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Original Article

An Android Based System for Reporting Coronavirus Outbreak in Educational Institutions using Social Media Services

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Abstract *- At the beginning of the year 2020, the humanity has been subjected to a new enemy known as Coronavirus pandemic, which its destructive effects are quite different from its former peers. This new enemy initially appeared in the Chinese province of Wuhan and spread very quickly in all countries of the world to cause a large number of injuries and fatalities in various sectors of the society including education. With the outbreak of this powerful epidemic, the increasing number of Coronavirus reporting calls placed a great strain on the traditional emergency communication systems which are not eligible to receive it; especially in developing countries. To greatly reduce the burden on the traditional communication systems, this research paper presents an Android based emergency system to enable the member of the educational institution to send the panic request about the newly detected cases of Coronavirus in his educational institution using social media services. The efficiency of the proposed system has been evaluated on two levels. In first level, it was guaranteed that the proposed system has been worked on various smartphones devices with Android version of 4.4 KitKat or higher. In second level, the performance of the proposed system was arbitrated by two arbitration groups: Android developer experts and Android smartphone end users. The arbitration outcomes indicated that, the proposed system achieved a high level of arbitrators' acceptance, where the overall acceptance rate reached 96.48%.*

Keywords *- Coronavirus, Mobile Health, Android Phones, Social Media, Educational Institutions.*

I. INTRODUCTION

At the beginning of this century, the humanity was exposed to a large number of emergencies, which caused millions of injuries and thousands of deaths worldwide[1]. However, the causes of these risks were known to the competent national authorities, where some of them due to natural events/parameters, while others back to man-made technological factors [2].In the recent few months, the humanity was on a date with an invisible new global health enemy called Coronavirus (Covid-19) disease[3].

The Covid-19 initially emerged in the Chinese city of Wuhan, then due to a set of natural, political and organizational factors, it has extended rapidly to all parts of the world [4]; causing a great panic for different human ages [5].The novel Covid-19 is characterized by unknown damaging characteristics, that enabled it to penetrate all health systems of all the countries of the world, whether developing countries with low quality health services or developed countries with strong health systems, such as France, Italy and Spain [6].

When the serious impacts of the Covid-19 have reached the peak level, which exceeded the imagination of the medical community throughout the globe [7], the World Health Organization (WHO) has declared this virus as pandemic on March 11 2020[8].In an attempt to control the outbreak of the Covid-19 pandemic, the governments launched campaign urging people to stay at home as long as possible [9]. Moreover, they took a series of urgent precautions for social distancing, such as school closures, business curtailments, travel restrictions, isolation and quarantines [10].

Unfortunately, this crisis has revealed several problems in Emergency Services Sector (ESS) in various countries of the world, where in more times the clinicians are being forced to make hard decisions regarding patient who gets life-saving treatment and who dies, due to the lack of critical healthcare resources [11].

The ESS is the country's first defense line for preparedness, preventing, responding, recovering from emergencies, man-made and natural disasters, terrorist attacks, accidents and other daily operations that represent a great danger to security and stability of human life [12,13]. The ESS includes a large number of well trained employees, along with the physical and electronic resources[14]. The ESS consists of a group of sectors and disciplines, such as: emergency management, medical emergency management, law enforcement management, fire-fighting management, search & rescue management, ...etc [15].

The medical emergency management sector has become the most significant sector, because having a high level of healthcare services is one of the most important priorities of modern society. With higher rates of population growth and current changes; the medical emergency management sector is exposed to high demands of emergency calls, leading to a lot of unanswered calls, due to the lack of government funding needed to develop the communication systems, which puts the lives of many patients at a high risk [16]. For that, the communication systems have become the key factor in dealing with different types of emergencies [17].

Despite the recent progress in communication systems, the risks associated with communication failure are still serious issue; because the infrastructure in third world countries has no ability to handle the huge amount of emergency calls at the same time [18].In the last few decades, the infrastructure development has become the focus of academics, politicians, researchers and economists; because it positively affects production, employment and productivity in a long-term [19].

