

Research Article

Thamer Alameri*, Ahmed Hazim Alhilali, Nabeel Salih Ali, and Jawad Kadhim Mezaal

Crime reporting and police controlling: Mobile and web-based approach for information-sharing in Iraq

<https://doi.org/10.1515/jisys-2022-0034>

received January 05, 2022; accepted March 01, 2022

Abstract: Crimes are increasing in our society as a serious worldwide issue. Fast reporting of crimes is a significantly important area in anticrime. This problem is visible in Iraq as people avoid information-sharing due to the lack of trust in the security system despite some contact lines between citizens and police in Iraq. Furthermore, there has been a little empirical study in this field. We proposed a multi-approach for crime reporting and police control to address these issues. First, this study has two goals: (1) investigating the adopted method in reporting crimes to police sectors to identify the gap and, (2) developing a mobile application for crime reporting and keeping it undisclosed and exclusive for crime witnesses to report. The approach utilised 200 participants to develop the proposed app. Results have shown that the proposed system can quickly monitor and track criminals based on a cloud-based online database. In addition, the application user will specify certain details to be sent, such as location, case type and time. Other information will be sent directly by the system following the designed algorithm.

Keywords: crime reporting, track criminals, police, mobile application, geolocation

1 Introduction

Technological advancement in our lives has led to the growth of automation machines that utilise diverse life animations such as at home, work, health, and transport, to name a few [1]. Therefore, the researchers envisaged technology can enforce the law agencies and eliminate crimes [2]. The increasing numbers of attacks and crimes and many still being unreported are a crucial concern in other nations [3]. Therefore, citizen safety is the primary concern of a country's Police. The lack of confidence, fear, security threats, lack of time and inconvenience are several factors that cause the dramatic rise in unreported crimes and scarcity of proper evidence nowadays [4,5]. Some of the crimes are unknown due to unreliable data for investigation and others from undefined crime areas; people also refused to report a crime for security concerns, resulting in a complicated decision-making process. Hence, the identification area for a crime is based on numerous aspects such as demography, economic, outdoor use, indoor use and transportation [6]. Crimes create fear in the community, disrupt peace in the nation, impede the typical liveliness of the individuals and consequently require extensive attention from society and collaboration between government and the entire community to eliminate or eliminate or reduce crimes [7].

* Corresponding author: Thamer Alameri, Iraqi Police College, Baghdad, Iraq, e-mail: alamery.thamer@outlook.com

Ahmed Hazim Alhilali, Nabeel Salih Ali: Information Technology Research and Development Centre, University of Kufa, Kufa, Iraq

Jawad Kadhim Mezaal: State Company for Oil Projects (SCOP), Baghdad, Iraq

Crime-Report (CR) information ranking plays a significant role in internal security issues. The branches of law enforcement agencies should have adequate and fast CR Information Sharing (CRIS) mechanisms [8]. Literature has been substantially suggested and performed to improve the CRIS in fighting crimes worldwide. Many studies have focused on classifying intelligence or developing mathematical models to enhance analytical products [9]. Inferior information-sharing methods report incidents and collect enforcement agencies became apparent in Iraq. However, considering the limitation of empirical study in the Iraqi police sector, extant research has not been done and has not addressed a mobile application for CR, thus lacking CRIS. CRIS, therefore, could help the contacts share emergency cases with specific sections, which were confusing and took time when emergency help was needed [10,11].

This work has two primary objectives: first, investigating previous works related to the police sectors in the context of CRIS and technology adoption that identify problems, controversies or knowledge gaps in the field of study. Second, developing mobile and web-based app CRIS between citizens and police agencies.

1.1 Literature survey

In the 2000s, the crime rate increased, especially the type of crimes related to terrorism. The recent increase led to a renewed interest in developing anti-crimes products [12]. Several researchers suggested information sharing (IS) in this sector [4,10,13]. Several studies worldwide examined the relationship between IS and mobile apps in the crime sector [14]. In addition, research [14,15] showed that people could use mobile to report highway incidents. It's make-proof when used mobile phone data is an easy and reliable predictor of incidents on highway [4]. Presented geographic information system (GIS) for mobile app. to report a crime on location-based with an Android operating system. The result showed a spatial map representing different colour combinations varying from black to white and then analysed by GIS in varying areas with dense clusters of events [4]. The study [16] explored maps of registered crimes and perception of safety, whose benefits will improve the neighbourhood enhance life with GIS methods. Meanwhile, a graph-based clustering method is proposed to recognise crime reports depending on the restructuring of large unnamed crime corpora. The introduced work deals with crime reporting in India, the United States of America and the United Arab Emirates and the evaluations are conducted in terms of different supervised and unsupervised processes [16].

