Department of Computer Science & Engineering

A Mini Project Report

On

“SMART BRIDGE-AUTOMATIC HEIGHT INCREASE”

Submitted in partial fulfillment of the

requirements for the award of the degree of

Bachelor of Technology

In

Computer Science & Engineering

By

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CERTIFICATE

This is to certify that the project entitled "**SMART BRIDGE-AUTOMATIC HEIGHT INCREASE**" has been submitted by **P. REENA (21R21A0543), K.SAIPRIYA (21R21A0526), B.RAMESH(21R21A0506), SHAIK MUBEEN (21R21A0554)** in partial fulfillment of the requirementsfor the award of degree of Bachelor of Technology in Computer Science and Engineering from Jawaharlal Nehru Technological University, Hyderabad. The results embodied in this project havenot been submitted to any other University or Institution for the award of any degree or diploma.

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DECLARATION

We hereby declare that the project entitled "Smart Bridge-Automatic Height Increase" is the work done during the period from August 2023 to January 2024 and is submitted in partial fulfillment of the requirements for the award of degree of Bachelor of Technology in Computer Science and Information technology from Jawaharlal Nehru Technology University, Hyderabad.

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ABSTRACT

Bridges are the foundation of a country’s transport and they are expensive to build and maintain.In recent years, due to increase in different global climatic conditions, bridges have been damaged. To over come this problem, a smart bridge system is introduced to maintain the bridges in a proper conditions at different climatic conditions. Here,the height of the bridge increases automatically whenever the water level reaches its maximum point, and it prevents from the damage caused to bridge

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CHAPTER-1

1. INTRODUCTION

Smart bridges integrate technology to enhance monitoring, maintenance, and functionality. They utilize sensors for real-time data on structural health, traffic, and environmental conditions, improving safety and efficiency. Smart bridge systems often employ IoT, AI, and data analytics for predictive maintenance, reducing costs and enhancing resilience. Advanced communication networks enable remote monitoring and control, making smart bridges a key component in modern infrastructure for sustainable and intelligent transportation systems. Smart bridges, which combine a synergistic combination of technologies to maximize performance and guarantee safety, represent a revolutionary advancement in infrastructure. Sensors that are positioned strategically throughout the bridge to continuously monitor temperature, vibrations, traffic, and structural health are essential to its operation. The Internet of Things (IoT) effortlessly integrates this abundance of data, facilitating effective coordination and communication among diverse bridge components.

CHAPTER-2

2. LITERATURE SURVEY.

There are several research papers and articles available online that discuss similar projects, which can serve as a good starting point for literature review. Here are some of them:

1."Design and Implementation of Automatic Bridge Height Adjustment System Based on Arduino" by Li et al. This paper proposes a system that uses Arduino, a servo motor, and an ultrasonic sensor to automatically adjust the height of a bridge based on the water level.

2."An Automatic Bridge Height Adjustment System Based on IoT Technology" by Wu et al. This paper presents a bridge height adjustment system that uses an Arduino-based IoT platform and a moisture sensor to detect the water level and adjust the bridge height accordingly.

3."Development of an Automatic Water Level Controller Using Arduino" by Hafiz et al. This paper describes the development of an automatic water level controller using an Arduino board and a moisture sensor to detect the water level.

4."Design and Implementation of a Servo Motor Control System Based on Arduino" by Wang et al. This paper presents a servo motor control system that uses an Arduino board to control the movement of the servo motor.

5."Water Level Monitoring and Control System using Arduino and GSM Module" by Azam et al. This paper proposes a water level monitoring and control system that uses an Arduino board and a GSM module to send alerts to the user when the water level exceeds a certain threshold.

6."Automatic Irrigation System using Arduino and Soil Moisture Sensor" by Singh et al. This paper describes the development of an automatic irrigation system that uses an Arduino board and a soil moisture sensor to control the water supply to the plants. Overall, these research papers can provide you with valuable information on the design, implementation, and testing of automatic height-adjusting bridges using Arduino, servo motor, moisture sensor, and water level increase detection

2.1. EXISTING SYSTEM

Existing System is to Bridges are structures designed to span physical obstacles such as rivers, valleys, or roads to provide passage over them. years, due to increase in different global climatic conditions, bridges have been damaged. A bridge is a structure built to span a physical obstacle (such as a body of water, valley, road, or railway) without blocking the way underneath. It is constructed for the purpose of providing passage over the obstacle, which is usually something that is otherwise difficult or impossible to cross. There are many different designs of bridges, each serving a particular purpose and applicable to different situations. Designs of bridges vary depending on factors such as the function of the bridge, the nature of the terrain where the bridge is constructed and anchored, the material used to make it, and the funds available to build it.

