AUTOMATIC DAM SHUTTER CONTROL

A Project report is submitted in partial fulfillment of the requirements for the award of Degree of Bachelor of Science in Electrical and Electronic Engineering.

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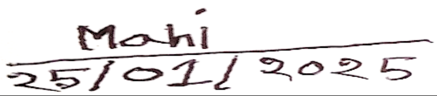
Declaration

I hereby declare that this project "**Automatic Dam Shutter Control**" represents my own work which has been done in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering, and has not been previously included in a thesis or dissertation submitted to this or any other institution for a degree, diploma or other qualifications. I have attempted to identify all the risks related to this research that may arise in conducting this research, obtained the relevant ethical and/or safety approval (where applicable), and acknowledged my obligations and the rights of the participants.

Signature of the candidates



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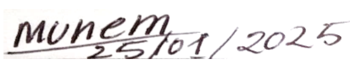

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Approval

The project entitled "**Automatic Dam Shutter Control**" submitted by **Mohiuddin Mahi**, ID No:212-33-5402 & **Md. All Munem Shariar**, ID No:212-33-5403, Session: Fall 2024 has been accepted accepted as satisfactory in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering in August 2024.

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Dedicated

To

Our Parents

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First of all, we want to give thanks to **Almighty Allah**. With his blessing we are able to complete our work with best effort.

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To our beloved family, we want to give them our deepest love and gratitude for being very supportive and also for their inspiration and encouragement during our studies in this University.

ABSTRACT

Every aspect of our lives is connected with the control systems in some way. Hardware and software designers work together to create control systems. Even with today's sophisticated technology, several dams still use human methods to operate their gates. If anything is done by hand, human flaws and shortcomings will be there. The development of a control system for the "Dam Gate Automation Control System Based on Arduino" is covered in this project. The goals are to design a completely automated dam gate control system using Arduino, propose a water level-based gate opening control system, and manufacture a dam gate control system prototype. With the application of a water level sensor, the opening and closing of the dam gate can be regulated by sending a signal to a servo motor that moves the dam gate. The water level is monitored at various levels, and the gate is closed or opened accordingly.

CHAPTER1: INTRODUCTION

1.1 Research Background

The Automatic Dam Shutter Control system emerged to address the limitations of manual dam management, which is labor-intensive and prone to delays and errors. Early research introduced remote monitoring but lacked automated responses. Advances in sensor technology, IoT networks, and machine learning now enable real-time data collection, predictive hydrological modeling, and automated decision-making, allowing shutters to adjust proactively to prevent floods and ensure water availability. Recent studies focus on using these technologies to create sustainable systems that respond dynamically to changing weather conditions, helping optimize water release for flood prevention, agriculture, and energy production. The field has evolved from basic monitoring to sophisticated, autonomous solutions that improve safety, efficiency, and environmental stewardship.

1.2 Problem statement and significance

Manual control of dam shutters is prone to human error, slow response times, and inefficiencies, especially during critical events like floods or droughts. Automatic control ensures optimal water levels, preventing floods and droughts. Reduced risk of human error in critical situations. Faster response times to changing conditions. Automation minimizes the need for manual labor. Data-Driven Decision Making: Real-time data enables informed decisions.

1.3 Objectives

1. To design and develop a robust and efficient automatic control system for dam shutters.
2. Assessing the system's ability to maintain desired water levels and flow rates.
3. Conduct a cost-benefit analysis to assess the economic feasibility of automated control Systems.
4. Developing a user-friendly interface for system monitoring and control.

CHAPTER2: LITERATURE REVIEW

Automatic dam shutter control systems are intended to operate automatically, requiring minimal human interaction. These systems use water levels, weather conditions, and other key parameters to control the opening and closing of dam shutters. They want to improve safety, efficiency, and resource management**.**

Several studies have investigated the feasibility of Automatic dam shutter control systems. Vishal Wankhade et al. (2021) examined the Automatic dam shutter control system in a university campus in the India. The findings revealed that false positive/negative comparisons were performed before and after the system was installed. The response time for opening and closing the gate decreased. The system prevented incidents from occurring. [1]

Mr. Lingnagouda. (2020) analyzed an automated dam shutter control system in a university campus in India. The study discovered that autonomous dam and drainage systems were an effective and efficient way to manage tidal water and drainage in low-lying locations. The use of Arduino-based automation, along with real-time sensor data, resulted in a highly efficient, cost-effective, and scalable system for flood control and irrigation. [2]

