas, as the extended distances between call centers results in a prolonged response time (911.gov, n.d.). In many of these scenarios, it would be beneficial to have a system which would take some of the stress off of the 9-1-1 system; it could be utilized to assist individuals in non-life-threatening situations, provide access to quicker help in rural areas, and provide another source of aid in the events of a 9-1-1 system overload or a natural disaster.

Competitor Analysis

There are various existing products which are meant to fulfill similar goals that are desired from the mobile application, but these products have associated issues. One of the main issues for hardware technology targeted towards emergency aid is that it will be a manufactured product, ensuing in high prices. For example, many hardware devices solely created with the objective of GPS tracking cost, on average, between eight and forty-two dollars (Helmy, J., & Helmy, A., 2016). On the contrary, smartphone applications do not require hardware, resulting in minimal costs for consumers.

Current application options to fail satisfy certain criteria. Table 1 illustrates the capabilities and pitfalls of several competitors.

Table 1

	Competitor Applications				
Criteria	SoS Emergency "GPS Bodyguard"	SoS Emergency App	5Star Urgent Response with GPS	Emergency Response App	mySos SA
Ability to send messages					
Sending contacts information					
GPS Directions					
Specific Radius based system					

Competitor Applications					
Criteria	SoS Emergency "GPS Bodyguard"	SoS Emergency App	5Star Urgent Response with GPS	Emergency Response App	mySos SA
Overall Review					
Server					
Access while locked					
Voice Activation					

Note: If a cell is filled in green, it means the application offers the corresponding criteria. If a cell is filled in red, it means that the corresponding criteria is not satisfied.

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