

## Using GIS Application to Control the Recording of Traffic Accidents in the Large AL-Najaf City

Ahmed Yaha Abd Abas<sup>1</sup> , Hamid Athab Al-Jameel<sup>2</sup>

University of Kufa-Faculty of Arts- Geographic Dep.

University of Kufa-Civil Engineering Dep .

### Abstract

Recently, the number of accidents in Iraq increases sharply after 2003 as the number of vehicles increases rapidly. The absence of adequate documentation system leads to unclear picture of the cause of these accidents. Therefore, this study tries to put the first step toward recoding the accurate details of the accidents. The GIS technique has been adopted as a knowledge base for the accidents recording along different types of roads within Al-Najaf city as study case. Reference points have been suggested on roads using electrical columns which already were installed along these roads. To link these referencing points together with GIS, there is a need for new accident form. This form will includes, in addition to the types of accidents, the causes of accidents and the name of roads, the referencing point which is close to the accident location. This system has been built according to field data collecting from miscellaneous resources. The developed model is able to indicate the black spot location (i.e. the location with high frequency of accidents) by change the color of points or segments relating to black spot. The developed system now is ready to be used by the authority of traffic.

**Keywords:** Traffic accidents, safety, GIS, expert system, countermeasures.

### 1. Background

Traffic accident problems are widely used and lead to actual concern around the world. Sawalha [1] introduced three new safety applications of accident prediction models. Firstly, a methodology of ranking hazardous locations for priority of treatment was developed. Secondly, a countermeasure-based procedure was considered as another application of the developed model. Thirdly, a cross-sectional method for evaluating the safety benefits of road improvement measures prior to their implementation was represented a third application of the model.

In Iraq the problem of accidents increases rapidly as the number of vehicles increases after 2003. Al-Jameel [2] reported that there is no adequate safety system in Iraq. This could be attributed to the absence of accident recording system or inadequate recording system the accurate location of where accidents were occurred within at least 100m. The author also indicated that the minor accidents were not considered in the recording system if the drivers involved in that accident are conciliated. Therefore, the accidents just only involved with the fatalities would be recorded. However, there is no serious safety study was introduced using Geographical Information System (GIS) technology to solve the accident problems in Iraq.

Al-Obaedi [3] conducted an evaluation study to investigate the number of death comparing with the number of population according to data collected from traffic agencies in Al-Diwanyia city. The author found that the

number of death is approximately twice than the world's average and 20% of total accidents are not recorded. However, this study did not introduce any practical solutions using modern technology such as adopting GIS or intelligent system for reducing and managing traffic accidents.

In the light of above, the confidence level of number of accidents is very low because a huge number of accidents are not recorded. These minor accidents cancelled may be the sign of inaccurate design for the part of a road at which these minor accidents happened.

Recently, Yohannes and Minale [4] utilized the GIS technology to identify the causes of accidents and to determine the black spot location along Bahir Dar to Gondar roads. The results of their study demonstrate that the severity of traffic accidents and they recognized 25 black spot sites for the roads understudy. The authors found that the GIS is a vital tool to analyze road accidents and recognize black spot locations.

This study aims to build the accurate geographical information system for recording the accident data. This could be achieved through adopting new accident form together with putting referencing point along each type of roads.

### 2. An overview of traffic accidents

The Ministry of Planning indicated that the number of accidents in 2014 was about 8814. Whereas, the number of fatality accidents was 2769. The number of accidents is

less than the number of accident for the previous year (2013) which is about 9725 [5]. Table 1 demonstrates that the number of fatal accidents increases rapidly from 1789 in 2005 to 6826 in 2015. In this year, Iraq was classified as sixth country among Arab countries in the number of fatal accidents to the number of population as reported by Iraq News Agency [6].

Table 1 Number of fatal accidents in Iraq.

