

**BLENDING THE MOST FUNDAMENTAL REMOTE-SENSING PRINCIPLES (RS)  
WITH THE MOST FUNCTIONAL SPATIAL KNOWLEDGE (GIS) WITH THE  
OBJECTIVE OF THE DETERMINATION OF THE ACCIDENT-PRONE PALMS  
AND POINTS  
(CASE STUDY: TEHRAN-HAMADAN HIGHWAY ON SAVEH SUPERHIGHWAY)**

M. Rahmani, M. Moradhaseli

Department of Urban Planning, College of Arts and Architecture, Hamedan Branch, Islamic  
Azad University, Hamedan, Iran

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**ABSTRACT:**

Remote sensing makes use of sensing systems with various features. One of the most substantial and dominant of such sensing systems is the imaging and image-processing systems by taking advantage of the pictorial data and geography is regarded as a branch of remote sensing science in the format of aerial imaging within two large scientific disciplines, one is photogrammetry which is intended to generally mean the procurement of mapping systems and the other one is interpretation which is taken to mean the identification and detection of the objects on earth and the surrounding areas. This article which has been extracted from a research plan performed in the Islamic Azad University, Hamadan branch, is considered as an applied research and the researcher has tried to take advantage of the most fundamental principles of the remote sensing knowledge in the realm of geography through deploying the second form of the aerial photographs

Author Correspondence, e-mail: [mohammad.rahmani1@gmail.com](mailto:mohammad.rahmani1@gmail.com)

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uses in which the identification and the detection of the objects on earth and surrounding areas is conducted aiming at the interpretation of the objects and the peripheral surrounding of the object aiming at the identification and the recovery of the study area and through adopting such an attitude in a case study on Hamadan-Tehran highway and based on the information gathered from highway police the researcher has attempted to deal with the investigation of the localities in which road accidents have been according to the extant documented evidences higher and the researcher takes effort to study the area from the perspective of the factors contributing to the accidents, the type and the intensity of the incurred damages within the area of interest and meanwhile classifying the information, the obtained data have been matched and juxtaposed on the aerial photos to determine the safe points and breadths and accident-prone areas and finally the researcher attempts to recover the identified points

on the aerial photos according to the information obtained for the technical features of the roads from the related offices and also via conducting field observations of the natural surroundings and the existing signs and in the end the researcher try to come up with applied strategies to reduce the road accidents along the path.

**Keywords:** remote-sensing, geographical information system, aerial photos, road accidents, road palms

## 1. INTRODUCTION

The acquisition of information about an object or phenomena without making physical contact with the purpose of detecting, identifying and determining the objects on earth and their surrounding features through the use of aerial photos is called geographical remote-sensing. The remote distance in such a science discipline has a relative definition and it ranges from several meters to several thousand kilometers. In the present article the researcher makes use of aerial photos to detect the natural objects and survey the determined points by the highway police within a specified area on the road and through the field observations and performing the necessary correspondences with the predefined coordinates on the aerial photos each of the points have been classified

according to the reasons and factors contributing to the occurrence of the accidents and the magnitude of the damages and losses taken place and then these data have been inserted into the geographical information system database and analyzed consequently through the use of which the researcher intends to determine the points and the breadth along which the circumstances and conditions lead to a higher frequency of accidents occurrence. The current research and the results obtained therein are the result of blending the remote-sensing knowledge of the geographical information in road transportation studies and these can be taken advantage of as an effective and applied method with the capability of being taken into practical use.

**Overview:****Study type and methodology:**

The data collection method in the current study has been based on a field study and the study follows a direct and an indirect observation procedure. The data analysis is performed by taking advantage of bivariate correlation analysis. The study is considered among the applied researches since the results can be used by various groups of planners and managers.

**Study objectives:**

- The survey of the accident-prone areas leading to physical damages and life loss on extra-city routes
- The determination and identification of the safe and dangerous breadth on the roads outside the city
- Presentation of suggested solutions to reduce the accidents on the outer-city roads

**Information gathering tool:**

In the present study, the information have been collected via the use of maps, aerial photos and the documented information existing in the highway police offices and headquarters, especially from Hamadan-Tehran route on Saveh Autobahn.

**Study variables:**

- Independent variables: outer-city roads accidents

- Dependent variable: human and natural reasons behind accidents

**Data analysis method:**

The data analysis method is based on the survey of the points where the driving accidents are more likely to occur which usually result in life losses and physical damages by taking advantage of the geographical remote-sensing methods and geographical information system (GIS).

**Theoretical bases:****Remote-sensing:**

Recovering, detecting and recognizing the objects on earth and the surrounding areas from distance which are usually conducted by the use of images and instruments is defined as the remote-sensing (Zobeydi et al, 1991:1). The remote-sensing is generally a tool with two distinguishable features: image-processing by the use of photographic data and image-processing by the use of digital data or non-photographical data (Alizadeh and Rabi'ee, 2004:77). In the current study, part of remote-sensing which deals with the photographic images has been the focus of the attention by the researcher.

**Aerial photos:**

Aerial photo is a very important and functional component of the remote-sensing science which plays a significant role in two great scientific disciplines, one is photogrammetry and map preparation and the other is changing the identification code and the determination of the surrounding terrains from the images.

**What is geographical information system?**

Geographical information system is a computer-aided system which has been used for inserting, storing, changing, analytical managing and displaying the geographical data and the related existing problems and the preparation of the maps (Alemi Rad, 2004). It can be said that in geographical information system we are faced with two technological and problem-solving approaches regarding the system. From the technological perspective, the geographical information system is a collection of the tools for inserting, storing and retrieving, synchronizing, managing, analyzing the input data and

obtaining an output from the space data and, eventually, the output from the obtained results blended with the skills and specialized knowledge of the system operator leads to an appropriate perception of the problem solving procedures (Farajzadeh Asl, 2005).

