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Design Simulation of Automatic Lifted Bridge System using Arduino Uno

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ABSTRACT

The existence of bridges is needed as a means to connect interrupted paths separated by rivers, ravines, or the sea. On the one hand, the existence of bridges is sometimes an obstacle for large ships whose shipping lanes are blocked by bridges, so a bridge is needed that is able to move up to facilitate shipping to the lane. Usually, this raised bridge system is operated manually by the operator, so it is still inefficient. In this paper, we try to create a prototype design using an Arduino Uno microcontroller that displays an automatic raised bridge system. When a large ship is detected to be passing through the bridge, the system will give a warning that traffic on the bridge will be temporarily stopped with a red traffic light marked and the portal for motorists will be closed and then continued with the bridge open to ships. But if it is detected that there are still vehicles on the bridge, then the system will warn the ship to stop for a moment waiting for conditions or conditions on the bridge to become conducive, and then the bridge opens. After the ship has been detected far away from the bridge, the system and traffic on the bridge will return to normal.

Keywords*: Bridge System, Prototype Design, Arduino Uno, System Automation.*

1. INTRODUCTION

The Bridges are infrastructure designed to connect areas separated by ravines, seas, rivers, and lakes. The existence of bridges has a different level of importance for each person. Likewise with everyone's view of the bridge. So the bridge will be an interesting thing to study further. Bridges will not be too important for people who live on flat plains but will be very meaningful for people who live in certain areas that tend to be difficult to reach [1].

In addition to being a link, in the view of some people the bridge is often considered an obstacle for large ships whose shipping lanes are blocked by the bridge, so it requires a dynamic bridge, that can open and close so that it can be used as a link that does not become an obstacle to the ship's shipping lane.

From the data that has been found, several countries already have dynamic bridges that can open or close, one of which is Indonesia. But in this increasingly advanced era of globalization, it is considered that the dynamic bridge is still considered less efficient because it must be operated manually by the operator [3]. With the help of technology, the bridge system will work automatically with the detection of large ships that will pass coupled with a door portal security system for vehicles that pass traffic in the area around the bridge.

In this project, the team wants to make a prototype in the form of an automatic open bridge system using Arduino microcontroller technology. This is because using Arduino is easier than using other technologies. Arduino is an electronic kit that has a microcontroller chip in the form of an AVR from the company Atmel. This chip can be programmed using a computer as desired. So, the function of this microcontroller is as a brain that controls the input, process, and output of electronic circuits [2].

Each microcontroller requires programming as a command to be able to initiate sensors and move actuators using the Arduino IDE software. The Arduino IDE is a tool for writing programs for the Arduino board. Arduino IDE is open-source software that can be downloaded and installed on a computer. The Arduino IDE provides many libraries that are ready to use. By using these libraries, Arduino developers will save a lot of time [4].

2. METHOD

This section will display the methods used in designing a prototype simulation of a bridge system that can lift automatically. Among other things, it includes processes as in Figure 1.

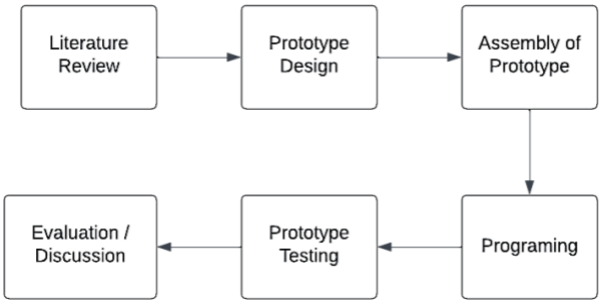

Fig 1. Development Method.

A flowchart related to how the system works on the prototype of an automatically open bridge system is shown in Figure 2. Starting with proximity sensor 1 detects the approaching ship within 5 cm of the bridge. This detection distance uses a scale of 1: 20000 so that 5 cm here describes 1 km at the original distance. When detected, the red traffic light turns on then the portal closes the road for motorists who will pass through the bridge.

