RESEARCH ARTICLE

DOI: 10.34256/ijcci2224

International Journal of Computer Communication and Informatics

24X7 - Travelling Womens Safety in Metrocity Traffic

Devikanniga Devarajan [a],*

[a] Department of Computer Science and Engineering, JAIN (Deemed-to-be University), Bangalore, Karnataka-562112.

* Corresponding Author: mail4kanniga@gmail.com

Received: 14-10-2022, Revised: 09-11-2022, Accepted: 15-11-2022, Published: 30-12-2022

Abstract: As technology has advanced quickly, more individuals are using smartphones for a variety of functions such as marketing, business, social media, surfing, etc. This has also increased the threat of information sharing across various sites, which is one of the major reasons for harassment cases and other security threats against women. Surveys reveal that, smartphone usage by women has risen upto 5 folds in the last 6 years which is an average increase by 27% per annum. The increase in usage means that, there are high chances for misuse of information which results in security threats for women. The proposed system aims to create awareness of smartphone usage in mobile computing among women to efficiently handle it by avoiding physical assaults and harassments against women. It focuses to provide a Global Positioning System (GPS) dependent, android based safety application exclusively designed for women who travel farther distances on daily basis. Here it is implemented with help of Dijkstra's Algorithm to find out locations based on Breadth First Search to form shorted path tree for reachable locations.

Keywords: Mobile Computing, Dijkstra's shortest path algorithm, Breadth First Search (BFS), Shortest Path Tree (SPT), Global Positioning System (GPS) and android.

1. Introduction

The proposed system aims to create security awareness among women who travel a long distance daily. It facilitates self-protection among women during any critical situation by usage of smart phone with a GPS system. The application does not only provide safety actions, but also focusses on alerting the police officials on time to arrive at the location and act on the critical situation. Usage of smartphones has rapidly increased among people across various domains like business, finance, marketing, and personal uses like texting, emailing, social media access, information searches, etc. Despite its importance, Surveys claim that women smartphone users have risen upto 5 folds in the usage of smartphones in the last six years which is around 79%

increase per annum [1]. This is one of the major reasons of developing this application to ensure women's safety and create awareness on usage of smart phones in an efficient way for women across the country. Women's safety in smart cities must be guaranteed. Women's safety is a global problem despite the adoption of numerous legal and technical measures. Although there are various mobile applications that guarantee the protection of women, they are ineffective and only make minimal use of societal action. When crime response, crime analysis, and crime prevention strategies are not coordinated, gaps in guaranteeing the safety of women result [2].

Nowadays, physical harassment is the one of the most common and frequently happening offenses against girls and women in India. It is also revealed that in 98% physical harassment cases, the culprit is someone close to the victim like neighbour or relative, where bureaucrats cannot do much to control as it is not possible to keep watch on each house every time [3]. High usage of smartphones has also increased the threat for information sharing across various sites which is one of the major reasons for harassment cases and other security threats against women [4]. 35 percent of women globally experience unethical sexual harassment in public spaces like railway stations, bus stops, footpaths, and so on, according to polls from the WHO and NCRB-Social Government [5]. That is stated in the WHO report. "An act of violence against women disrupted society's public health and violated women's human rights," [6]. The application focuses to provide an GPS dependent, android based safety application exclusively designed for women who travel farther distances on daily basis [7]. With the increase in urbanization across major cities of India, there is an increase in demand for mobility. Public transports on most scenarios are not able to satisfy the need of an efficient transportation method due to proportionate increase in population vs increase in vehicle owners. Increase in demand for mobility when compared with less road space leads to heavy traffic congestion on the roads of metro cities like Chennai, Bengaluru, Kolkata, Mumbai, etc [8].

