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BRIDGE MONITORING AND ALERTING SYSTEM USING ARDUINO

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Abstract

Now a days, natural diaster is happening mostly in all over the world .this is because of change in natural conditions .These types of disasters will destroy the many structure like bridges and this will damage the life.

Hence to always monitor the conditions on bridge we use the system called bridge monitoring system .Bridge monitoring system will help to know the current natural conditions on bridge like Windspeed, Temperature, Weight etc .According to the readings of different sensors we can compare it with critical values and we will be alert before any disaster.

Keywords- Arduino, Load cell, Vibrator sensor, Ultrasonic sensor, Metal sensor, Servo Motor, GPS module, GSM module.

INTRODUCTION:

Bridge health monitoring with Arduino involves installing sensors to detect various parameters like strain, temperature, and vibrations. These sensors provide data to assess the structural integrity of the bridge over time. Load weight age detection can be achieved by integrating load cells or pressure sensors to measure the forces exerted on the bridge .Arduino microcontrollers can process sensor data, allowing real-time monitoring and analysis. The collected information helps identify potential issues ,ensuring timely maintenance and preventing structural failures. Additionally ,load weightage detection aids in understanding how external factors impact the bridge's structural health, enhancing overall safety and durability.

EXISTING SYSTEM:

In the olden days the main drawbacks for reducing the lifespan of bridges is that how much weight of the vehicle should pass through the bridge. Due to the drawback the life span is reduce.

PROPOSED SYSTEM

In the proposed system, we are implementing the new method which will determines the exact weight of the vehicle with load. the system will setup at the entrance of the bridge to calculate the vehicle load, At the entrance of the gate weare placing the servo motor for opening and closing the gate. if the load is normal , the servo motor will automatically open the gate, if the load is overweight then the gate remains close and an alarm will generate and it will upload to the cloud. in addition to these we are adding the water level of the bridge, if the water level is high then automatically system will generate an alarm sound and upload to IOT.

COMPONENTS

ARDUINO:

The Arduino UNO is a popular standard board that is currently on the market. Its main feature is ATmega328 chip; it doesn't contain a lot of SRAM and flash memory which limits the programs. Arduino consists of 8bit CPU, 16MHZ clock speed, 2KBSRAM, 32kb flash storage, and Arduino features are-:It has 6 analog input pins,removable microcontroller, and 14 digital input and output pins.It is the platform for both Software and Hardware sectors.

Figure 1:Arduino uno

LOADCELL:

A load cell is a transducer that converts force or weight into an electrical signal.It typically consists of a metal body with strain gauges

attached to it. When a force is applied to the loadcell, it deforms slightly, causing the strain gauges to change resistance, which in turn alters the voltage output. This change in voltage is proportional to the force applied, allowing for precise measurement of weight or force in various applications, such as force monitoring in machinery. Load cells come in various types, including hydraulic, pneumatic, each suited for different environments and measurement ranges.They play a crucial role in ensuring accuracy and reliability in weight and force measurement systems across industries

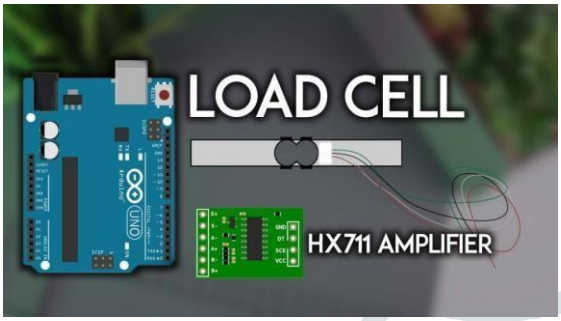

Figure 2:Load cell

METAL SENSOR:

Metal detection sensors are devices designed to detect the presence of metallic objects or materials in a given area .They are widely used in various industries and applications, including security screening, industrial manufacturing ,food processing, and archaeological exploration .Metal detectors work based on the principles of electro magnetic induction or magnetic field disruption.

Figure 3: Metal sensor

VIBRATION SENSOR:

Vibration sensors are measuring tools, it is used for analyzing. It also calculates linear velocity, acceleration, force, proximity, and displacement.It is also used in sensors to detect a type of problem.It is a tool to detect location.Vibration sensor uses piezoelectric effects; it also measures fragrance in the air with the help of capacitance measuring and its quality.

Figure 4:Vibration sensor

FLOAT SWITCH:

The system continually monitors water levels beneath the bridge with the float switch.When water levels rise to potentially hazardous levels,the arudino-based control system engages servo motor to automatically adjust the bridge's height, ensuring the safety of bridges and vehicles.

Figure 5: Float switch

LCD16*2:

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are in expensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations,etc.