At the same point, numerous studies confirmed that the infrastructure development in education sector helps to avoid the emergency hazards that can occur during the presence of students, employees and teaching staff in the educational institution. But practically; it requires significant human capital, which is often difficult to provide in educational institutions, due to the economic crisis in most countries of the third world, which does not allow the addition of other employees to perform this function [20].To overcome this challenge, early researchers tend to use the traditional method, which depends on allocating the public warning and alert tools to save lives and protect property during the emergency time [21]. But at the present time, modern studies prefer to use another faster and more popular alternatives, such as social media [22].

Social media refers to a set of internet based electronic communication tools, which enable people to perform various types of communications, whether directly (synchronous) or indirectly (asynchronous).Social media tools can cross geographical borders for transferring a variety forms of digital media, like text, photo, audio, video, animation, … etc. Now, the tools of social media are used in educational institutions in a wide range, because they provide many benefits that are not provided by other means [23].

Really, using social media tools to interact, communicate and obtain information from others; requires a certain kind of mobile devices called smartphones[24]. According to Merriam-Webster Dictionary, the smartphone is a cellular phone that includes additional software and services. Today smartphone has become an integral part of our lives for the following reasons [25]:

1) It gathers various sophisticated features.
2) It enables users to keep memories, pictures, correspondence and different types of data (personal, financial and health) upon one device.
3) It combines advanced computing capability, such as internet communication, information retrieval, video calls, E-commerce, …etc.
4) It allows people to keep continuous communication regardless of their movements and distances.

The goal of this paper is to develop an Android based system for reporting Coronavirus outbreak in educational institutions using popular social media messaging platforms. The rest of the paper is structured as follows: Section II, presents background of the study. Sections III, defines the study problem. Section IV, provides the proposed system details. In Section V, the obtained results are discussed. Finally, the last section concludes the paper followed by future research directions.

II. BACKGROUND

In this section, we review the key issues related to the current study including introduction to emergency medical services and an overview of social media platforms.

A. Emergency Medical Services

Emergency is a life threatening situation that occurs at anywhere, any time without prior warning and requires fast intervention [26].Practically speaking, the best way to deal with emergency is to prepare an integrated plan to predict emergency situations in advance and take appropriate action when it happens [27]. A common assertion among many researchers is that the disaster gives rise to the emergency, so both terms are used interchangeably[28].

Over history, mankind has been exposed to large numbers of emergencies with different damage levels. The types of these emergencies were reviewed by several international agencies, such as World Health Organization, Federal Emergency Management Agency and Mid-Florida Area Agency on Aging. These global agencies concluded that, all the emergencies can be divided into three major categories: Natural, Man-Made and Hybrid emergencies [29]. Natural emergencies are hurtful events that arising from natural causes without any human intervention. Man-Made emergencies are hurtful events that resulting from human actions and responses. Hybrid emergencies are harmful events that producing from the combination of both natural forces and human activities [30,31].

Lately, emphasis has been placed on Time-Sensitive medical emergencies in low and middle income countries; because almost a third of all deaths are caused by health reasons, such heart attack, transport accidents, childbirth, ... etc. At the same point, the international organizations have emphasized the importance of focusing on emergency medical care sector in low income countries. Among these organizations is the World Health Assembly, which issued a decision that recognizes the necessity of evidence-based approaches for developing emergency care and asks the World Health Organization to promote emergency

medicine research. Despite the positive repercussions of this decision on various aspects of medical care sector in developing countries, the lack of emergency medical vehicles remains a major problem [32].

It is known that, the transportation of patients is one of the most important services in the emergency medical sector [33]. During the past decade, the ambulance service is used to transport patients in emergency medical situations all over the world [34]. With the technological development, the ambulance has been supplied with a technical apparatus and a medical crew consisting of two members, one of them a well-trained paramedic [35]. Therefore, the role of ambulance services is no longer limited to transport patients, but significantly has developed to become venues for initiating life-saving treatments before reaching medical facility as well as providing a wide range of health care needs, such as fracture management, hemorrhage control and referrals to alternative healthcare professionals [36].