### **Defining Transportation:**

Transportation is a product of a sort of service the demand for which depends on the distance for offering other products (commodities and services) and the supply of which greatly influences the offering of the goods and services (Ja'afari et al, 2010:10). The concept of transportation economically is intended to mean the individuals' dislocations and movement from one place to another (passengers' transportation and goods transportation to and from geographical localities). Transportation is the coming and going flow and/or human and commodities/services movements between traveler-prone and traveler-receiving regions by the use of available transportation facilities in an accepted and systematic manner (Mahmoodi, 1997, cited from Ja'afari, 2010:12). In marketing science, transportation includes all of the activities which bring about an opportunity for gaining in profit through a change in the place. The longer and the wider the transportation facilities radius become a broader and more expanded market will become available and enlarged markets necessitate greater production which is cheaper, as well. In this way, the final result of the development and progress in the transportation and its cheaper prices would be specialization in production (Mahmoodi, 1983:2).

### **Various types of transportation systems:**

Transportation is among those activities which is carried out in a multiple manner (by sea, air, land, and pipeline) and multiple proprietorship (public, private, cooperative) and multidisciplinary (engineering, economy, bioenvironmental management, international political) and multinational regional (intra-city, provincial, national, overseas). Land transportation is any type of transportation which is conducted by land or by underground for the purpose of carrying goods and passengers. This group includes automobile, bus, railroad, escalators, pipeline and so forth (Toula'ee, 2007: 58).

### **Degree 1 arterial roads:**

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It is a road in the design and exploitation of which more weight is given to the movement and mobility of the motorized vehicles. To observe such access superiority for the motorized vehicles, the pedestrians' movement, as well, should be regulated across the road. Degree 1 arterial roads can be classified in their relation and connection to the degree 1 outer-city road network into freeway, highway and carriageway (Qanizadeh, 2010).

**Freeway:**

It is route along the entire length of which the bilateral traffic has been physically separated and the traffic can flow on it incessantly (freely) that is the motorized vehicles are not forced to stop unless there is a reason such as accidents and jams. To safeguard the free flowing of the traffic no level crossing is allowed and the correct entrance and exit method of the vehicles has been carefully designed (accommodation and city-building ministry, 1995).

**Highway:**

It is a way that its bilateral traffic has been isolated from one another and a continuous traffic flow can be assumed along a considerable length of it. To provide for such a situation, the correct entrance and exit style of the vehicles need to be designed. Highways can be equipped with a few numbers of level crossings on the condition that they are spaced (more than about 2.5 km) in long distances from each other (Ibid).

**Carriageway:**

The continuation of the two-lane bilateral outer-city roads can be chased into the cities (usually small and medium cities) provided that their carriage function can be preserved into the cities or villages and to do so, the entrance and exit function of the vehicles to and from these roads should be carefully designed and regulated and the level-crossings on such roads are not spaced in short (about 2.5 km) distances from one another (Ibid).

**Degree 2 arterial roads:**

It is route in the design and exploitation of which more superiority is given to the movement and access of the motorized vehicles. To provide for such superiority, the pedestrians' movement from across the streets should be controlled. Degree 2 arterial

roads are of intra-city functions and they comprise the main network of the intra-city routes (Ibid).

### **Trip and travel:**

Travelling or as it is used more frequently taking a trip is the unilateral movement and change in location performed by an individual which is usually carried out by some sort of transportation means. Thus, it can be said that a trip has a destination and a source. Not all of the journeys are congruent in their characteristics and it is the more real models which create separate estimations for the purpose of taking a trip or journey (Afandizadeh, 2000). Unlike trips which are unilateral and unidirectional another travelling method which is also popular in English language is taking a journey which is the term given to the series of trips which are initiated from a source for instance the home and finished at the return to the source again. In other words, by adjoining two or several number of trips (direct coming and going to and fro a destination) travelling is shaped.

In most of the statistical surveys trips have been categorized into two categories, and they are as below:

- Home-based trips: all of the trips which are started at the base of a home and end in the home again. These incorporate four fifth of the trips and it is said that they are so-called generated by and from the home.
- Non-home-based trips: they are those trips the source and the destination of which are not one's home. Like the trips which are taken in order for a mission to be accomplished in another location or shopping centers (Montazeri and Edawi, 2006).

### **Driving accidents:**

Various events resulting in injury, death, damage and/or a combination of them which have been created as a consequence to the crashing of one or several vehicles into one another and/or a human, an animal and an external object are termed as driving accidents. Driving accident is the expression used for the street or road traffic incidents in which at least one street vehicle hits another vehicle, or another user, or an object at

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the side of the roads or with another automobile which is usually followed by financial or life losses (Rahmani, 2014:17).

**Driving incidents:**

Events besides driving accident in the course of which a vehicle or its passengers incur financial and life or physical losses and injuries such as falling down, turning over, avalanche, mountain rock-fall, landslide and flooding (guidelines of the transportation and driving incidents management, enacted 8/4/2009).

**Different factors contributing to road accidents:**

There are numerous factors involved in the occurrence of an accident and these can be evaluated under three headings: human factor, vehicle factors, and road and environment factors, the most important of which is the human factor; it is worth mentioning that the issue can be analyzed more accurately in such a manner that Professor Agden believes that “instead of attributing an accident to a single last factor (the last chain loop-), accidents should be proof-read regarding various causes a lot before the time it has taken place (Rahmani, 2014:32).

**Gathering information and reporting an accident:**

In order for the transportation studies to be effective and to increase the road safety we should have at hand information regarding the place of happening, number of accidents, their intensities and type of the accident. The more complete we find these information and the more accurate the incident explanations the simpler the determination of the reasons behind the occurrence of an accident and offering scales and standards for the correction of the conditions and increasing the safety (Oryani, 2006: 63).