Figure 6: LCD 16*2

BUZZER:

A buzzer is a simple yet versatile device commonly used to generate audible alerts or signals in various electronic circuits, appliances, and systems.Typically composed of an electro mechanical component,it produces a buzzing or beeping sound when activated.

Figure 7:Buzzer

SERVO MOTOR:

A servomotor maybe a simple motor, controlled with the assistance of servo mechanism..the motor as a controlled device, releated to servo mechanism is DC servo motor. If AC operates the controlled motor, it's referred to as a AC servomotor.

Figure 8:Servo motor

GSM MODULE:

GSM Global System For Mobile Communications. It is a set of mobile communications standards and protocols governing second-generation or 2G networks, first developed and deployed in Europe. GSM is a digital cellular communication standard that is universally.

Figure 10:GSM Module

GPS MODULE:

We often familiar with this feature in our smart phones, the GPS module is known as the"Global positioning system". It completely uses a satellite system to provide the location of the particular object by using satellite and ground stations and also uses the same to measure and compute position on earth. The Navigation system is one of the operations of GPS.GPS module does not need the internet to position the place of object.It requires four satellites for accuracy and perfection. It always calculates position and time. It gives output on Tx pin having 9600 Baud rate it Mainly calculates, the output depending upon longitude latitude altitude etc.

Figure 11: GPS Module

1. BLOCK DIAGRAM

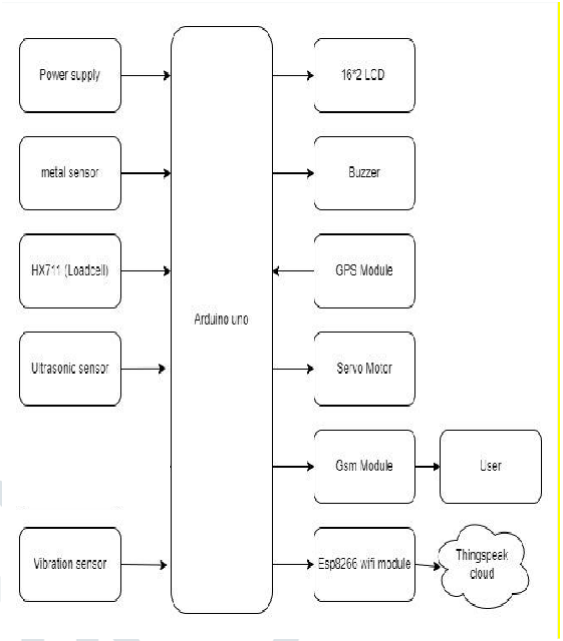

Figure 12: Block diagram

WORKING PRINCIPLE

Bridges are continuously subjected to destructive effects of material aging, wide spread corrosion of steel reinforcing bars in concrete structures, corrosion of steel structures and components, increasing traffic volume and overloading, or simply overall deterioration and aging. These factors, combined with defects of design and construction and accidental damage, prompt the deterioration of bridges and result in the loss of load carrying capacity of bridges. The condition of heavily used urban bridges is even worse: one in three are classified as aging or unable to accommodate modern vehicle weights and traffic volume. Therefore, a significant number of the structures need strengthening, rehabilitation, or replacement, but public funds are not generally available for the required replacement of existing structures or construction of new ones. Many sensors are being used to monitor the bridge remotely and using various sensors and Latest Technology which is internet of things which will help us directly to connect with sensors and also the heart of our project is the Arduino Uno which will be used to connect all the sensors and link everyone together. WI-FI (Wireless Fidelity) Module whichesp2866 Is used to connect all the sensors to the data center and helps to manage the bridge Remotely. A barrier system is been used so that whenever the parameters of the bridge cross the value the barrier will close and the bridge traffic will be stopped. So, considering these parameters the bridge monitoring system will work and give the desired output.

EXPERIMENTAL RESULT

To show the results of our smart bridge monitoring and alerting system

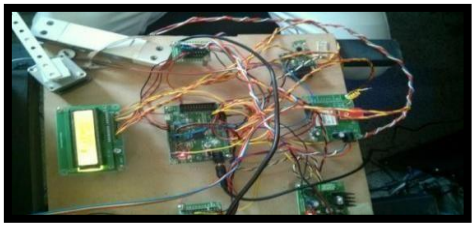

Figure 13: *The components of bridge monitoring system*

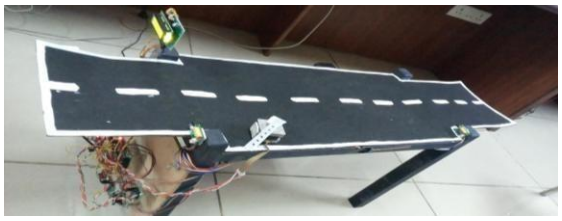

Figure 14:*Implemented bridge monitoring system*

• In fig13 & 14 the bridge monitoring system was designed, and the hardware is built.