The proposed system aims to focus on creating awareness and efficient usage of smartphones among travelling women with help of a safety application considering the traffic and transportation scenarios of metropolitan cities. The application focuses to be cost effective as it just uses the GPS system that is available in all basic models of smartphones so that it can fit into the needs of a common working women without investing on costly gadgets. SMS-based continuous location monitoring information makes it easier to locate the victim promptly and rescue them securely. Traveling ladies may use this app to plan their trip and notify the police about it to safeguard their safety. During unplanned travel or daily work routines, having the application installed and running in the background, app is capable of searching for a nearest police patrol and alert them with the location co-ordinates of the women who is in crisis. This helps Police department to quicky sense and act on the crisis and the criminals who are involved in it. Thus, helping to avoid crucial attacks and physical harassments on women who travel farther distances during late hours of the day via unknown or offline transportation routes. The application has been implemented using Dijkstra's shortest path algorithm which helps to identify the nearest patrol police vehicle as soon as an alert is triggered from the victim who is in crisis.

Further part of the paper has been sectioned as follows: Research methodology and related works are discussed in Section 2. Section provides details about the proposed system and its design viewpoints. 3. Experimental results are analysed and discussed with statistical data in Section 4. Finally, the proposed work is concluded in Section 5 with a proposal of possible future enhancements.

2. Survey and Related Work

Surprisingly, the majority of researchers adopt the premise that users select the sensing tasks on their own and are unaware of how their methods affect how well each activity is sensed based on this assumption. It is quite likely that most users will participate in an activity that is already popular while the other activities would struggle to attract enough users. The quality of the sensing services and the incentives for the users may be impacted as a result of an unbalanced allocation of the users' resources. Additionally, the writers of most works have not taken into account the resource limitations of each user's accessible wireless channel.

The users' limited resources, however, may have an impact on the sensing performance of the smartphone sensing networks in a typical scenario where the jobs need real-time data uploading or the necessary data feedback rate for uploading is quite high [9].

Disadvantages

- The users' collaboration is considered as a potential solution to the resource imbalance issue.
- When selecting their sensing tasks, sensors make separate selections and are unaware of how their tactics affect how well each task is sensed.

Since more and more individuals in the modern world are utilising smartphones, these devices may be effectively employed for personal security and other types of protection. This essay introduces Abhaya, an Android app for women's safety that may be launched with a single click whenever the situation calls for it. A single click on this app locates the position of the place using GPS, sends a message to the registered contacts including the location URL, and calls the first registered contact to assist the user in an emergency. This application's special feature is that it will send messages automatically every five minutes to the contacts you have entered until you click the "stop" button.

Continuous SMS location monitoring information enables the victim to be located immediately and securely rescued [10]. A rise in the number of unresolved cases nationally may result from officers in command giving high quantities of crimes and emergency cases late attention. In order to reduce the difficulties experienced by Police and Fire Fighters in obtaining correct information when patrolling high-risk areas, the author of the study advocated the use of Pull & Push Location Based Service model in trials of the deployment of Location Based Service environment. Police and firefighters in the emergency case department frequently have issues with the amount of time it takes and the veracity of the information. They must get the

appropriate information at the appropriate moment on their walkie talkies or mobile phones [11]. When users are retrieved or pushed based on their geolocation, updates on crimes or emergency situations nearby are delivered. The application flow begins with the location position being retrieved, and information about emergency situations is then shown in accordance with the given dates [12]. The mechanism that refers people can be used to find and assist women who are in need. It displays the precise location of the person and sends the point of interest to her family, guardian, and friends via Short Message Service (SMS) [13].

Table 1. Comparison of Shortest Path Algorithms

Algorithm	Bellman- Ford Algorithm	Floyd-Warshall Algorithm	Dijkstra's Algorithm	Prim's Algorithm	Kruskal's Algorithm
Definition	It is a single-source shortest path algorithm works with negative edge graphs.	It is all-pairs shortest path algorithm.	It is a single-source shortest or algorithm.	Builds a shortest spanning tree from any vertex in the graph.	Builds a shortest spanning tree from the vertex having the lowest weight in the graph.