Year	Number of fatal accidents
2015	6826
2014	2769
2012	5450
2011	4040
2005	1789

According to the statistical report from the Traffic Directory in Al-Najaf City, the number of accidents from January to August in 2012 reveals that the number of collision (vehicle to vehicle) has the highest number whereas the overturn is the lowest among other collision as indicated in Table 2. The number of fatalities related to the pedestrians is higher than other accidents due to several safety shortcomings such as absence of suitable cross-walk zones, foot bridge/tunnel, pedestrian traffic signal, etc. However, the recorded number of accidents is less than the reality because most of minor accidents are not documented.

Table 2 Statistical report from Najaf Al-Traffic Directorate [7].

Type of accident	Number	Injuries	Fatalities
Collision with other vehicle	397	468	40
Overturn	47	60	20
Collision with Pedestrian	337	306	63
Total	781	834	123

Regarding to the above statistical report (Report no.1, 2012), the number of vehicles which are recorded in Al-Najaf City is about 64119 vehicles. In addition, the report also indicates how the types of accidents distribute among eight months in 2012 as shown in Figure 1. The figure demonstrates that the number of accidents in July represents the highest among other months under study whereas March is the lowest one. Moreover, July also shows the highest number of fatalities. In fact, statistical study without accurate information will be insufficient to solve accident problem; therefore this study focuses on building or putting infrastructure system for getting accurate data using GIS technique.

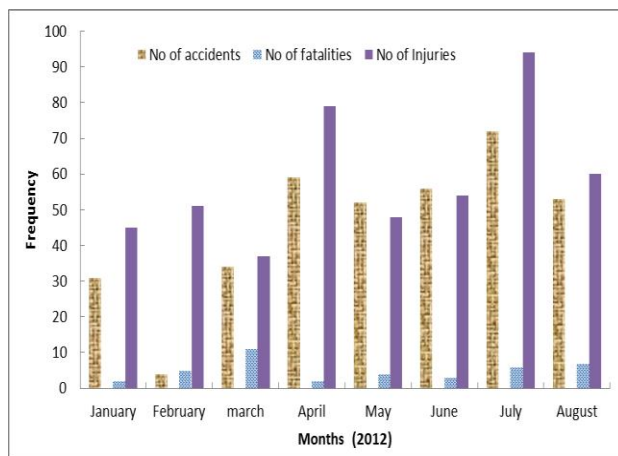


Figure 1 Number of accidents, injuries and fatalities.

### 3. GIS technology

The GIS is an active mean to connect the descriptive data with the spatial data using the sophisticated techniques in capturing, storage, processing, analyzing and outputting data as maps with tables or sketches showing information under study. In this case, the system will indicate the accident data in Al-Najaf city with all necessary information.

The Large Al-Najaf City will be used in this study to represent both Al-Najaf and Al-Kufa cities because there is a high interaction between the two cities due to their expansion. These cities are from the important in terms of their historical and religious issues. So the study area lies to the southwest from Baghdad between two east longitudes (44° 14' 40") and (44° 26' 24") and north latitudes (31° 56' 27") and (32° 7' 37"). The area of this polygon is 231.506 km<sup>2</sup> according the preliminary design for both cities in 2010 as indicated in Figure 2.

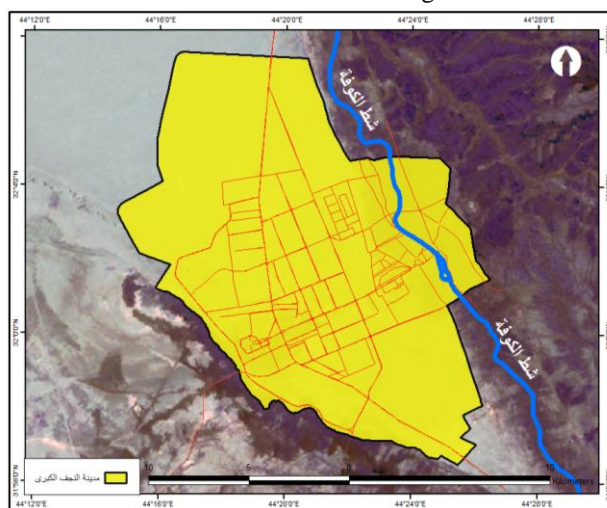


Figure 2 Spatial boundary for the Large Al-Najaf City (Najaf and Kufa).