**Study finding analysis:****Hamadan-Tehran route on Saveh Autobahn:**

Hamadan province with an area of 19493 square kilometer has been located between the 33° 59′ to 35° 48′ of the north latitude and 47° 34′ to 49° 36′ eastern longitude from Prime Meridian and it is regarded as one of the superior exchange and offering of the services centers in western Iran and it is of a very great importance in the Country's road network. Geopolitically, Hamadan Province is the connecting chain between the west



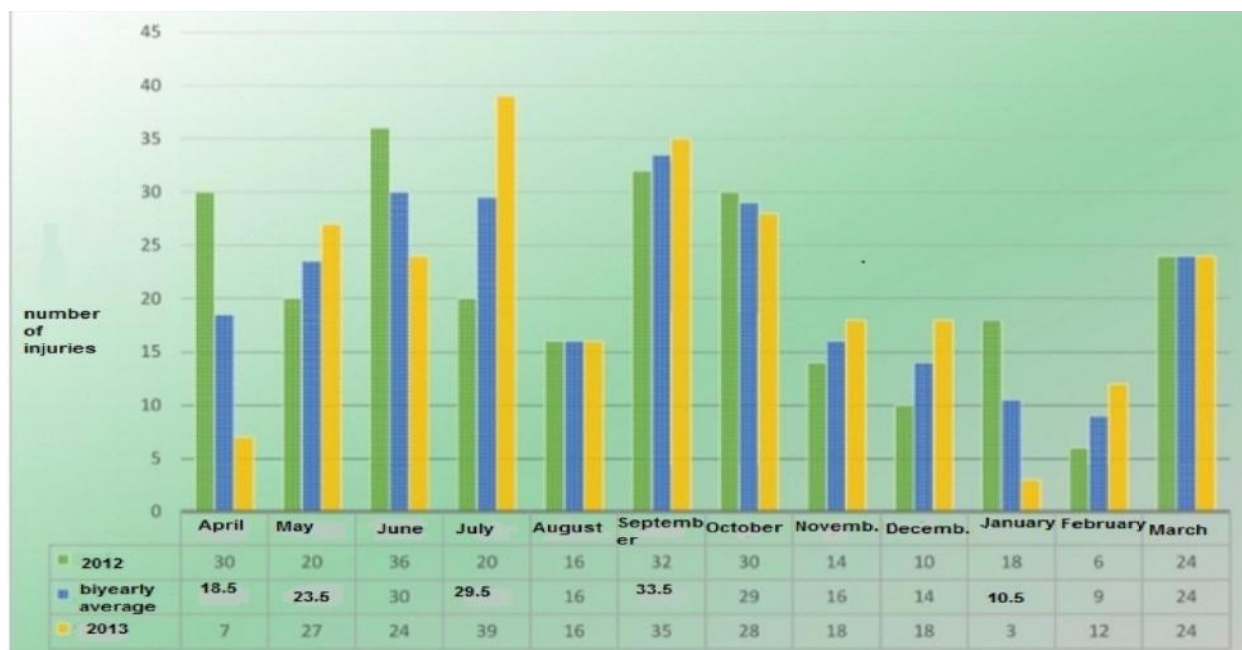
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and the capital and with all the efforts which have been endured during the past years for the development of the roads, due to the reasons which are going to be elaborated in the following sections we are constantly bearing witness to the occurrence of unpleasant accidents and incidents along the route of interest length, thus in the present article the researcher attempts to study road accidents leading to death and injuries in several major points and breadth through the use of the most fundamental preliminary principles of remote-sensing and geographical information systems during the years 2012 and 2013 along Hamadan-Tehran route on Saveh autobahn and analyze the results and conditions to come up with a more exact delimitation of the issue.

**An analysis of the accidents resulting in injuries by month in 2012-2013:**

Table (1) and diagram (1) deal with the survey of the accidents resulting in injuries by various months of the year in the study time span on Hamadan-Tehran route in Saveh autobahn and according to the reports presented by highway police the highest number of the injuries belongs to July, 2013, and the yearly average for the years 2013-13 has happened in August and the lowest number of the accidents leading to injuries has been introduced to have happened in February. In an in-depth look at the documents of the issue in the organization of transportation and terminals and the reports presented by the highway police regarding the accidents resulting in injuries on this route or the routes opening to Hamadan province we can deduct the similarity and the congruence of the statistics provided.

Table (1) and Diagram (1): comparing the number of the injured people in road accidents on Hamadan-Tehran route in Saveh Autobahn by month in 2012-13

