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IMPLEMENTATION OF LBC AS A NOBLE METHOD IN MANAGEMENT OF MASSIVE BRIDGES IN IRAN

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ABSTRACT

Today, in order to review and inspectthe bridges in Iran, handy or non-handy methods are utilized. These two methods have inherent and visual limitations which lead to non-efficient results and high error rates. In addition, evaluation and ranking the existed bridges and their Alma depends on experts' personal ideas which may make the uncertain results. In this paper, software was prepared to inspect and register the damages of bridge structures and to evaluate the bridge harms based on LBS concept (Location-Based Computing) as a computerized method. This system is not available in Iran since problems in (As built) maps, non-standardized inspections and lack of computerized soft ware's.To solve this problem, a pack of soft ware's and hard wares were utilized to perform the systematic parts of bridge management automatically. Putting these parts together, a three dimensional system called GIS was prepared which includes unique data analysis. Preparation and implementation of this system were used for massive bridges in Khuzestan. It can be introduced as the first intelligent local GIS system to manage the country bridges.

Keywords: LBC, Management, Massive Bridges, Iran

INTRODUCTION

Info World news station has reported various events for thirty years. These reports contain production of personal computers, rise of spywares, viruses and iPhone mobiles. This station has predicted 10 important events in the world in its thirtieth birthday[4]. According to this news station, the second important event in World Digital Technology

during the next ten years (2018) is the Human/Machine Interface. Human/Machine Interface will be available anywhere and people may use their mobiles and glasses walking as monitors to look at the world. Users of iPhone mobiles will face to iBeltBuckle ، iGlasses and iEarRings. Accoding to this introduction it is concluded that Location-Based technology has great effect in our lives and we are going to need it efficiently in the near future. Designing the bridge management system according LBC will be indispensable in the future and it will be vital for the main essential substructures. It should be designed for the massive bridges at least.

Inspection bridge forms are paper-pencil one and they should be rewritten in other particular forms. It is also difficult to the damaged part of the bridge. In addition, inspector team or individuals must identify the damaged parts of the bridges while walking up, match the bridge with map and record the reports at the same time. All these problems lead to inaccurate inspection and numerous errors. Therefore according to computerized technology, it is essential to use electronic and portable instruments to simplify the inspection.

Concept of Location-Based system

Location-based systems develop digital technology in to the real physical world. The users inter the real word by technology instruments such as mobiles, PADs, laptops, audio-visual files, and computer games or even covered computers. Sensors are responsible to record the locations, type of works or even their emotions [3]. Therefore the users will never be separate from their PCs and they are mixed together. Location-based systems composed of three different technologies such as mobile devices, wireless networks and local sensors [2].

Description of soft ware details

This soft ware has visual basic language and composed of three parts:

1. Information bank
2. Three dimensional model
3. Relative soft wares

All items are described blow.

Information bank

To save the information about bridges, MS Access soft ware's are used which include bridge code, bridge name, axis name, kilometer age , number and size of craters, the width of the bridge, following type, authorized tonnage to cross over the bridge, city areas, GPS code, year of establishment and damaged parts of the bridges.

Three dimensional model

To prepare the detailed and efficient three dimensional models for the bridges, we should fallow below stages:

1. Gathering the information and maps for (As built) bridges
2. Field Visit of bridges
3. Controlling the bridge dimensions , comparing to present maps and reform them
4. Photographing, filming and mapping of bridges
5. the three-dimensional maps of the province to separate areas of the city
6. Preparing three-dimensional maps in AutoCAD software and 3D MAX
7. Changing the three-dimensional models useful in software