Notation	v[i].distance <= v[i-1 (mod k)].distance + v[i-1 (mod k)]v[i].weight	distance[i][j] = min(distance[i][j], distance[i][k] + distance[k][j])	dist[u] = dist[v] + Graph.Edges[v, u].
			dist[u]
				If (!selected[j] && G[i][j]) {
				if (min > G[i][j]) {
				min = G[i][j]; x = i;y = j;}}
					if find-Set(u) ≠ find-SET(v):
					A = A ∪ {(u, v)}
					union(u, v)
					return A

Time Complexity	O(V.E)	O(V3)	O(E log V)	O(Vlog|V| + ELog|V|)	O(|E| Log |V|)
Space Complexity	O(E)	$O(V^2)$	O(E)	$O(\|V\| + \|E\|)^2$	O(|E| Log |E|)

Runtime	O(|V|.|E|)O(|V|·|E|)	O(|V|^3) O(|V|3)	O(|V|^2)O(|V|2)	O(E+VLog V)	O(|V| + |E| Log |V|)
Advantages	Supports negative edged graphs and is optimal.	Uses dynamic programming approach.	Uses BFS Search which improves runtime and easy to compute.	Runs faster in dense graphs	Runs faster in sparse graphs and is easy to impleme nt.
Disadvantag es	Quality of obtaining shortest path is less. Slower due to changing topology.	Has static weight for each node. No path updates during flow and has complex computation.	It is not used in distributed systems.	Works well only for list data structure and a connected graph. Edges needs to be searched from the beginning every time and is harder to implement	Works well only for heap data structure. Does not guarante e to provide a shortest tree with least weighted edges.

Women's safety has grown in importance globally over the past few years. Women in today's world are autonomous and powerful. However, they continue to worry about their protection from harassment and violence as they travel at night through uncharted territory. An Android phone can be used to safeguard women in dangerous situations since there has been a significant growth in the number of Android users. In an emergency, the user can use this app to phone or text the police and the designated contact number. The notification includes information about the user's present location [14].

None of the available mobile humanitarian applications precisely has the capabilities that a victim needs in danger or right away after being harmed.

3. Proposed Work

In the proposed system, which is an android application to safeguard the passengers those who are travelling in the private vehicles such as auto, cab, bus etc. The android application will have the capability to transmit the location details to the patrol system during critical situations. The application will search and list out the number of patrol cars that are placed in that particular location to track these kinds of illegal incidents through Dijkstra's shortest path algorithm. The patrol police will get an alert message in mobile phone to track the vehicle and find out the actual location of the person. During planned travel schedules, users can enter their daily schedule along with their locations. So that application will run a cron job to cross check whether the person is in same location on that time frame or else will capture the exact location and forward to their security contacts which they had already entered in their mobile through E-mail or SMS. The advantage of this proposed system is that the patrol police can track the illegal incidents very quickly and act on the victim, because it is transmitting the data to the server with the help of WI-FI/GPS.

The proposed system has following modules in it:

Policy Module-GPS System: The application will have the capability to transmit the location detailsto the patrol system in and around the radius of the location through GPS during critical situations. **Policy Module - Patrol System**: The patrol police will get an alert message in mobile phone and then he can login and track the vehicle location to find out the person.

AdminModule–Registration: After installation and Post registrations provide mandatory details like email address,city,state, pin code, contact details for emergency contact purpose.

Monitoring Module- Time Schedule: The programme locates the IMEI and SIM mobile number during installation and saves them on a remote server.

Monitoring Module – Tracking: To contact a patrol or send an SMS to the subscriber code, the victim must dial a number. Here, GPS is utilised to send the mobile device's latitude and longitude to the server. Using Dijkstra's algorithm, the server will look for the patrol's GPS location that is closest to it.