### 4. Methodology

The building of such system required modeling and collecting data. The used data and information have been

collected from different resources such as governmental offices and institutions and field surveys. In addition, maps of Al-Najaf and Al-Kufa cities achieved by Architect Designer Company (ADEC), Liewelyen DaviesYeang and TRIBAL Urban Studio in 2010. These maps are in scale of (1:60000) and (25000); they are also in Pdf form. Then, these maps have been converted to Tiff form using Office Convert Pdf to Image V5.0 program. The converted maps were corrected and returned geographically (Registration) according to Universal Transverse Mercator (UTM) satisfying image to image option using ERDAS IMAGINE 14 program depending on American Visual Satellite (Quick Bird) in the corrected accuracy of 60cm from its origin.

The current study mainly depends on the map from American Visual Satellite (Quick Bird) with the accuracy of 60cm for both Al-Najaf and Al-Kufa cities with all surrounding areas in 2013. This map is already corrected from the origin source. This satellite map has been adopted in visual interpreting depending on standards and elements such as the size, color, shape, texture, etc. This map is used as a background for drawing layers. Shape files have been created. These files are three types: firstly, point files which represent control or check points. Secondly, line files represent different types of roads in the city. Thirdly, polygon files show the geographical area under study. Then, all features have been connected with tables called attributes representing their characteristics. This process has been implemented using ARC GIS 9.3.

In this model, referencing points (RF) have been suggested on the entire network for the whole area understudy. The total of 245 RP points have been distributed among all roads starting with RP1 and ending with RP245 covering all intersections and road segments as indicated in Figure 3 to Figure 12. Figure 3 pinpoints the RF or check points spreading on every location with potential accident or with conflict point such as intersections, roundabouts, merging, diverging, etc. Figure 4 demonstrates how these RPs are distributed in city center around the Holy Shrine of Al-Imam Ali (A.S.). These points are assigned for the more probable locations for accidents such as conflicts points at intersections and merging areas.

These RPs will help in determining the precise locations of accident occurrence. According to the field visits to the traffic police offices, it is clear that there are no accurate locations for the accident location. Therefore, adding such RPs in the accident form is vital to pinpoint the specified location in the RPs themselves or even in the link between any two particular RPs. Consequently, determining the high speed location (Black or hot spot) is more easily by this system using different colors to differentiate the RPs or links matching the high number of accidents.



Figure 3 Referencing points within the study area.

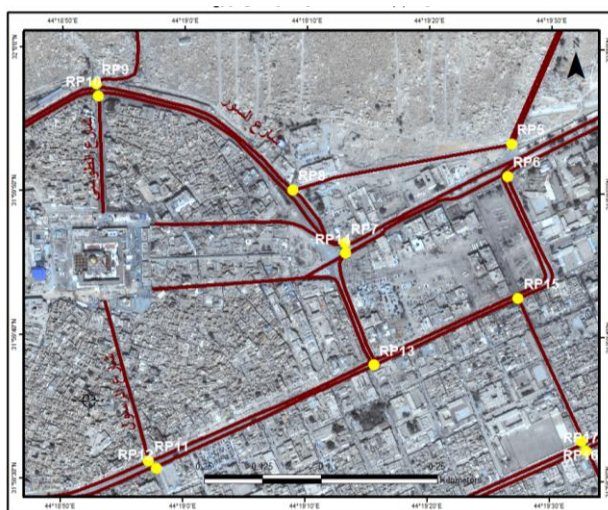


Figure 4 Referencing points within the city center of Al-Najaf city.