Apart from the study [7], the authors proposed an intelligent system that applied instant crime reporting to improve the time consume for crime reporting. The system can be extended to contact areas where Wi-Fi-enabled devices are scarce. It should also work with enhanced security concerning eavesdropping. Likewise, in the study [17], the authors proposed an app that individuals can use in Riyadh, the Kingdom of Saudi Arabia, to report and manage their complaints effectively. The proposed app aims to enhance the efficiency and effectiveness of interaction procedures between citizens and police agencies. This study proposed an online tool that monitors and tracks the country's criminals. In addition, an online unlawful event-reporting scheme with cloud-based technology is proposed to provide an appropriate and secure system for reporting and limiting crime that combines digital signatures, e-certificates, and symmetric/asymmetric keys [18]. Moreover, the study proposed a mobile app that gathers reported crimes in Metro Manila via unsupervised crowdsourcing information [7]. The aim of the study is to provide a method of the victims or citizens to reporting the crimes without going to police stations. Finally, in the study [2], Melden is an Android-Based mobile crime reporting app that uses crowdsourcing to allow individuals to convey various street crime reports directed to officials. The app also aims for an easier, faster and more reliable way of reporting incidents to officials. Thus, the apps help report incidents and collect information about the incidents.

1.2 Challenges

The security concern is one of the open problems for the Iraqi government, which had persisted since 2003 when the USA invaded Iraq [11]. Section 1 critically investigated and examined the studies in the case study. Consequently, we found insufficient academic literature on Iraq. Notably, in the context of CRIS and the empirical gap within the arena of the police domain [10], this scarcity leads to unsatisfactory solutions. Nearly all data for this case study were collected from reports, media, news, observations and interviews. Unstructured interviews and observation techniques were conducted for this study to seek how CR procedures are implemented in Iraq.

Furthermore, the current process for Iraqi CRIS is making a phone call by the citizen through help contact lines and then reporting the case. Then, the issues are forwarded to specialist departments. In this case, the caller will provide his details and use him to witness some patients. The Iraqi government uses many contact lines and e-mails for different situations, but the most popular helpline is 104. The latter is the same as 911 in other countries, but it does not contain all conditions, such as health and corruption cases. In addition, line 104 is linked with emergency security cases. The weakness of technology adoption at the Law Enforcement Agency (LEA) level is evident in Iraq. Recent developments in crime techniques have heightened the need for technology use within the LEA field. Unfortunately, the current information systems and processes are insufficient to deal with the threats of this situation.

However, the statistics of paper-based crime reports takes a long time, weakening the decisions for action. Knowledge within IS processes is inadequate in the LEA sector and has no clear policies. The data-sharing mechanism is lacking to keep pace with data collection operations by a different LEA. The initiatives to improve IS to fight crimes are not well coordinated. It leads to a lack of effective integration, increasing the risk that agencies will overlook or never receive the information needed to prevent crimes.

The CRIS within the context of the geographic region is not clear. However, the geographic region influences IS and information sharing across geographical differences is an initial step for future research. After 2003 the allies developed Iraqi force communities based on their experiences in this area instead of the case study that generated many failures in this context [11]. Increasing efforts should be exerted to study IS and the analysis, communication and technology used in the CRIS sector. It plays a critical role in decision-making, especially on battlegrounds and in situations where national security is under threat.

The rest of the sections are as follows:

Section 2 describes methods conducted to achieve the research objectives. The data collection and analysis are explained in Section 3. Section 4 presents the proposing approach encompassing paradigm, architecture, and implementation of the conducted system. Three modules are discussed in Section 5 to explain, describe and discuss the results. Finally, Section 6 denotes the research conclusions and highlights future directions.

2 Method

The mixed-method is used as a research approach to experiment with the actual use of the CR mobile app by Iraqi citizens.

First, a focus group approach was utilised as a qualitative research method [19,20] because the research problem was limited [9,21] to provide input for the second stage. Then, the CR mobile app was established in the second stage. Figure 1 shows the process of both stages. The focused method was used to identify the directions to developing a CR app linked to the mobile app needs of Iraqi users.

The first stage developed a questionnaire form. Participants were queried broad and open questions such as the following:

Stage one	Stage two
Investigations of existing works.	Design questionnaire and pilot.
Finding of case study / identify Iraqi Crime Report tools.	Determine population/sample size.
Highlight problems, research questions, objective, and scope.	Collect & Analyze data from the focus group.
Select research method.	Develop software

Figure 1: Process of two stages for CR.

- “What affects you to keep using a certain mobile app?”
- “What interface of mobile app do you like?”
- “How can you identify your location through the mobile app?”
- “How long do you keep your mobile per day?”
- “Did you use a mobile app at least once a day?”
- “What qualities of mobile apps are your worry?”
- “Where does your satisfactory with mobile apps come from?”
- “What is your vision for the CR mobile app?”
- “What influences your loyalty to a specific mobile app?”

Similar to previous studies, the results of the focus group discussion have shown that clients’ satisfaction with the mobile services quality is related to perceptions of the app (e.g. [22,23]).

Visions were perceived depending on what mobile app clients had earned. Clients mentioned that ease of use is a success factor in using mobile apps. It enhanced their loyalty to an experience. Another factor was the popular interface of mobile apps, which is essential for evaluating clients’ choices of mobile apps for future development.

The questionnaire items were developed according to the literature on mobile apps. An example is, satisfaction with the quality of mobile services [24–26]. The perception of clients’ expectations reflected a source to evaluate the performances of mobile services [27] depending on what clients think when using the apps [28]. A previous study mentioned registering the user experience [29,30] and behavioural intentions to use mobile apps [31,32] in post-use attitude.