Functionality of the existing system

FIGURE 2.1.1 Bridge

FIGURE 2.1.2 Increased water level on Bridges

2.2.PROPOSED SYSTEM

The targeted use for this proposed system the height of the bridge increases automatically whenever the water level reaches its maximum point, and it prevents from the damage caused to bridge. A Smart Bridge typically refers to a bridge equipped with advanced technologies for monitoring, maintenance, and improved functionality. It often involves the integration of sensors, and communication systems to enhance efficiency and safety. They utilize sensors for real-time data on structural health, traffic, and environmental conditions, improving safety and efficiency

Bridge Model

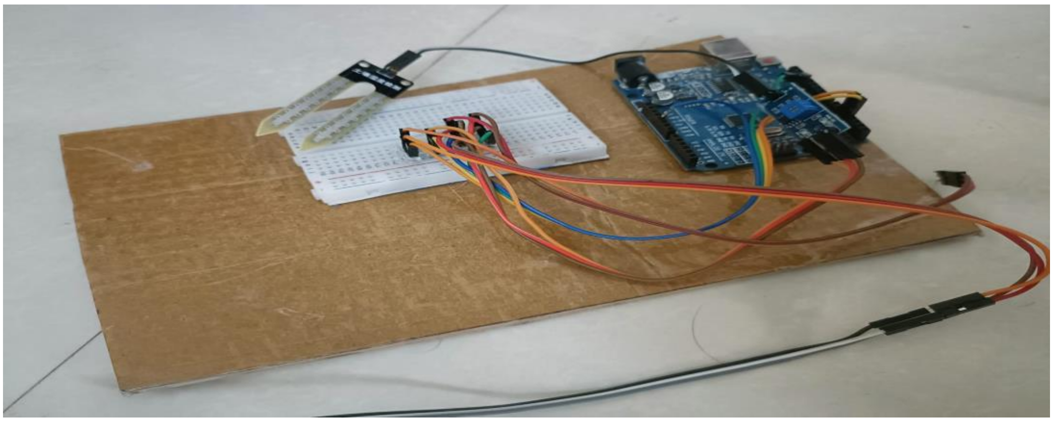


Figure 2.2.2: Bridge Model

Bridge increased height

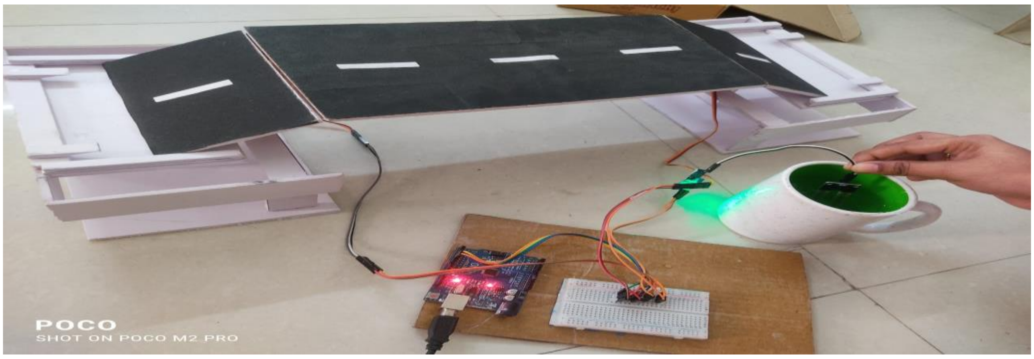


Figure 2.2.3: Bridge increased height

Working Principle

The soil moisture sensor detects moisture levels in the soil. When the moisture level exceeds a certain threshold, the Arduino Uno microcontroller activates the servo motors to raise the bridge's height. This allows water to flow through and drain the area, preventing damage to the bridge and surrounding areaThe IoT-based smart bridge employs water level sensors placed strategically along the riverbank. When these sensors detect a significant rise in water level, they send real-time data to a central control system. This system, equipped with a microcontroller and actuators, processes the information and triggers the height adjustment mechanism. The mechanism may involve hydraulic or pneumatic systems that lift the bridge to a predetermined height, ensuring it remains above floodwaters. This automated response enhances the bridge's resilience and minimizes the risk of damage during floods.