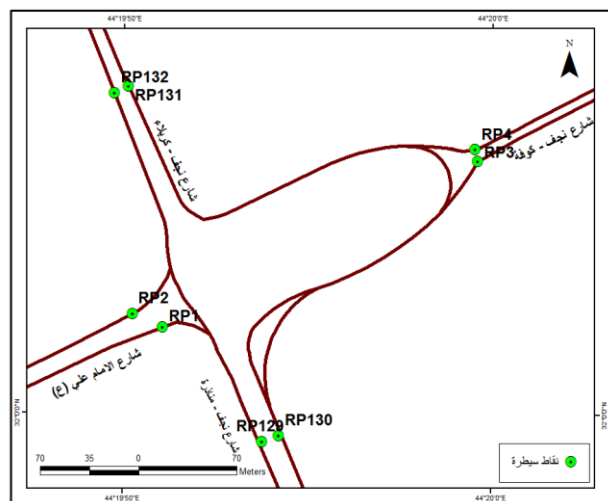


Figure 5 Referencing points close to Muchaserat Thourat Al-Ashreen in Al-Najfa city.



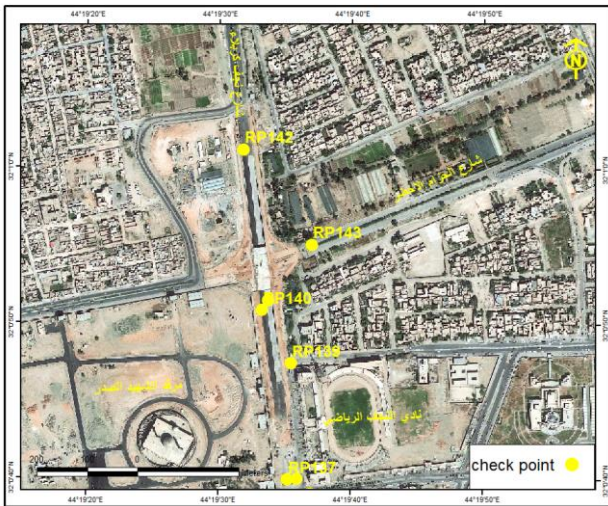


Figure 6 Referencing points close to Al-Askreen Tunnel.

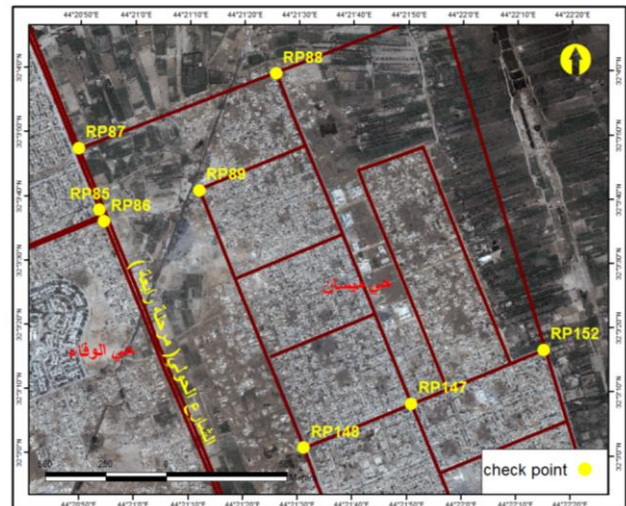


Figure 9 RPs within quarters in Al-Najaf and Al-Kufa cities.

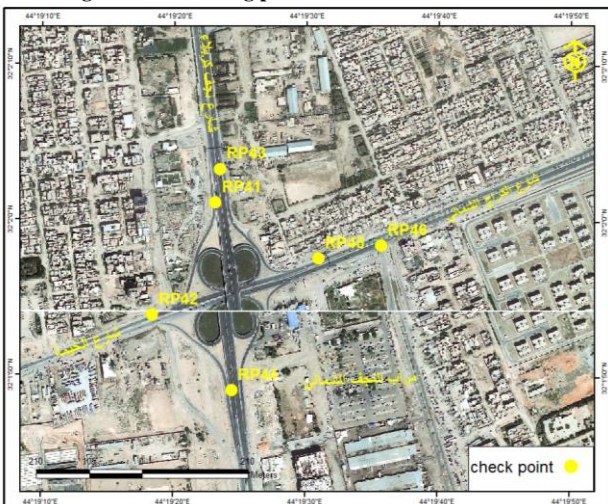


Figure 7 RPs close to Al-Garage Al-Shamalee in Al-Najaf city.



