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An Automated Safety Gate Model for Enhancing River Bridge Safety during Floods

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Abstract

We delve into the pressing issue of bridge safety during the rainy season, where overflowing rivers pose a significant threat to public safety. The unfortunate reality is that many accidents occur as people attempt to cross these hazardous bridges, often resulting in tragic consequences. At the core of our mission lies a commitment to protecting lives and preventing accidents during overflow situations. We have introduced the Automatic Safety Gates model. Designed with precision and care, our Automatic Safety Gates are specifically crafted to mitigate risks and ensure the safety of individuals using bridges in critical scenarios. Our primary goal has always been to develop solutions that effectively prevent accidents, and this model is a testament to our unwavering dedication. We believe that with the implementation of our Automatic Safety Gates, you can rest assured that lives are safeguarded, risks are minimized, and safety is prioritized at all times. In the paper we discuss about the model named Safety Gates for Bridge. As we have seen in rainy season many bridges are dangerous to cross because of over of river. And while crossing the bridge many people swept away with river water. Thus, the aim of our research is to prevent the accidents on bridge during overflow. Therefore, we have worked on the model of Automatic Safety gates. This model prevent the life loss during overflow.

Keywords: *Automated Safety Gate, Bridge Safety, Flood Detection, Arduino Uno, Water Level Sensor, Servo Motor, Disaster Management, Embedded System, Flood-Prone Areas, Real-Time Monitoring*

Introduction

Recently, there has been a concerning rise in the number of accidents occurring on the bridge during rainy seasons. The safety of our citizens is paramount, and it's concerning to see these incidents on the rise. It is imperative that we address this issue promptly to prevent any further tragedies. Our innovative approach involves installing gates at both ends of the bridge. When the river water level rises to a dangerous point, sensors will detect this change and automatically close the gates. They will remain closed until the water level recedes to safe levels. Moreover, we have incorporated a red signal system that will alert people from a distance about the potential danger, ensuring enhanced safety measures for all. We believe that this model will revolutionize bridge safety and significantly reduce accidents during adverse weather conditions.

Scope and Significance of the Study:

The scope of this study is focused on bridges located in flood-prone areas. These are places where heavy rainfall and overflowing rivers often make bridges unsafe. The system can be applied to both small rural bridges and larger urban ones. By using automation, the project aims to create a safety mechanism that works without human help.The significance of this study lies in its ability to protect lives. Many rural areas do not have proper warning systems, and people often cross bridges without knowing the danger. With automatic gates and signals, accidents can be prevented. This project also shows how computer science and electronics can be applied to solve real-world problems.This model uses simple components like Arduino Uno, sensors, and servo motors, which are affordable and easy to maintain.

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This makes it possible for governments and communities to install the system efficiently.In the long term, this project can influence infrastructure planning. If adopted widely, it can become a standard safety measure for bridges in India and other countries. It highlights the importance of combining technology with disaster management.

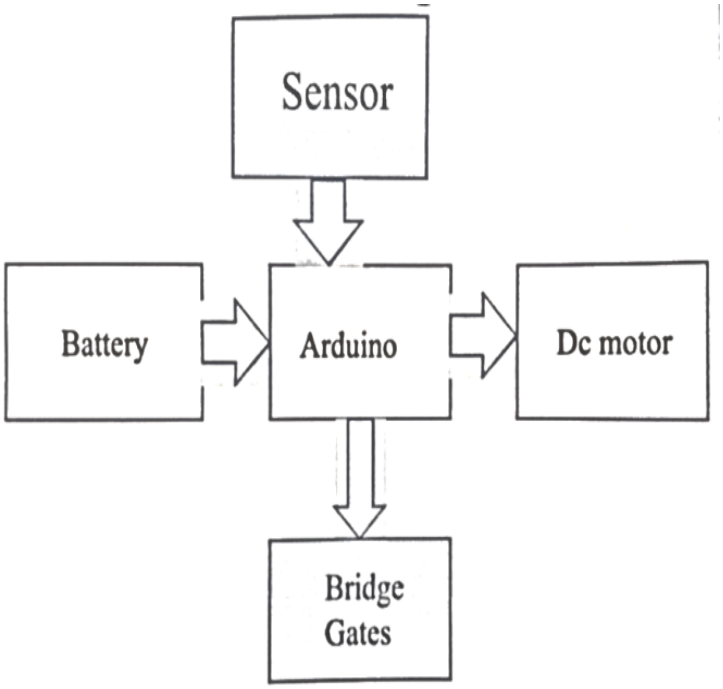
Literature Review:

Many researchers have studied flood detection and warning systems. Sensors such as ultrasonic sensors, soil moisture sensors, and infrared detectors are commonly used to measure water levels. These sensors are often applied in agriculture, environmental monitoring, and disaster management. They provide accurate data about water content and help predict floods. Microcontrollers like Arduino are widely used in automation projects. They are small, affordable, and easy to program. Previous studies have shown how Arduino can be used in traffic management, railway crossings, and smart home systems. Automated gates are already used in railway crossings to prevent accidents, and these systems have proven to be reliable. However, very few studies have focused on bridge safety during floods. Most flood warning systems only provide alerts, such as sirens or text messages. While these warnings are useful, they do not physically stop people from crossing dangerous areas. Our project adds a new dimension by combining detection with automatic gate control. This ensures that people cannot cross the bridge when it is unsafe. By reviewing existing studies, we found that automation reduces human error and improves safety. Our project builds on these ideas but applies them in a new way, filling a gap in current research.