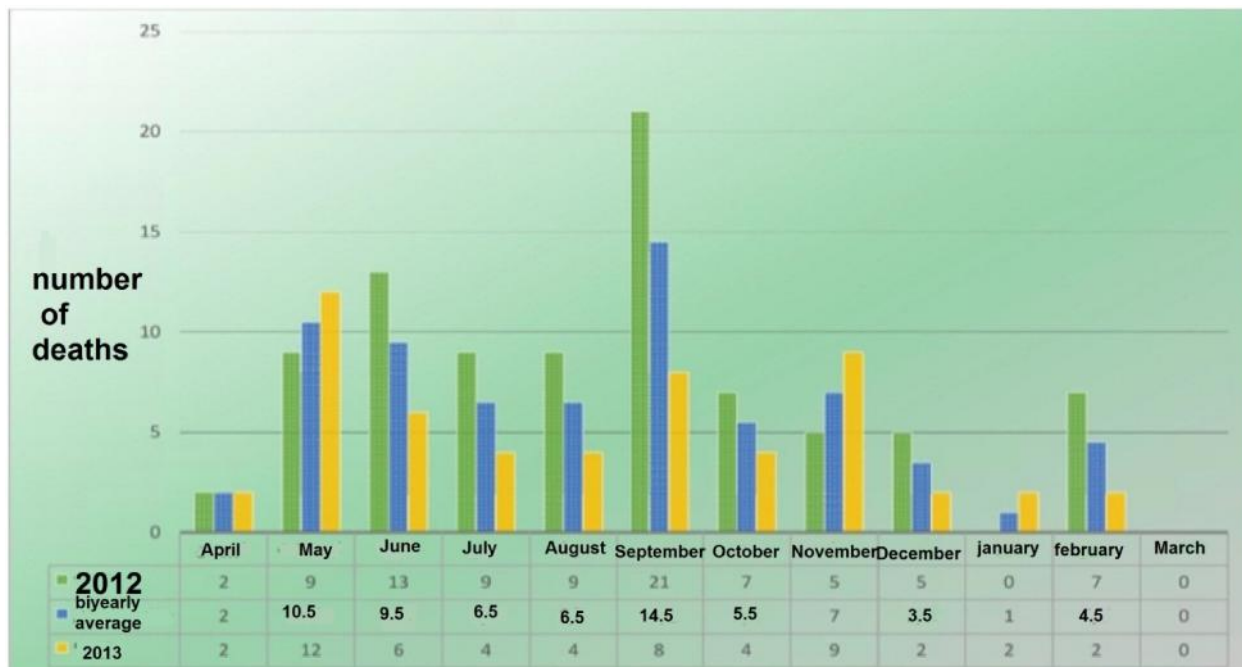


**Fig.1.** Analysis of the accidents resulting in death by month in 2012-13

In this section, with the survey of table (2) and diagram (2) which have been obtained based on the information pointed out above, the driving accidents leading to death by various months of the year in 2012-13, September has been indicated as the month with the highest number of accidents resulting in death on Hamadan-Tehran route in Saveh autobahn due to reasons such as the ending month for summer vacations and March has been introduced as having the lowest number of the accidents resulting in death.

The comparisons and the analytical surveys conducted on the routes opening to Hamadan province indicated that the above mentioned times and periods as the periods with the highest number of accidents resulting in death on Hamadan-Tehran route in Saveh autobahn precisely conform to the other routes leading to Hamadan Province and therefore such a situation is reflective of the idea that the trips volume in these routes completely corresponds with the tourism programs planned by the touring offices in Hamadan province and it seems necessary that training and cultural programs should be compiled and taught which concentrate on the summer trips and the other related days and seasons to reduce the accidents.

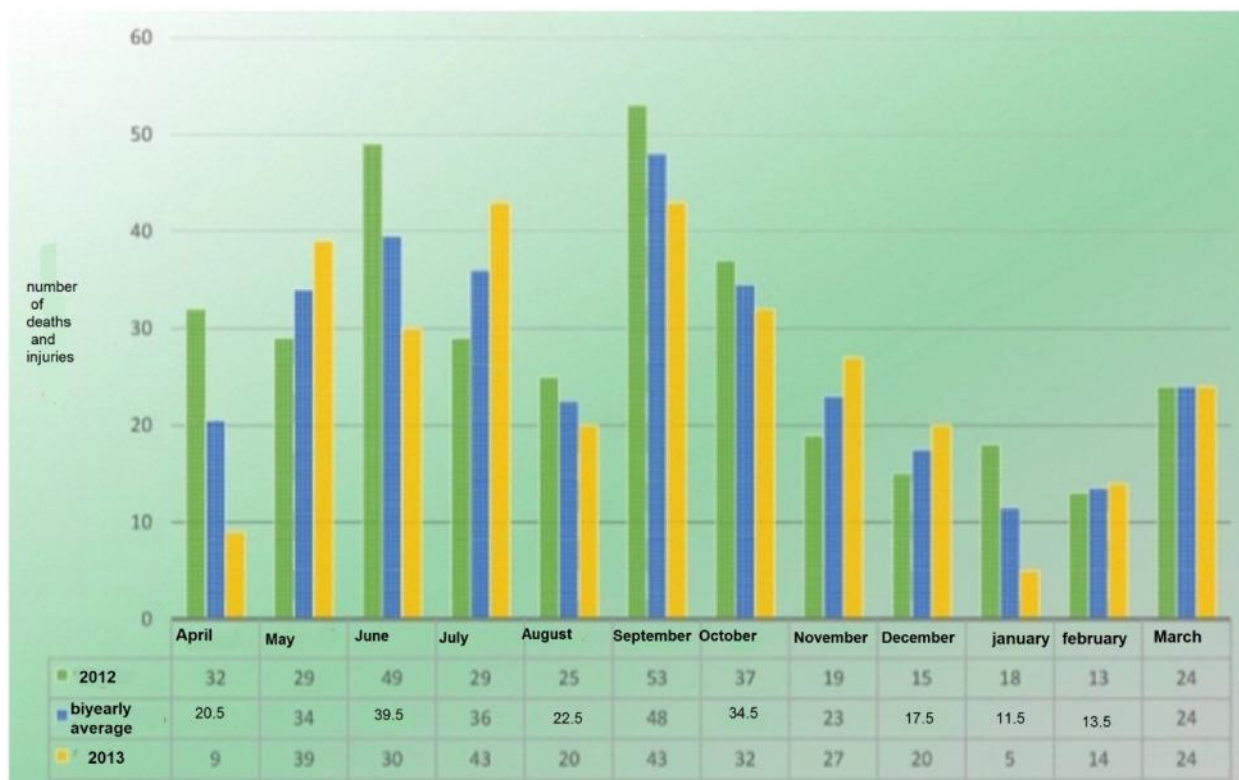
Table (2) and diagram (2): the comparison of the number of road accidents mortality rate on Hamadan-Tehran route in Saveh autobahn by month in 2012-13



**Fig.2.** An analysis of the accidents resulting in injuries and death by month in 2012-13

In summing the existing information in the documents published by highway police and the Iranian organization of transportation and terminals and the results obtained from the studies performed during the two study years, September is ranked first regarding both the accidents leading to death and the accidents resulting in injuries. In these surveys it became clear that two months in winter exhibit the lowest number of accidents. It is important to note from the field observations that the majority of the accidents on this route are related to the inappropriate road spaces from the perspective of road surfaces-drivers’ speed incongruence and the absence of proper and sufficient signing system which are per se factors paving the way for the occurrence of the road accidents resulting in injuries and death.

