

Development of Smart Bridge – Automatic Height Increase When Floodings Take Place

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Abstract

This paper gives a brief idea about the historical background about the development of bridges. Bridges are the foundation of a country's transport network but they are expensive to build and maintain. So, care should be taken for the bridges. For that purpose, sensors are used. The idea of controlling different parameters through proper functioning, monitoring and analysis of data is effective for preventing the bridge from damages. This project predominantly focuses about monitoring and evaluation of bridge condition through various sensors used. Advancement in sensor technology have brought the automated real-time bridge health monitoring system.

Introduction

Floods lead to a vast loss of life and property in many countries. But in developing countries the lack of proper technology leads to more loss of life and property due to flood. Bridges are important in modern world. Bridges add beauty to the roads. Bridge failures are one of the most infrastructure problems in the world. It often leads to the catastrophic consequences, loss of life, restricted commerce. The objective of this project is to monitor the flood situation lift the bridge in case of danger in the form of buzzer sound [1].

A smart bridge is one that senses some significant condition of its environment or behaviour and then automatically reacts to that condition. Bridges play a critical role in modern transportation infrastructure, enabling the smooth movement of vehicles, pedestrians, and goods over water bodies and rugged terrains. Ensuring the safety and structural integrity of bridges is of paramount importance to avoid potential disasters and prolong their lifespan. In recent years, with the advancement of technology, smart bridge monitoring systems have emerged as a revolutionary solution to address these challenges. These systems leverage various sensors, data communication technologies, and microcontrollers like Arduino to collect and analyze data continuously. Arduino, being an open-source electronics platform, offers an affordable and flexible way to build sophisticated monitoring systems for various applications, including bridge monitoring [2].



Fig. 1 : A typical bridge flooded with water

An automatic height-adjusting bridge is designed to maintain a safe height during heavy rain or floods. It is equipped with a servo motor, which is connected to an Arduino board that controls its movements. The servo motor is attached to a hydraulic system that raises or lowers the bridge's height based on the water level. The Arduino board receives input from a moisture sensor that detects the water level and sends signals to the servo motor to adjust the bridge's height. The moisture sensor is installed in the water channel, and it sends data to the Arduino board through a wireless connection. The servo motor is connected to the hydraulic system that raises or lowers the bridge's height. When the moisture sensor detects a rise in water level, it sends a signal to the Arduino board, which then sends a signal to the servo motor to raise the bridge's height. This process continues until the water level decreases to a safe level. Similarly, when the water level decreases, the moisture sensor sends a signal to the Arduino board, which then sends a signal to the servo motor to lower the bridge's height. This helps ensure the bridge is at a safe height, preventing any accidents or damage during heavy rain or floods [3].

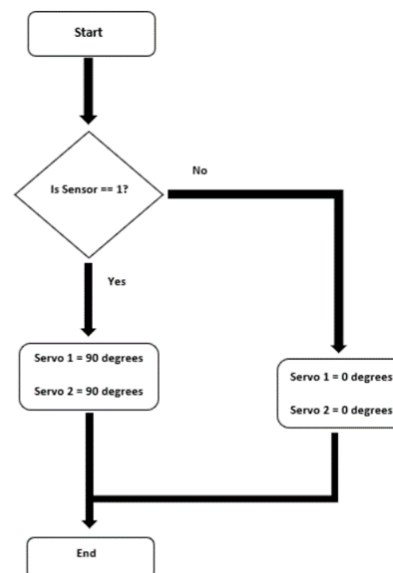


Fig. 2 : Flow chart of the developed smart bridge

Scopes & Objectives

In this section, the scopes & objectives are being presented w.r.t. the proposed research work.

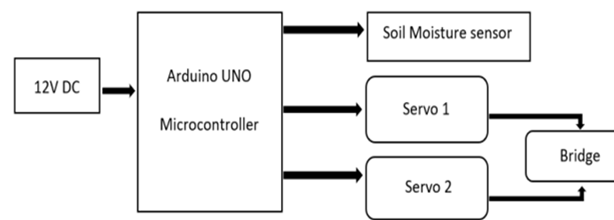


Fig. 3 : Proposed block-diagrammatic representation of the Arduino Uno Micro-controller

Scopes

- System can be implemented at a global level in which different countries can manipulate data of their bridges at a single server.
- Implement on high cost suspension bridge.
- Monitoring Structural Performance and Applied Loads.