Methodology

This ground breaking model aimed at enhancing bridge safety during rising flood situations. Our automatic safety system, comprising of Arduino, sensors, and servo motors, is designed to save lives by alerting people and preventing accidents in critical times. To kick-start this initiative, our first step involves creating a detailed circuit diagram for the model. This crucial stage will not only help us understand the intricate connections within the system but also provide a clear roadmap on how the model will function seamlessly in real-world scenarios. By following the circuit diagram, we meticulously connected the components and successfully installed the Arduino IDE application on our server. Using the IDE, we compiled and uploaded a custom C program onto the Arduino Uno board. This program incorporated intricate mathematical and logical operations to regulate motor rotation and sensor functionality effectively. Subsequently, we meticulously tested the circuit's performance after making necessary connections.

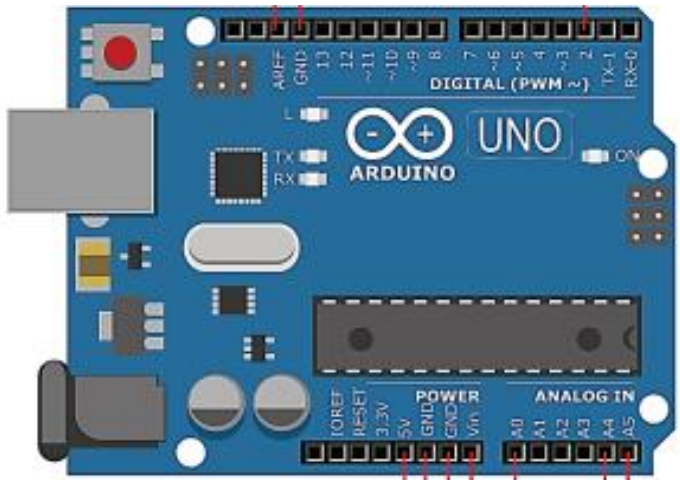
Block Diagram:



Components:

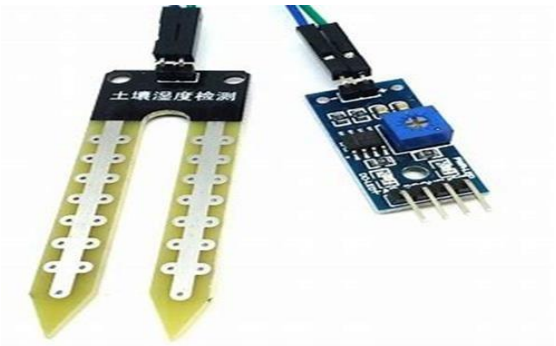
1. **Arduino Uno:**

The Arduino Uno serves as the central control unit for the proposed automatic irrigation and fertilization system. Based on the ATmega328P microcontroller, it operates at 5 V with a 16 MHz clock frequency. It acquires data from the soil-moisture sensor, processes the readings, and controls the DC water pump and fertilizer-dispensing solenoid valve via relay modules. Its advantages include low cost, easy programming (Arduino IDE), abundant digital and analog I/O pins, and suitability for real-time agricultural automation.



2. **Soil moisture sensor:**

A soil moisture sensor is an essential tool used to measure the volumetric content of water within the soil. When inserted into the soil, the sensor reports the water content as a percentage. It is commonly used in scientific experiments related to environmental science, agriculture, biology, soil science and horticulture.



3. **Servo motor:**

A servo motor can be either a DC motor or an AC motor, depending on the power source and application requirements. The motor provides the mechanical power to rotate or move the output shaft. The sensor measures the position, speed, or torque of the output shaft and sends feedback signals to the controller.

Results / Findings:

The testing of our model gave positive results. When the sensor detected high water levels, the servo motor closed the gate successfully. The buzzer and red light installed on bridge also worked, giving clear warnings to people nearby. One important finding is that the system works in real time. It reacts quickly to changes in water levels, which is very important during floods. nother finding is that the system does not need human control. Once installed, it can operate automatically, reducing delays and mistakes. The prototype is small, but it shows that the idea can be applied on real bridges. Larger gates and stronger sensors can be used for actual installations. The results prove that automation can make bridges safer during floods. We also found that the system is cost-effective. The components are affordable and easy to maintain. This makes it possible for communities and overnments to use the system widely. Overall, the findings confirm that the Automatic Safety Gate System is a practical solution for bridge safety.

Conclusion and Future Scope:

This paper presented the design and development of a safety gate system for bridges aimed at preventing accidents during the rainy season and flood conditions. The proposed model addresses a critical safety concern by restricting vehicle movement on bridges when rising water levels pose a potential risk. The methodology, system architecture, and key hardware components used in the development of the safety gate model were discussed in detail, demonstrating the feasibility and effectiveness of the proposed approach. The system operates by continuously monitoring the water level near the bridge. When the water level reaches a predefined danger threshold, the safety gates are automatically activated.

Future Scope:

The proposed system can be further enhanced by integrating advanced sensors for improved accuracy and reliability. Incorporation of IoT-based remote monitoring, GPS-based location alerts, and mobile application interfaces can provide real-time updates to authorities and the public. Future work may also include solar-powered operation, AI-based flood prediction, CCTV integration, and large-scale deployment on flood-prone bridges to strengthen disaster-resilient transportation infrastructure.

Model:

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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