Table (3) and diagram (3): the comparison of the number of the injuries and deaths related to road accidents on Hamadan-Tehran route in Saveh autobahn by month, in 2012-13

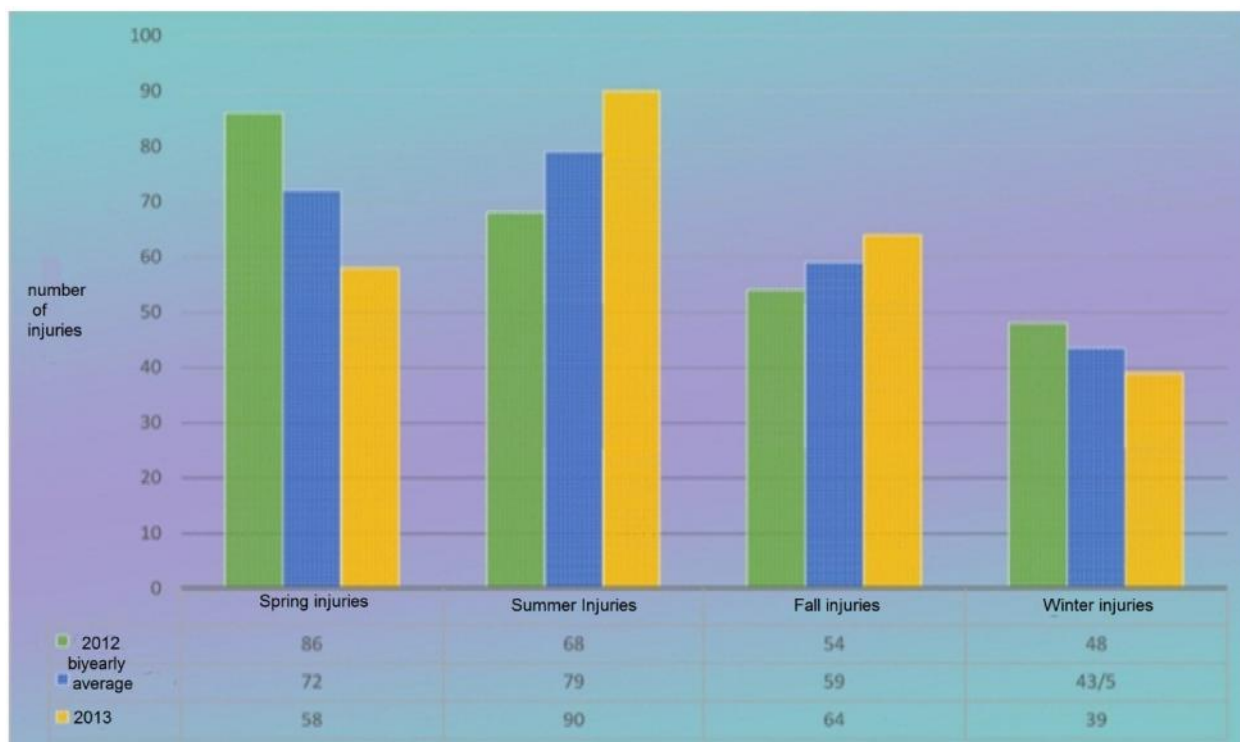


**Fig.3.** An analysis of the accidents resulting in injuries by season in 2012-13

According to the studies performed by the cooperation between World Bank, Oxford University and World Health Organization in 1999, traffic accidents were considered as the ninth factor contributing to the potential useful life losses and based on this it has been predicted that until 2020 traffic incidents are among the top three reasons for the losses of potential useful life in a global level and the situation is worst and complicated in developing countries in such a manner that 85% of the entire world road accidents and 90% of the potential years lost in accidents takes place in such countries (Poormo'alem et al, 2009:25). Since Hamadan province is situated on an elevated and mountainous land the differential between its highest and lowest ground level is over 2000 meters. The provincial climate is subject to its latitude, elevation, location, mountains ranges and the long distance from the sea and according to the reasons enumerated here the winters are usually cold and the precipitations are usually in the form of snowfalls and the summers are moderate.

In this section the researcher attempts to analyze the road accidents based on various seasons and the information will be presented in the following parts in the format of tables and diagrams. According to the climate characteristics which were summarized above, the great majority of the trips take place along the routes opening to the city and potentially in summer that the people come to the city to enjoy the pleasant and moderate weather of the city and since most of the trips along Hamadan-Tehran route are carried out via Saveh Autobahn from hot and arid cities such as Qom, Saveh and/or the city of Tehran, the highly polluted metropolitan in Iran, the highly motivating factors for taking a trip to Hamadan from this route happens during summer and therefore the highest number of the accidents leading to injuries on this route belong to summer according to table (4) and diagram (4).

Table (4) and diagram (4): the comparison of the number of the injuries resulting from road accidents on Hamadan-Tehran route in Saveh Autobahn by month in 2012-13