Bing Shen et al. (2024) investigated the feasibility of installing dam shutter control system in a university campus in the China. Remote monitoring sensors were used to capture real-time data and automate control. Low-cost Internet of Things sensors were used to improve operational efficiency. Standardized monitoring technologies were used to assess a wide range of environmental conditions. [3]

Despite the study's promising results, installing dam gate control systems presents several problems. One of the key issues is correct planning, design, and maintenance. According to May Thwe Oo et al. (2019), an automated PLC-controlled dam gate system can considerably improve water resource management, eliminate errors, and mitigate flood risks. However, all of the following dam-related materials can be. [4]

CHAPTER3 MATERIAL AND METHODS

3.1 MATERIAL AND METHODS

In this thesis, we want to build and implement a revolutionary automated dam shutter control system for flood water management. To provide a durable and efficient system, a multi-phase strategy is used, combining hardware, software, and simulation. Identifies the unique issues and limits of current dam shutter control systems. Conducts a detailed examination of flood management systems and automation technology. Defines system requirements, which include critical features like real-time monitoring, automated decision-making, and fail-safe methods. Creates a dam shutter control prototype that comprises sensors (for example, water level, rainfall, and flow rate sensors) and actuators (such as motors or hydraulic systems). Creates a control algorithm that uses decision-making logic to integrate sensor data and automatically manages the shutter's opening and shutting. Gathers historical flood and water level data to model various flood scenarios. Simulation tools are used to test and validate the control algorithm under a variety of scenarios. Sensors and actuators are deployed in a scaled-down model to imitate the environment of a real dam. Programs use algorithms in a microcontroller or embedded device to operate the shutters. Functional testing is used to guarantee that the system functions as intended under both typical and exceptional settings. Stress tests are conducted to assess system stability and response time during unexpected rises in water levels. Validates system performance using preset parameters like accuracy, efficiency, and resilience. Refines control algorithms to increase response speed and error reduction. Optimizes hardware for both longevity and cost-effectiveness.

CHAPTER4: RESULT DISCUSSIONS

4.1 Introduction

Water management is vital for a variety of applications, including irrigation, hydroelectric power generation, flood control, and water delivery. Dams must function properly to regulate water flow, provide safety, and optimize water use. Traditional methods of operating dam shutters frequently need manual involvement, which can be time-consuming, error-prone, and inefficient during emergencies. Automatic Dam Shutter Control systems overcome these constraints by utilizing innovative technology to automate the process of opening and closing dam shutters based on current conditions. These systems use sensors, microcontrollers, and actuators to monitor water levels, flow rates, and weather conditions, resulting in responsive and precise control. Automatic systems use sensors to continuously monitor parameters such as water level, inflow, and downstream conditions. The technology automatically operates the shutters using established thresholds and algorithms, eliminating the need for manual intervention. Operators can remotely monitor and operate the system via interfaces such as SCADA (Supervisory operate and Data Acquisition) or mobile applications. Automated systems optimize shutter movements to reduce energy consumption. Ensures prompt response in crucial conditions such as heavy rainfall or abrupt inflows to avoid floods or building damage. Accurate regulation of water discharge reduces waste and maximizes resource utilization. Reduces the dangers of human mistake and delays during crises. Reduces operational expenses by minimizing manual labor and maintenance requirements. Promotes effective water management to meet environmental and agricultural needs. Dynamically adjusts discharge rates to prevent overflow. Ensures continuous water supply to agricultural fields. Hydropower Generation: Controls water flow to maximize electricity generation. Urban Water Management: Helps to conserve water in urban settings. [5]

4.1.1 Microcontroller

Microchip Technology (previously Atmel) created the 8-bit ATmega328P microcontroller, which belongs to the AVR family. Because of its ease of use, low power consumption, and extensive feature set, it is frequently utilized in embedded systems, including commercial devices, IoT applications, and hobbyist projects. built on the Enhanced RISC architecture of the AVR. carries out the majority of commands in a single clock cycle.20 MHz is the maximum clock frequency.8 MHz internal oscillator. 32 KB of flash memory (used to store applications). Two KB of SRAM (for runtime data). EEPROM: 1 KB (for storing nonvolatile data). modes with low power usage (standby, power-save, and idle). Voltage range for operation: 1.8V to 5.5V.