Questionnaire items were acclimatised to suit the research context. The Iraqi citizens who had downloaded and utilised mobile app services are the study’s target population. Then, the sample was selected from a friend or a friend of a friend of authors. First, items were translated to the Arabic language then translated back to English to evaluate the translation’s validity [11,33]. A pilot examination was implemented on the questionnaire to check the consistency of meaning, comprehension, clarity, reliability and validity. Mobile app usage was tested via self-reporting, where users were requested to think about their favourite mobile apps, and they answered accordingly [1,11].

In the other stage, the researchers implemented focus group interviews in the sampling location (e.g. mobile users in Iraq). Finally, researchers asked the respondents to answer face-to-face regarding the survey Items [21]. The sample size comprised 200 participants. Respondents were grouped into two (100 per group), and interviews were divided into ten stages in eight weeks. Firstly, this study investigated the best requirement to design CR apps based on Iraqi citizens’ needs. Secondly, developing CR apps according to the results comes out from the first stage. Unfortunately, the proposed system was not examined in real-time, and 30 interns evaluated it, and it was used during the training stage to develop the CR app. The developed app provided a good opportunity to deepen our conception of crimes in the environment of Iraq and how the technology tools were injected into the Iraqi environment life cycle.

3 Data analysis

The same reports were analysed based on the available guidelines for theoretical construction via qualitative study [34]. The authors assumed the role of moderators in ten full group sessions. Other researchers also played the roles of observers and note-takers and discussed themselves at the end of each session to specify and verify initiated themes depending on their interpretations [21]. Afterward, each author developed a list of constructs according to the reviewed transcripts. The contributor's lists were then triangulated via discussions [34]. The constructs were identified for the CR app based on the correlation with the popular objects from the received responses.

This research approach allowed Iraqi citizens and law enforcement authorities to review its entirety and the authors to present a case study, obtain their viewpoints and interpret their perceptions.

4 Proposing approach

Section 4 provides a detailed overview of the system paradigm, objectives and development of mobile and desktop-based apps for reporting crimes by individuals and controlling the system by a police station.

4.1 System paradigm

As described briefly in Figure 2, the proposed system paradigm and objectives present the suggested multi-purpose app processes. The central individuals are the people who send information (crime reporting) via a mobile app based on the police station that consumes this information. The individual scenario is to produce a complaint about a previous crime report via a mobile-based app in the same area. Moreover, when a report arrives at a police station, a controlling and validating reporting system will be worked out following several metrics concerning the policy rules based on the web app.

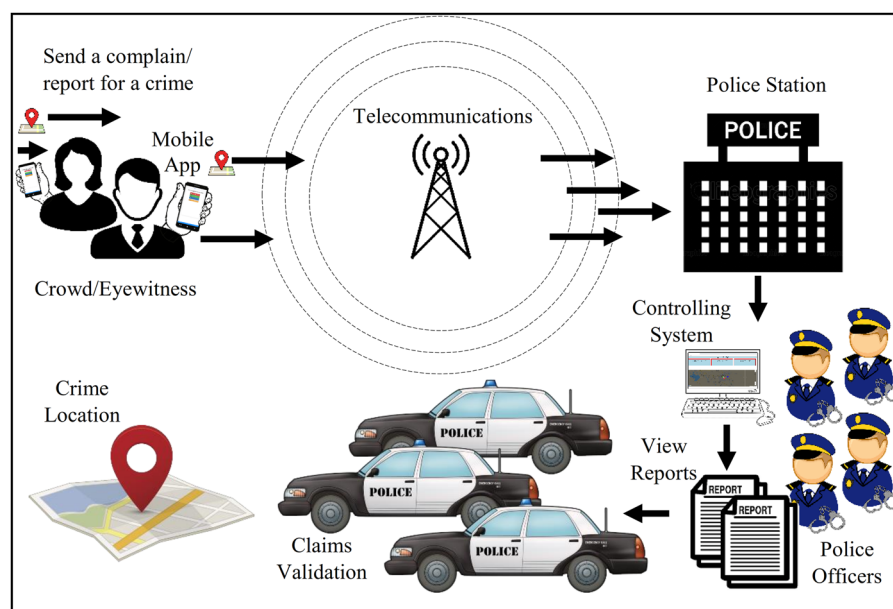


Figure 2: System paradigm.

4.2 System architecture

4.2.1 Crime reporting based on individuals

Society has to cooperate with the government to control crimes by reporting [35]. Unreported crimes have been rampant in other countries than Iraq [7]. In addition, the current advancement in technologies easily facilitates the involvement of society to provide information about committed crimes. Hence, some countries have proposed diverse online crime reporting apps in the literature to assist their communities in reporting any criminal activities. These apps, such as mobile-based apps, enable citizen crime reporting via smartphones, such as those in India [14] and KSA City [5].

This study aims to provide a mobile app that concentrates on collecting crime activities in an identified geographical area in Iraq by helping the citizens report a crime. The proposed system receives many reports of a single criminal commitment from diverse sources that provide authorities with the ability to collect data and eliminate or reduce the crime. Furthermore, the presented approach allows citizens to send a criminal activity report after setting the crime types from the app. The system will detect the location of the crime scene precisely based on geolocation information provided by the system to ensure report accuracy, as seen in Figures 2 and 3, respectively.

