



THE APPLICATION OF ACCURATE DIGITAL CAMERAS WITH GPS AND USE THE GOOGLE IMAGES FOR MONITORING HIGHWAY BRIDGES

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Abstract: The monitoring process is important for any structure for many reasons, but unfortunately most of Iraqi constructions suffer from the lack of their drawings and plans due to different reasons. Such drawings and plans are very important in monitoring process to identify locations of damages, thus a new approach has been applied to monitor highway bridges damages using accurate digital cameras with GPS to determine locations of the damages in site, then such defined locations axis have been used to obtain the related Google images of the site to locate the position of damages on images. Also a new colored code of arrows has been used to locate the damage position and identify the direction of images. It has been proved that using such approach was very successful and will reduce time and efforts due to their activity, accuracy and easiness of both damages recognition or identification of damages location when compared with respect to the traditional method of monitoring process as well as the new approach was essential to solve the problem of missing drawings and plans of the sit

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تطبيق الكاميرات الرقمية الدقيقة مع نظام تحديد المواقع واستخدام صور كوكل لمراقبة جسور الطرق السريعة

الخلاصة: إن عملية الرصد تكون مهمة لأي منشأ لعدة أسباب، ولكن لسوء الحظ المنشآت العراقية تعاني من نقص في المرسومات والمخططات لعدة أسباب. إن هذه المرسومات والمخططات مهمة جدا في عملية الرصد لتحديد مواقع الاضرار ولهذا تم تطبيق الاسلوب الجديد لرصد اضرار جسور الطريق السريع باستخدام كاميرات رقمية دقيقة مع نظام تحديد المواقع العالمي في تحديد مواقع الاضرار في الموقع وان احداثيات هذه المواقع قد تم استخدامها للحصول على صور Google العائدة لها في الموقع لتثبيت الاضرار على هذه الصور. كذلك تم استخدام رموز ملونة للاسهام لتحديد مواقع الاضرار ولتحديد اتجاه الصور. لقد تم البرهان بان استخدام هذا الاسلوب كان ناجحا جدا ويقلل الوقت والجهد بسبب فعاليته ودقته وسهولة تمييز الاضرار وتحديد مواقعها عند مقارنتها بالطريقة التقليدية في عملية الرصد وكذلك فان الاسلوب الجديد كان ضروريا لحل مشكلة فقدان مرسمات ومخططات الموقع.

1. Introduction

Each construction should be periodically monitored or inspected to maintain its safety, performance as well as to increase its useful life while in the meantime, most of

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constructions in Iraq suffer from the lack of their drawings and plans due to improper documentation and also due to the events of robbery and vandalism that took place in an2003.

Such drawings and plans are essential to identify locations of damages especially for constructions in Iraq that faced many risks due to lack of care and interest as well as due to the effects of wars and their consequences in the past.

Many researchers have used digital cameras for monitoring such as in [1-3] that presented a modern approach of visual inspection using Global positioning System (GPS) and high resolution DSLR cameras with a 600mm long focal length lens for inspection of bridge and large structures (Dams and Cooling Towers) respectively.

Also in [4] it was explained the importance of digital camera, binoculars and some other tools in the measurement and documentation in visual inspection for structural Integrity at risk in which cracks of width 0.75mm to 31.5mm were documented because of differential settlement induced by inadequate foundations. Also, in [5] Kodak camera DSC 660 was used with a six-megapixel (3000 x 2000) resolution with a lens of focal length 28-mm for similar monitoring process.

Thus to minimize the efforts and time of visual inspection and also to overcome the problems of missing drawing and plans for most sites, it has been proposed this attempt to inspect highway bridge through the use of accurate digital cameras which are able to find all the damages that can be found by visual inspection (may be more) as well as using Google images. The use of this method can also reduce the time and effort through photograph rather than description each damages with the references of their positions on the drawings and plans in the traditional method. This method requires sufficient experience in the selection and use of digital camera as well as lenses and also sufficient experience to evaluate the damages through images which is done usually indoors. The evaluation process is also depends on images quality.

2. Required Preparations and Selection of Tools

The Inspection process requires well preparation to identify the project condition which includes damage types, movability/accessibility to the damage, light condition and so to select the most appropriate tools for the project condition as well as to find the most suitable time to implement such process.

The most important option fall into the selection of tools especially the required digital cameras and their lenses to keep the quality of images that would be used to evaluate the damages later. The selection of type of cameras and lenses depend on their features, lighting condition and required image quality while the selection of lenses focal length depends on the movability or accessibility to the damage as well as on the size of damage.

Some other photographic accessories may be needed for further requirements such as light meter, external flash, tripod and so. Such selection may greatly affect the quality and sharpness of the images.

3. Needed Tools and Results

The first step to select which camera and lens are suitable to be used, thus it has to find out the intensity of reflected light from the dark surfaces that was the main factor of selection the most appropriate camera through measuring the reflected light by light meter as shown in fig. 1.



Fig. 1 Sekonic light meter.