Figure.1 Use case diagram for User and Patrol Modules

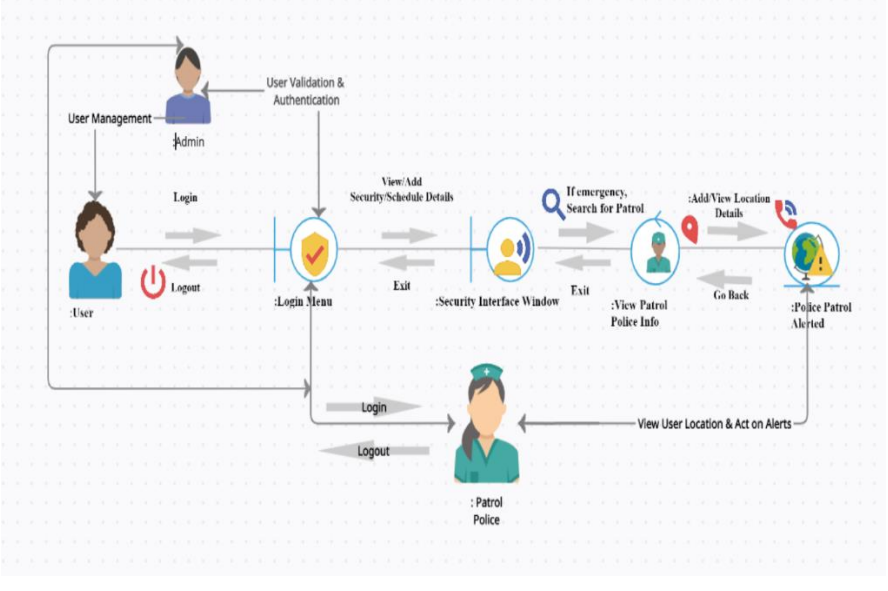

Figure.2 Collaborative model of the application

Monitoring Module – Notification: The application will get started in the boot start-up and will continue running in the background. This help the user not to turn on the application when the person is in trouble, just might give a gentle shake in anticlockwise direction to alert the patrol. The distance is calculated as:

dist[u]=dist[v]+Graph.Edges[v,u].dist[u] (u,v is vertices)

and its corresponding java implementation as follows:

```
void find_nearest_patrol(int locationgraph[][], int alert_location)
{
int distance[ ] = new int[startnode];
Boolean location_set[ ] = new Boolean[startnode];
 for (int i = 0; i < startnode; i++)  {
   distance[i] = Integer.MAX_VALUE;
    location_set[i] = false;   }
   distance[alert_location] = 0;
    for (int count = 0; count < startnode - 1; count++)
    {
      int u = minDistance(distance, location_set);
      location_set[u] = true;}
    for (int v = 0; v < startnode; v++)
    {
       if (!location_set[v] && locationgraph[u][v] != 0 && distance[u] != Integer.MAX_VALUE
  &&        distance[u] + locationgraph[u][v] < distance[v])
    distance[v] = distance[u] +    locationgraph[u][v];
  }  }
```

From the study made in Table 1., Dijkstra's algorithm is a preferable BFS (Breadth First Search) based approach for proposed system because of its shorter runtime complexity and helps to find the patrol vehicle quicker than others.

4. Experimental Results with Performance Analysis

The suggested system is tested using the Bellman-Ford, Floyd Warshall, and Dijkstra algorithms, and it is implemented in Java. In this, Dijkstra's Algorithm has the best time complexity trend when compared with Bellman-Ford and Floyd Warshall algorithms. As it works on BFS method, distance of traversing from one node to other nodes is always achieved in quick span of time and can be stopped once shortest path is achieved to the destination node.

Hence with the running time of O(n2), a greedy optimal path to the destination node can be achieved in shorter time. So, its time complexity is O(E log V). It means that All destination places may be considered (log V) for analysis to the particular woman(E log V).The processing time of the different number of nodes (places) for different algorithms are measured as follows.

