International Journal of Research In Science & Engineering e-ISSN: 2394-8299
Volume 3 Issue 1 January 2017 p-ISSN: 2394-8280

BRIDGE CRACK DETECTION ROBOT USING RASBERRY PI & IOT

Mr. Ajay L. Ghatol[1],Mr. Ajay N. Mohurle[2] , Mr. Amol V. Tipramwar[3],Miss. Dipali A. Ingole[4,] Prof. Anuprita P. Linge[5]

B.E. Students, Electronics & Telecommunication,
Shri Shankarprasad Agnihotri College Of Engineering (SSPACE), Wardha, Maharashtra, (India).

Abstract—This paper is to design and develop a robotic system for inspecting the bridge cracks and to make it a multipurpose robotic system.The bridge maintenance is an important category in order to provide a safety and efficient transportation of heavy vehicles for long distances. Crack inspection is an important task in the maintenance of bridge and it is closely related to structural health of bridge.Currently it is done through a very manual procedure, an experienced human inspector monitors the whole bridge surface visually and tries to detect cracks on the bridge and marks the location of crack. But this manual approach having some limitations such limited accuracy. Proposed research focuses on implementing a system having a robot, equipped with an ultra-sonic sensor detect the cracks.The robotic system is developed based on considering the path selection on the bridge for ensuring that the entire bridge is inspected. The information exchange will be done through a simple SMS and geographical location should be done through the Wi-Fi connected to it.

Keywords: Crack inspection, IOT, Ultra Sonic Sensor, computer vision.

I. INTRODUCTION

Manual approach is slow and is limited by different factors. Here we have developed a system detect cracks with the help of ultrasonic sensor. We have used raspberry pi kit with mobile robot which is equipped with internet of things use to send message to the receiver.

Concrete bridges exist throughout the India of various sizes and different forms. They are integral part of highway system even though they are most neglected element of the infrastructure. Safety inspection of concrete structures like bridges is an important factor since it is related to structural health of structure and provides information whether bridge require maintenance or not. About fourty years ago, technology was not enough advanced and manual approach were adopted. Safety was not important concern as today.

According to the National Bridge inspection standards, if a bridge is 20 ft long, is to be inspected at least once every 12 month, can reduce risk of catastrophic failure. Different studies have shown that regular and periodic inspection and maintenance is acost effective investment.Thesurface of Bridge deck is affected by different environmental condition as well as direct load of vehicles so the bridge deck surface is first component to be inspected and maintained. The owners of these bridges whether be a local orstate government, always look for the cost effective means for inspection and maintenance. Safe operations are demanded.protection of workers safety and health as both moral obligations. Inspecting and correcting minor deficiencies like cracks while the structure still in good condition will ensure the structural reliability and small repairs, activities will be performed to keep the bridge in good condition and thereby avoid large expenses in major rehabilitation or replacement but this manual approach having some limitations. Such as limited accuracy since human inspector having limited visual capability may require repeatability due to

variability and inconsistencies in inspection. It is dangerous job to inspect the bridge with passing traffic also these inspections become too laborious and slow. So there is a need of designing a system which works with achieving high accuracy. The system proposed will be equipped with a robot, ultra sonic sensor to detect the crack of surface and IOT send the message to authorized person.

Bridge surface is always been an important concern in maintenance of bridges since surface of bridge carries all passing traffic also it is exposes to different wheatear conditions, so bridge surface needs regular inspection and detection of cracks on it. Currently inspection is done manually by an engineer who walks through bridge and points
out the locations of cracks. This approach is having certain disadvantages since human eye visibility is limited beyond.

A certain limit due this minute cracks are not visualized properly also it is tedious job to inspect the bridge while Passing traffic.It is dangerous job to inspect the bridge with passing traffic also these inspections become too laborious and slow. So there is a need of designing a system which works with achieving high accuracy.