The average readings of light meter for the intensity of reflected light from dark places (Exposure Value EV) was 8.6 while the average reading in the newly painted surfaces was 10.1 that means there is a difference of 1.5 of EV, in other words the difference in light intensity was 3 times. Therefore, for such darkness places, it is preferred to use low resolution camera with capability of image stabilization or vibration reduction to get qualified images, thus Nikon D5000 DX camera was used (as shown in fig. 2) which is a Digital Single Lens Reflex (DSLR) that has 12million pixel or Mega Pixel (12MP) with the zoom lens 18-55mm Vibration Reduction (VR) & 55-200mm VR to cover damages in nearby to distant places.



Fig. 2 Nikon D5000 Camera.

For the purpose of determining the site location, Sony a65 camera was used (as shown in fig. 3) which is a Digital Single Lens Translucent (DSLT) camera that has 24MP with The Global Positioning System (GPS) that can determine the site location which based on satellite navigation system that provides location and time information in all weather conditions. It also has in body image stabilization with zoom lens 18-55mm and 55-200mm.



Fig. 3 Sony a65 camera.

The need for Sony a65 camera was mainly to determine GPS coordinates that can be used to find the related location from Google maps as well as to get high images resolution in good light condition.

4. Determine Damage Locations on Google Images

There was a big problem to find most of drawings and plans of most parts of Mohammed Al-Qassim bridge, which are essential to identify location of damages and to solve such problem,

Google images were adopted for the location that were obtained according to the predefined location axis by GPS of Sony a65 through the aid of the Department of Geographic Information System (GIS) in the Mayoralty of Baghdad.

Google images are preferred than Google maps because they have more details and represent locations in three dimensions. Also a new colored code of arrows has been used to locate the damage position and identify the direction of images.

The first location was in the Mohammed Al-Qassim bridge over Sheikh Omar Street as shown in fig. 4. The colored arrows identify the locations and directions of the images of damages.

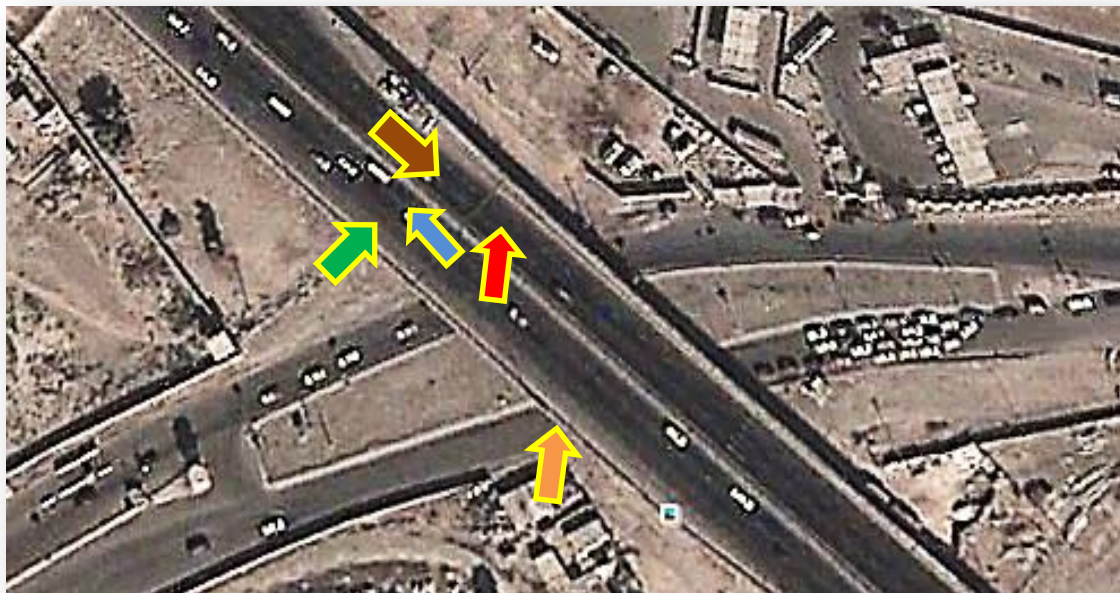
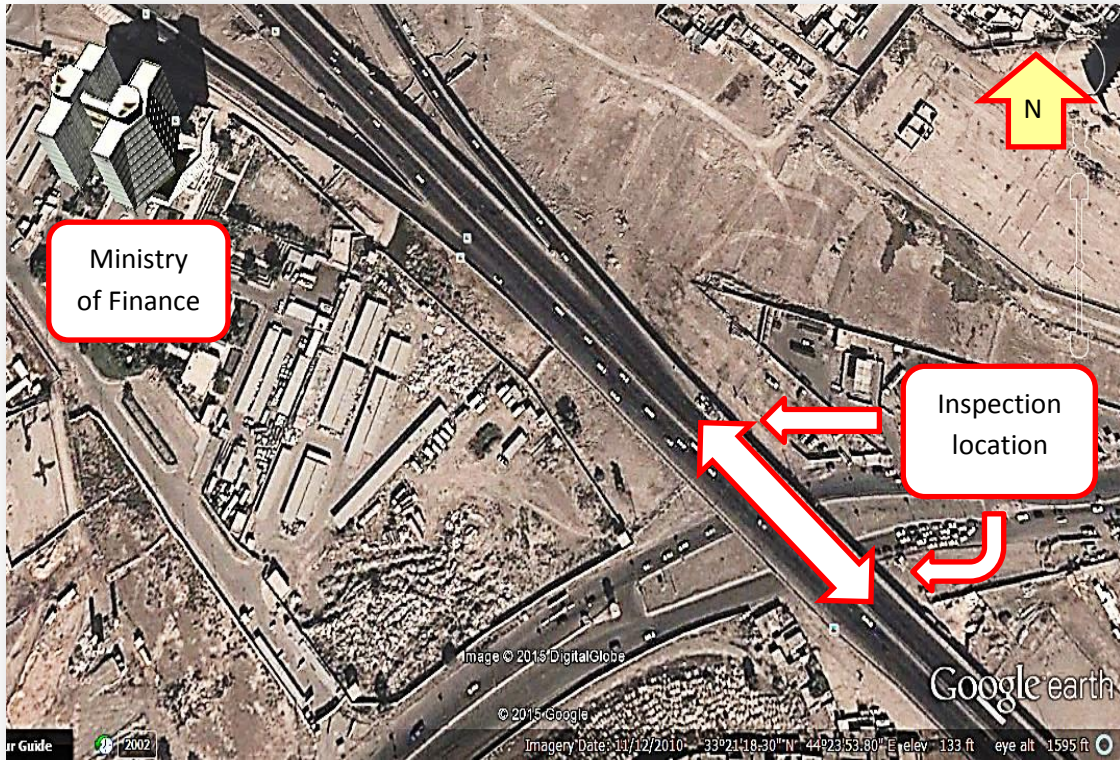