2.3. SYSTEM REQUIREMENTS

2.3.1.Hardware Requirements:

Arduino UNO
servo motor
Moisture sensor
Bread board
Jumper wires

2.3.2.Software Requirements:

Arduino ide
C++

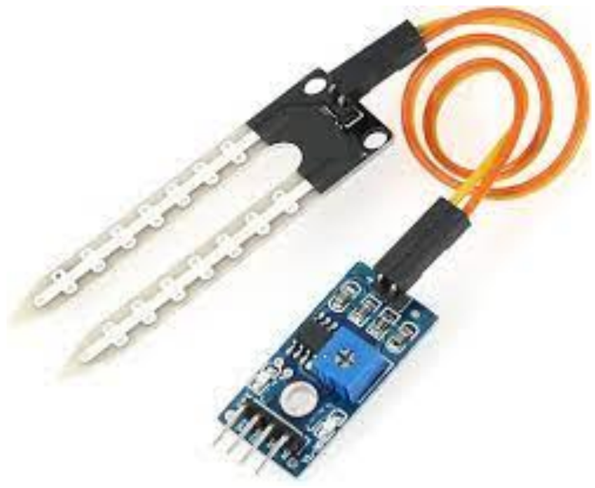
Arduino UNO

The Arduino Uno, powered by the ATmega328P microcontroller, features 20 pins crucial for interfacing with the physical world. Its 14 digital pins, D0 to D13, offer a versatile digital interface, with six supporting pulse-width modulation (PWM) for nuanced control. These pins are instrumental in diverse projects, facilitating tasks such as LED brightness adjustment and motor speed control.The board's 6 analog input pins, A0 to A5, provide the capability to read continuous voltage levels from sensors. This dual functionality enhances the Arduino Uno's adaptability, allowing these analog pins to serve as digital input/output when needed.Power-related pins, including 5V, 3.3V, GND, and VIN, contribute to the board's functionality by regulating voltage and providing grounding. The RESET pin enables manual or programmatic restarts, aiding in debugging and reprogramming without physical disconnection.It allows users to establish connections with sensors, actuators, and other electronic components, unlocking a realm of possibilities for innovation. Whether it's interfacing with a temperature sensor, controlling a servo motor, or creating an interactive display with LEDs, the Arduino Uno's pins serve as the conduit between the digital realm of code and the tangible world of hardware.

Servo motor

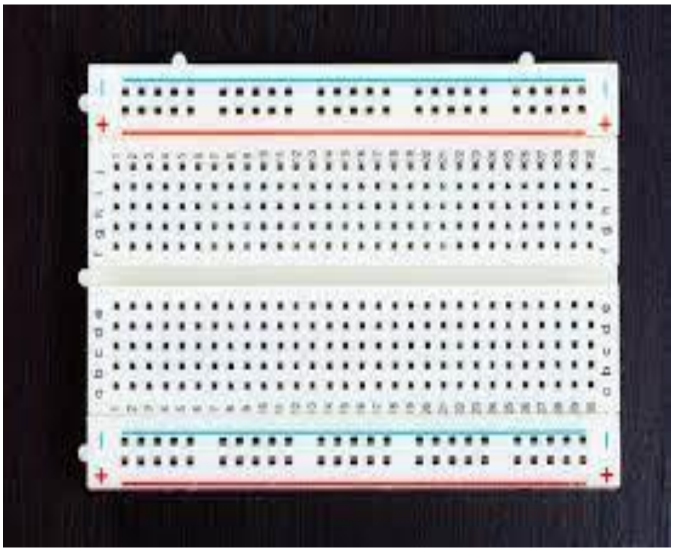
A servo motor in a smart bridge system for automatic height adjustment plays a crucial role in physically moving or adjusting the bridge structure. In this context, the servo motor can be employed to control mechanical components like pulleys, gears, or hydraulic systems that raise or lower the bridge.When the Arduino Uno or a similar microcontroller receives data from sensors indicating the need for a change in bridge height, it can send commands to the servo motor. The servo motor, in turn, adjusts the bridge's height by moving the connected components. This precise and controlled movement provided by the servo motor enables the automatic increase or decrease of the bridge height to accommodate varying vessel sizes or water levels.