Figure 10 RPs close Al-Kufa mosque in Al-Kufa city.

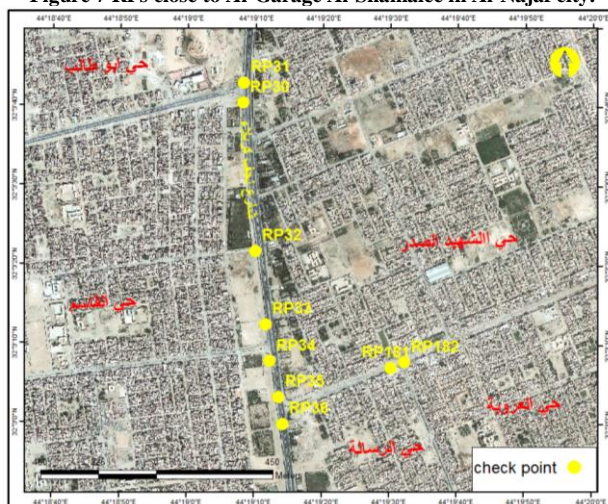


Figure 8 RPs within northern quarters in Al-Najaf city.

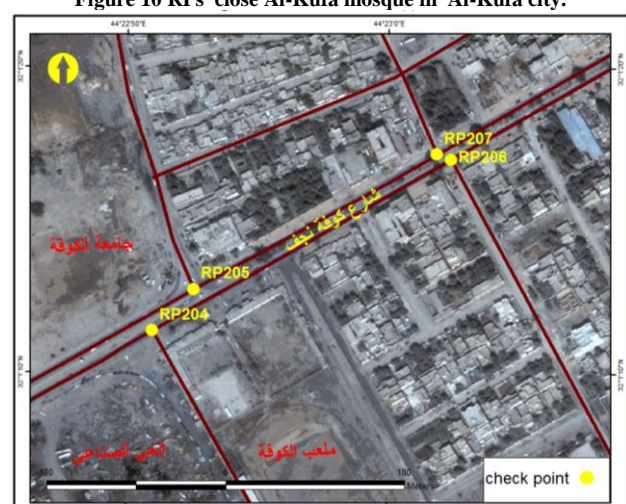


Figure 11 RPs close to the University of Kufa.



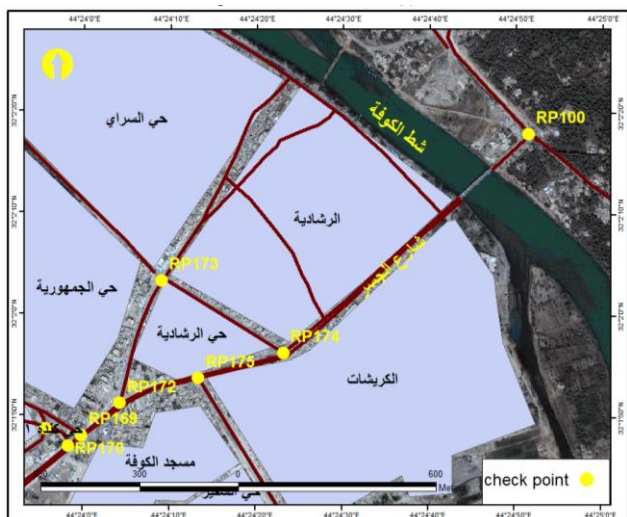


Figure 12 RPs close to the Al-Kufa River.