The proposed mobile app relied on the Geolocation application programming interface (API) provided by Google to allow users to submit and store their location on the web app's database after being asked for permission to report their location information. Geolocation API refers to determining the geolocation of a user or a smartphone device using different data collection mechanisms. It uses network routing addresses or internal GPS devices to determine the location.

The public plays a vital role in verifying that the reports are actual and referring to the same incident. The system administrator will accept them when the reports and the information match.

4.2.2 Controlling and validating the system for crimes

The proposed system assists police officers in determining unreported crimes or identifying the geolocation of the criminal acts via citizens' reports. People do not report crimes because of security threats, fear and the thought that reporting would not make any difference. Therefore, investigating many criminal acts is difficult due to unreliable data, lack of proper evidence and unreported incidents. These reasons increase the chances of crimes reoccurring in the future eventually. Accordingly, the proposed system will allow the public to work together with the proper authorities in achieving peace and reducing crimes in their respective areas.

The process flow of the mobile app presented in Figure 4 shows the system, registers the criminal report from the individual, traces geolocation, sends the notification to the police authorities and saves data and

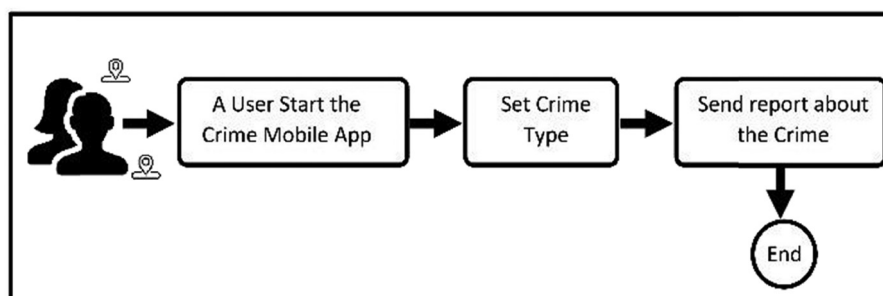


Figure 3: Incident reporting steps by unknown claimer.

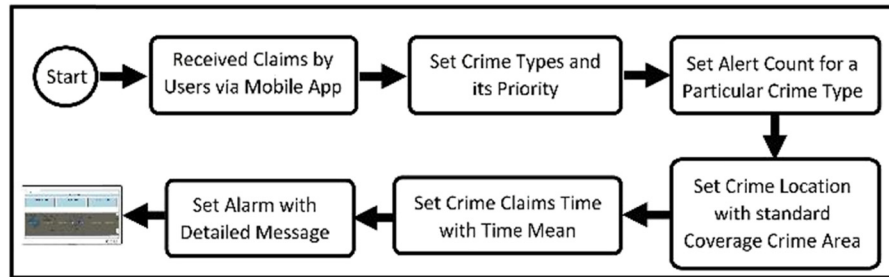


Figure 4: Presents the steps for controlling and validating the report system.

location to a database. Thus, the prominent participants are the public who spread information to the police authorities, utilising this information.

The system designates the public as the sender of reports for a particular crime. The reports would be controlled and validated by the system administration in the police officials' station. As shown in Figure 5, a desktop app describes the app's process flow to maintain and validate the citizen reports.

After storing all the location information sent by the app users, we calculated the distance between the locations. We used the Haversen equation to determine whether the distance of a circle between two points given their latitude and longitude is equal to or less than 3 km. The haversine formula will be used to calculate the distance of the stored locations based on equation (1).

$$d = R \times 2 \times \arcsin(\sqrt{(a + c)}), \quad (1)$$

To calculate the value of a in equation (1), the below equation (2) will be used.

$$a = \sin\left(\frac{\Delta lat}{2}\right)^2, \quad (2)$$

Also, we use equation (3) to get the value of c .

$$c = \cos(lat1) - \cos(lat2) \times \sin^2\left(\frac{\Delta long}{2}\right), \quad (3)$$

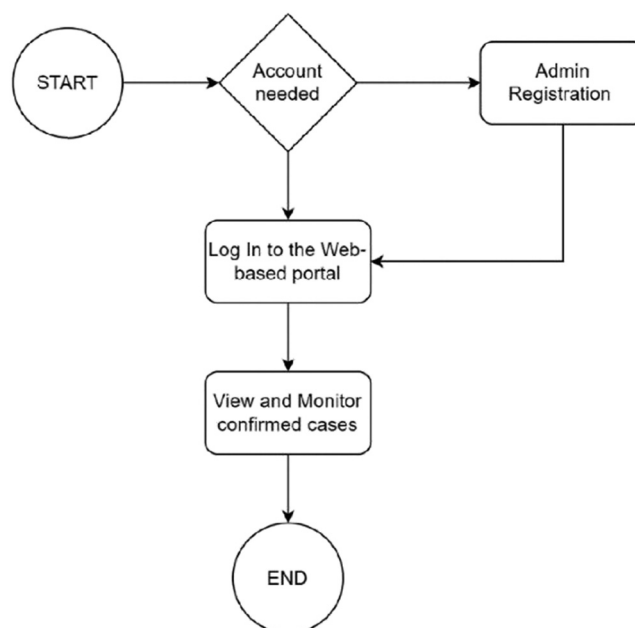


Figure 5: Desktop app process flow.

