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Design and Implementation of Real Time Monitoring of Bridge by Using Sensor Technology

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Abstract: ***Now a day's bridges are important as per travel aspect since it make passing of river or a ground easier in the travel and transport. But the bridges may collapse anytime due to flood to the river or due to aging and lead to disaster. Hence it is important to monitor the bridge conditions every time. Such type of bridge is dangerous to travel or use. The people who are using the bridge, they may face the unpredictable situations due to damaging of bridges. Hence, continuously monitoring the bridges is necessary for the better health of bridge. In this proposed system, we can see real time monitoring of bridge where we can detect flood, crack detection, load on the bridge, by using different sensors. Here, sensors help us to give information about bridge conditions to alert the user. This system contains water level sensors, load sensor, jumping wire for providing the information about real-time condition of bridge. The user of bridge gets the alert about the bridge conditions via LCD screen, LED and Buzzer. These all sensors, wire and alert devices are connected to microprocessor Arduino Uno .This system make sure to provide alert to all users so that many people who are going to use the bridge get protected from biggest accidents. In this way this system is helpful to save the life of people.***

Keywords: Arduino Uno, Sensor technology , Microcontroller, Bridge safety, GSM (Globlal System for Mobile Communication)

I. INTRODUCTION

Problems like a flood can be huge natural disasters, it causes damage to the houses, industries, personal properties and mainly to the bridges. Controlling the situations which occur in these disasters are so difficult and the bridges are always the most vulnerable parts in these situations. The reason is because bridges are the nearest to these spots like rivers, mountain areas etc. Every year many accidents happens related to the bridges where thousands of peoples get killed. Somehow in particular situations the manual monitoring cannot be well affected to solve these issues, because it is quite difficult to monitor the whole condition of bridge manually. Where manual monitoring fails the sensor technology can help a lot which detects the problem in fraction of second and sends alert to the authorities of that bridge. Sensor technology can detect the measure issues like flood, cracks in the pathway and inform the authority. If situations are intense and can cause any danger, then the system can take quick actions like closing the doors of bridge to avoid pedestrian entries. There are multiple reasons behind the flood like climate change, heavy rainfall and improper management of water releasing from the dams. After releasing level in the rivers in some situations they are not able to take actions quickly due to lack of manual information and improper communication, In these situations sensor technology can be really helpful to catch the problem and situation related to the bridge and by merging message passing technology it can solve the problem related to the improper communication between the villagers and bridge condition. If there is any problem related to the bridge or if bridge is collapsed, then it sends message to the villagers who uses the bridge and stops their entries on to the bridge areas.

II. LITERATURE SURVEY

Reference [1] " Real Time Monitoring of Bridge Using Wireless Technology ",Sampath Kumar, Chethana K, Bhavana B (2021) proposed the system that manages to collect the data from all the sensors. Here the data is sent to server with the help of Wi-Fi module. Whenever bridge require any servicing the processor and server get the information as the data crosses the threshold value. Then the alert message will be sent to the user via application, also it will share with the company who monitor and maintain the bridge.

Reference [2] Kirti A. Gunjal, Purtata D. Gunjal, Trupti C. Gunjal (2020), in " IOT based monitoring and Maintenance of highway Bridges" using wireless sensor network, proposed system which is the development of bridge monitoring system using IOT. The system continuously monitors the bridge condition. Here the bridge is having different sensors where they monitor the bridge conditions. The bridge has sensors mounted are water level sensor, vibration sensor, Accelerometer and flex sensor to get the real time information of bridge. At any point if any data collected from sensors cross their threshold value system informs the management by giving an alert.

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Reference [3] "Bridge Safety Monitoring System Using IOT, B. Dhanalakshami, A. Prakadeesh, R. Roshan Kumar (2020), In this system it checks the bridge conditions from the safety point of view whether there is rise in the water level, any crack in the bridge due to earthquake. If there is any situation which will be harmful for the people using the bridge the wireless communication system send alert to the team which manages the bridge.

Reference [4] "Monitoring and Maintenance of Highway Bridges Using Wireless Sensor Networks " Vishal Chandankede (2021) This paper proposed a system that monitor the bridge by using a wireless sensor network. Here it uses a sensor network for data collection and RF transceiver module that made a communication link between the bridge and the bridge management team. Here the system having sensors and one microcontroller. The PIC18 controller monitor the data and it get transfer to the bridge management via CC2500 node. Then Raspberry pi microcontroller have used to send alert to the operator.