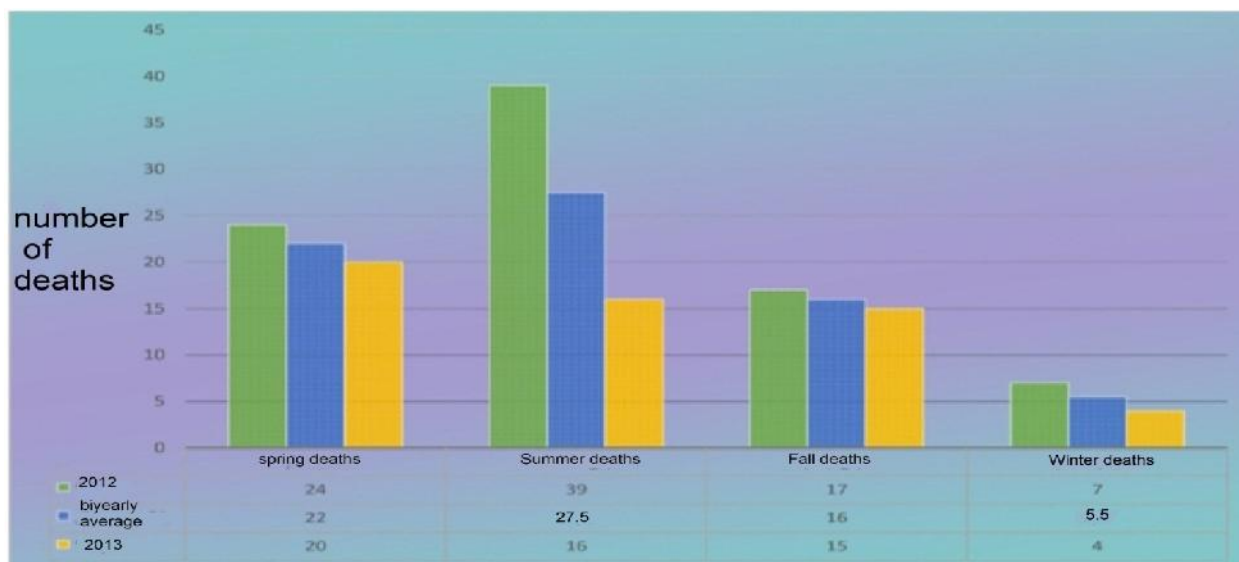
**Fig.4.** An analysis of the accidents resulting in death by seasons in 2012-13

Annually, more than 25 thousand individuals lose their lives due to reasons such as traffic incidents and unfortunately the victims of such an issue are the people with the

age group of 35 and higher and they are mostly productive age group (Kazemi et al, 2012).

Table (5) and diagram (5) indicates the deadliest season on Hamadan-Tehran route in Saveh autobahn during summer and summer journeys are shown as the most frequent motivations for taking trips to Hamadan via the aforementioned route and with the beginning of the cold season and winter the accidents decrease completely to their lowest level.

Table (5) and diagram (5): the comparison of the number of road accidents deaths on Hamadan-Tehran route in Saveh Autobahn by season in 2012-13

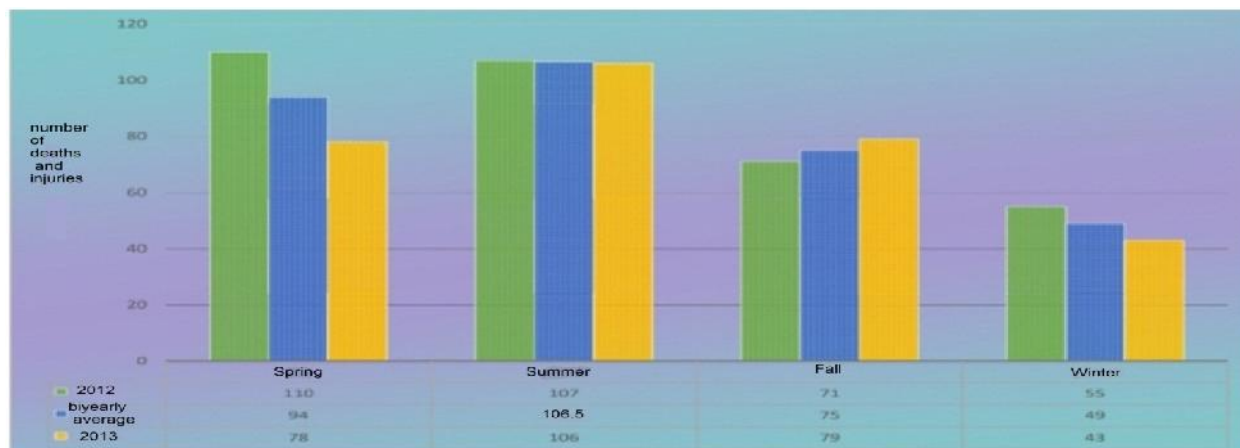


**Fig.5.** An analysis of the accidents leading to injuries and deaths by month in 2012-13

The surveys conducted on the information published and the results obtained up to this point by the current research is suggestive of the idea that hot seasons of the year and clear and sunny sky despite what is being naturally considered have played a considerable role in the rate of the accidents occurred. In the following section, the sum of the results in table (6) and diagram (6) is well-reflective of the reality that the total sum of the accidents resulting in injuries and deaths in 2012-13 have taken place in summer and they are regarded as the most voluminous accidents on the above-mentioned route

and also the winter in both of the years has contained the lowest number of the accidents.

Table (6) and diagram (6): the comparison of the total number of road accidents injuries and deaths on Hamadan-Tehran route in Saveh Autobahn by season in 2012-13



**Fig.6.** The determination and analysis of the deadly and injuring prone areas on Hamadan-Tehran route in Saveh Autobahn with the exploitation of the remote-sensing Knowledge and Arc GIS software.

In this section of the study, the researcher has corresponded all of the spatial information from the perspective of any form of accidents by the use of aerial photos intended for detection and field observation data. After the related data to the number of the accidents injuries and deaths on this route were classified and the information was inputted to the ARC GIS software, the spatial distribution and the volume and the rate of the accidents resulting in death or injury in various points on the route were mapped on the aerial photos and the information were analyzed by taking advantage of the software and the distribution and the scattering of the accident-prone areas and points were recovered and determined on the aerial photos by the use of a range of color tones (ranging from yellow to red) in the paradigm of 4 breadth of safe, relatively safe, dangerous and accident-prone. Then through summing up the number of the injured and died individuals along the route and giving the died individuals a coefficient of 3 due to the more importance of the accidents leading to death in respect to the accidents resulting in

injuries a better and more precise survey of the accident-prone areas was carried out by the use of ARC GIS software.

