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# Structural Health Monitoring Of Bridges By Using Ultrasonic Sensor

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***Abstract*** *Bridges are vital components of the Indian surface transportation system and support the growth of this nation's economy. But recent unexpected collapses and near to collapses of bridges underline the need for effective structural monitoring. There are multiple causes: poor technical state of bridges and roads, failure to traffic rules, vehicle built to modern highway traffic regime As the cost for monitoring and repair is much lower than the cost for reconstruction of new structures, monitoring is vital for civil infrastructure facilities, which form the lifeline of our country's economy. Current maintenance operations and integrity checks on a wide array of structures require personnel entry into normally-inaccessible or hazardous areas to perform necessary non-destructive inspections. Recently there has been increase in need for adopting smart sensing technologies to SHM so this review focus on sensing, monitoring and assessment for civil infra-structure. At present, the commonly used crack detection methods include physical and electrochemical methods, but there are shortcomings such as large equipment area, low detection frequency, and complex operation. This research develops and validates an array of Ultrasonic sensors for surface crack detection. It is a non-destructive testing (NDT) with potential applications for locating and up monitoring cracks and flaws during structural health management. This research presents the quantitative crack detection capabilities of the Ultrasonic sensor, its performance in actual structural environments, and the prospects for structural health monitoring applications.*

**Keywords -** *Crack detection , Infrastructure , Non-destructive testing , Structural monitoring , Ultrasonic sensor.*

## *I.* INTRODUCTION

Association of American State Highway and Transportation Officials (AASHTO) defines a bridges as "a structure, including supports, erected over a depression or an obstruction such as water, highway, or railway, having a track or passageway for carrying traffic or other moving loads and having an opening measured along the center of the roadway of more than 6 m between under-copings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes; it may also include multiple pipers where the clear distance between openings is less than half of the smaller contiguous opening."(AASHTO, 1999). The most frequent reasons of bridge failures were not due to design and construction fault but due to floods and collision. Bridge overload and lateral impact forces from trucks, barges/ships, and trainsreulted inaround 20% of the total bridge failures.

The principal causes of bridge failures were categorized as deficiencies in design, detailing, construction, maintenance, use of weak materials, and inadequate consideration of external events. Deficiency in design constitutes error, mistakes,oversight, omission, or conceptual flaw that could have taken place during the design process of the bridge. Detailing is a process between design and construction periods, in which the details of the structural design are prepared for their implementation through shop drawings.

The main scope of the research is to develop an integrated monitoring system for durability assessment of bridges. The system must interface and integrate the actual practice mainly based on visual inspections and combine the response of a number of different reliable sensors, installed on the structure to monitor the progress of damage, with enhanced realistic deterioration models .

## II. METHODOLOGY

The existing method uses various different cracks detecting methods and algorithms. Initially thermal, visual, dielectric and acoustic sensors are used. It produces better accuracy in greater reliability. Performance and lifetime of the sensor are low. Secondly a charge coupled device is used for detecting the crack in fatigue and sewer pipes. It is a used along with the camera scanning device. There arises an illumination problem in dark environment. Thirdly shock observer device and vibration sensor are used so that the space and leakage is also being detected. For detecting the crack in pipelines the full automated mobile pipeline, exploration robot (FAMPER) is used, but it is sensitive to heat exploration.

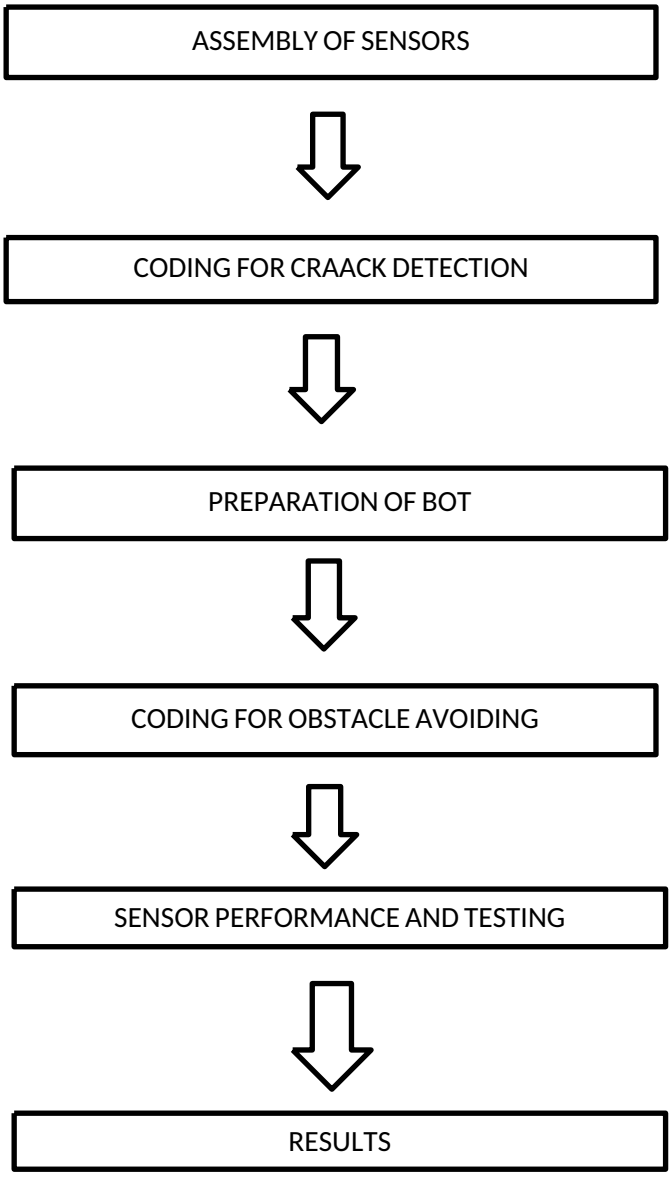
Complete coverage path planning algorithm is used for covering the total area of the field automotive turning off the robot is not possible. LED and LDR combination of sensor is used for detecting the exact location of the crack then it consume less power but is not programmed to operate in different lightning condition. Common 5V LED and cadmium supplied LDR was found to be sufficient. The LED is powered using one of the digital pins of the Arduino. The LDR and 45 Kilo Ohm resistor form a potential divider arrangement. The output of the potential divider is given to one of the analog input channels of the Arduino. Micro electro mechanical switch (MEMS). It can operate in both ballast and slab tracks which detect the shakes of the structure. Replaces the wireless sensor into a solar sensor for energy conservation.