Relative soft wares

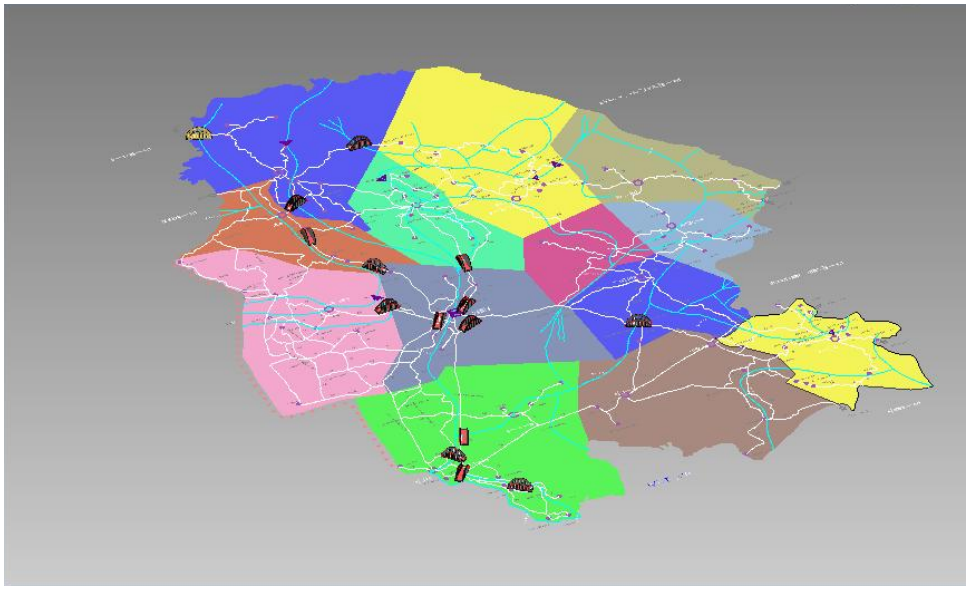
Relative soft ware's composed of three main dimensions:

1. Tree structure for easy access to particular bridge, the province in which the bridge is located, date of bridge inspection, list of main parts of the bridge, description of damaged parts and previous reports.
2. Three Soft ware's themes include the map of roads and bridges features, search and analysis and inspection reporting which have subgroups
3. The map of the three-dimensional models for cities and bridges

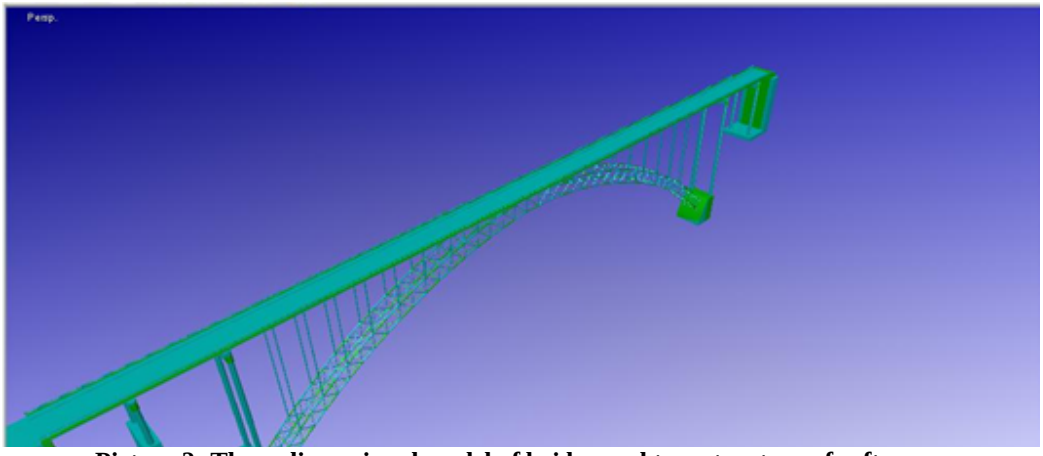
How to use the soft wareObserving the three-dimensional model of bridges, their damage history and maintenance

In order to use this soft ware, first of all it should be installed on a suitable director and copy. To inter the main environment, run the software. As it was mentioned before, the main environment contains a tree structure on the left, main themes of the soft ware and a three dimensional model of Khuzestan province (picture 1).