The conducted analysis output is a map on the region's aerial photo on which numerous points have been pointed out ranging from safe breadth to accident-prone. The safe breadth of the route is the area with the lowest number of accidents resulting in deaths and/or injuries and they are shown on the map with yellow and with the increase in the occurrence of the incidents into the accident-prone areas the color changes to red.

Determination and analysis of the points resulting in death and injuries on Hamadan-Tehran route in Saveh Autobahn by taking advantage of ARC GIS software in 2012

According to the explanations presented above on the spatial detection figure of the accidents resulting in death and injury through the use of geographical remote-sensing on the aerial photos and also according to the exposition given considering the correspondence of the points via direct observation by the researcher in recovering the accident points and the classification of the accidents in 2012, with the selection of the highest number of the accidents which is the sum of the accidents resulting in death and in injuries and by taking the coefficient which was given to the number of the deaths into consideration and regarding the fact that the sum of the injured and dead people in 2012 has been the highest incurred loss up to date, after the aforementioned coefficient was operated on by geographical information system the output obtained by the system was 69 based on which the classes distance in the determination of the limits of the safe points to the accident-prone points was calculated as being equal to 17.25 on the aerial photos.



**Table 7.** The classes distance obtained via the sum of the frequencies of the accidents resulting in death and injuries in determination of the breadth levels on Hamadan-Tehran route (2012)

| Breadth type | Safe    | Relatively safe | Dangerous  | Accident-prone |
|--------------|---------|-----------------|------------|----------------|
| Distance     | 0-17.25 | 17.25-34.5      | 34.5-51.75 | 51.75-69       |

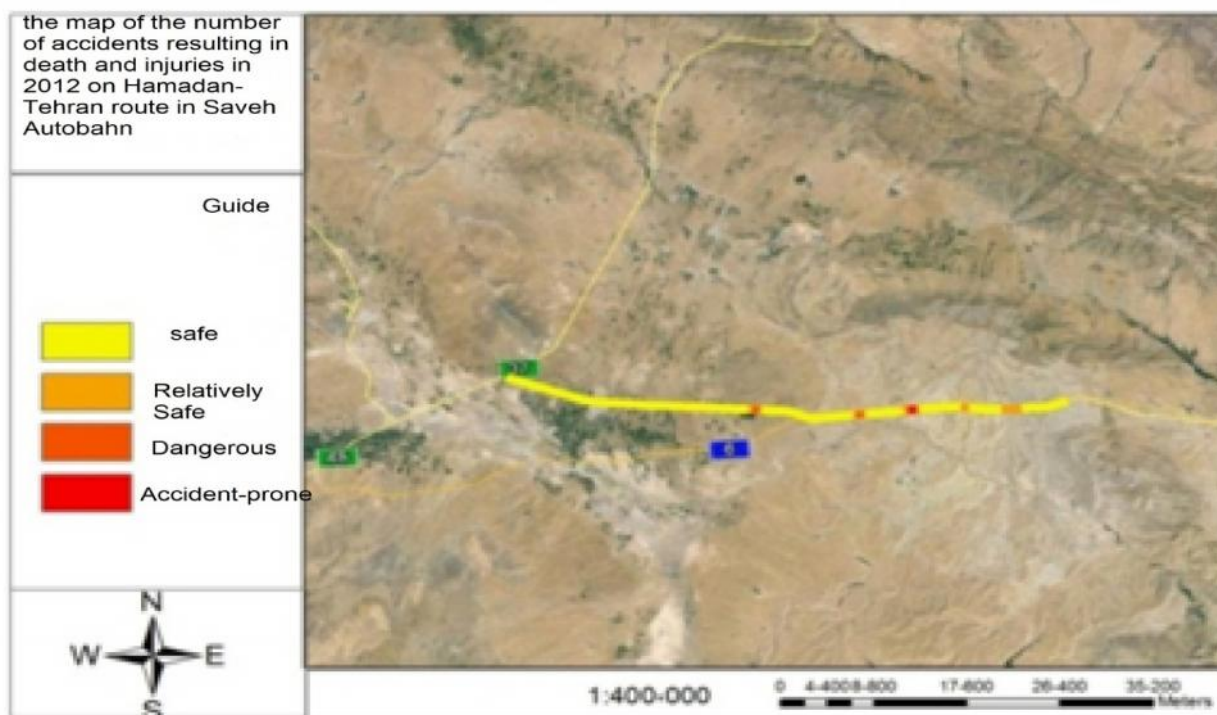
According to the analysis of the total number of the deaths and injuries based on the overall study index on this route in 2012, the data given in table (8) are indicative of the relatively safe, dangerous and accident-prone points drawn on the premise of the kilometers on aerial photos of the area with a colorful tone.

Table 8: the determination of the accident points leading to death and injury based on the breadth levels determined on Hamadan-Tehran route (2012)

|                        |                 |
|------------------------|-----------------|
| <b>Relatively safe</b> | <b>45-49-50</b> |
| <b>Dangerous</b>       | <b>25-35</b>    |
| <b>Accident-prone</b>  | <b>40</b>       |