The increasing population in the third world countries has negatively affected the traditional ambulance services, as the severe overcrowding in the streets causes poor accessing of ambulance services to the remote areas. To optimize the ability of the traditional ambulance to travel long distances, another type called "Air Ambulance" appeared. The main purpose of air ambulance is to transport patient for a long distance up to 241 kilometers with fast medical treatment. Air ambulance can be used to transport patient whether from remote hospital to central hospital or from specialist hospital to special care unit [37].

B. Overview of Social Media

After World War II, General MacArthur realized that, the conflict between countries around the world would be governed by new elements other than traditional tools including weapons, machineguns and aircrafts. The most important of these elements are telegraph, radio and Internet [38].

In this era of Big Data, it has become easy for users to daily produce massive amounts of digital data from various digital sources to be handled by several methods and stored into electronic data warehouses. With this huge amount of data, there was a need for online communication means to exchange contents, opinions, thoughts, trends, pictures, music, videos and so forth between users. Recently, social media has become the preferred way for performing personal communications among all available means [39].

Social media is highly interactive platforms that utilize mobile and web technologies to enable individuals and communities share, discuss and modify others generated content [40]. In other words, social media is a form of online discourse, where the user can create tweet about specific topic and share it on a large scope at a high speed [41].

Social media includes text, images, audio, video, podcasts and other types of multimedia communications. It has facilitated the speed and breadth of information spread, 24 hours a day. Therefore, it has become an important part of all aspects of the life, including personal and professional sides [42].

Historically, the origins of social media date back to after 2002, when Web 2.0 technology appeared. The important contribution of Web 2.0 technology is that it has provided a new culture of interaction, where its use is not limited to the social level, but it can be used at other levels. Specifically in business, it helps to advertise products and services, connect with other companies and professionals and create more links to their website, which improve the website's rating on Google and other search engines[43].These days, a lot of people spend the majority of their time on online interaction platforms instead of traditional news organizations for the following reasons [44]:

1) Following news on social media platforms is more timely and less expensive than traditional news media such as newspapers or television.
2) Sharing, commenting and discussing news with friends and other readers on social media platforms is more easier compared to traditional methods.

Practically speaking, the use of social media is a double-edged sword [45], because it has positive effects and also has some negatives. Some merits of social media platforms are [46]:

- It helps user to keep in touch and communicate with others, whether they are from the family or distant friends.
- It helps user to interact with people who share similar interests or feels.
- It helps user to make new friends.
- It provides user space for self-expression.
- It allows user to get positive support from others.
- It allows user to know what others are doing.
- It helps user to easily get new information, news and learn new things.
- It is a good place to entertainment and publish joys.

On the other hand, some demerits of social media platforms are [Ibid]:

- It gives young people the opportunity to speak badly with the old people and teach hate and belittle each other.
- It allows people to say whatever they want with anonymity, which distorts reality and gives an unrealistic view of others.
- It greatly harms the social relationships.
- It makes it difficult for people to socialize in real life, because they become accustomed to not interact with people face to face.
- It helps to spread of rumors and fake news.

- It takes teens to some inappropriate sites that may cause psychological problems.
- It allows students to spend too much time on social media platforms instead of doing their homework.

Lately, there are a large number of websites that can be classified as social media websites, because they allow the users to create an personal account to communicate with others through text and non-text tools. Examples of the most popular and well-known social media websites are: Facebook, Twitter, MySpace, Digg and JISC [47].

With the recent changes, social media platforms can be employed in education sector on a large scope for the following [48]:

- It allows students to express their opinions on general issues of their daily life.
- It allows students to express their views on learning process in an informal way.
- It allows students to interact with the academic content generated by others.
- It helps to know students' experiences and problems.
- It helps to identify joys, emotions, stress of students and provide them social support.
- It helps to identify educational mentality and tacit knowledge of students.
- It helps to increase students' retention, success and employment.
- It helps researchers and educational practitioners to understand students' problems outside the classroom environment.
- It helps to make and improve institutional decision.
- It helps to improve the quality of educational process.