Legend:

1. R = earth's radius, which is equal to 6,371 km
2. $\Delta\text{lat} = (\text{lat}2 - \text{lat}1)$
3. $\Delta\text{long} = (\text{long}2 - \text{long}1)$
4. c = axis intersection calculation
5. d = distance (km)

The system administration will supervise the web-based portal to view and monitor the confirmed reports from the public.

The app for controlling and validating crimes provides a role for scouring criminal acts from the public based on the types, rated into four categories as Terrorist, Theft, Kill and other registered criminal acts. After registering the report from individuals, the apps set the criminal act types to score the crime types and their priority to capture the culprits and provide better public safety intervention. Moreover, the system marks public reports as an alert to the app in crime types. Therefore, each type of crime has several warnings from unknown people to validate those collected from the rule of Iraqi Official police in the ministry of home. Likewise, a standard coverage geographical area based on police rules is set to identify the crime location from public reports. Moreover, a mean time will be set to count the crime claim or report the time to verify the public's crime alerts. Finally, when all steps are scored and acted upon, the report will display a detailed message in the central station for the police authorities.

4.3 System implementation

As mentioned in Section 4.2.2, the presented system has two modules or functions - crime reporting by the public based on a mobile app (see Figures 2 and 3) and controlling crime reports (see Figures 4 and 6) based on a desktop app. The objectives of the mobile-based app include:

- 1) Set a crime type and
- 2) Register case via the map,
- 3) Save details and location to the database, and
- 4) Send crime reports via the internet to the police station.

Figure 7 lists the detailed implementation steps for the crime-reporting module.

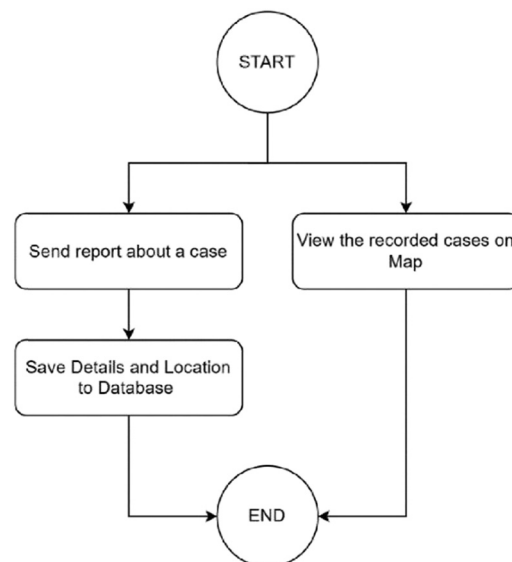


Figure 6: Mobile app process flow.