II. EXISTING SOLUTION

A conventional and manual approach for bridge deck inspection is human visual inspection which is considered as primary inspection method over other methods and it heavily relies on subjective judgment of inspector. In this method, first entire bridge surface is visually inspected from a close distance, the inspector walk through the surface and try to detect cracks on the bridge and marks the location of cracks. Also this method is carried out using an inspection trolley that travels along surface of bridge which is inconvenient and time consuming. This manual approach having certain limitations such as limited accuracy since human inspector having limited visual capacity and it is dangerous job to inspect the bridge with passing traffic. This method is also used for cable inspection of bridge.

In this section we review various studies and development carried out by many researchers. We will also see existing robotics and localization based studies. Sung-yul An, Jae-ho Jang, Chang-soo Han, and Pyung-hwa Kim has presented an automated inspection system using a mobile robot that can detect concrete cracks in a tunnel employing an illuminator. In their system cracks are inspected vertically and horizontally. The mobile robot system consists of a CCD camera that can capture images of concrete structure and maximizes contrast distribution of cracks and non cracks. The camera usually require high power illuminator, a maximum of 1000 W halogen light is used. The numerical information of cracks are extracted and computed by crack detecting system which utilizes software. To ensure that camera captures fine images mobile robot has to maintain a constant distance from the structure therefore a laser sensor is used to obtain distance from structure. This system was limited by complete use of the automation in an unpredictable environment Thereby; the data read to navigate the robot is becoming complicated.

III. PROPOSED SOLUTION

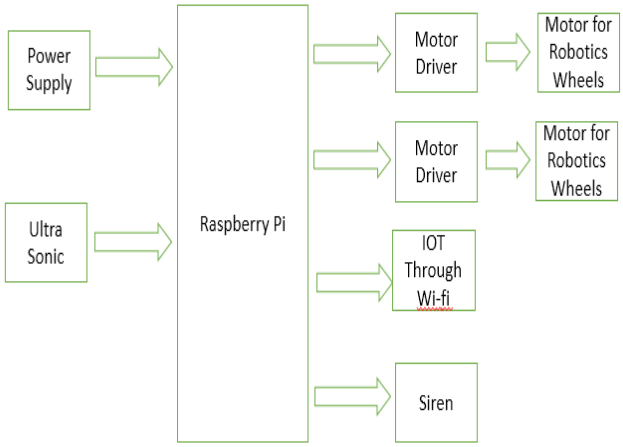
In the proposed solution, the robot is equipped with a GSM module to intimate the place of cracks occurred to the manager with the simple SMS technology. The entire bridge was divided into zones; if a crack is occurred in zone1 then a simple SMS is sent to the manager for speedy recovery. The place of identification is not done in the existing solution, but it is done in the proposed solution. Cracks were identified with the help of IR Sensor Systems were used for identifying the cracks of a bridge. It is method having certain limitation and

radiographic technique are complicated. Operational safety is important concern and this method is slow and takes several hours.

IV. IMPLEMENTATION

Raspberry Pi is booted with a Linux OS Distribution of named Wheezy Raspbian and the robot is interfaced to Raspberry Pi via Motor Driver (Current Amplifier). Ultrasonic sensor is also interfaced to Raspberry Pi for detecting cracks and an Internet of Things Module is interfaced to UART port of Raspberry Pi. As the GPIO Header of Raspberry Pi. A status LED's were also connected to the Raspberry Pi for user understanding, what's happening at Raspberry Pi. The three programs (Robot Running, IOT Sending SMS, and Ultrasonic Detection) were written in Python and they were executed automatically upon a boot.In this way, we can detect the crack in high accuracy level.

V. SYSTEM ARCHITECTURE



.

- **Ultrasonic Crack Inspection**

Ultrasonic inspection which can detect the presence of defects or cracks in the concrete structures. This method can also be used for cable inspection of bridges. An ultrasonic device consists of a 'Transmitter' which can send high frequency sound wave and reflected signals are received by a 'Receiver '. An acoustic emission technique is used which can find out presence of defect or crack in the structure. Structural defects as a discontinuity reflect the transmitted signal to receiver as a sign of presence of defects. For transmission, long guided waves are used as a transmitting signal. The size and location of defects and cracks can be computed by magnitude as well as delay time of reflected signal. The ultrasonic test results are subjective to the inspectors experience and judgment as well as proper handling of device.