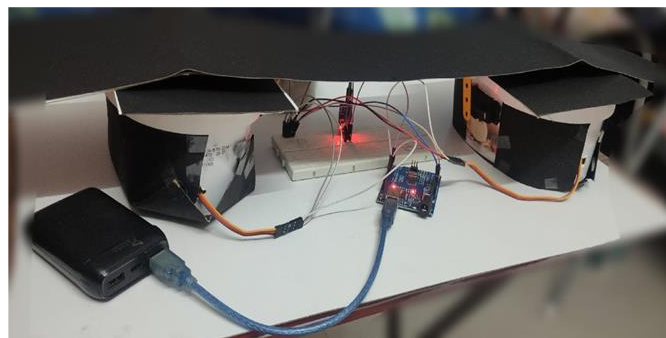


Fig. 4 : Experimental results obtained

The scope of the smart bridge monitoring system using Arduino is vast and encompasses various aspects of bridge health and safety. The system aims to continuously monitor and analyze the condition of bridges in real-time to ensure their structural integrity and safety. The problem addressed by the smart bridge monitoring system using Arduino is to overcome the limitations of traditional bridge monitoring methods. These traditional methods often rely on manual inspections and periodic assessments, which can be time-consuming, expensive, and may not provide real-time information. The lack of real-time monitoring can lead to delays in detecting structural issues, potentially compromising the safety of the bridge and causing significant maintenance costs [4].

Objectives

- To provide security to all the users who are using it bridge
- To provide reliability to the users
- To maintain integrity of already built and old bridges in India
- To help India for making it digitized
- Smart city mission
- To save the many lives

Proposed Methodology & Block Diagram

- Build the bridge
- Install the servo motor on the bridge and connect it to the Arduino
- Connect the moisture sensor to the Arduino
- Write a program for the Arduino that will read the moisture sensor data and control the servo motor to adjust the height of the bridge accordingly

- Test the system by increasing the water level and making sure that the bridge adjusts its height automatically
- The basic idea is that the moisture sensor will detect when the water level increases, and the Arduino will control the servo motor to adjust the height of the bridge. As the water level decreases, the bridge will move back down to its original position.

Experimental Results

The results of implementing a smart bridge monitoring system using Arduino can be seen through the data collected, analyzed, and the overall impact on bridge safety and maintenance. The continuous monitoring, data-driven insights, and timely maintenance contribute to prolonging the lifespan of bridges and ensuring the safety of commuters and communities that rely on these critical structures. Such a system will help to control the dynamic parameters of the bridge for preventing it from the disaster which can save the many lives and also wealth. This system is unique in its ability to monitor the bridge environment, transmit the environmental data through wireless communication. The implementation is greatly useful [5].

Advantages & Applications

In this section, the advantages & dis-advantages of the developed work is presented.

Advantages

- To save lives and property
- Take real time information of bridge
- It has safe and easy operations
- Provides smooth and accurate acceleration
- Quantity of materials can be reduced to construct bridge

Applications

- To react timely
- Work under an automated control system
- And be able to collect information for making smart decisions
- Water Level Monitoring & Emergency management

Conclusions

We have developed the Arduino based automated river bridge control system for open and close of river bridge. This automated process able to reduce the man power required in this process. The main aim of this project is to minimize the structural damages and prevent the life and property. The working principle of Bridge Monitoring, we display data using LCD display when there are signs of collapsing the bridge. This system will help to reduce big disasters in future. This system can save the lives of many people. In conclusion, an automatic height-adjusting bridge would be a great application of Arduino, servo motors, and moisture sensors. This system would help prevent accidents and provide a safer way for people to travel across bridges, especially during periods of heavy rainfall or flooding [6].

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