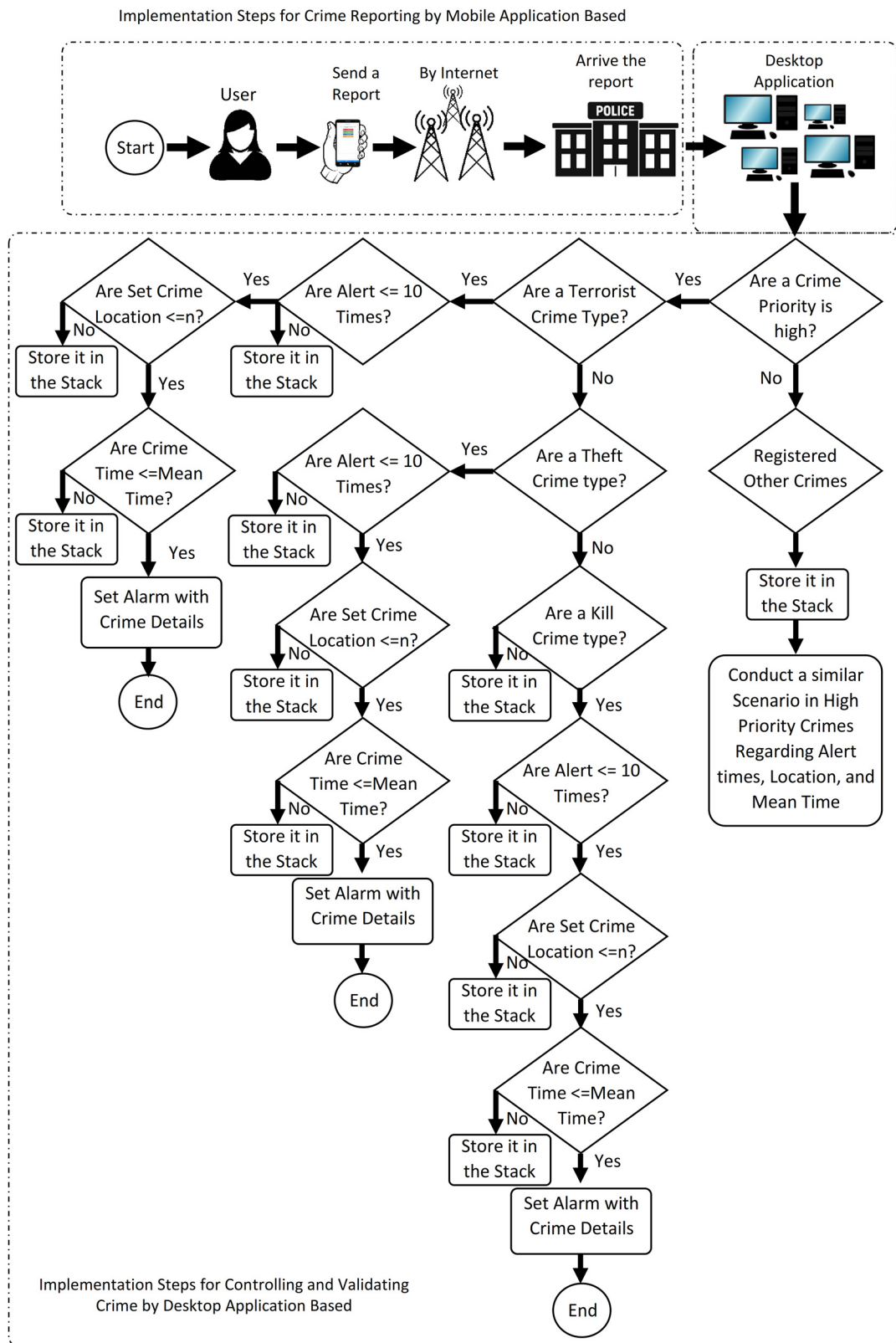


Figure 7: Implementation steps for the proposed system.

By contrast, the desktop app controls and validates crime reports as the main aim, including several goals such as (1) they were investigated for actual or fake crime reports sent by the public, (2) levels the crime type priority depending on their high significance in saving society from criminal acts, (3) counts the report alert times according to n , which is assumed to be less or equal to 10 alerts for each type of crime, (4) setting the crime location whether less or equal to n , which takes 3 km for a particular crime type and finally (5) conduct a crime time mean, which assumes 30 min for each crime report to validate the reality of the public reports. Otherwise, the crime type has a low priority and is registered as another crime type. Figure 5 explains with comprehensive information all the steps to implement controlling and validating the crime reports based on the desktop app.

5 Results and discussion

5.1 Mobile module

Figure 8(a) shows the main screen of the mobile app. It is used to send reports about incidents that are being witnessed. The system classifies the cases into three categories depending on the importance and the crime priorities, including terrorism, killing and stealing. After sending a report, a message appears to notify the sender that the reported case has been recorded (see Figure 8(b)). In addition, through the same screen, the people can view the recorded topics within their current location (see Figure 8(c)).

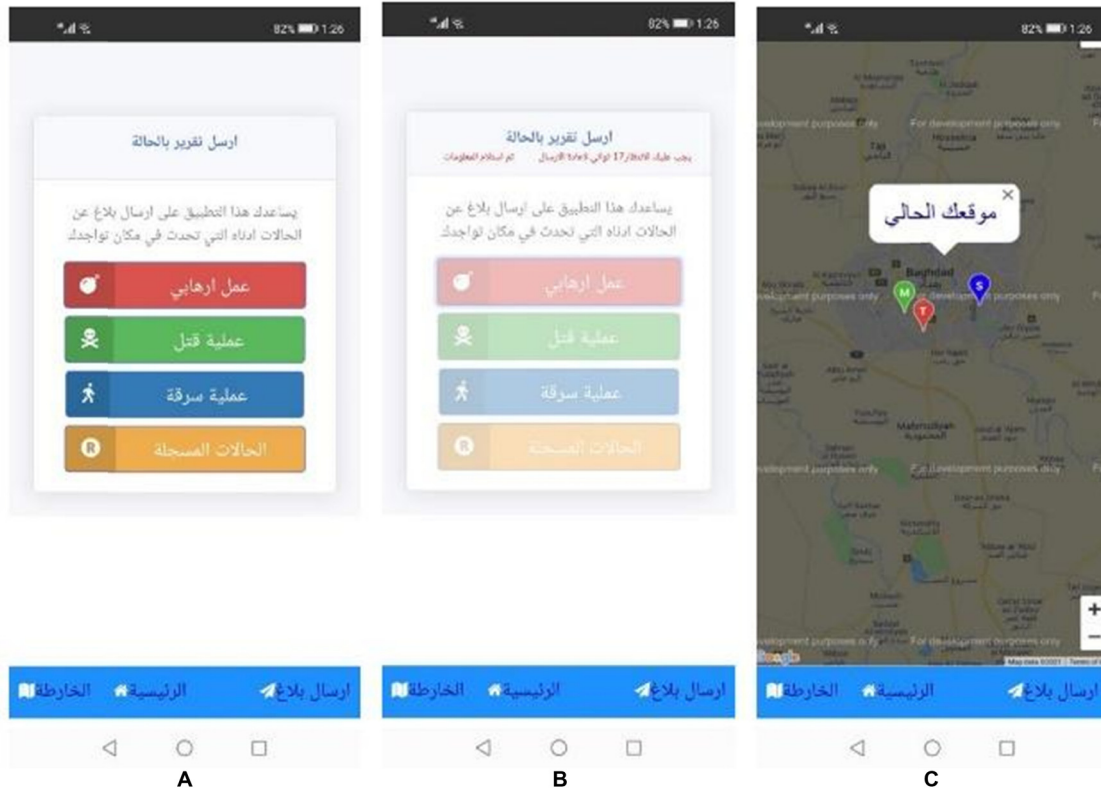


Figure 8: Home screen and map of the mobile-based application. (A) Home screen to send a report. (B) Screen to confirm sending the report. (C) Location mapping.