Due to different lightening conditions, illumination, low stability to withstand in high temperature system produce poor results in detection of crack. To overcome the drawback we proposed a robotic system called non-destructive sensing robot for crack detection and deck maintenance. In this we have used two ultrasonic sensor along with L298N processor, two L293D motor driver, four gear motors and Arduino Uno. Ultrasonic sensor which uses the sound wave for identifying the obstacle and take a different path to avoid accidents. Another Ultrasonic sensor which emits the ultrasonic waves and identifies the cracks on roads.

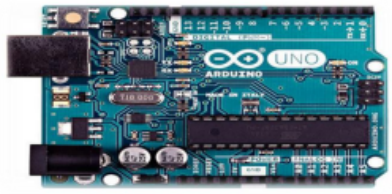
Sensor programmers, for ultrasonic sensor installed on the micro kit. One Ultrasonic sensor is used for detecting the crack on the superstructure& other for Obstacle avoiding. Firstly both the ultrasonic sensors placed above the moving robot. The sensor will emit the radiation continuously once it detect the own operation, it will perform the operation .Another Ultrasonic sensor used for obstacle avoiding. When the signal gets interact with the object and make an echo signal back to the sensor. It senses the echoed signal and compared it with the transmitted signal length. By measuring the signal strength the obstacle distance is identified. Then servo motor rotate left & right for checking the obstacle if sensor cannot detect any obstacle then it move forward

A DC motor is equipped with magnets, either permanent magnet or electromagnetic windings, that produce a magnetic field. When current passes through the armature, also known as the coil or wire, placed between north and south poles of the magnet, the field generated by the armature interacts with the field from magnets and applies torque. In a DC motor the magnet forms the stator, the armature is placed on the rotor and a commentator switches the current flow from one coil to another.The commentator connects the stationary power source to the armature through the use of brushes or conductive rods. Furthermore, DC motor operates at as a fixed speed for a fixed voltage and there is no slip. Battery source is used as a power for the motor, low operating voltage is desirable because fewer cells are needed to obtain the specified voltage. However, electronic to drive motor are typically more efficient at higher voltage. Basically, DC motor is inexpensive, small and comfortable to use and it is controlled by motor drive.

Proposed Approach



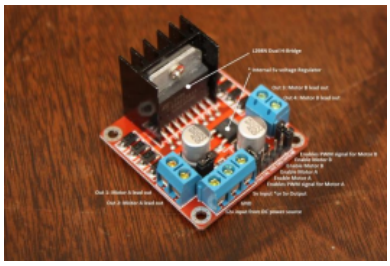

## III. FIGURES AND TABLES




Arduino Uno

Jumping wires


Ultrasonic Sensor



L298N Dual H Bridge Motor Controller

Table1: Electric Parameter of ultrasonic Sensor

| | |
|---|---|
| Working Voltage | DC 5 V |
| Working Current | 15mA |
| Working Frequency | 40Hz |
| Max Range | 4m |
| Min Range | 2cm |
| Measuring Angle | 15 degree |
| Trigger Input Signal | 10uS TTL pulse |
| Echo Output Signal | Input TTL lever signal and the range in proportion |
| Dimension | 45*20*15mm |

## IV. CONCLUSION

• Proper design, regular inspection and maintenance of drainage system is of utmost importance in preserving the investment made on highway system and in providing comfort and safety to the road user.
• The classifications of all types of distresses have been identified. The cause and treatment is different for different severity levels of each distress.
• The defects in existing highway system and in maintenance practices must be clearly understood. The influencing parameters considered in this study are cracks and cracking pattern, roughness, rut depth, pot holes and deflections.
• The above parameters have been classified according to their severity levels. Maintenance decision can be taken based on the criteria of reaching any one or all of the influencing parameters to their maximum acceptable limits.
• The small distress (cracking, potholes, shoving, rutting, etc.) must be repaired before any major maintenance (overlay, renewal coat) is done.
• Even reduced thickness of overlay will show better results if minor defects are repaired before overlays are done

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