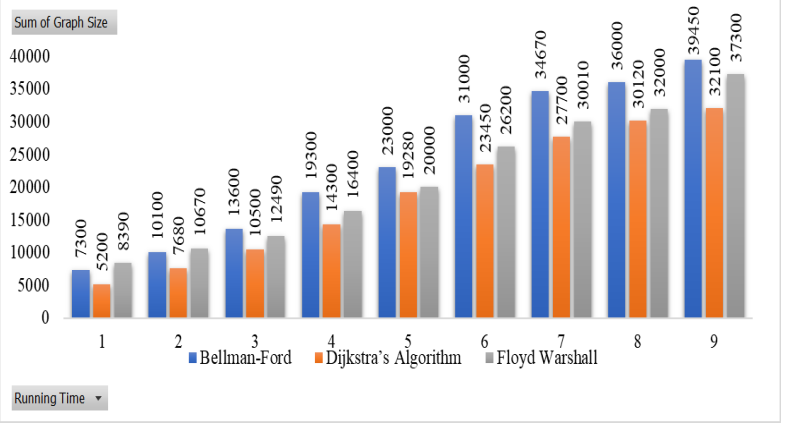

Figure.3 Runtime Performance of Application using Dijkstra's Algorithm

Table.2 Time Complexity of Application using Dijkstra's Algorithm

Time Taken (in mins)	No. Of Nodes Hopped
0.1	170
0.2	210
0.3	230
0.4	245
0.5	260
0.6	331
0.7	389
0.8	410
0.9	477
1	513
1.1	546
1.2	580
1.3	622
1.4	750
1.5	810
1.6	899
1.7	968
1.8	1009
1.9	1105
2	1200

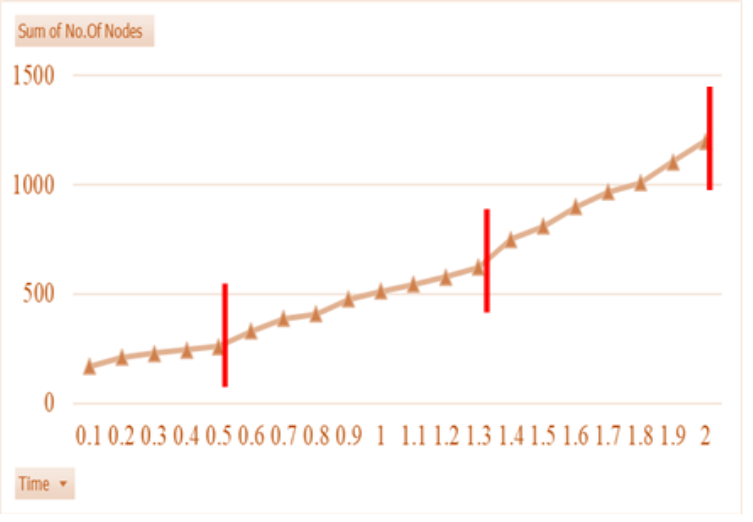

Figure.4 Time Complexity of application using Dijkstra's Algorithm

It is observed from Fig.3, that graph size has an exponential increase across all the algorithms when compared based on their running time.It is observed from Fig.4, that Dijkstra's algorithm has a simpler complexity which is almost very linear in trend. Here the x-axis denotes execution time in milliseconds(ms), whereas the y-axis denotes the number of places. The algorithm has been implemented here to find the nearest police patrol vehicle in case of an emergency. As analysed, algorithm seems to quickly find the optimal path of the nearest patrol vehicle with 30secs with minimal hopping of nodes which is considered a best-case scenario. At the same time, it takes a considerable amount of time of upto 63-65 secs to identify a nearest available patrol which is considered as an average performance of the application considering the city traffic and location where the alert has been triggered.

However, we feel that if an emergency alert notification has been triggered from outskirts of the city or from any unknown roads like non-residential areas, forest routes, etc., there will be considerable time taken by the application of upto 2mins or even more for it to contact nearest available patrol vehicle and alert them about the emergency location.

