

BRIEF REPORT

An Integrated Emergency Response Tool for Developing Countries: Case of Uganda

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ABSTRACT

This paper presents a First responder emergency response tool (EMApp) as a step towards achieving integrated emergency care in developing countries, the case of Uganda. The EMApp prototype has potential to support health emergency response from various emergency stakeholders. This innovation is in line with strategic plans to embrace technologies towards the establishment of integrated social services such as emergency health-care services (EHS) in Uganda. We describe the prototype and provide its functionalities that can be further enhanced to enable access to emergency services and save life. The possible assumptions, potential challenges and recommendations to implement and deployment of such a system are provided. There is currently no such integrated emergency response system in Uganda as is the case in many other developing countries. For future studies, there is need to deploy the tool and assess its impact on the communities.

1. Introduction

Developing countries like Uganda face many challenges including poor (internet) infrastructure, unreliable power supply, and others which hinder the accessibility to (health, social or judicial) services. Public health systems in such developing countries are underfunded, understaffed, and struggling to deal with emergencies^[1]. Nonetheless mobile technologies have gained trust among communities and are being applied in various disciplines^[2,3] including as health assistants and as financial transaction medium/platforms.

A good health system is one that responds well with emergencies, notably, the best health care systems globally^[4,5] emphasize speed of access to health care and equitability of such access. Notably, no African health system

is ranked among the first 50 best global health systems as of 2019 where South Africa ranks 53rd position^[4]. Many Ugandans loose lives due to the ill state of health care access infrastructure especially in areas outside the cities and the remote.

The current growth in information communication technologies (ICT) and their wide uptake among the communities in developing countries offers a wide potential to enhance access to social services including emergency response services although less of such technologies have been utilized for access to emergency health care services (EHS) in the developing countries. On the other hand, in the developed world, customized apps and devices provide a range of services from health management to cost effective health care services at the patients' convenience^[6]. Emergency care systems have the potential to avert half of all

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deaths in low- and middle-income countries (LMIC) [7].

Emergency health services comprise hospital emergency department, ambulance services and a number of aero-medical retrieval and transfer services that provide integrated medical care to people in acute illness and injury [6]. Such a service enables early recognition and lifesaving interventions for time sensitive situations in which delay in action may result in death, disability or render treatment less effective [8]. EHS range from on-scene care to a global demand to improve efficiency of health systems. In this work we consider emergency condition to include road traffic, trauma, infections, non-communicable diseases and complications of pregnancy which accounted for 90% of the leading death in low and middle income countries in 2017 [7]. The emergency panic/deficit brought by the COVID-19 outbreak has shown the ill preparedness of health systems and highlighted the need to priorities emergency services in Uganda [9].

We introduce 1st Responder's Emergency Mobile Application (EMApp) to address the delay in response time by first responders to emergencies due to inadequate, inaccurate and untimely communication between the incident reporter and first responders. EMApp will trace and track emergency information to such emergencies and providing emergency remedial information to those in emergencies that could lower the threat levels of a situation as they await rescue from first responders. EMApp is to be deployed in Kampala district where communication infrastructure is sufficient and inhabitants utilize the smart phones but also the area that is more prone to emergencies due to population density.

The pilot EMApp coverage includes

- i. Ambulance service
- ii. Police
- iii. Fire Brigade

The rest of this paper is organized as follows; section 2 is on EMApp functionalities, section 3 describes the deployment requirements, while section 4 presents snapshots and describes usage, section 5 is a discussion and conclusion.

2. Materials and Methods

A survey on Uganda's health system was carried out in selected districts particularly to identify the hindrances. Major to the challenges was access to emergency health care, which is in line with literature [10-12]. An integrated emergency response prototype was developed while considering user requirements from the same survey. The tool is in such a way that emergency services are integrated so that the appropriate service is called up and the right stakeholder is contacted in time of emergency to save the

victim.

2.1 Deployment and Target Users

The application is supported on android operating system 5 or higher and the iOS. The application inter-operates with GPS and google map systems. The application was developed using a distributed architecture wherein databases are distributed to different regions of the country to enable quick access and processing information requests. The application enables connectivity of different and independent emergency service providers to aggregate services and provide comprehensive emergency care.

2.1.1 Target Users

Emergency responders such as public health field workers who offer field service, the health authorities who receive timely reports from the system as well as the individuals who report the incidents. First responder is an insurance application to many sorts of incidents and therefore connects the emergency victim with the first responders to reduce risk on health. Law enforcement authorities can also utilize the tool in the case of forensic tracking. Researchers and developers of health instruments are potential users of the tool for further enhancement or development of related tools. Generally, EMApp can be used by all service providers whose line of work is emergency response. Users who need to dispatch or book resources at particular health institutions and quick relay of information to firefighting services are targeted.

2.1.2 Installation

The tool is installable on a dedicated server at the central health authority for better governance. The tool has a mobile application that is downloadable from google plays stores to be installed to mobile gadgets and used to register use for emergency services. The tool requires a national ID or passport for best validation at time of registration. The back end (dashboard) of the tool is an executable file that is installable on computer for administration of responses ie, monitoring, dispatch, reporting and tracking resources as well as ring-fencing resources required for a particular emergency.