Figure 15: *GSM module*

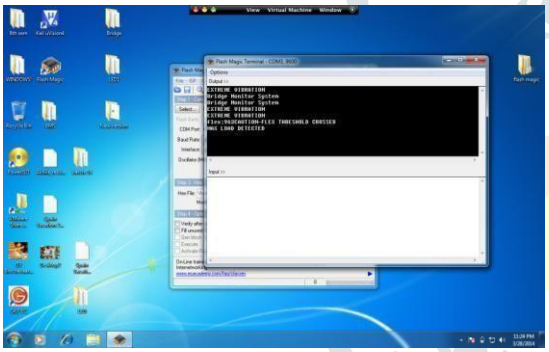

Figure 16: *Message to bridge monitoring house*

• In fig15 & 16 ,When the system is powered up, there will be a display of "Bridge Monitoring System" on LCD. Also the information is sent to the monitoring house .

Figure 17: *Float switch*

• In fig 17 Float switch, when the bridge is located on river and river gets flooded the gate will be automatically closed.

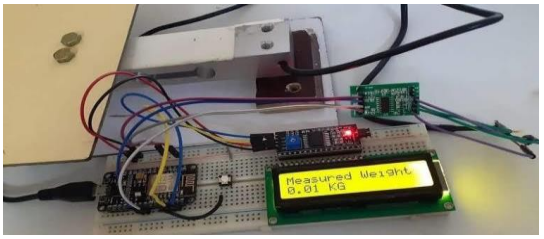

Figure18: *load cell*

• In fig18, load cell here is a load sensor at the entry of the bridge, which detects the load on the bridge. The gate is closed when there are heavy loads. The information is sent to the monitoring house via and the monitoring head via GSM. In orderto open the gate, "K" command has to be sent by the monitoring house.

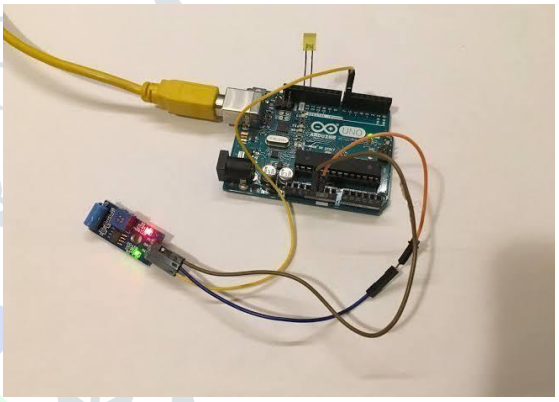

Figure 19:*Vibration sensor*

• In fig19,vibration sensor, There is a vibrator sensor at the bottom of the bridge, which detects the earthquakes(heavy vibrations).The gate is closed when there are heavy

• vibrations. the information is sent to the monitoring house.

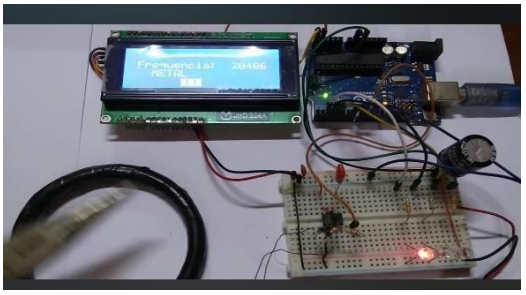

Figure 20: *Metal sensor*

• In fig 20, Metal sensors detect and monitor the corrosion process in bridge materials. They measure electrical-resistance, electrochemical potential, or changes in material properties to identify corrosion. Metal sensors help in the evaluation of bridge corrosion levels, enabling pro active maintenance and protection measures.

ADVANTAGES

- To improve the life span of bridges.
- By using different sensors we can easily monitoring the bridge condition.
- The vehicle load testing station and improve work efficiency in the transport sector.
- Easy to operate i.e.user friendly.
- As a microcontroller is used inside so it has good sensitivity.
- Compact in size, easily accessible, Easy to under stand.

APPLICATIONS

Bridge monitoring sensors have wide-ranging applications that contribute to the safety, performance, and long evity of bridges.

CONCLUSION

In conclusion, the ongoing refinement and implementation of over loadvehicle resistance and anti-travel bridge construction methods contribute to the sustained safety, longevity, and efficiency of critical infrastructure.Continued research and collaboration are essential to adapting these measures to evolving challenges and technological advancements.

FUTURESCOPE

The future scope of Heavy Vehicle Load Detection using Arduino and IoT involves advancing precision,enabling real-time monitoring through cloud connectivity, and integrating with autonomous vehicles for enhanced efficiency and safety.

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