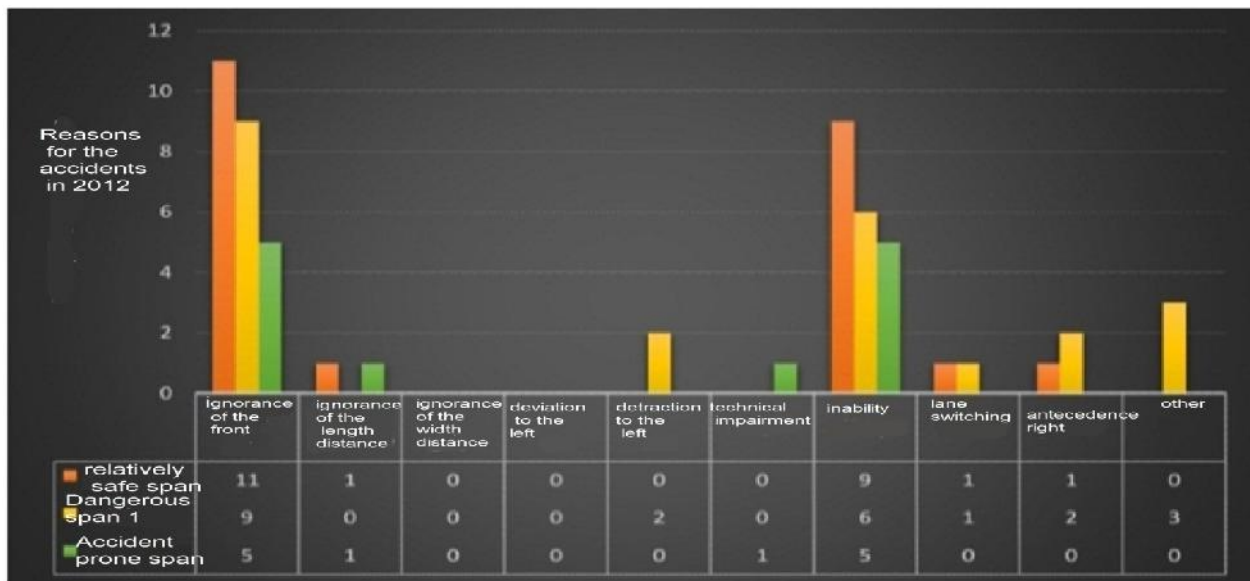
Thus, on the output illustration obtained from ARC GIS software analysis on the aerial photo of the study area the safe to accident-prone breadth can be observed as being demarked with yellow color at the outset and then to the accident-prone which is marked red (map 1).

Map 1: spatial distribution of the accident-prone points based on the number of the deaths and injuries on Hamadan-Tehran route in 2012



**Fig.7.** The survey of the reasons behind the accidents on breadth level on Hamadan-Tehran route (2012).

Then we deal with the study of the factors contributing to the accidents on this route and as it can be seen from table (9) and diagram (7) which are given for the illustration of the reasons behind the accidents on Hamadan-Tehran route in 2012, in all of the points including the relatively safe, dangerous and accident-prone points the most important reason for the expression of the accidents was related to driver's negligence of their front. It is surprising that the second reason for the occurrence of the accidents on this route within the three of the breadth defined above was the driver's inability in controlling the vehicle and as it can be seen the reasons behind the accidents in the threefold breadth are close to each other and identical strategies with little variations can be devised according to the existing conditions along the route to reduce the accidents. Table (9) and diagram (7): tenfold reason behind the occurrence of accidents regarding the breadth levels on Hamadan-Tehran route, in 2012



**2. CONCLUDING REMARKS:**

In the end, to achieve a general summation of the study which has been obtained after the analysis performed in ARC GIS software it can be understood that on points that the driving accidents have been conducted the driver’s inability in controlling the vehicle and the driver’s ignorance of the front gave been recognized as the most frequent factors contributing to the accidents on the route.

Table 10: the determination of the accident points resulting in death and injury based on the breadth levels delimited on Hamadan-Tehran route in 2012-13

|                        |                        |
|------------------------|------------------------|
| <b>Relatively safe</b> | <b>5-6-15-30-49-55</b> |
| <b>Dangerous</b>       | <b>25-46-50</b>        |
| <b>Accident-prone</b>  | <b>35-40-45</b>        |

**Solutions and suggestions:**

**Applied solutions for enhancing safety and reducing the accidents on Hamadan-Tehran route in Saveh Autobahn:**

1. On Hamadan-Tehran route in Saveh Autobahn, July is the most dangerous month for the occurrence of the accidents resulting in injuries and it is coincident with the outset of the summer trips to Hamadan and therefore being equipped with appropriate educational, cultural programs and proper traffic sign installation respective to the contents of the tourists trips can be effective in reducing the accidents resulting in the injuries.
2. On Hamadan-Tehran route in Saveh Autobahn, September is the return time for the travelers to their homes which is accompanied with their hasty driving along the path and therefore it is the deadliest time about which there seems to be needed preparatory undertakings.
3. Most of the trips taken on the route are a function of the summer trips and journeys to enjoy the city mountainous climate and favorable and riant nature and it seems necessary to establish a summer committee for the management of the summer trips.
4. According to the fact that the Hamadan-Tehran route (Saveh Highway) has provided the drivers with the higher speed limits due to the enhancement of the road and the its facilities, therefore ignorance of the front and the driver's inability to control the vehicle are among the factors resulting in the majority of the accidents. Thus, there is a need for the necessary preparatory measures on the 35-40 kilometer of the road in order for the accidents stemming from the factors mentioned above to be reduced.
5. The implementation of asphaltting project in the U-turn on the kilometer five of Hamadan-Tehran route
6. Installation of speed reduction facilities on the kilometer six of Hamadan-Tehran route
7. Installation and enhancement of the lighting system on the kilometer 15 of the route
8. The implementation and asphaltting the entrance and exit ramp on the kilometer 21 located near Ghoshijeh village crossing

9. Correcting the turn on the kilometer 25 on Hamadan-Tehran route
10. Organizing Bozchelo crossing on the kilometer 30 of Hamadan-Tehran route
11. Correcting the entrance and exit near Ireh Goni village on the kilometer 40 of the route of interest
12. The implementation of the entrance and exit ramp, installation of the speed-reducing bumps on Golkhandan village junction on the kilometer 45-46 of Hamadan-Tehran route
13. Implementation of the entrance and exit ramp and the installation of speed reduction bumps on Dehlagh village junction on the kilometer 49 of Hamadan-Tehran route

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