5.2 System controlling module

The central control station will view all the recorded data through the web-based portal. The portal is divided into three main windows according to the case categories. Each one shows the confirmed cases, such as the type, time and location see Figure 9. Moreover, all the confirmed cases will be displayed on the map with different colours and letters, symbolising the case type (red T for terrorism, green M for killing and blue S for stealing).

5.3 Database module

The system used a MySQL database to store all the data to perform activities and provide information when queried, such as location, case type and time. In contrast, other details were generated based on unique algorithms. Table 1 explains the structure of the saved data.



Figure 9: Controlling and validating crime reporting system.

Table 1: Database structure

Field name	Data type	Constraint
ID	Int(80)	Primary key
Lat	Varchar(80)	Not null
Lng	Varchar(80)	Not null
Type	Varchar(30)	Not null
Time	Varchar(200)	Not null
Status	Int(10)	Null
Counter	Int(80)	Null

6 Conclusion

This paper has discussed the reasons for inferior reporting crimes methods between citizens and branches of law enforcement agencies in Iraq.

This study seeks to develop a mobile app that concentrates on collecting crime activities in an identified area in Iraq by helping the citizens report a crime. The developed app was based on individuals' needs through multi-focus group interviews. The app seeks to enhance the efficiency of the interaction process between the police and people. The results appear in the tool to indicate and track the criminals in the country and perform them online. The app also aims for a reliable, faster and easier method of reporting incidents to Iraqi officials. The system allows citizens to send a criminal activity report after setting the crime type from the app. This study indicates that developing countries need more studies regarding the interaction between citizens and law enforcement agencies. This research extends our knowledge of employing mobile apps with human interaction in terms of crime reports. While this study did not confirm the ability to interact with the app with the hotline of crime reporting, it did substantiate that utilising the mobile app for crime reporting without voice calls and hiding the reporter information would increase the crime reporting percentage. Finally, several important limitations need to be considered. First, the suggested system was not experimented with in real-time and was evaluated by 30 interns to develop the CR app during the training stage. Second, this study did not discuss any theory related to mobile technology. Future studies are suggested using quantitative study and discussing various theories in mobile technology may help understand the Iraqi barriers. The government is encouraged to use e-tools that enhance the law enforcement performance in Iraq. The media must encourage the citizens to use new technology services.

Funding information: None.

Author contributions: Writing – original draft, investigation, methodology, review and editing by Thamer Alameri. Writing – original draft, writing – review and editing, and coding by Ahmed Hazim Alhilali. The investigation, methodology, visualization, result analysis, writing – original draft, writing-review and editing by Nabeel Salih Ali. Writing – original draft, writing-review and editing by Jawad Kadhim Mezaal.

Conflict of interest: No conflict of interest.

Permission to reproduce materials from other sources: None.

References

- [1] Alameri T, Hammood MN, Mezaal JK, Eneizan B. E-payment model for the iraqi public sector: a passport issuance E-system. *J Eng Sci Technol.* 2022;17(1):0435–51.
- [2] Rey WP, Balderama NAMS, Hipulan SL, Salayon AAC. MELDEN: An Android Based Mobile Crime Reporting App Using Crowdsourcing. Paper presented at the Proceedings of the 2019 5th International Conference on Industrial and Business Engineering; 2019.
- [3] Ali NS, Shibghatullah ASB, Alhilali AH, Al-Khammasi S, Kadhim MF, Fatlawi HK. A comparative analysis and performance evaluation of web app protection techniques against injection attacks. *Int J Mob Commun.* 2020;18(2):196–228.
- [4] Maghanoy JAW. Crime mapping report mobile app using GIS. Paper presented at the 2017 IEEE 2nd International Conference on Signal and Image Processing (ICSIP); 2017.
- [5] Tabassum K, Shaiba H, Shamrani S, Otaibi S. E-Cops: An online crime reporting and management system for Riyadh city. Paper presented at the 2018 1st International Conference on Computer Apps & Information Security (ICCAIS); 2018.
- [6] Mohd Shamsuddin NH, Bin Othman MS, bin Selamat MH. Identifying of potential crime area using analytical hierarchy process (AHP) and geographical information system (GIS). *Int J innovative Comput.* 2013;2(1):15–22.
- [7] Fabito BS, Lacasandile AD, Trillanes AO, Yabut ER. Leveraging crime reporting in Metro Manila using unsupervised crowd-sourced data: A case for the iReport framework. Paper presented at the 2017 International Conference on Control, Electronics, Renewable Energy and Communications (ICCREC). IEEE; 2017. (pp. 231–235).