Moisture Sensor



A moisture sensor in a smart bridge system might seem unusual at first, but its purpose could be to monitor environmental conditions around the bridge. Specifically, it could be used to detect the presence of moisture or water accumulation in the bridge surroundings.This information can be valuable for decision-making in the context of bridge height adjustment. For example, if the moisture sensor detects heavy rainfall or flooding in the vicinity, the smart bridge system could respond by automatically raising its height to avoid potential damage or unsafe conditions. Integrating various sensors, including a moisture sensor, allows the smart bridge to respond dynamically to changing environmental factors for enhanced safety and functionality.

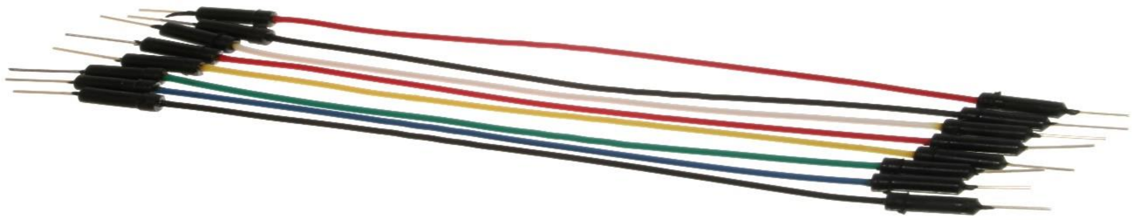
Bread board



A breadboard is typically used for prototyping and testing electronic circuits. In the context of a smart bridge with automatic height adjustment, a breadboard may not be directly involved in the operational components of the system. Instead, it could be utilized during the development and testing phases.

Engineers and developers may use a breadboard to create and experiment with the electronic circuits that interface with sensors, microcontrollers (like Arduino Uno), and other electronic components before implementing them on a more permanent circuit board within the bridge's control system. Once the design is validated on a breadboard, it can be transferred to a more robust and permanent circuit for integration into the smart bridge system.

Jumper wires



Jumper wires in a smart bridge system with automatic height adjustment serve as essential connectors to establish electrical connections between various components. They are used to link different elements of the circuit, such as sensors, microcontrollers, and actuators like servo motors.Jumper wires provide a flexible and convenient means to create the necessary connections on a breadboard or other prototyping platforms. During the development and testing phases, engineers can easily adjust and rearrange the components by using jumper wires without the need for soldering. This flexibility is crucial for the iterative process of refining the electronic components and connections in the smart bridge system before a final, more permanent implementation is achieved.

Arduino ide

The Arduino IDE (Integrated Development Environment) in a smart bridge system with automatic height adjustment is used for programming and uploading code to the Arduino microcontroller, such as the Arduino Uno. The IDE provides a user-friendly platform where developers can write, edit, and upload the software code that controls the behavior of the microcontroller.In the context of a smart bridge, the Arduino IDE allows engineers to program the Arduino to read data from sensors (like distance sensors or moisture sensors), process that data, and control actuators (such as servo motors) to adjust the bridge's height accordingly. It facilitates the development and implementation of the logic that governs the bridge's automatic height adjustment based on real-time environmental data.The Arduino IDE is a crucial tool for coding and configuring the behavior of the Arduino microcontroller in the smart bridge system.

2.4. Functional Requirements

Automated Height Adjustment: The smart bridge should have the capability to automatically adjust its height based on predetermined criteria, such as approaching vessels or adverse weather conditions.

Sensors: Integrated sensors, including proximity sensors, weather sensors, and water level sensors, to accurately detect and assess the surrounding conditions for height adjustment.

Communication System: A robust communication system to receive real-time data from external sources, such as maritime traffic control or weather monitoring stations, enabling the bridge to proactively adjust its height.

Safety Protocols: Implement safety measures to ensure that height adjustments are carried out securely, avoiding potential collisions with passing vessels or endangering the structure's integrity.

Maintenance Monitoring: Implement a system for monitoring the health of components related to height adjustment, providing alerts for maintenance or replacements as needed.

Regular Training: Provide training for operators and maintenance personnel to ensure proper understanding of the smart bridge's automatic height adjustment system and its associated procedures.