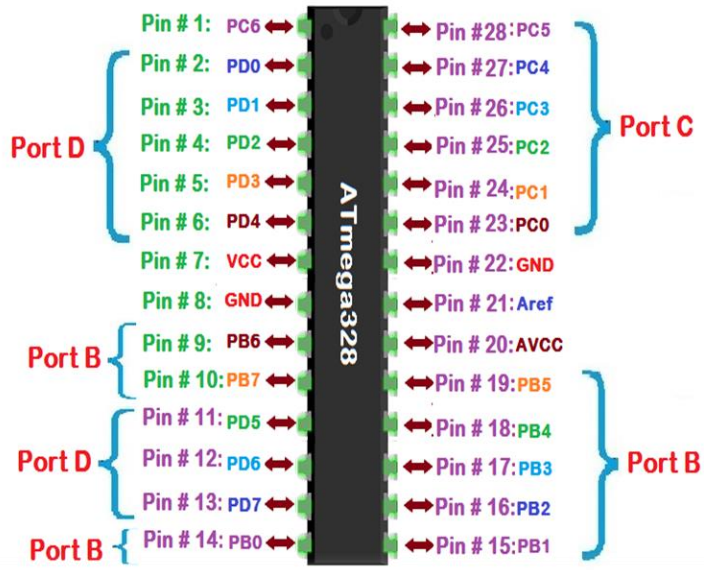

Figure 4.1: 8-bit ATmega328P microcontroller

There are 23 GPIO (General Purpose Input/Output) pins. Analog-to-Digital Converter (ADC) has 6 channels and 10 bits. Six PWM channels (for dimming LEDs, controlling motors, etc.). Protocols for I2C/TWI, SPI, and USART communication. An independent on-chip oscillator in a watchdog timer. sensor for the internal temperature.

4.1.2 USB interface chip

The ATmega16U2 is an 8-bit microcontroller from Microchip Technology that belongs to the AVR family. It is widely used in embedded systems and is well-known for its interaction with development platforms like Arduino boards (for example, the Arduino Uno for USB connection).

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Figure 4.2: USB interface chip

The microcontroller core uses an 8-bit AVR RISC architecture. Program Memory: 16 KB of In-System Programmable Flash. 512 bytes of EEPROM. One KB of SRAM. Clock Speed: Up to 16 MHz. USB Support: Includes a Full-Speed USB 2.0 Controller. Offers USB-to-serial connection capabilities. I/O ports include 22 programmable I/O pins. Two eight-bit timers. A 16-bit timer. Communication interfaces include SPI, UART, and I²C (TWI). Operating voltage ranges from 2.7 to 5.5 V. Power Consumption: Low power, with many sleep modes. Other features: Watchdog timer. Analog-to-Digital Converter (ADC) having a 10-bit resolution.

4.1.3 crystal oscillator

The microcontroller requires a clock signal to sequence activities and execute instructions. The crystal oscillator has a very constant frequency of 16 MHz, which means it oscillates 16 million times a second. Timing precision: The crystal's precision ensures exact timing for operations like as delay functions, communication protocols (such UART, I2C, and SPI), and PWM signal production.

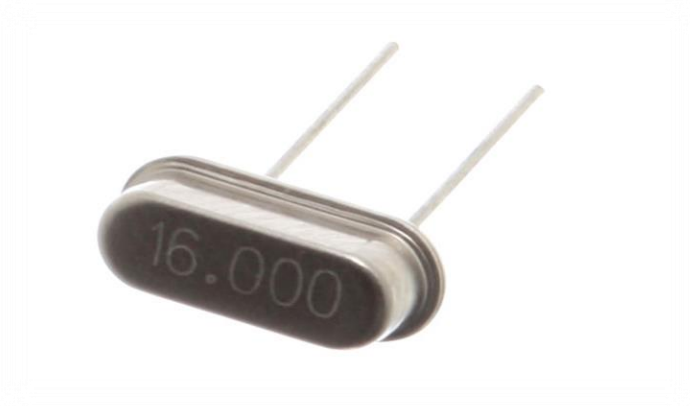

Figure 4.3: crystal oscillator

Synchronization guarantees that the microcontroller's internal processes, including as instruction execution and peripheral control, are synced.16 MHz frequency is standard for most Arduino boards, including the Uno. Two capacitors: Normally, capacitors (22 pF each) are attached to the crystal to stabilize the oscillation. Low power consumption. Ensures efficient energy consumption. External Component: The crystal oscillator is installed on the PCB next to the ATmega328P.