Finally, the impact of social media in education sector has been studied at Purdue University. The results of this study showed that, the best five social media platforms for students were: Facebook, Instagram, Twitter, Snapchat and YouTube [49].

III. PROBLEM DEFINITION

In Egypt, when a person is exposed to emergency health situation and needs medical assistance, he calls the emergency medical service (Egyptian Ambulance) using the number (123) and expects a quick response on the other end. But, unfortunately collides with some real problems such as, failed connection, busy signal, no reply, inability to locate the event, ... etc.

Currently, with the appearance of the Coronavirus epidemic in the first months of 2020 and its quick spread in different countries of the world including Egypt, the aforementioned problems increased dramatically, because the communications infrastructure in Egypt is not eligible to meet the high demand of medical emergency calls resulting from infection with this epidemic.

As the educational institutions like their peers are not isolated from the external world, their members (students, teaching staff, employees, ... etc) are vulnerable to infection with this dreaded epidemic, whether during the period of official works inside the institution or while their practical daily activities outside the institution. Therefore, providing advanced alternatives for reporting the outbreak of Coronavirus in educational institutions of Egypt has become an urgent necessity.

IV. PROPOSED SYSTEM

To report the outbreak of the Coronavirus epidemic, an Android based system has been proposed. This section of the paper describes the details of the proposed Coronavirus Reporting System (CRS) including: the system design, the system development and the user interface.

A. System Design

The main operations included of the proposed CRS are generally shown in Figure 1.

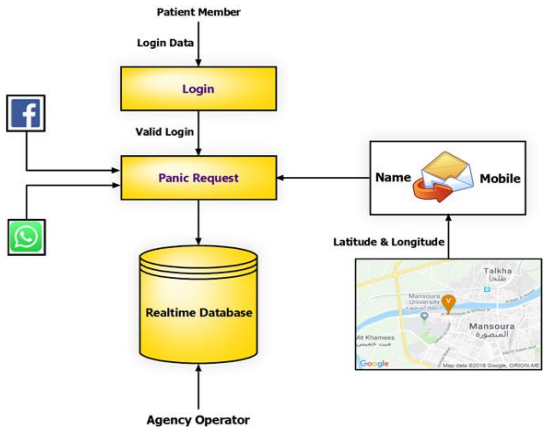

Fig. 1 Flowchart of proposed CRS

From the above diagram, the infected educational institution member firstly enters the system login data (user name, password). Then, the system matches the data entered with the reference one. If a valid authentication occurs, the logged-in member moves to the next step to make a panic request using one of the three reporting methods provided by the proposed CRS. In method-1, the educational institution member enters the required data (name, mobile number, message) and the system automatically reads his location at the time of a query using Google Maps service. Then the member sends the panic request directly from within the system across the communication internet protocols. In method-2, the system automatically moves the educational institution member to the Facebook chat window of the relevant health agency, then the member sends the panic request from outside the system via his personal Facebook account. In method-3, the system automatically moves the educational institution member to the WhatsApp chat window of the relevant health agency, then the member sends the panic request from outside the system via his personal WhatsApp account. After the panic request is sent through any of the previous reporting methods, the data of the infected member is stored in the Firebase realtime database. On the

other hand, the healthcare agency operator has privilege to access this data.

B. System Development

The proposed CRS has been developed to work only on smartphones with Android 4.4 KitKat or higher. The development phase of proposed CRS relied on a number of tools. The Internet transfer protocols are one of these tools, while the rest are:

- **(Java SE):**
  This tool was used to build the proposed Android App.
- **(Xml):**
  This tool was used to design the Graphical User Interface.
- **(Google Firebase Realtime Database API):**
  This tool was used to store the patients' data as JSON in a cloud-hosted database and synchronized in realtime.
- **(Facebook API):**
  This tool was used to transmit the data of the patient member from his Facebook chat window to its counterpart in the healthcare agency.
- **(WhatsApp API):**
  This tool was used to transmit the data of the patient member from his WhatsApp chat window to its counterpart in the healthcare agency.
- **(Google Map API):**
  This tool was used to get the whereabouts of the patient member during the query.