2.5. Non Functional Requirements

Reliability: The smart bridge should demonstrate high reliability, ensuring that the automatic height adjustment system functions consistently without frequent failures or disruptions.

Scalability: The system should be scalable to accommodate potential future enhancements or modifications, adapting to changing technological standards and requirements.

Performance: The height adjustment mechanism should respond swiftly to external stimuli, providing timely and accurate adjustments to ensure the safety and efficiency of the bridge operation.

Availability: Maintain a high level of availability to meet the demands of continuous operation, minimizing downtime for maintenance or repairs.

Robustness: Design the system to withstand environmental factors, including extreme weather conditions, to ensure reliable performance in various situations.

CHAPTER-3

3. SYSTEM DESIGN

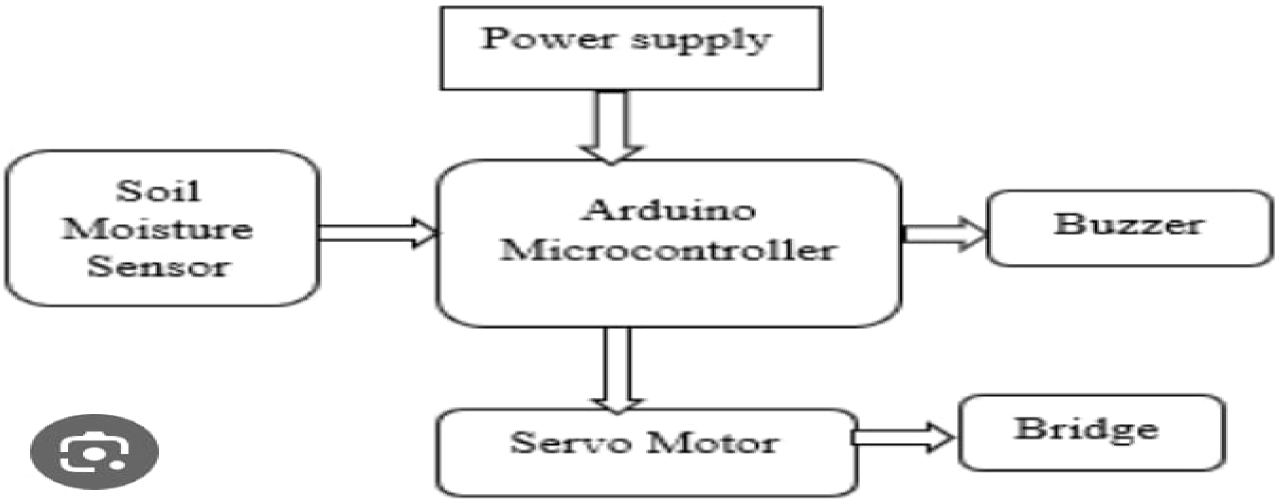


Figure 3.1: System Flowgorithm

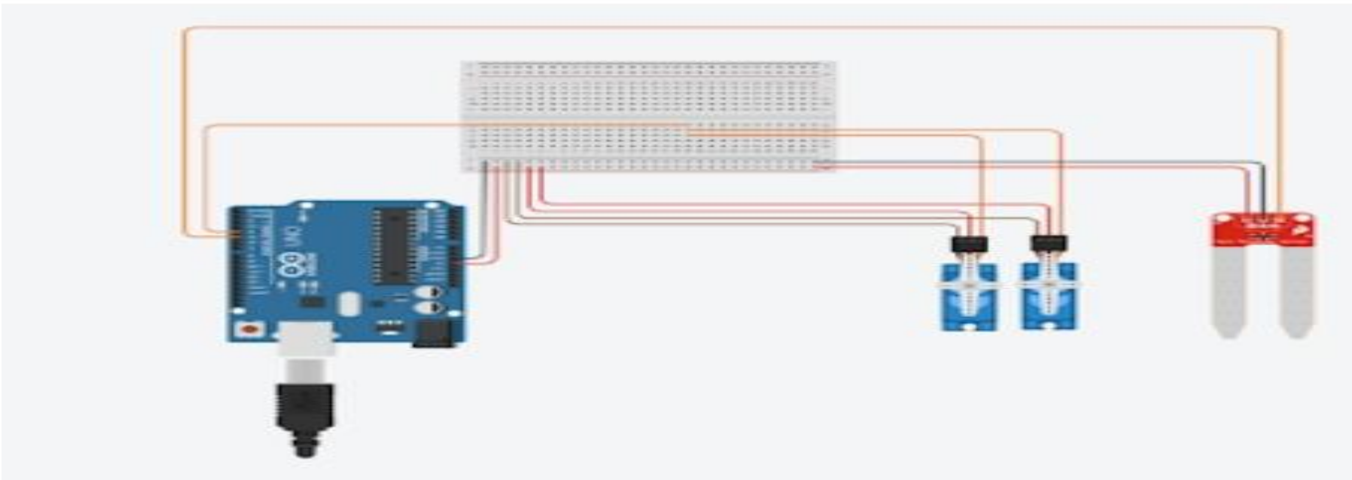


Figure 3.2: System Architecture

CHAPTER-4

4. IMPLEMENTATION

Implementation steps of automatic height increase of smart bridge

4.1 : Design and Planning