Fig. 4 Google Images of the Mohammed Al-Qassim Bridge location across Sheikh Omar Street with GPS Coordinates (axis) in the upper image, while the lower image shows the colored arrows that identify location and direction of the images of the damages which are shown below.



Fig. 5 Concrete delamination and exposure of Reinforcement in pier Capital due to heavy traffic loads & low strength of concrete cover.



Fig. 6 Cracks, Delamination and Reinforcement exposure of Pier Capital due to heavy traffic & low strength of concrete cover.



Fig. 7 Cut in wires of the girder flange due to crash with high-rise vehicles.



Fig. 8 Cracking in the pier capital due to heavy traffic loads & low strength concrete.



Fig. 9 Spalling and exposure of reinforcement in pier capital due to heavy traffic loads and low concrete strength.

It is clear that most damages occurred in pier and pier capital which are casted in place due to low concrete strength with respect to the high traffic loads, also some places suffer from insufficient cover thickness.

The second location was in Mohammad Al-Qassim highway across Al-Nahda square (see fig. 10) and as it is shown before, the colored arrows identify the location and direction of the images.

The location located in a crowded area that filled with sellers of scrap who are afraid of photographers because they thought that purpose of such photograph is for sending them away.

Thus, to avoid such problem and because of the difficulty of movement in the place which is full of used furniture and scrap materials which make the movement around to inspect damages very hard, thus a bigger focal length of zoom lens such as 55-200mm is required to cover such distant locations.

This location is characterized by the presence of a large number of girders suffered from crashed flanges that was mainly caused by accidents with crane vehicles resulted in cuts in post tension wires as shown in fig. 11, the other figures show the different damages that have been inspected there.



Fig. 10 Google Images of the Mohammed Al-Qassim Bridge across Al-Nahda Square (Colored arrows identify images location and direction).



Fig. 11 Crashed girder flanges and cut post tension wires by accidents with crane vehicles.



Fig. 12 The disappearance of the concrete cover and exposure of reinforcement of pier capital due to heavy loads & badly constructed.



Fig. 13 The disappearance of the concrete cover and exposure of reinforcement of pier capital and girders.



Fig. 14 The disappearance of the concrete cover and exposure of reinforcement of pier capital due to heavy loads & badly constructed.



Fig. 15 Poorly repaired area in pier capital (just by plastering).

It is clear as seen from above damages that most damages occurred in pier capitals and that can be related to one or more of the following:

- 1- Heavy traffic loads.
- 2- Insufficient concrete cover thickness.
- 3- Low strength concrete with respect to applied loads.

Also some girders suffered from crashing by crane and high rise vehicles causing serious damages in girder flanges and cutting in post tension wires.

The damages that require attention have been identified, located and presented to Mayoralty of Baghdad to be utilized later. Some attempts have been applied to repair some of damages in pier capitals through using plastering method which may be the cheapest way but it is insufficient where most of those layers fell after a period so it has been suggested to use fiber reinforced cement after cleaning such places with sand blast.

5. Conclusions

- Experts of majority of Baghdad have approved that using such approach was very successful and will reduce time and efforts due to their activity, accuracy and easiness of both damages recognition or identification of damages location when measured with respect to the traditional method.
- The new approach of monitoring process was essential to solve the problem of missing drawings and plans of the site.

- Google images are very useful and present clearer details than original drawing or any maps and also easier to find locations of damages especially when used with colored arrows that present positions and directions of images of the damages.

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