Clicking on any icon s on the bridge, Structural, geometrical and geographical characteristics of bridge are appeared above the map along with a picture of whole view under the main theme. The tree structures of soft ware presents the name of bridge and province area. Double clicking on the on the bridge icon shows the three dimensional view of bridged (2). You can see the bridge through different dimensions by tool bars above the page. You can rotate the picture or make cuttings to observe the small parts carefully or omit the unnecessary parts. Therefore, this soft ware can show well by three dimensional models.

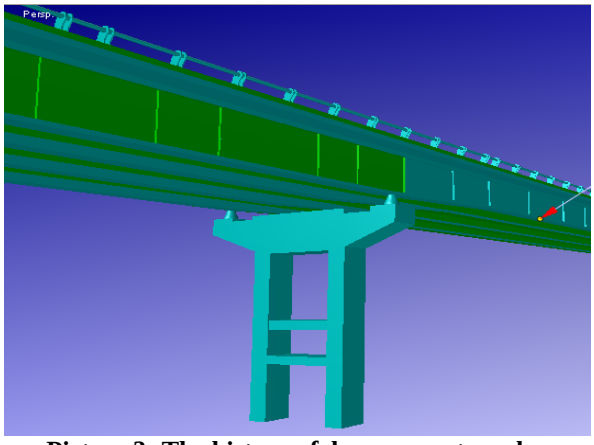


Picture 1- The main environment of LBC soft wares



Picture 2- Three dimensional model of bridge and tree structure of soft ware

In the next step, we should observe and record the exact location of damage parts on the bridge or review the pervious results. To get this aim, we should double click on the tree structure of bridge. Several dates are appeared under the bridge name in a tree structure which is the dates of previous inspections. If you double click on any date you can see six main components of the bridge such as tablet, backpack, and central base wall of water guidance, support and River Engineering. By clicking on any option you can see or edit the previous damaged parts. Thus, we have access to a complete history of inspection and maintain of bridge through a graphic picture. Simultaneously you can see the exact location of damages and guide in to the previous inspections.

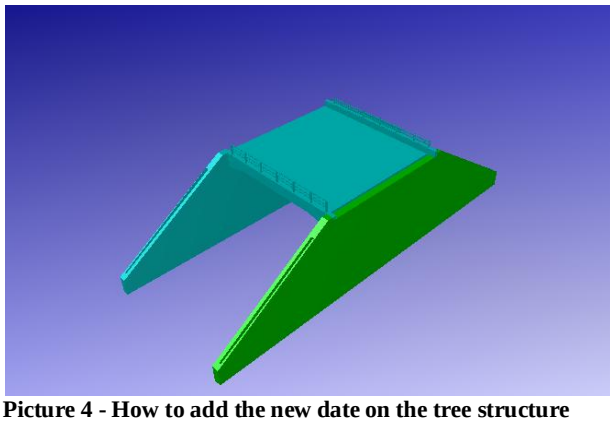


Picture 3- The history of damage parts and previous inspections on a three dimensional model

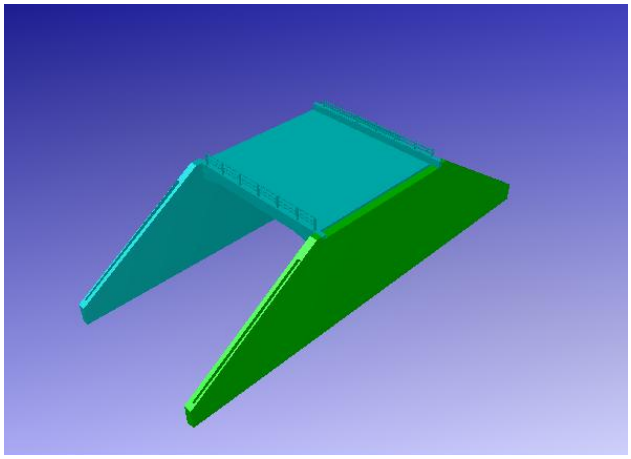
Register the new inspection

If the inspector is on the bridge and s/he wants to register or save the damages on the soft ware, should fallow these steps:

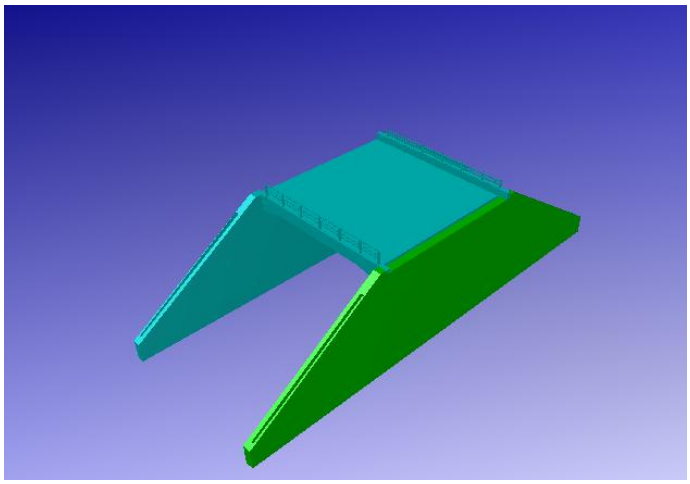
First of all, s/he should click on the bridge icon of province three dimensional models. Then s/he should click right on the tree structure of bridge and select “add”. Next s/he should write the date and description of inspection (4 & 5)



Picture 4 - How to add the new date on the tree structure



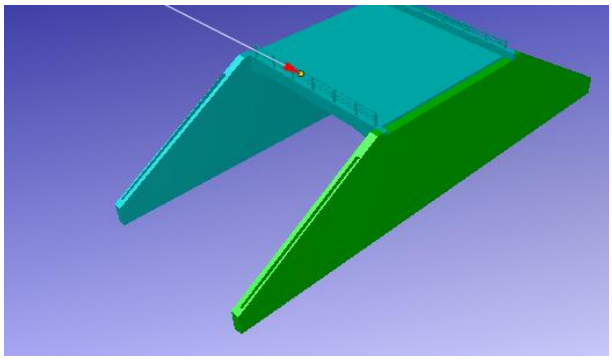
Picture 5- How to add the new date on the tree structure



Picture 6- Adding damage to three dimensional methods

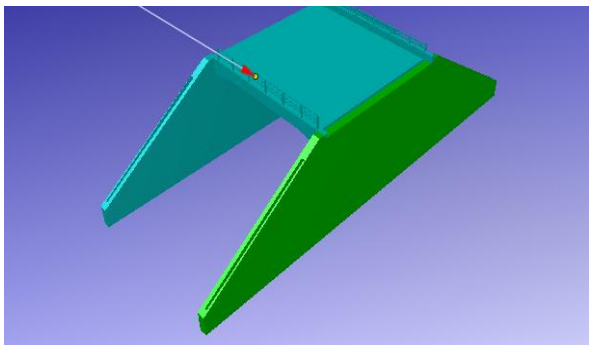
A new date is added to the previous dates. We inter the present date by “cause and edit” tab. The interred date changes update. Then we should double click on that to see the six main parts of the bridge. By right clicking on our real location, we select “add” and then “damage”. Next we go to “cause and edit” tab and select the damage from damage description. Intensity of damage should be selected form “intensity part”. We can give a maximum healthy score from the score list. If

we put the mouse on the damaged place of three dimensional model and click, we can see a short description of model will be shown as well as its intensity. Therefore we have easy access to damage description, damage intensity (though different colors). The individual or team inspectors save their evaluations on this soft ware (6, 7 and 8).