C. User Interface

To enable the educational institution member to easily communicate with the services of the proposed CRS, an attractive Graphical User Interface (GUI) has been designed to run on android phones. At the beginning, when the educational institution member launches the proposed CRS, the mobile interface of the CRS splash screen is displayed as shown in Figure.2.This screen waits just few seconds before proceeding further and includes three components: the logo of Mansoura University, three icons represent available Coronavirus reporting methods and a royalty-free Coronavirus image.

Fig. 2 CRS Splash Screen

After few seconds, the educational institution member moves automatically to the login screen of the CRS, which enables the member to enter the login data required to access the proposed CRS as shown in Figure.3.

Fig 3:Screenshot of CRS Login Screen

Upon correct authentication, the educational institution member moves to the main screen of the CRS, which enables the member to perform the target tasks and utilize the system services as shown in Figure.4.

Fig. 4 Screenshot of CRS Main Screen

When the Report button of the CRS main screen is pressed, the educational institution member moves to the panic request screen, which enables the member to report the suspected cases of Coronavirus in his educational institution in several ways as shown in Figure.5. This screen is divided into two parts: the top part of the screen is designed to transfer the panic request from inside the system via various Internet transmission protocols. In this part of the screen, the member writes his name in the first textbox, his phone number in the second textbox, presses the "Get My Location" button to get his address from the

Google Maps widget to be written automatically in the third textbox and presses the "Submit" button to write the patient data in the database of the healthy agency through the Internet transmission protocols. On the other hand, the bottom part of this screen is designed to transfer the panic request from outside the system by social media intermediaries such as Facebook and WhatsApp. Once the "Facebook" button is pressed, the educational institution member moves to the Facebook chat window of the healthy agency, which enables the member to report the new Coronavirus cases in his educational institution by using his personal Facebook account; (if any). On the other side, once the "WhatsApp" button is pressed, the educational institution member moves to the WhatsApp chat window of the healthy agency, which enables the member to report the new Coronavirus cases in his educational institution by using his personal WhatsApp account; (if any).

Fig. 5 Screenshot of CRS Reporting Screen

When the Live Update button of the CRS main screen is pressed, the educational institution member moves to the Coronavirus live update screen, which enables the member to follow the latest news of Coronavirus through the Worldometer website (https://www.worldometers.info/coronavirus/). This website provides a real-time statistics on the Coronavirus pandemic in all countries of the world including Egypt as shown in Figure.6.

Fig. 6 Screenshot of CRS Live Update Screen

When the Help button of the CRS main screen is pressed, the educational institution member moves to the assistance screen, which enables the member to obtain advice for avoiding the Coronavirus pandemic through the WHO website (https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public).This website provides a set of guidelines to prevent the spread of Coronavirus pandemic as shown in Figure.7.

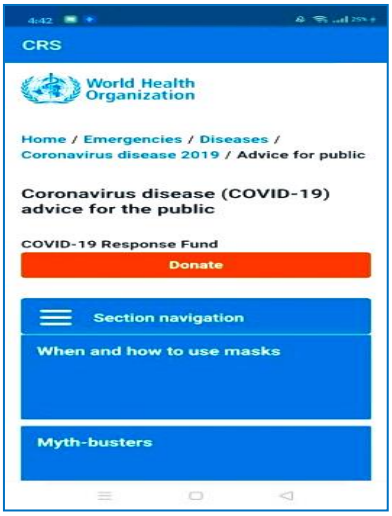

Fig. 7 Screenshot of CRS Help Screen

Finally, when the Exit button of the CRS main screen is pressed, the CRS is closed.