4.1.4 voltage regulator

A 5V variant of the low dropout (LDO) linear voltage regulator LM1117MPX is one of several fixed voltage output options. Applications needing a low dropout voltage and a steady, dependable 5V supply are a good fit for it.

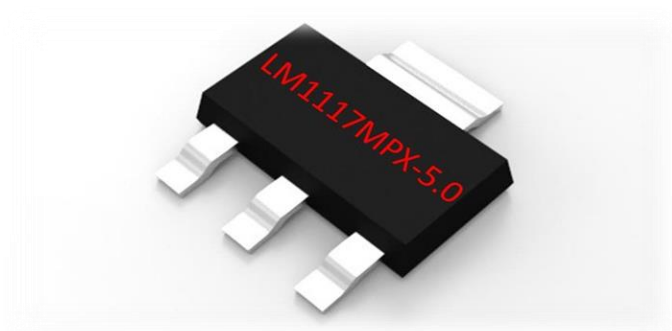

Figure 4.4: voltage regulator

Low dropout voltage: Typically, about 1.1V at 800mA output current.
Maximum Output Current: Up to 800 mA.
A fixed output voltage of 5V is offered, as well as an adjustable version (LM1117-ADJ).
Thermal protection includes protection from overheating.
Overcurrent Protection: A built-in current limit ensures safety.
Compact packaging: It is frequently offered in a SOT-223 packaging, making it ideal for compact designs.

4.1.5 reset switch

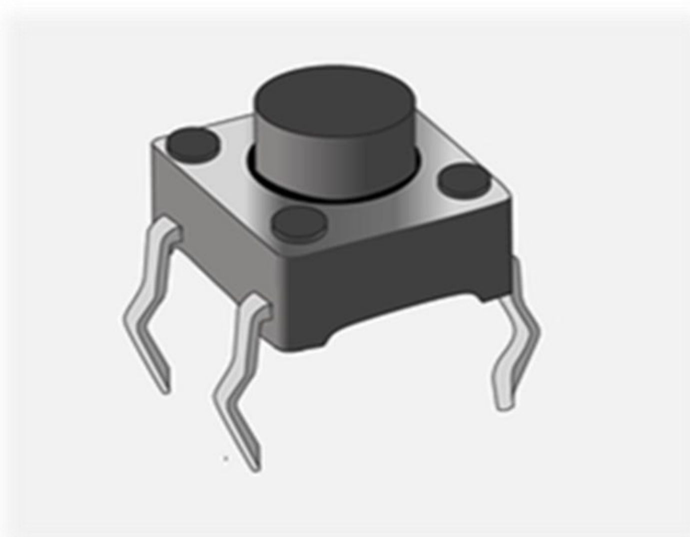

Figure 4.5: reset switch

A reset switch on a microcontroller is used to restart the device by resetting its internal state. This is an important tool for debugging, recovering from faults, and just restarting the system without power cycling. This is an overview:

Typical Reset Switch Circuit Components:
1. Push Button

4.1.6 USB Connector

A USB connection is a standardized interface that allows devices to communicate, transmit data, and supply power. USB stands for Universal Serial Bus, and it is extensively used in a variety of devices including computers, cellphones, printers, cameras, and more. There are various varieties of USB connections, each with a unique design and functionality.

Figure 4.6: USB Connector

USB-B is a square-shaped connection often seen in printers, scanners, and other peripheral equipment.

Micro-USB: A tiny connection commonly seen in older smartphones, tablets, and other portable devices. It has been mainly supplanted by USB-C in current products.

Mini-USB: A slightly bigger variant of the Micro-USB that was previously widely used for digital cameras, GPS devices, and older mobile devices.

4.1.7 Power Port

A DC Jack Socket Plug Power Supply Module is a component that supplies direct current (DC) power to an electronic device. It often has a DC power jack (female) or plug (male) and is intended to connect to a power source, such as a wall adapter or battery. These modules are commonly utilized in a broad range of electronic projects, particularly embedded systems, microcontroller-based devices, and power-sensitive applications.