Reference [5]" Bridge Monitoring System using Wireless Networks", Ashwini R, Sneha Shivanand Mesta, Varsha A U, Ravichandran G , Haritha K (2020), In this system it consists of wireless sensor network(WSN), where large number of nodes there which are used to sense the data, process it and transfer that data to the bridge monitoring & management team.

III. HARDWARE REQUIREMENTS FOR SYSTEMS

Proposed system provide functionality to detect the water level by using water level sensor, crack in the bridge by using the jumping wire and load on the bridge using load sensor. This all sensors provide the data about bridge condition. These all data get collected by the microprocessor called Arduino Uno.

Here the signal send to system from the sensors about the situation on the bridge. One system gets signal about any dangerous situation the system provides alert message which will be display on LCD, Buzzer will be on and LED will turn RED to alert the user about situation on the bridge. Also this alert message will be send on the application which is connected via Bluetooth with the system. So the users having application will be informed about the bridge and they will avoid to use it until it gets repair again.

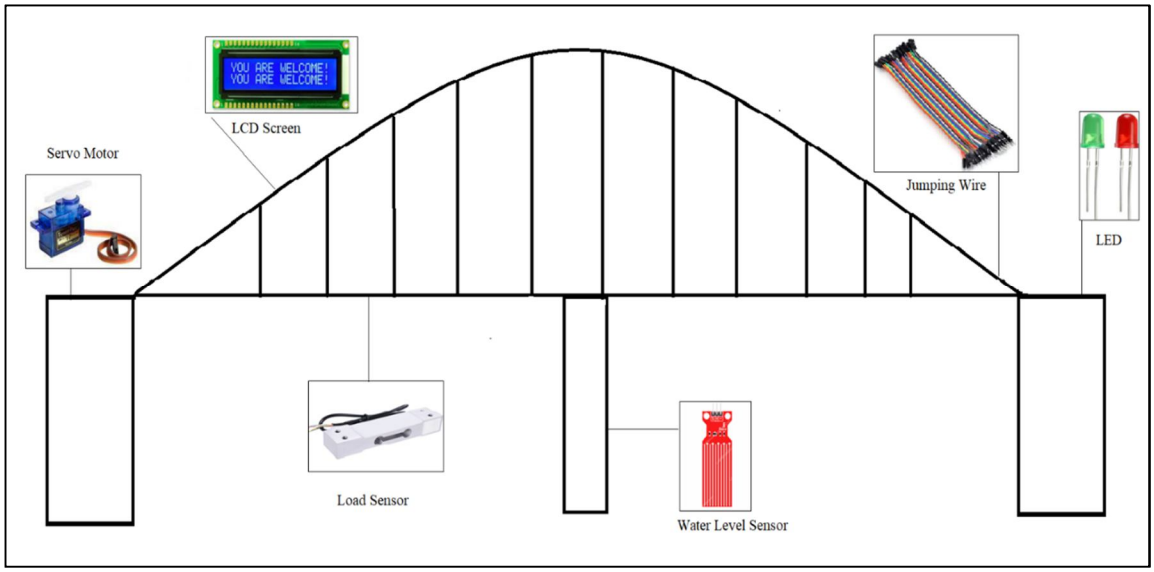


Fig.1 Placement of hardware components on the bridge

Following hardware components are used in the system:

1) *Arduino Uno*: It is a micro controller. It controls all the sensors. It able to read the inputs like data sense by the sensor. Now turning the data sense by microcontroller into output like turning LED green to red, activating servo motor, display alert message to LCD and turn on the buzzer.
2) *Water Level Sensor:* This sensor detects the water level, so that bridge will not get flooded due to the increasing level of water.
3) *Load sensor*: The load sensor is used to determine the weight of an object. It is specially use to detect the load on the bridge, so that bridge does not get overloaded, and if it is going to overloaded it will be detected by load sensor.
4) *Jumping Wire:* In this system jumping wire is used to detect the crack detection.
5) *Bluetooth:* The Bluetooth is designed for wireless communication. It is make devices in the system enables to communicate with each other.