The first step would be to design the smart bridge system, taking into account the specific requirements and constraints of the bridge and its environment. This would involve determining the desired height range, the type and placement of sensors, and the mechanism for adjusting the bridge's height.

4.2 : Installation of Sensors

Sensors would need to be installed on the bridge to monitor its condition and environment. These could include strain gauges, displacement sensors, temperature sensors, and others. The sensors would need to be connected to a data acquisition system for collecting and processing the sensor data.

Figure 4.2.1 :Soil Moisture Sensor

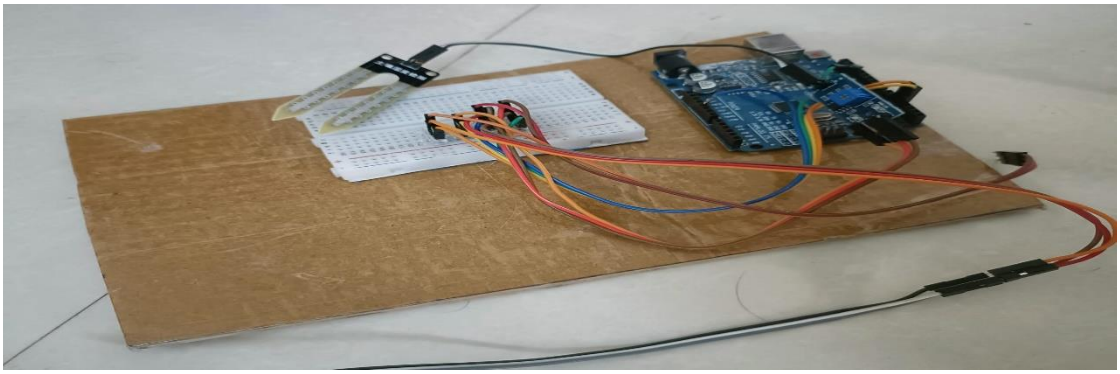
4.3 : Implementation of Height Adjustment Mechanism

The next step would be to implement the mechanism for adjusting the bridge's height. This could involve hydraulic or electric actuators, controlled by a motor or other power source. The system would need to be designed to ensure safe and stable operation of the bridge during height adjustment.

Figure 4.3.1:Servo Motor

4.4 : Development of controlled System

A control system would need to be developed to manage the height adjustment based on the sensor data. This could involve setting up rules or algorithms for when and how much to adjust the bridge's height. The control system could be implemented using programmable logic controllers (PLCs), microcontrollers, or other control electronics.