V. RESULTS & EVALUATION

To evaluate performance of the proposed CRS, it has been subjected to a series of different experiments. These experiments tested the proposed CRS into two main scenarios as follows:

A. (Scenario1) Fundamental Test:

In this test, the compatibility of the proposed CRS with different types of smartphones was evaluated by a group of Android device owners who tested the system's application over several smartphones with Android version 4.4 KitKat or higher. Each Android device owner participated in this test was asked to rate the result of his experience with the proposed CRS either as Full Pass, Partial Pass, or Full Failure. The results of first evaluation test were recorded and presented below in Table 1.

Table 1. Outcomes of First Evaluation Level

Android Device	Test Result
Alcatel Pixi 3	Full Pass
Asus ZenFone 4	Full Pass
Acer Liquid Z500	Full Pass
Huawei G629	Full Pass
HTC One Max	Full Pass
LG Optimus G	Full Pass
Lenovo A6600	Full Pass
Motorola Moto X	Full Pass
Samsung Galaxy Not 5	Full Pass
Sony Xperia E3	Full Pass

From the results shown in the previous table, it can be seen that the proposed CRS was capable of running on various smartphone devices with Android version 4.4 KitKat or higher regardless of their different brand names and specifications.

B. (Scenario2) Functionality Test

After the initial testing of the proposed CRS was completed, the proposed CRS was subjected to another type of test. In this test, the processes and functions of the proposed CRS were evaluated by two arbitration sets. Set-1, included a number of Android developer experts who had a deep information in touchscreen devices with Android operating system. While, set-2 included a group of typical end-users who own Android smartphones. Each arbitrator participated in this test was asked to fill the questionnaire form which included a set of multiple-choice questions, that covered evaluation dimensions of common interest (usefulness, satisfaction and ease of use).Then, each arbitrator was required to record his overall acceptance rate of the proposed CRS. The outcomes of the second evaluation test have been recorded, analyzed and simply described through descriptive statistic as shown below in Table2.

Table 2. Outcomes of Second Evaluation Level

No. Arbitrator	Acceptance Rate [%]	
	Expert	End User
Arb-1	97.54	99.79
Arb-2	96.25	98.87
Arb-3	94.84	97.65
…	…	…
…	…	…
…	…	…
Arb-N	92.82	96.64
Average	95.44 [%]	97.52 [%]
Overall Average	**96.48 [%]**	

The results shown above indicated that, there was a variation in the CRS acceptance rate between the two groups involved in this test, where the overall average of experts' acceptance was (95.44), while the overall average of end users' acceptance was (97.52). The difference between these two viewpoints is due to the fact that, the experts in any field have an extensive knowledge, skill and experience through practice and education for a long period of time. Thus, the judgments of Android experts were more objective, comprehensive and accurate compared to end users' arbitrations. The above results also showed that, the proposed CRS achieved a high level of acceptance, where the overall average of arbitrators' acceptance was 96.48.These encouraging results motivated us to generalize the proposed CRS to report the infected cases of Coronavirus in various educational institutions.

VI. CONCLUSION & FUTURE WORK

Currently, the whole world is fighting a violent battle with the devastating novel Coronavirus epidemic. This hidden epidemic has caused thousands of injuries and deaths in various countries of the world, including Egypt. With the escalating of the Coronavirus infection curve, the traditional communication systems have been exposed to huge bottlenecks caused by the large number of emergency calls to report both suspected and confirmed cases of Coronavirus. The poor communications infrastructure in various sectors of the society including education motived us to provide an Android based system to report Coronavirus outbreak in educational institutions using internet protocols and social media services.The proposed CRS was evaluated on two levels. In first level, the ability of the proposed CRS to work on various Android devices was checked. In second level, the performance of the proposed CRS was arbitrated by a group of specialized Android developer experts and a group of typical Android smartphones' end-users. The evaluation outcomes indicated that, the proposed CRS successfully worked on various smartphones with Android 4.4 KitKat or higher and achieved distinctive levels of arbitrators' acceptance, making it a useful tool to report the outbreak of Coronavirus epidemic in the education sector of Egypt.

Future work focuses on developing the current system. The future development plan will include the addition of another module that will enable the healthcare agency to take a series of actions to save the lives of the educational institution members who infected with Coronavirus epidemic.

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