Picture 7- Adding the damage and its short description on three dimensional models

In this step, we use "save" to record and register the place and date of inspection (8)



Picture 8- Saving the damage on inspection date

Concept of percentage and area of bridge health

By inspection of bridge we find out the necessary operations for it[5]. On the other hand, considering the position of bridge net work level give opportunity to decision makers to have a better perform better some politics such as bridge maintain, necessary credits, priority of bridges repair, recognition and analysis of damages in the network level, strategies to repair and keep a bridge in a collection, city or country[1].

We need to define a concept which is a subordinate of bridge components as well as descriptive situation of bridge through capacity utilization and repair priority. To get this definition, experts of the Ministry of Roads and transportation utilized Danish company as executive manager. To rank the bridges, we utilized two concepts called health percentage and health area. This system has six main par called tablet, backpack, central base wall of water guidance, support and River Engineering presented in tables 1 to 6.

Table 1- Evaluation table form

Evaluation table form				
No	**Inspection subject**	**Maximum mark**	**Received mark**	**Other**
1	**The quality of the concrete slab and the Potters are appropriate**	**5**		
2	**slab and the Potters amateurs are presented**	**5**		

3	the underside of slab has no crack	5
4	Potters are in a support without crack	5
5	Potters have no crack on the central opening	5
6	Table is not rusted	5
7	connective screws are tight	5
8	Welding is OK	5
9	Diaphragms are operated correctly	5
10	Inhibitory are operated correctly	5
11	Ceiling beams and accessories are not Ricochet	5
12	table truss are not damaged or ricochet	5
13	Metal ceiling covers are not rotted	5
14	Width of pass is suitable	5
15	There is no sharp beam	5
16	The beams are long enough	5
17	Ceilings are safe and fenced are tight	5
18	The color of fences are OK	2
19	Drain of bridge is suitable	4
20	Expansion seams are OK and clean	4
21	the tables are not rotted because of chemical effects	5
22	Walking on the table is OK	5
23	Tables do not shake while passing the trucks	5
	Health percentage	

Table 2- Backpack evaluation form

No	Inspection subject	Maximum mark	Received mark	Other
1	The quality of the concrete backpack is OK	10		
2	Amateurs of backpacks are not seen	5		
3	There is no crack on backpack	5		
4	There is no crack under supports	10		
5	The walls are arranged in stone backpack	10		
6	Water does not damage the wall	5		
7	Foundation does not expose water	20		
8	Foundation is not settled	30		
9	Drain of backpack is OK	5		
10	Expansion seams are OK	5		
11	Concrete slabs are OK	2		
12	Slab reinforcements are not presented	2		
13	There is no crack on slab surface	1		
	Health percentage			

Table 3- Evaluation form of walls conduct water

No	Inspection subject	Maximum mark	Received mark	Other
1	The quality of concrete is OK to conduct water	10		
2	Wall amateurs are not presented	5		
3	There is no crack on wall surface	5		
4	Conducting water is OK and the water does not pass the backpack	20		
5	Arranging wall is OK	10		
6	Water does no separate wall parts	5		
7	Wall foundation do not expose water	20		
8	Wall foundation is not settled	30		
9	Wall drain is OK	5		
10	Expansion seams are OK	5		
11	Wall is tight enough	10		

Health percentage	

Table 4- Evaluation form of support

No	Inspection subject	Maximum mark	Received mark	Other
1	Neoprene is tight enough	5		
2	Neoprene is exactly under the beam	5		
3	Neoprene is healthy enough	5		
4	Connective pages are not rusted	5		
5	Concrete platforms are used to fix the side buildings	5		
6	When there is no concrete platform, the beams are Inhibited	5		
	Health percentage			

Table 5- Evaluation of central base

No	Inspection subject	Maximum mark	Received mark	Other
1	Quality of concrete columns are OK	10		
2	columns amateurs are not presented	5		
3	There is no crack on the columns	5		
4	There is no crack on the columns under supports	10		
5	Arrangement of walls is OK	10		
6	Water does not separate parts	5		
7	Column foundations do not expose water	20		
8	Column foundations are not settled	30		
	Health percentage			

