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Autonomous Robot For Crack Detection Using Raspberry Pi With IOT & Ultrasonic

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Abstract

Detection of cracks on bridge decks is a vital task for maintaining the structural health and reliability of concrete bridges. 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 try 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 a raspberry pi with ultra sonic connectivity with the help of IOT to detect the crack. The robot is travel from start point to end point through an IR sensor. Cracks were identified with the help of ultrasonic waves. Sensor Systems were used for identifying the cracks/holes of a bridge. Raspberry Pi is used as a processor for this robot, which is also best alternative used than the existing one, processing and intimating the manager is done with the help of Raspberry Pi. 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, IR sensor*

INTRODUCTION

The manual method of site inspection is a time-consuming process for long-span bridges. Skilled inspectors go to the site and assess the deck condition, marking the corrosions and cracks on a chart, all under strict traffic control. Automated and accurate condition assessment that requires minimal lane closure is highly desirable for fast large-area evaluation. 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. 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 a cost effective investment. 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 [1–3]. 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. Bridge surface is often been a vital concern in maintenance of bridges since surface of bridge carries all passing traffic additionally it's exposes to completely different thrush conditions, thus bridge surface desires regular scrutiny and detection of cracks thereon. Presently scrutiny is finished manually by an engineer World Health Organization walks through bridge and points out the locations of

cracks. This approach has bound disadvantages since human eye visibility is restricted on the far side.

A certain limit due this minute cracks aren't visualised properly additionally it's tedious job to examine the bridge whereas Passing traffic. Presently scrutiny is finished manually by an engineer World Health Organization walks through bridge and points out the locations of cracks. This approach has bound disadvantages since human eye visibility is restricted on the far side a particular limit due this minute cracks aren't visualised properly additionally it's tedious job to examine the bridge whereas passing traffic. We've got developed a system which may examine and sight cracks with the assistance of ultra-sonic device and inspected space showing cracks in it. We've got used mobile golem that is provided with raspberry pi use to send message through web of things to laptop computer wherever this process technique is employed to sight crack [4–6].

EXISTING SOLUTION

Manual approach, initial entire bridge surface is visually inspected from an in depth distance, the inspector practice the surface and take a look at to observe cracks on the bridge and marks the situation of cracks. Conjointly this methodology is dispensed victimisation scrutiny trolley car that travels on surface of bridge that is inconvenient and time overwhelming. This manual approach having bound limitations like restricted accuracy since human inspector having restricted visual capability and it's dangerous job to examine the bridge with passing traffic. This methodology is additionally used for cable scrutiny of bridge.

In this section we have a tendency to review varied studies and development dispensed by several researchers. We'll conjointly see existing artificial intelligence and localization based mostly studies. Sung-yul, Jae-ho Jang, Chang-soo Han dynasty, Pyung-hwa Kim has bestowed an automatic scrutiny system employing a mobile mechanism that may observe concrete cracks in a very tunnel using an illuminator. In their system cracks are inspected vertically and horizontally. The mobile mechanism system consists of a CCD camera that may capture pictures of concrete structure and maximizes distinction distribution of cracks and non cracks. The camera sometimes need high power illuminator, a most of one thousand W grouping light-weight is employed. 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 [7–10].

PROPOSED SOLUTION

In the projected answer, the mechanism is provided with a GSM module to intimate the place of cracks occurred to the manager with the straightforward SMS technology. The complete bridge was divided into zones; if a crack is occurred in zone1 then an easy SMS is distributed to the manager for fast recovery. The place of identification isn't worn out the prevailing answer, however it's worn out the projected answer. Cracks were known with the assistance of IR sensing element Systems were used for characteristic the cracks of a bridge. It's methodology having bound limitation and picture taking technique square measure sophisticated. Operational safety is vital concern and this methodology is slow and takes many hours.

IMPLEMENTATION

Raspberry Pi is shoed with a linux OS Distribution of named Wheezy Raspbian and also the mechanism is interfaced to Raspberry Pi via Motor Driver (Current Amplifier). Inaudible sensing element is additionally interfaced to Raspberry Pi for police investigation cracks and an IOT Module is interfaced to UART port of Raspberry Pi. Because the GPIO Header of Raspberry Pi. a standing LED's were additionally connected to the Raspberry Pi for user understanding, what's happening at Raspberry Pi. The 3 programs (Robot Running, IOT causation SMS, and inaudible Detection) were written in Python and that they were dead mechanically upon a boot. IR sensing element that is employed for terminate the mechanism in between beginning and finish purpose of the bridge. During this means, we are able to sight the crack in high accuracy level.