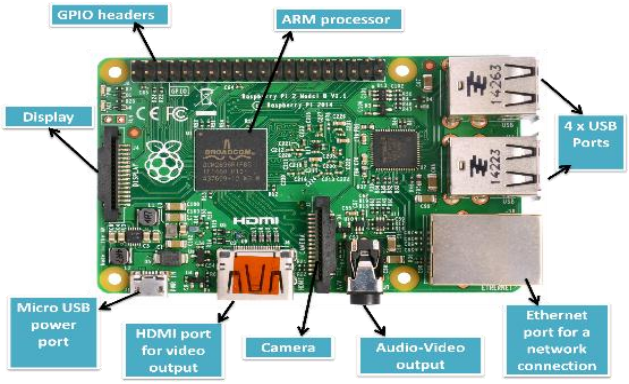
- **L293D Description**

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16 pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge Motor Driver integrated circuit (IC).

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.

- **Raspberry Pi**

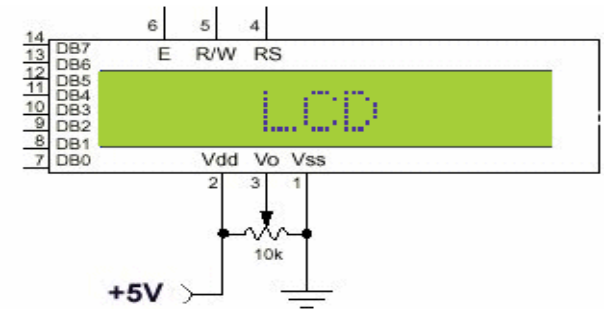
The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.



- **Liquid Crystal Display**

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.



VI. WORKING

The Multipurpose robotic system working start from powered up and it is continuously run along with bridge whenever the crack will be detected and also whenever the bridge decks gets damage it will also get detected then immediately the location details will be sent to the authorized person through IOT and Wi-Fi technology.

VII. FEATURE

- It avoids the accident.
- It gives a fast response.
- Save time
- Less human effort

VIII. CONCLUSION

From the above studies we can propose automatic crack detection which is capable to detect crack on the bridge surface. This system, we develop will consist of mobile robot which will moves along the bridge surface. We try to send massage wirelessly to the computer all these together provide an efficient system for inspection of bridge surface.

In this paper, a crack detection presented for the application of bridge maintenance.

IX. REFERANCES

[1]. "Mississippi River Bridge", Wikipedia, 2007.

[2]. V. Giurgiutiu, C. A. Rogers, Y. J. Chao, M. A. Sutton and X. Deng "Adaptive health monitoring concepts for spot-welded and weld-bonded structural joints", Proc. ASME Aerosp. Division, vol. 54, pp.99 -104

[3]. C. R. Farrar, H. Sohn and S. W. Doebling "Structural health monitoring at Los Alamos National Laboratory", U.S.-Korea Conf. Sci. Technol., Entrepreneurship and Leadership, pp.1 -11

[4]. H. Sohn, C. R. Farrar, M. L. Fugate and J. J. Czarnecki "Structural health monitoring of welded connections", Proc. 1st Int. Conf. Stell Composite Structures,

[5]. E. Sazonov, K. Janoyan and R. Jha "Wireless intelligent sensor network for autonomous structural health monitoring", Proc. SPIE Int. Soc. Opt. Eng., vol. 5384, no. 1, pp.305 -314

[6] H. Moon, and J. Kim, "Intelligent Crack Detecting Algorithm On The Concrete Crack Image Using Neural network," in Proceedings of the 28th ISARC, Pages 1461-1467, Seoul, Korea, 2011

[7] Sylvie Chambon. “Detection of road cracks with multiple images ", in International Joint Conference on Computer Vision Theory and Applications, VISAPP, Angers, France , may 2010