Table 6- Evaluation of River Engineering Form

No	Inspection subject	Maximum mark	Received mark	Other
1	Bridge dimensions are OK	30		
2	Bridge is in correct location	15		
3	Bridge does not expose water	10		
4	The blow part of the bridge does not expose harvest	10		
5	Bridge mouth is open and water can pass easily	10		
6	redoing and breeding are performed if necessary	10		
7	redoing and breeding are healthy enough	10		
8	The river is peeled in the concentration of Alluvium	15		
	Health percentage			

As you see, there are six main parts as well as a maximum number. There are columns to register the score that should be completed by inspectors. At the end, the scores are added and we can find the Health percentage. Then the numbers are interred in to the tables such as 7.4 and multiplied to the coefficient of weight and importance of bridge. The final number is from 0 to 100 as the health score.

Table 7- Considering the bridge parts and identifying the percentage

No	Bridge parts		Health percentage	coefficient		Bridge health
				One mouth	Several mouth	
1	Main Parts of bridge	table		0.25	0.2	
2		backpack		0.6	0.3	
3		Central base		0	0.35	
4	Conducting wall			0.09	0.09	

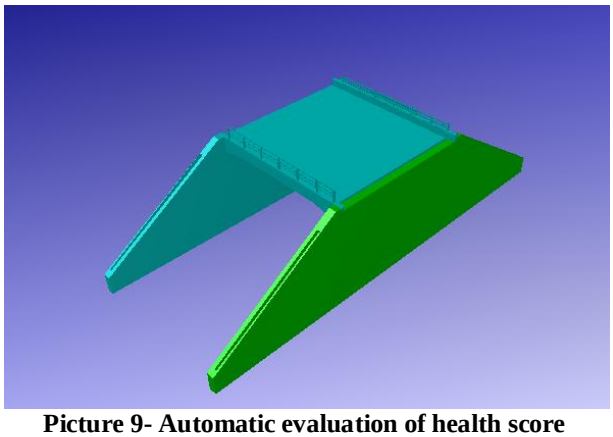
5	support	0.01	0.01
6	River engineering	0.05	0.05
	Health percentage		

Unfortunately the gained number does not help to inspectors. Therefore we should utilize the 4.8 table to make suitable decisions about repairing and maintaining the bridge.

After scoring any Alma, the soft ware gains the health score automatically. The health score is presented by special colors (4.10).

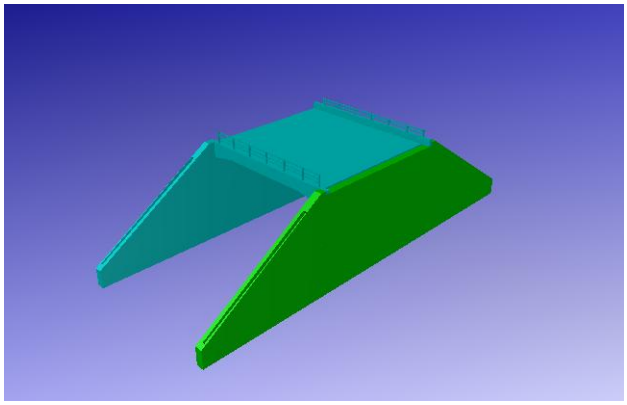
Table 8- Exploitation of bridge

No	Bridge situation	Health area
1	Bridge cannot be used and it should be stopped	0-25
2	There should be light traffic to repair the bridge	25-50
3	The bridge needs essential necessity to repairing	50-75
4	Bridge needs to recover	75-90
5	Bridge is OK and it only needs maintained	90-100