SYSTEM ARCHITECTURE

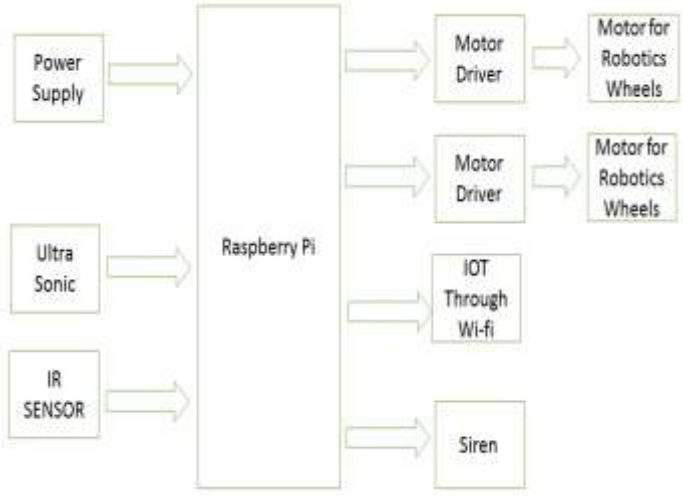

Fig. 1: *System Architecture.*

RASBERRY PI

The Raspberry Pi could be a low price, credit-card sized laptop that plugs into a laptop monitor or TV, and uses a regular keyboard and mouse. It's a capable very little device that permits individuals of all ages to explore computing, and to find out a way to program in languages like Scratch and Python. It's capable of doing everything you'd expect a microcomputer to try to to, from browsing the web and taking part in high-definition video, to creating spreadsheets, word-processing, and taking part in games.

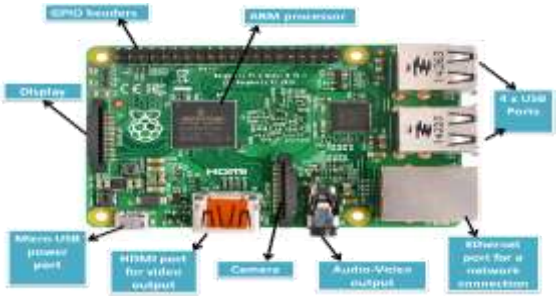

Fig. 2: *Rasberry PI.*

ULTRASONIC CRACK INSPECTION

Ultrasonic inspection which might discover the presence of defects or cracks within the concrete structures. This methodology may also be used for cable examination of bridges. A supersonic device consists of a 'Transmitter' which might send high frequency wave and mirrored signals area unit received by a 'Receiver'. An acoustic emission technique is employed which might decide presence of defect or crack within the structure. Structural defects as a separation mirror the transmitted signal to receiver as a symbol of presence of defects. For transmission, long guided waves area unit used as a sending signal. The scale and site of defects and cracks will be computed by magnitude additionally as delay time of mirrored signal. The supersonic take a look at results area unit subjective to the inspectors expertise and judgment additionally as correct handling of device.

IR SENSOR

An IR LED, also known as IR transmitter, is a special purpose LED that transmits infrared rays in the range of 760 nm wavelength.

1) Such LEDs are usually made of gallium arsenide or aluminum gallium arsenide. They, along with IR receivers, are commonly used as sensors.

2) The appearance is same as a common LED. Since the human eye cannot see the infrared radiations, it is not possible for a person to identify whether the IR LED is working or not, unlike a common LED.

3) To overcome this problem, the camera on a cell phone can be used. The camera can show us the IR rays being emanated from the IR LED in a circuit.

Fig. 3: *IR Sensor.*

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.

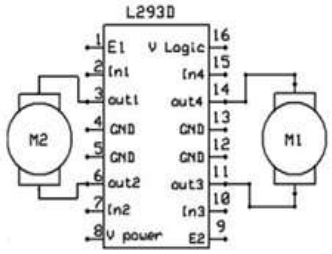

Fig. 4: *L293D.*

LIQUID CRYSTAL DISPLAY

LCD (Liquid Crystal Display) screen is associate electronic show module and notice a large varies of applications. A 16x2 lcd display is extremely basic module and is extremely ordinarily utilized in numerous devices and circuits. These modules area unit most well-liked over seven phases and alternative multi segment LEDs. The explanations being: LCDs area unit economical; simply programmable; don't have any limitation of displaying special & even custom characters (unlike in seven segments), animations and then on. A 16x2 lcd suggests that it will display 16 characters per line and there are a unit two such lines. during this lcd every character is displayed in 5x7 picture element matrix. This lcd has 2 registers, namely, Command and information.

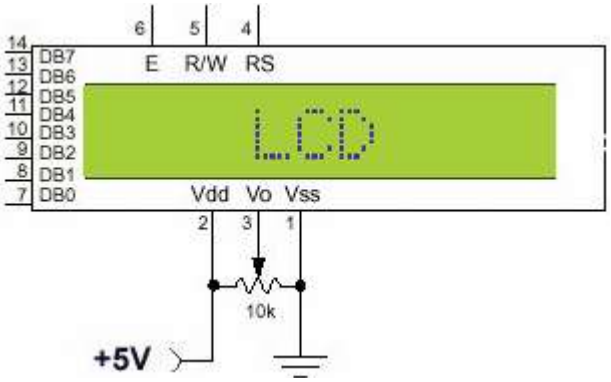

Fig. 5: *Pin Diagram of 2x16 line LCD.*

WORKING

The utile robotic system operating begin from battery-powered up and it's ceaselessly lie with bridge whenever the crack are detected and conjointly whenever the bridge decks gets harm it'll

conjointly get detected then in real time the situation details are sent to the licensed person through IOT and Wi-Fi technology..

FEATURE

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

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.

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