Figure 4.7: Power Port

Here are some important characteristics and data of such modules:

DC Jack Socket (Female): This is where you insert the male DC power connector. It connects to a power source, such as a charger or a battery.

Voltage Rating: The module will be able to handle a certain voltage rating. The right voltage rating is critical for effective performance and protection against harm.

Current Rating: The module will have a current rating, which specifies how much current it may safely transport. Higher current ratings are required for gadgets that consume more power.

Polarity: DC electricity is normally polarized, with one pin positive (+) and the other negative (-). Many modules come with clear labeling to show which terminal corresponds to which polarity.

4.1.8 Arduino UNO

The ATmega328P microprocessor serves as the foundation for the open-source Arduino Uno microcontroller board. Its ease of use, low cost, and large support network make it popular in teaching, prototyping, and do-it-yourself electronics.

Figure 4.8: Arduino UNO

Important attributes:

ATmega328P microcontroller

5V is the operating voltage.

7–12V is the suggested input voltage.

I/O in digital Six of the fourteen pins can be utilized as PWM outputs.

Pins for Analog Input: 6

32 KB of flash memory, 2 KB of SRAM, and 1 KB of EEPROM

16 MHz is the clock speed.

Communication methods: SPI, I2C, USB, and UART.

Why use the Arduino Uno?

Ease of Use: Intended for beginners and hobbyists.

Large Community: Access to numerous tutorials, forums, and sample projects.

Versatility: Suitable for robots, IoT, sensors, and other applications.

Plug-and-play: USB interface allows for simple programming with the Arduino IDE.

Typical Applications:

Projects using home automation

Systems for recording data

Motor control and robotics

Internet of Things (IoT) gadgets

Engineering project prototype

4.1.9 servo motor

A servo motor is a type of motor that precisely controls angular or linear position, velocity, and acceleration. It is widely utilized in applications that need great accuracy and repeatability, such as robots, CNC machines, and automated manufacturing. [6]

Figure 4.9: servo motor

Key Features of a Servo Motor:

Closed-Loop System:

Servo motors work in a closed-loop system in which the motor's output (such as position and speed) is continually monitored by a feedback sensor, which is frequently an encoder or potentiometer. The motor's operation is modified using this feedback to comply with the intended command.

High Precision:

With resolutions frequently in the fractions of a degree, servo motors are capable of making incredibly exact motions.

Compact and Efficient:

Servo motors are often small and energy-efficient, even with their strength and accuracy.

Control Signals:

Pulse Width Modulation (PWM) signals are used to control servo motors. The motor's position or speed is determined by the pulse width.

Types of Servo Motors:

AC Servo motors are typically employed in high-performance applications that need a lot of torque. They run on alternating current.

DC Servo Motors: Usually used in smaller, lower-torque applications, these motors run on direct current.

Stepper Motors with Servo Control: For increased precision, hybrid motors combine servo control and stepper motor technology.

Applications:

Robotics: Accurate manipulation of robotic joints and arms.

Packaging machines, pick-and-place systems, and conveyor belts are examples of industrial automation.

Actuation systems for landing gear, ailerons, and flaps in aerospace.

Consumer electronics: cameras with zoom and autofocus systems.

4.1.10 Ultrasonic sensor

An ultrasonic sensor uses sound waves to estimate the distance to an item. It works by releasing ultrasonic sound waves (high-frequency waves that are beyond the range of human hearing) and measuring how long it takes for the echo to return after bouncing off an object. The distance to the item may be determined using the sound speed. [6]

Figure 4.10: Ultrasonic sensor

Components of an Ultrasonic Sensor:

Transmitter: emits ultrasonic sound waves.

Receiver detects sound waves that reflect back.

Controller: Analyzes the signal and estimates the distance.

Working Principle:

The transmitter produces ultrasonic sound waves.

These waves move through the air and reflect back when they reach an item.

The sensor detects the echo and measures how long it takes for the waves to return.

The distance to the item is computed using the formula:

$$\text{Distance}=\frac{\text{Speed of Sound}\times\text{Time Taken}}{2}$$

The division by two represents the round journey (to and from the item).

Applications:

Obstacle detection: Used for navigation and collision avoidance in robotics and automobiles.

Distance Measurement: Used in industrial automation and liquid level monitoring.

Security systems: For intruder alerts and motion detection.

Healthcare: In equipment such as ultrasonography scanners.