Then the system will process the data and determine whether the bridge can be opened or held first based on the situation and traffic conditions on the bridge. Then, when the ship has left the bridge and is detected by proximity sensor 2, the first thing the system does is the bridge is closed again then the traffic light will turn green and the portal will open then the traffic on the bridge can return to normal.

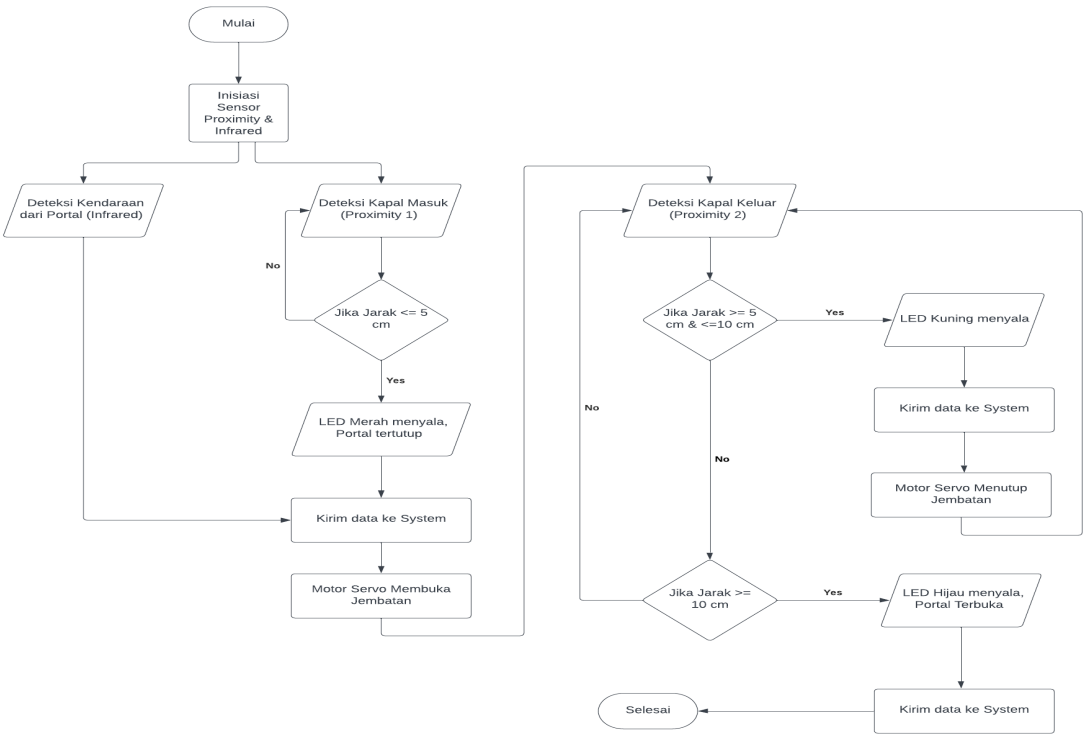

Fig 2. System Flowchart

3. RESULT AND DISCUSSIONS

In this part, we present the results of the project, including the design and successful simulation of an automated raised bridge system using an Arduino Uno. The project involved designing and simulating the system, through software tools and then with hardware model components, to demonstrate how the bridge can be controlled using an Arduino Uno as the main processor.

The Arduino Uno is a popular and versatile microcontroller board. It is one of the variants of the board made by the Arduino company. The Arduino Uno is often used by developers, beginners, and electronics hobbyists to create various automation, control, and electronic interaction projects.

Table 1. Specification of Arduino Uno.