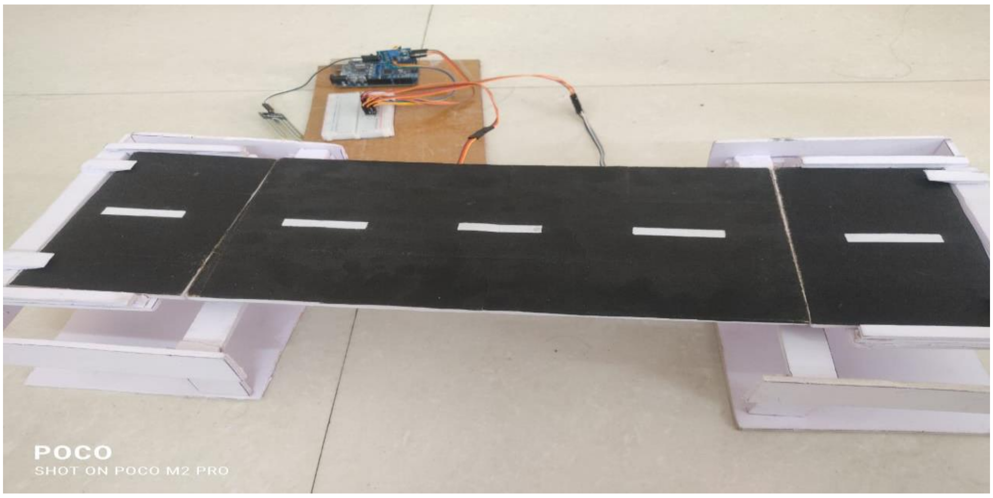


4.5 : Testing and Commissioning

Once the system is installed and configured, it would need to be thoroughly tested to ensure it operates correctly and safely. This would involve testing the system under various conditions and making any necessary adjustments or repairs. After testing, the system could be commissioned for regular use.

4.6 : Monitoring and Maintenance

After the system is implemented, it would need to be regularly monitored and maintained to ensure it continues to operate correctly. This could involve periodic inspections, data analysis, and software updates.



4.7: SOURCE CODE

The code for the automatic height increase bridge is written in Arduino programming language. The code initializes the servo motors and soil moisture sensor, and continuously reads the soil moisture sensor values. When the soil moisture level exceeds a certain threshold, the servo motors are activated to raise the bridge's height.

1. The code includes the necessary library for using a servo motor.
2. It declares variables and assigns pin numbers for the sensor and the servo motor.
3. In the setup() function, the sensor pin is set as an input and the servo motor is attached to its corresponding pin.
4. The loop() function continuously reads the value from the sensor using digitalRead().
5. If the sensor value is 0, it means that there is no input detected, so the servo motor is set to 0 degrees using tap_servo.write(0).
6. If the sensor value is 1, it means that there is input detected, so the servo motor is set to 90 degrees using tap_servo.write(90).

This code essentially moves the servo motor to different positions based on the input from the sensor.

```
#include <Servo.h>
#include <Servo.h>
Servo tap_servo;
int sensor_pin = 4;
   int tap_servo_pin =5;
int val;
     void setup(){
  pinMode(sensor_pin,INPUT);
  tap_servo.attach(tap_servo_pin);
}
    void loop(){
  val = digitalRead(sensor_pin);
         if (val==0)
  {
    tap_servo.write(0);
  }
  if (val==1)
  {
    tap_servo.write(90);
    }
}
```

CHAPTER-5

5.RESULT

The height of the bridge increases automatically whenever the water level reaches its maximum point,and it prevents from the damage caused to bridge. system the height of the bridge increases automatically whenever the water level reaches its maximum point, and it prevents from the damage caused to bridge. A Smart Bridge typically refers to a bridge equipped with advanced technologies for monitoring, maintenance, and improved functionality. It often involves the integration of sensors, and communication systems to enhance efficiency and safety. They utilize sensors for real-time data on structural health, traffic, and environmental conditions, improving safety and efficiency.

CHAPTER-6

6. CONCLUSION

To cover water scenarios, an automated height-conforming ground might be built with Arduino, servo motors, and humidity sensor. The servo motors would adjust the ground's height as the water position increased to ensure climbers and cars could pass safely. The Arduino would repurpose the data and send commands to the servo motors such that the humidity detectors would continuously cover the water position. This outcome would provide a safer and more efficient means of managing shifting conditions on islands. Finally, an automatic height-conforming ground would be a fantastic application for humidity sensor, servo motors, and Arduino. This system would reduce accidents and provide a safer means of transportation between islands, particularly during periods of severe flooding or downslope movement

CHAPTER-7

7. FUTURE SCOPE

The targeted use for this proposed system the height of the bridge increases automatically whenever the water level reaches its maximum point, and it prevents from the damage caused to bridge. A Smart Bridge typically refers to a bridge equipped with advanced technologies for monitoring, maintenance, and improved functionality. It often involves the integration of sensors, and communication systems to enhance efficiency and safety. They utilize sensors for real-time data on structural health, traffic, and environmental conditions, improving safety and efficiency

CHAPTER-8

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