Popular ultrasonic sensors:

A popular ultrasonic sensor for robots and do-it-yourself applications is the HC-SR04.

SRF05 and SRF06: More sophisticated models with improved accuracy and range.

Advantage:

- Non-contact measuring.
- Works under varied lighting situations.
- Reliable at spotting translucent or shiny things.

Limitations:

Accuracy may be impacted by temperature, humidity, and air pressure.

Range is limited when compared to other sensors such as LiDAR.

It is difficult to notice soft or uneven surfaces that absorb sound waves.

4.1.11 16-pin display

A "16-pin display" is often an electronic display module with a 16-pin interface for connecting to a microcontroller or other control devices. These displays are typically LCD or OLED and can be either alphanumeric or graphical. A prominent example is the 16x2 LCD display (16 characters by 2 lines), which is found in many microcontroller applications. [7]

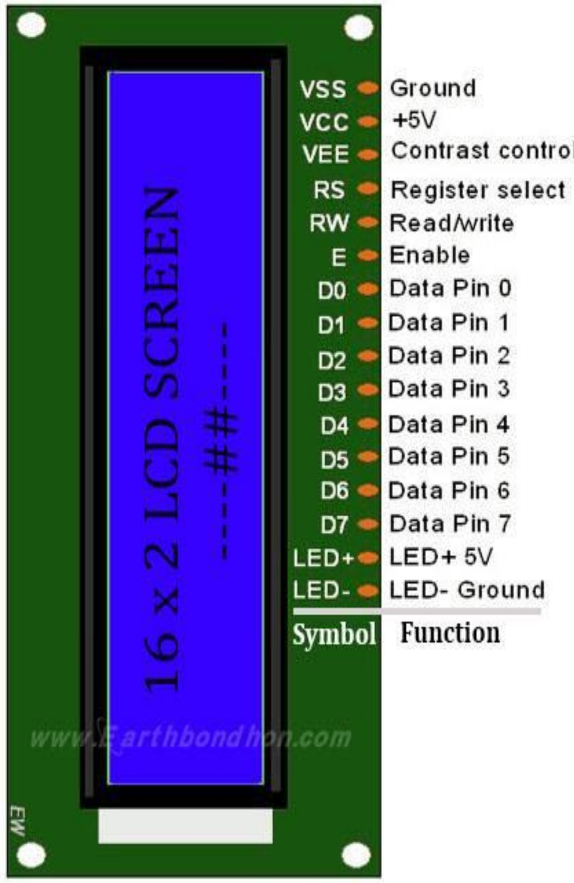

Figure 4.11: 16-pin display

Key Features:

Alphanumeric Displays: Shows text (16x2 or 20x4).

Graphical Displays: Provides pixel control for graphics.

Use 4-bit or 8-bit data modes to save pins.

Backlight: The display's backlight makes it visible in low light.

Control Protocol: Controlled using libraries such as Liquid Crystal for Arduino or comparable for other platforms.

How to Use:

Connect the pins: Power the display (VSS and VDD).

Adjust the contrast using a potentiometer on VO.

Connect RS, RW, and E to the microcontroller.

Use D4-D7 for 4-bit mode and D0-D7 for 8-bit mode.

Optionally, connect the backlight pins (15 and 16).

Applications:

Projects involving microcontrollers (such as the Arduino and Raspberry Pi)

Appliances such as washing machines and microwaves

Systems for user input that are embedded

4.1.12 I2c LCD module

Using the I2C (Inter-Integrated Circuit) protocol, an I2C LCD module is an interface module that attaches to an LCD display to make connection and control easier. For microcontroller projects with few GPIOs, such those using Arduino, ESP32, Raspberry Pi, or comparable devices, this module is perfect since it lowers the number of pins required to operate the LCD.

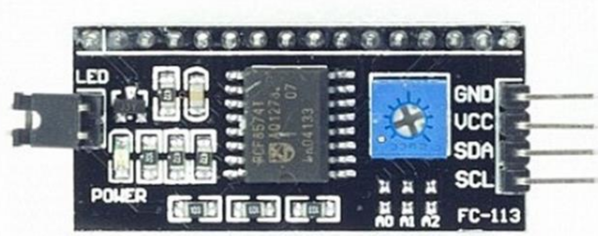

Figure 4.12: I2c LCD module

Features

1. Reduced Wiring: Communication requires only two pins (SDA and SCL) rather than many data pins.
2. Standardized Protocol: Communicates over the I2C protocol.
3. Adjustable Backlight: Usually comes with a potentiometer to change the brightness of the backlight.
4. Suitable with LCDs measuring 16x2 or 20x4: frequently utilized with character displays of this kind.