This critical point is best case scenario, and it is order of the growth is constant order. When the number of places is increasing after the first vertical line, the order of the growth is changing into linear order. The second critical curve is in-between the second and third curve points. Here the curve is travelling in near to exponential order. So, the time taken for execution is more. The third critical point is observed from first vertical line to second vertical, and suddenly it is increasing after first vertical line. The graph curve between first and second vertical line is predicted as liner order growth from the graph.

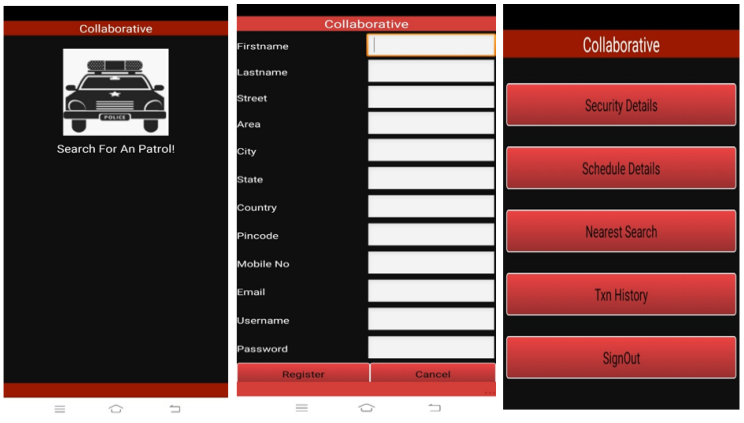

Figure.5 Application Screenshots – User View

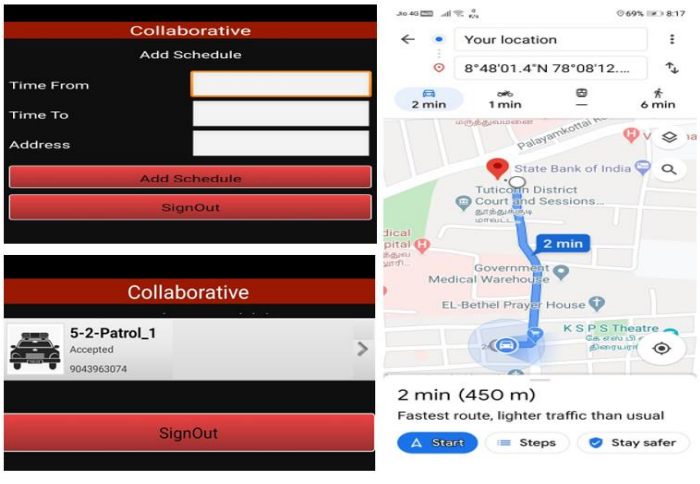

Figure.6 Application Screenshots – Patrol View

5. Conclusion

In this proposed system, the awareness of smartphone usage among women has been focused and with help of GPS system, women who are trapped in a critical situation are identified with help of this application. This is very much helpful for the police department to quickly identify harassment cases and other physical assaults happening for women as their location details are transparent and shared to police with help of GPS connectivity. Hence, with help of this application, women can travel safely to any location irrespective of time and if encountered a critical situation or any dangerous scenario, with just a shake of the smartphone, the application can sense the location and identify the nearest patrol police to alert them and act on the incident happening around. If she crosses long distances that are beyond patrol police-controlled location like forest reserved routes, hill stations, it will be difficult for tracking GPS location. In this case, Notification alerts may include cautioning of women about travelling in offline route and patrol

police about the last know trackable location of the women who is travelling in the area. It will be considered for future enhancement.