2.1.3 Interfaces

For hardware interface: The First Responder's Emergency Mobile Application is an iOS and Android mobile application that is built using React Native programming language and will communicate with a PHP web admin controller.

Software interfaces; EMApp is an iOS and Android

mobile application that is built using the PHP programming language. The primary data input into the system is in form of text and videos using the mobile application interface.

For communication interface; The application is a dependent mobile application that requires internet connectivity with need for a centralized server that will keep track of the emergency requests made and other data. The function enables liaison with other existing databases such as the national database (NDB), Police, insurance and hospital databases for optimized resource mobilization to suit the emergency at hand.

2.1.4 Documentation

The internal processes of the application have been documented with comments in all scripts. Specification document highlights all the user requirements interpreted as system functions. The users are provided a user manual for easy system usage. The user manual is aligned to the system requirements and hence functions for the optimal use of first responder tool.

Other documentation are suitable icon names that appropriately describe the function or response that is expected from the icons.

2.1.5 Assumptions for Suitable Deployment

The most important assumption is the availability of enabling infrastructure such as data communication network to enable communication and automated mobilization of resources to save life in a given emergency state. Other assumptions include availability of reliable response policing system and hospital response teams/system at registered hospitals. Also assumed is a willing and quick insurance response systems for the case of victims insured and response systems from other institutions required to save life in the emergency.

2.1.6 EMap Functionalities

EMap functions include user authentications and validation that is intended to reduce response to false and/or junk alarms by identifying the initiator of the emergency state in the system. The function is multifactor authentication based on user's prioritized authentication for example, the phone number used is legally registered to the person with a National ID (NID) or passport and such information can be probed from the NDB once the phone number is provided. The NID can easily be probed further for identify of the registered next of kin to the victim and notified of emergency. Biometrics (fingerprint and picture) is also registered in the NDB and hence ease of authenti-

cation verification and identification in case of catastrophic emergency rendering the victim unconscious. All this is possible through the inbuilt registration function that collects user details into the local database. The function of crime reporting involves the responder utilizing the app to send a crime report to the central policing authorities in various forms including compressed video or images while identifying and copying the closest police station to the crime scene. This function utilizes GPS and google maps to reduce to time of searching for the emergency service unit for example, nearest police station to take responsibility. The user (victim/requester) location function is also included for best estimate of distance to the nearest emergency services provider. Request emergency assistance function clearly identifies the type of emergency and prioritizes based on severity of the emergency. The function alerts the stakeholders to the emergency, these can include next of kin as registered on the NID, ambulance, insurance, legal personnel, domestic violence unit of police etc. The notify function implements SMS infrastructure to alert the next of kin but also email and web interface are inbuilt to report details of the emergency such as location coordinates (and nearby significant features), ID of the victim, brief crime report in order to elicit the right response to such an emergency.

The feedback function is necessary to generate important usability reports from the users in order to better the provided emergency services.

Donate function: although the service rendered by the EMap is free, this function enables funds raising from voluntary beneficiaries or well-wishers for maintenance and continued service support.

3. Results

The results are presented as screenshots of the prototype below.

16:53  90%



Figure 1. Startup Screen Interface

The user in emergency condition starts the application on their phone shown in Figure 1 and selects the specific

emergency category as in Figure 2 and initiates the emergency response by a single click to enable the application mobilize the right resources to save or assist the victim (s).