Microcontroller	Atmega 328
Voltage Operation	5 Volt
Voltage Input	opitmal 7 - 11 Volt
Voltage Input Limit	6 - 20 Volt
Pin I/ O digital	14 (6 for PWM)
Pin analog	6
DC Current on Pin	50 mA
DC on 3.3V	50 mA
Memori flash	32 kb ATmega 328
	0.5 kb for bootloader
SRAM	2 kb (Atmega 328)
EEPROM	1 kb (Atmega 328)
Clock Speed	16 z

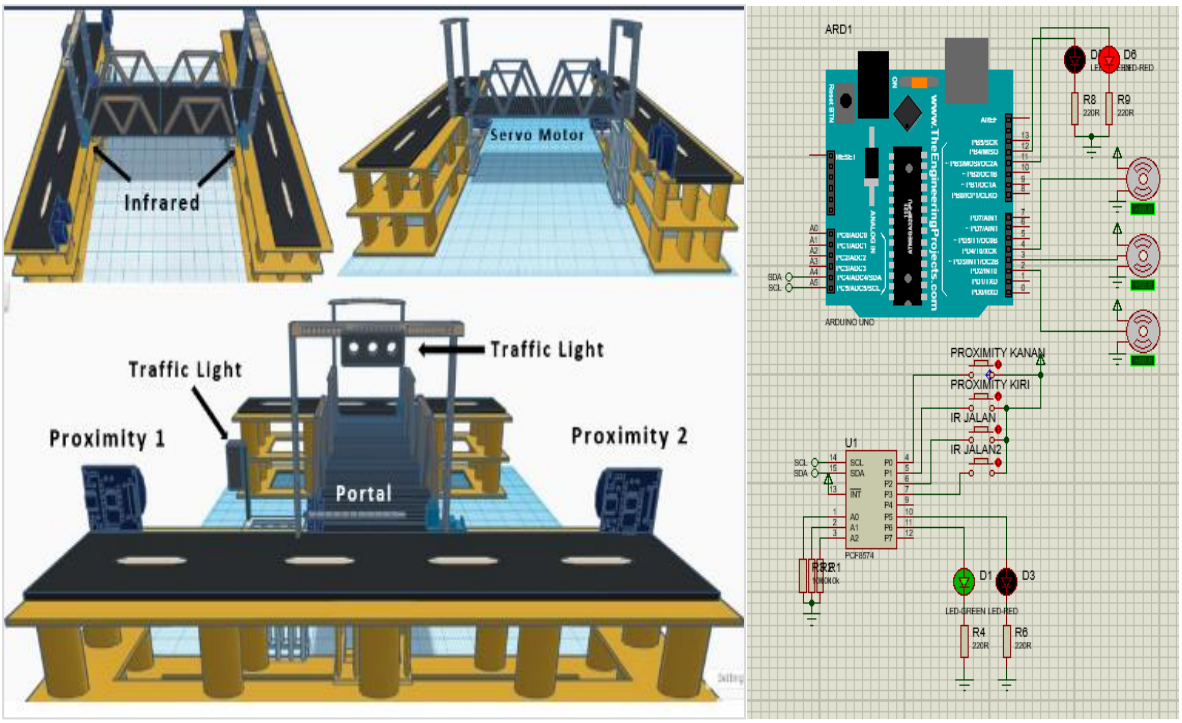

Fig 3. Modeling Design (Left) And Circuit Schematic (Right)

Figure 3 shows the design of a bridge prototype that can open automatically. In making this prototype used several components or tools as follows namely: Arduino Uno, a Proximity Sensor, an infrared sensor, an adapter, and an LED as a traffic light. All these components are assembled according to the design that has been made. After the assembly process is complete, the prototype enters the programming stage using the Arduino IDE software, where later the system on the bridge can be activated. The following is the code used in the Arduino IDE software.

```
#include <Servo.h>
#define SIGNAL_PIN 2
#define SIGNAL_PIN2 3
#define IR_PIN 4
#define LED_PIN 5
Servo myServo;  // Objek servo
void setup() {
  myServo.attach(9);  // Menghubungkan servo ke pin 9
  pinMode(IR_PIN, INPUT);
  pinMode(LED_PIN, OUTPUT);
  // Mengaktifkan serial monitor
  Serial.begin(115200);
}
void loop() {
  closedoor();            // Menggerakkan servo ke sudut 0
derajat
  safetyCheck();
}
void opendoor() {
  myServo.write(90);  // Menggerakkan servo ke sudut 90
derajat (counterclockwise)
  digitalWrite(LED_PIN, HIGH);
  delay(2000);
}
void closedoor() {
  myServo.write(0);  // Menggerakkan servo ke sudut 0
derajat (clockwise)
  digitalWrite(LED_PIN, LOW);
```

```
void gateSystem() {
  int sensorValue = digitalRead(SIGNAL_PIN);
  int sensorValue2 = digitalRead(SIGNAL_PIN2);
  if (sensorValue == LOW) {
     Serial.println("Gate Objek terdeteksi");
    opendoor();
    while (sensorValue2 == LOW) {
      sensorValue2 = digitalRead(SIGNAL_PIN2);
      delay(100);
    }
    closedoor();
    Serial.println("Tail Objek terdeteksi");
  }
}
void safetyCheck() {
  int checkIR = digitalRead(IR_PIN);

  if (checkIR == LOW) {
    Serial.println("IR Triggered");
    closedoor();
  } else {
    Serial.println(".");
    gateSystem();
  }
`
```