6) *LCD display*: It is used to display the alert message. It is placed on the bridge so that people who are going to use it get alert.
7) *LED*: It work as an indicator. The LED's are also placed on the bridge, so that the green LED indicate that the bridge is safe to use and Red LED indicate that bridge is not safe to use.
8) *Buzzer*: The buzzer is the audio signaling device which is used to alert the user who are going to use the bridge.
9) *Servomotor*: The device which control the angle of rotation by duration of applied pulse.

IV. WORKING OF THE SYSTEM

The proposed system is used for bridge monitoring system using Sensor technology. The sensors are mounted on various part of bridge to check conditions. As mentioned below we have used various sensors like water level sensor, load sensor etc. The sensors real-time data is stored and can be accessible by the user. And the user got to know the real time condition of bridge. If there will be any disaster happen or any critical condition occur then sensor will compare the status with the threshold value.
If any value from these sensors cross the threshold value, the system informs this via GSM to mobile app and we will have an alarm and a LED display. The alert message will display on the LED. The function of proposed system is as follows:

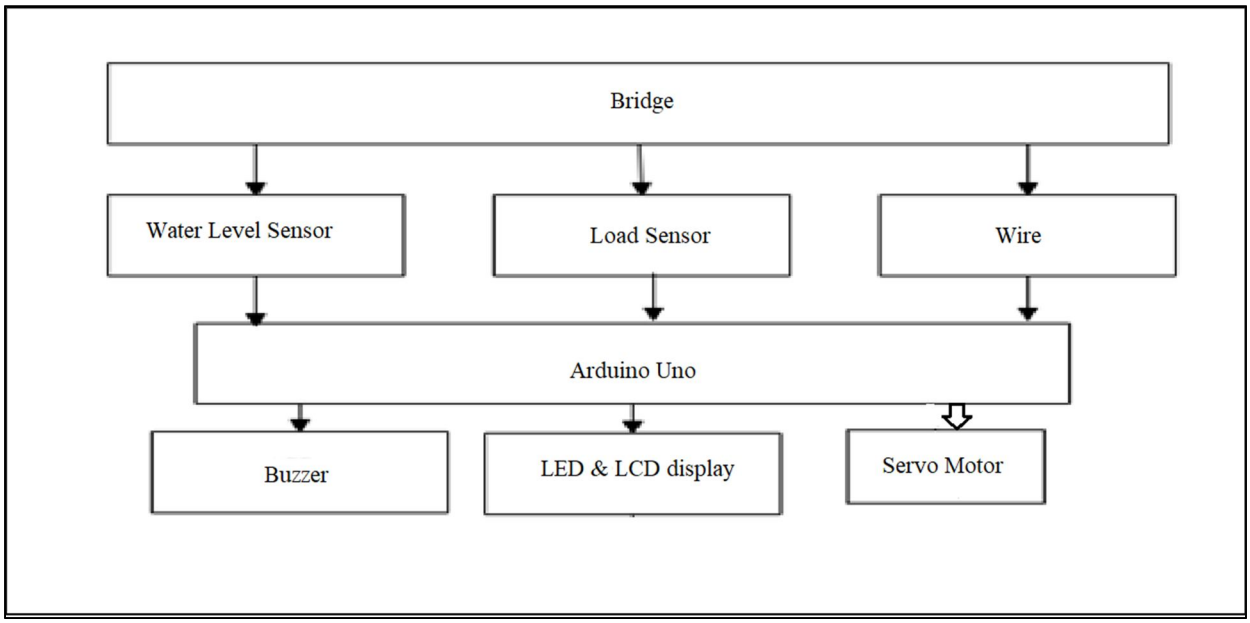


Fig.2 Block diagram of bridge unit

A. *Monitoring Real Time Water Level*

We are using two water level depth detection sensors for monitor the water level. Sensor detects the water level higher than threshold then it will send the signal to Arduino Uno. System sends warning message to the LED screen. signal to Arduino Uno then LED and buzzer will be On.

B. *Detect Crack*

In this system if crack is detected on the bridge, then LED and buzzer will be On.

C. *Load Detection*

Load sensors measure the amount of pressure i.e. applied by vehicle. Data collected from load sensor and compare with threshold. If it crosses above the threshold, then the warning/alert message is sent to the user.