The main important issue of this study is how to connect the proposed RP on the model with the points at the field. Recently, there are RPs along some of roads in Al-Najaf city such as Kerbalaa-Najaf, 1<sup>st</sup> stage and 4<sup>th</sup> stage of Ring Road as indicated in Figure 13. The figure demonstrates how these labels (RP) were put on electrical columns to be used for defining area and another issue. However, nowadays, they are widely by the community as bench mark. Therefore, using these electrical columns is vital to carry the labels of RPs for accidents adopting by this study.



Figure 13 Labels fixed on electrical columns along Ring Road in Al-Najaf city.

### 5. Application of the developed system

After building the model using GIS and required data gathering from different resources as mentioned above, it is necessary to make verification of such system. It was assumed a number of accidents just to show how the system will indicate the knowledge base. These accidents don't represent the reality but just to show how the developed system works as indicated in Figure 14. The figure demonstrates how the color of each link changes its color according to the frequencies of accidents. This could facilitate the location of black(black) spot.

On the other hand, the developed system is able to reflect the location with high frequency of accidents. This could be identified using different colors for the segment of high frequency of accident so one could easily figure it out. The

diagnosis of black spot location (black spot) will facilitate the problem location and find the cause of accident if it relates to the driver, vehicle and roadway.

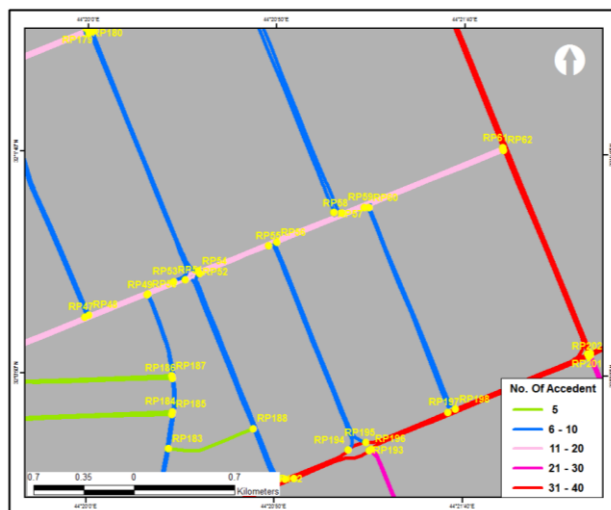


Figure 14 Different colors for different number of accidents in Al-Najaf City.

### 6. Conclusions and recommendations

The main important points could be summarized from this study are:

1. This study is considered as the first step in building a recording system linked with the field. This system used GIS technique with most recent satellite image for Al-Najaf and Al-Kufa cities available from local municipality.
2. The system provides a knowledge base for traffic accidents. Each RP in the developed model could be connected with the field in very economical way (i.e. just linked plastic label at electrical columns).
3. The developed model could be taught easily to the user of recording information about traffic accidents.
4. The system could be used for determining the location with high accident frequencies using different colors.
5. The developed mode could be used as a knowledge base to record traffic accidents with all possible probable causes and other characteristics into model attributes.

### References

[1] Sawalha, Z., 2002, " Traffic Accident Modeling: Statistical Issues and Safety Applications", PhD Thesis, The University of British Columbia.

[2] Al-Jameel, H., A., 2016, "Reducing the Number of Accidents in Iraq by Using Expert System", Journal of Babylon University, Vol. 24 (2), Iraq.

[3] Al-Obaedi, J., 2015, "Evaluation of Traffic Accidents Rates in Al-Diwaniya City", Journal of Babylon University, Iraq.

[4] Yohannes, A., and Minale, A., 2015, "Identifying the Black Spot Areas of Road Traffic Accidents", Jordan Journal of Civil Engineering, Vol.9( 3), pp.358-370.

[5] Shafaaq, 2015, <http://www.ara.shafaaq.com/47499> (access by 1-12-2015).

[6] Iraq News Agency, 2015, <http://www.iraqnewsagency.com/> (access by 20-11-2015)

[7] Report no.1, 2012, "Statistical Data", AL-Najaf Traffic Directorate, issue 11028.