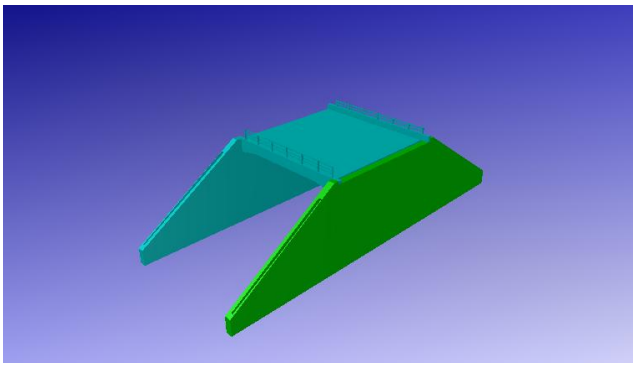
Picture 9- Automatic evaluation of health score

Sometimes the obtained score does not match the fact. Imagine a bridge with 5 mouths; it has obtained good health scores for the main parts ad Alma. But there is a small hole on one mouth which is really emergency to be repaired however it is not effective on health score. Therefore, there is another section in this soft ware called “expert ideas” that is filled be experts to decide the suitable priority. To know about the situation and priority of bridges we should click on “report” tab and select “description” similar to 10.



Picture 10- How to access the descriptions

To see the documents of bridges (for example their as built map, pictures or films), we should click on "document". Editing and omitting are possible as well (11)



Picture 11- How to access the documents in the soft ware

Abilities of soft ware

This soft ware has some abilities mentioned here:

- It is possible to see three dimensional map of a province by separation of country division
- It is possible to see three dimensional bridge with high accuracy
- Easy access to the history of bridge
- Easy access to pictures, films, maps and documents
- It is easy to edit the damage though tree structures
- Identifying the percentage of health bridge
- It is easy to have access to documents
- Devoting a repair method while observing o even predict the price repair

Table 9- Completed form about the exploitation of Hesseinieh Bridge

No	Situation of bridge	Health area
1	Bridge is not useful, traffic should be stopped	0-25
2	Traffic should be limited, repairing should start as soon as possible	25-50
3	Bridge needs emergency repair	50-75
4	Bridge needs repairing and recovering	75-90
5	Bridge is pleasant but it should be maintained	90-100

Table 10- List of inspected massive bridges according to their repair priority

Repair priority	Bridge code	Bridge name	index	kilometers	Year of Foundation	Health percentage	Export health percentage	Necessary credit to repair	methods	others	
									Arterial	Non-Arterial	rural
1	13020203	Hosseinieh	Andimeshk- Zal	30+000	1345	73.45	73.45	2500	×		
2	13080503	Karimi	Ramhormoz-Behbahan	34+200	1368	83.2	83.2	1700	×		
3	13020201	Navard	Ahvaz-Khoramshahr	0+000	1351	88.55	88.55	450	×		
total	4650										

CONCLUSION

The conclusions can be considered in two aspects, includes designing the inspection soft wares and identifying the situation of bridge

Designing the inspection soft wares

The results include:

- Utilizing Location-Based Computing in bridge inspections
- Designing a graphic interface with high quality and accuracy
- Having one particular logarithm to inspect the bridges by listing the main parts and identifying the possible damages through a soft ware
- Easy access to all documents, films ,pictures and maps
- Easy access to the history of bridge
- Easy access to three dimensional models with high quality and accuracy
- It is possible to look at the geometrical , structural, public and geographical features

Identifying the bridge situation

- Definition of health and area percentage
- Listing the possible damages in six mentioned sections
- Identifying the automatic and handy percentage of health and area bridged
- Preparing necessary reports with suitable format
- Devoting a repair method while inspection and predict the price

SUGGESTIONS

Since bridges are the most important foundation of the country, LBC system is suggested to manage and maintain of structures such as dams, tunnels or even historical building.

The other suggestion is to add warning system to this soft ware. It means if a

bridges' health score is below, the soft ware's start to warn automatically.

By considering the bridge damages, we can get a damage pattern. Therefore a pattern can be used to predict the similar situation. It is also suggested to use Bayesian nervous systems to repair the bridges.

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