References

[1] E. D. G. Vinarao et al., Athena: A Mobile Based Application for Women's Safety with GPS Tracking and Police Notification for Rizal Province, 2019 IEEE Student Conference on Research and Development (SCOReD), (2019) 117-122. https://doi.org/10.1109/SCORED.2019.8896274

[2] M. V. Shenoy, S. Sridhar, G. Salaka, A. Gupta and R. Gupta, A Holistic Framework for Crime Prevention, Response, and Analysis with Emphasis on Women Safety Using Technology and Societal Participation, in IEEE Access, 9 (2021) 66188-66207. https://doi.org/10.1109/ACCESS.2021.3076016

[3] S. A. Akash, M. Al-Zihad, T. Adhikary, M. A. Razzaque and A. Sharmin, "HearMe: A smart mobile application for mitigating women harassment," IEEE International WIE Conference on Electrical & Computer Engineering (2016) 87-90. https://doi.org/10.1109/WIECON-ECE.2016.8009093

[4] V, Mareeswari & Patil, Sunita. Smart Device for Ensuring Women Safety Using Android App. Lecture Notes in Electrical Engineering, (2018) 186-197. http://dx.doi.org/10.1007/978-981-10-8240-5_21

[5] S. K. Sharma and P. Ranjana, Women Safety-Saviour Android Application, International Conference on Advance Computing and Innovative Technologies in Engineering, (2022) 1552-1556. https://doi.org/10.1109/ICACITE53722.2022.9823496

[6] Paradkar, Abhijit, and Deepak Sharma, All in one Intelligent Safety System for Women Security," International Journal of Computer Applications, 130(11) (2015) 33-40.

[7] Sirish Kumar Pagoti, Srilatha Indira Dutt Vemuri, and Ganesh Laveti, GPS Receiver Position AugmentationUsingCorrentropy Kalman Filter in LowLatitudeTerrain, The International Arab Journal of Information Technology, 19(1) (2022) 72-80. https://doi.org/10.34028/iajit/19/1/9

[8] Chakrabartty, Aparajita & Gupta, Sudakshina, Traffic Congestion in the Metropolitan City of Kolkata. Journal of Infrastructure Development, 6 (2016) 43-59. https://doi.org/10.1177/0974930614543046

[9] R. Pavitra and S. Karthikeyan, Survey on womens safety mobile app development,"International Conference on Innovations in Information, Embedded and Communication Systems, (2017) 1-5. https://doi.org/10.1109/ICIIECS.2017.8276048

[10] R. S. Yarrabothu and B. Thota, "Abhaya: An Android App for the safety of women," 2015 Annual IEEE India Conference (INDICON), (2015) 1-4. https://doi.org/10.1109/INDICON.2015.7443652

[11] Nasim Matar, Tirad Almalahmeh, Bilal Sowan, Saheer Al-Jaghoub and Wasef MaterA Multi-Group Structural Equation Modeling For Assessing Behavioral Intention of Using

Mobile Cloud Computing-The Case of Jordanian Universities During the Covid19 Pandemic, The International Arab Journal of Information Technology, 19(2) (2022). https://doi.org/10.34028/iajit/19/2/7

[12] . Kamarudin and S. Salam, Enabling mobile Location Based Services for emergency cases, 2011 International Conference on Research and Innovation in Information Systems, (2011) 1-6. https://doi.org/10.1109/ICRIIS.2011.6125696

[13] P. Chaudhari, R. Kamte, K. Kunder, A. Jose and S. Machado, Street Smart': Safe Street App for Women Using Augmented Reality, 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), 2018, pp. 1-6. https://doi.org/10.1109/ICCUBEA.2018.8697863

[14] Dr. K Srinivas, Dr. Suwarna Gothane, C. Saisha Krithika, Anshika, T. Susmitha, "Android App for Women Safety", International Journal of Scientific Research in Computer Science, Engineering and Information Technology 7(3) (2021) 378-386. https://doi.org/10.32628/CSEIT1217368

Funding

No funding was received for conducting this study.

Conflict of interest

The Authors have no conflicts of interest to declare that they are relevant to the content of this article.

About The License