- [8] Strom KJ, Smith EL. The future of crime data: The case for the National Incident-Based Reporting System (NIBRS) as a primary data source for policy evaluation and crime analysis. *Criminol Public Policy*. 2017;16(4):1027–48.
- [9] Shih T-F, Chen C-L, Syu B-Y, Deng Y-Y. A cloud-based crime reporting system with identity protection. *Symmetry*. 2019;11(2):255.
- [10] Abbas T, Shibghatullah AS, Yusof R, Jaber MM. Effective environmental factors to performance of electronic information sharing in iraqi intelligence. *J Eng Appl Sci*. 2016;11(3):452–61.
- [11] Alameri T, Abudulmajeed S, Shibghatullah AS, Jaber MM. Towards proposing an electronic information sharing model for the intelligence sector: A methodological framework. *J Eng Sci Technol*. 2019;14(3):1687–702.
- [12] Cocq C. Development of regional legal frameworks for intelligence and information sharing in the EU and ASEAN. *Tilburg Law Rev*. 2015;20(1):58–77.
- [13] Bigdeli AZ, Kamal MM, De Cesare S. Electronic information sharing in local government authorities: Factors influencing the decision-making process. *Int J Inf Manag*. 2013;33(5):816–30.
- [14] Lal D, Abidin A, Garg N, Deep V. Advanced immediate crime reporting to Police in India. *Proc Computer Sci*. 2016;85:543–9.
- [15] Oteyo IN, Toili MEM. Improving Specimen Labelling and Data Collection in Bio-science Research using Mobile and Web Apps. *Open Computer Sci*. 2020;10(1):1–16.
- [16] Steenbruggen J, Tranos E, Rietveld P. Traffic incidents in motorways: An empirical proposal for incident detection using data from mobile phone operators. *J Transp Geogr*. 2016;54:81–90.
- [17] Ogneva-Himmelberger Y, Ross L, Caywood T, Khananayev M, Starr C. Analyzing the relationship between perception of safety and reported crime in an urban neighborhood using GIS and sketch maps. *ISPRS Int J Geo-Inform*. 2019;8(12):531.
- [18] Das P, Das AK. Graph-based clustering of extracted paraphrases for labelling crime reports. *Knowl Syst*. 2019;179:55–76.
- [19] Deshpande R. “Paradigms lost”: On theory and method in research in marketing. *J Mark*. 1983;47(4):101–10.
- [20] Creswell JW, Creswell JD. *Research design: Qualitative, quantitative, and mixed methods approaches*. United States: Sage Publications; 2017.
- [21] Ramadan R, Aita J. A model of mobile payment usage among Arab consumers. *Int J Bank Mark*. 2018;36:1213–34.
- [22] Wang K, Lin CL. The adoption of mobile value-added services: Investigating the influence of IS quality and perceived playfulness. *Managing Serv Quality: An Int J*. 2012;22:184–208.
- [23] Zhou T. An empirical examination of continuance intention of mobile payment services. *Decis Support Syst*. 2013;54(2):1085–91.
- [24] Liébana-Cabanillas F, Sánchez-Fernández J, Muñoz-Leiva F. The moderating effect of experience in the adoption of mobile payment tools in Virtual Social Networks: The m-Payment Acceptance Model in Virtual Social Networks (MPAM-VSN). *Int J Inf Manag*. 2014;34(2):151–66.
- [25] Orel FD, Kara A. Supermarket self-checkout service quality, customer satisfaction, and loyalty: Empirical evidence from an emerging market. *J Retail Consum Serv*. 2014;21(2):118–29.
- [26] Taha A, Jahed DH, Ahmad MN, Zakaria NH. Antecedents of customer satisfaction in mobile commerce: A systematic literature review. Paper presented at the 2013 International Conference on Research and Innovation in Information Systems (ICRIIS); 2013.
- [27] Kim J, Jin B, Swinney JL. The role ofetail quality, e-satisfaction and e-trust in online loyalty development process. *J Retail Consum Serv*. 2009;16(4):239–47.
- [28] Yen CH, Lu HP. Effects of e-service quality on loyalty intention: an empirical study in online auction. *Managing Serv Quality: An Int J*. 2008;18:127–46.
- [29] Laroche M, Habibi MR, Richard M-O. To be or not to be in social media: How brand loyalty is affected by social media? *Int J Inf Manag*. 2013;33(1):76–82.
- [30] Schierz PG, Schilke O, Wirtz BW. International Conference on Cybernetics and Computational Intelligence (CyberneticsCom). Understanding consumer acceptance of mobile payment services: An empirical analysis. *Electron Commer Res Appl*. 2010;9(3):209–16.
- [31] Sahin A, Zehir C, Kitapçı H. The effects of brand experiences, trust and satisfaction on building brand loyalty; an empirical research on global brands. *Proc Soc Behav Sci*. 2011;24:1288–301.
- [32] Hong IB, Cha HS. The mediating role of consumer trust in an online merchant in predicting purchase intention. *Int J Inf Manag*. 2013;33(6):927–39.
- [33] Munir S, Jami SI, Wasi S. Towards the modelling of Veillance based citizen profiling using knowledge graphs. *Open Computer Sci*. 2021;11(1):294–304.
- [34] Belk RW, Sherry Jr JF, Wallendorf M. A naturalistic inquiry into buyer and seller behavior at a swap meet. *J Consum Res*. 1988;14(4):449–70.
- [35] Saputra K, Nazaruddin N, Yunardi DH, Andriyani R. Implementation of haversine formula on location based mobile app in syiah kuala university. Paper presented at the 2019 IEEE International Conference on Cybernetics and Computational Intelligence (CyberneticsCom); 2019.