Specification

1) Android: We have used android mobile operating system which is a modified version of the Linux kernel and other open-source software, designed primarily for touchscreen mobile devices such as smartphones and tablets.
2) Embedded C: Embedded C is a general-purpose programming language used for the applications based on microcontroller.

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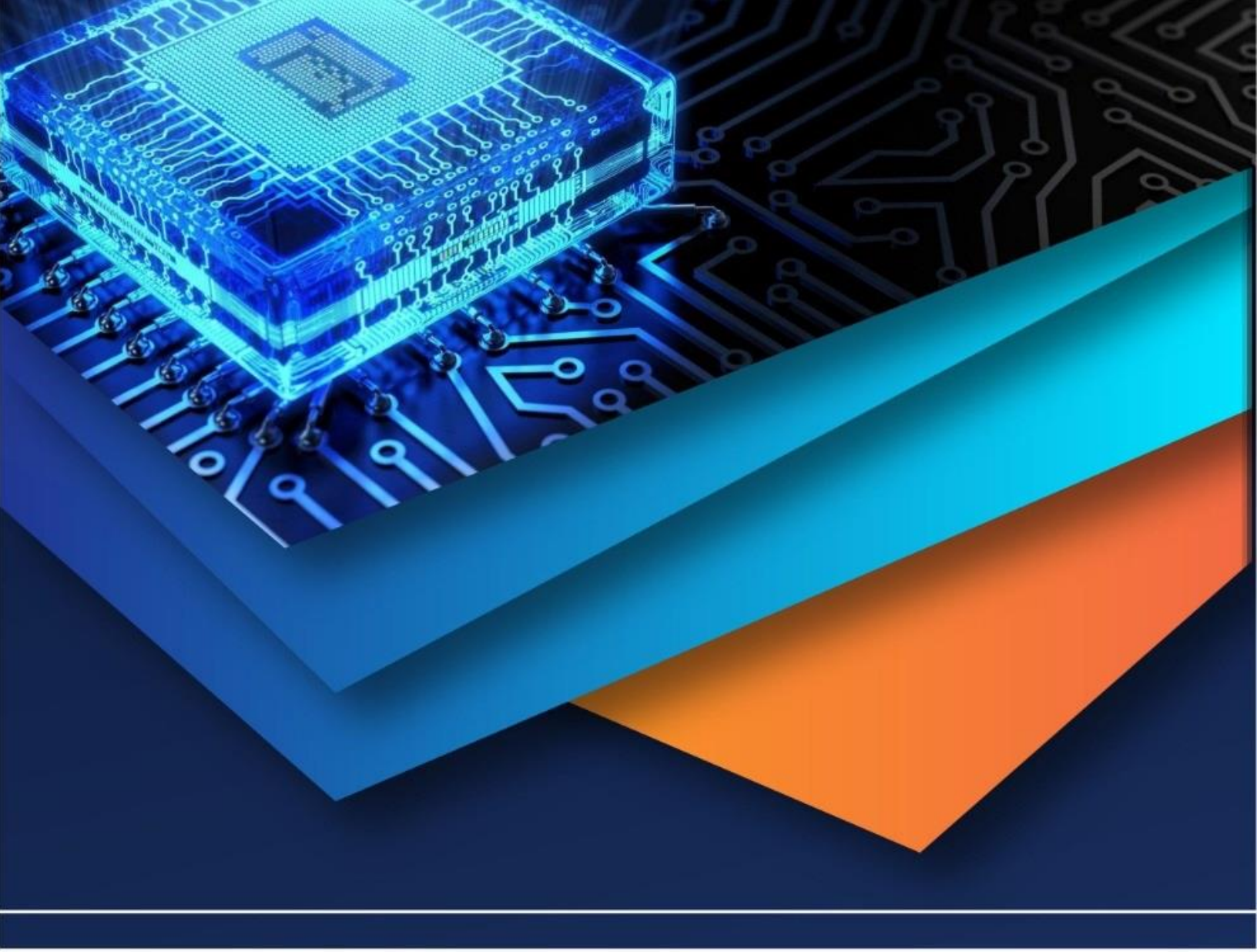
V. CONCLUSION

Our project continuously monitors various conditions on bridge using wireless sensor network. The GSM module is used for communication between bridge and application. The obtain result check with threshold value and the appropriate actions will be taken by the company head/police. The main purpose of this project is to minimize the structural damages and prevent the life and property.

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