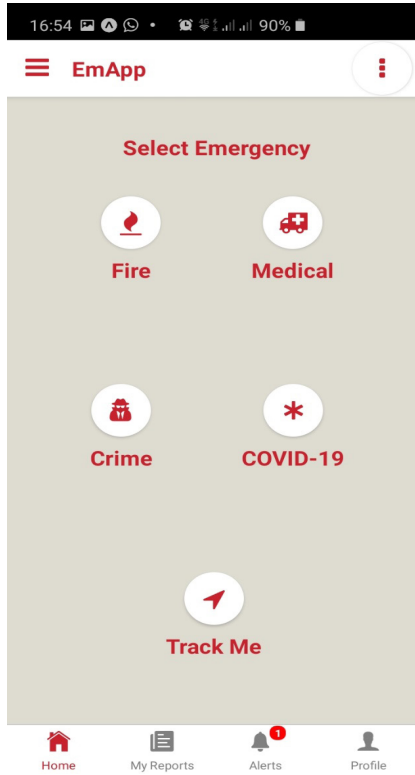


Figure 2. Home Interface or screen for selection of emergency category

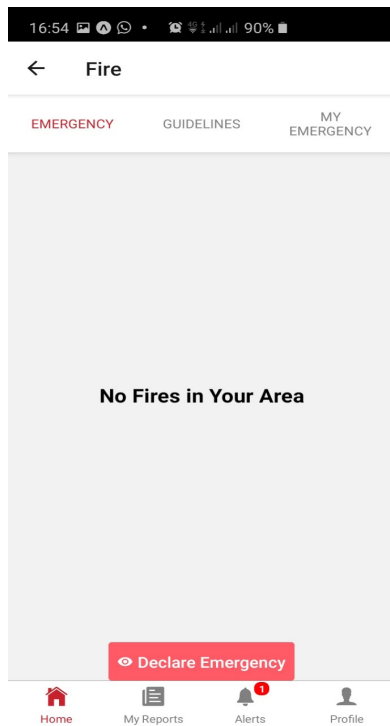


Figure 3. Selected Fire emergency

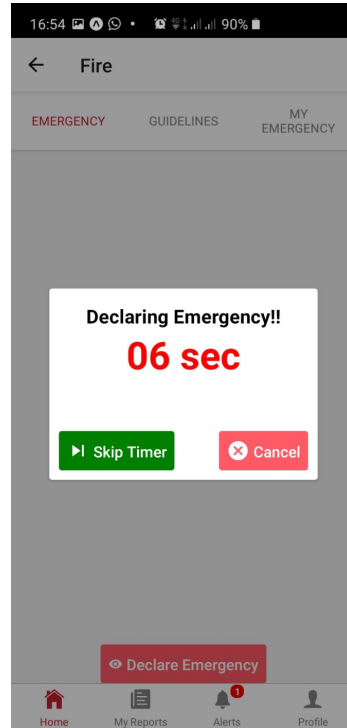


Figure 4. Declaration of Fire Emergency

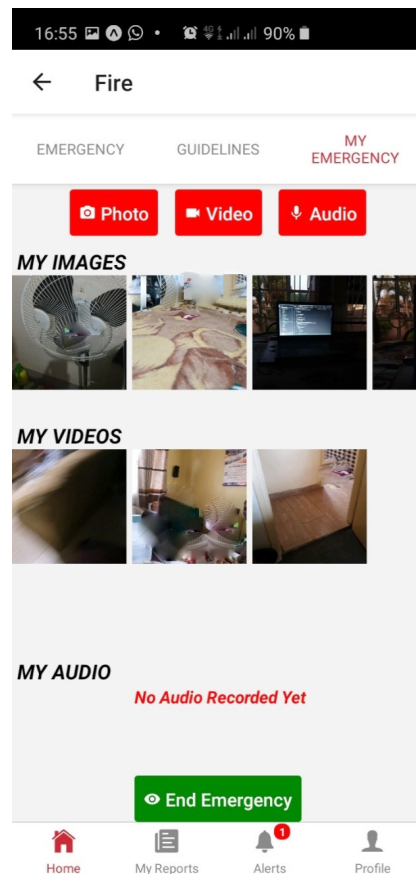


Figure 5. Interface to allow recording media in an emergency

The user opts for suitable media in which they want to log the emergency.

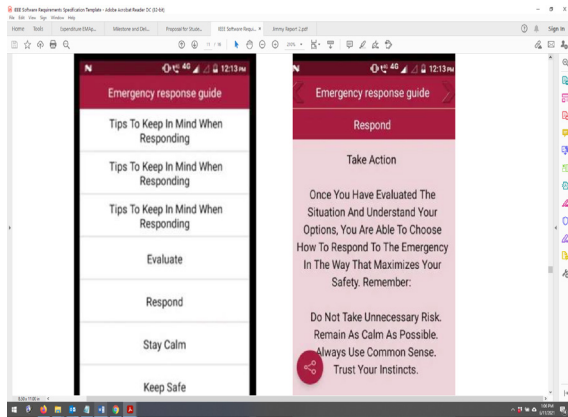


Figure 6. Emergency Response Guidelines and details screenshots

4. Discussion

The presented prototype is work in progress towards an integrated emergency first responder system that has potential to save many lives when deployed in Uganda or other countries where no emergency response system exists. The tool is evidently convenient to be utilized when faced with an emergency as evidenced in the screenshots.

EMApp is a step towards deployment of an integrated emergency response system for developing countries like Uganda and hence the focus should be on the additional scope towards reaching the integrated emergency services. It is imperative to establish a cost-effectiveness database to support the development and implementation of a scaled emergency response system for developing countries. Such database should form basis to inform policy makers and regulators on and assist prioritization for health and economic benefit.

The tool is recommended to complement the command and control functions^[10] of major emergency management operations such as in hospitals, health providing insurance, private ambulance services for better functioning and coordination of the emergency services. For future studies, there is need to deploy the tool and assess its impact on the health sector in Uganda. There is also need for inclusiveness by providing speech recognition and other functionalities for persons with disabilities (PWD), the tool should be compatible with hearing aid.

For better accessibility, emergency service should be accessible through a USSD code and verifying with already provided records such as national ID or passport before dispatch of service. This enables access by non-smartphone holders but possess the basic phone and

these are a large percentage of the phone users.

5. Conclusions

An integrated emergency response tool was developed and presented in this report. Uptake of the tool among the developing nations could enhance access to emergency care and save lives in time of emergency.

Author Contributions

Swaib Kyanda Kaawaase is the supervisor and part of the development team, a critical advisor and writer of this manuscript documenting the work done on the project.

Ekisa Rodney is the key developer, a guide to the direction of the project. He is also contributor to sections of the manuscript and reviewer.

Conflict of Interest

No conflict of interest to declare.

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