Output is the final stage of the overall research results after successfully designing and programming the prototype of the automatic bridge opening and closing system. The bridge prototype is shown in the figure.

Figure 4 shows the built prototype for implementation and testing of the automatic system. The bridge model was built using light woodsticks. Video on the form and workings of the design and simulation of the Automatic Lifted Bridge System using Arduino Uno within this project can be seen in the Arduino Uno.

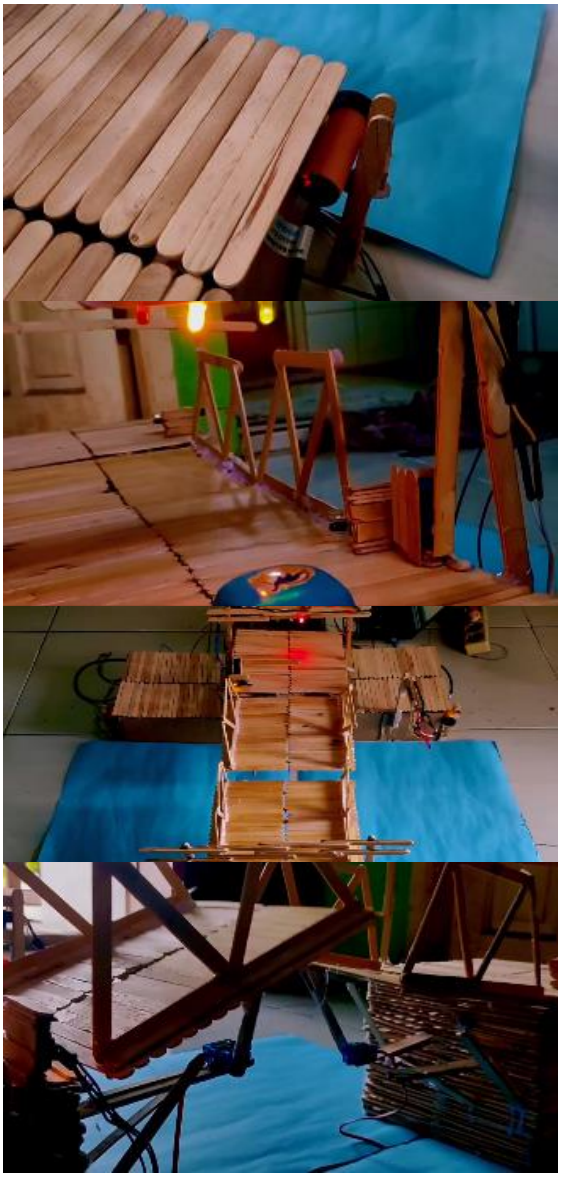

Fig 4. Prototype design.

4. CONCLUSION

Based on the results of research and prototyping, it is concluded that the creation of an automatic lifted bridge system is an innovation that is more modern than existing systems, the existence of an automatic system will add a higher efficiency value than a manual system because its use will be more effective and accurate based on the sensor data that has been

received. Apart from that, this automatic lifted bridge system is a step forward in the development of smart infrastructure, not only increasing efficiency and safety but also optimizing the use of technology.

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