Pin Configuration

- VCC: Attached to the power source, which is typically either 3.3V or 5V, depending on the LCD and module.
- Ground is GND.
- SDA: I2C connection data line.
- SCL: I2C communication clock line.

Advantages

- minimizes the usage of GPIO pins.
- makes coding and wiring simpler.
- allows several devices to share an I2C bus.

4.1.13 330 Ω Resistor

A passive electronic component that restricts current flow in an electrical circuit is a 330 Ω resistor. Its resistance value, which is 330 ohms, is shown by the "330 Ω". There are several uses for this resistance.

Figure 4.13: 330 Ω Resistor

Common Applications

1.LED Current Limiting:

- When using LEDs, a 330 Ω resistor is frequently utilized to keep the current within a safe range. For instance, it aids in limiting excessive current that might harm an LED in a 5V circuit.

- The current can be calculated using Ohm's Law:

$$I = \frac{V}{R}$$

If V = 5V and R = 330,

$$I = \frac{5}{330} \approx 0.015 \text{ A (15 mA)}$$

2.Voltage Division:

- It may be used in a resistor divider circuit to scale voltages.

3.Pull-Up or Pull-Down Resistor:

- In digital circuits, this is used to establish the default state (high or low) of input pins.

4.1.14 Green and red LED

Green and red LEDs (Light Emitting Diodes) are widely utilized in a variety of applications, including signaling, decorating, and lighting. Here is a brief overview:

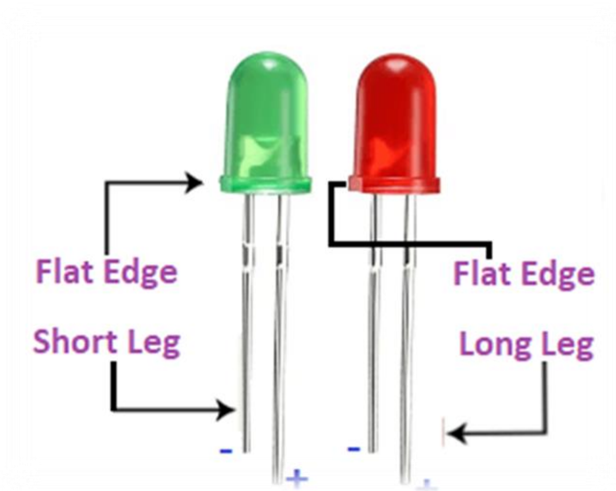

Figure 4.14: Green and red LED

Common Uses:

Indicator lights:

Green LEDs often represent "ON," "Ready," or "OK" condition. Red LED: Typically indicates "Error," "Stop," or "Warning" circumstances.

Multistate Indicators:

Dual-color LEDs: Some LEDs combine green and red in one package to display distinct states. They may light up as follows:

Green indicates normal functioning.

Red indicates an error status.

Orange/Yellow (when both colors are lighted at the same time) indicates an intermediate or warning state.

4.1.15 Linear Actuator

Figure 4.1.15 Linear Actuator

Electrical energy is transformed into linear motion via a 12V DC long-stroke linear actuator. Here's a detailed breakdown of how it works:

Important Elements

DC The movement is propelled by the motor.

The lead screw or threaded rod transforms the motor's rotational motion into linear motion.

Gearbox: Reduces speed and increases torque.

To provide linear motion, a piston or rod extends or retracts.

Limit switches: They cause the actuator to automatically stop when it is fully extended or retracted.

Housing: Offers structural stability and safeguards internal components.

How It Works:

How Power.

Input Operates:

The actuator's motor is powered by a 12V DC source.
The direction of motion (retraction or extension) is determined by the polarity of the input voltage.
Motor Function:

When powered, the DC motor starts to rotate.
The torque and rotational speed of the motor are determined by the applied load and their specifications.

To convert to linear motion, rotate:

Within the actuator, the motor rotates a threaded rod or lead screw.
As the rod rotates, a nut fastened to it travels linearly along the threads and is prevented from moving.
The piston or rod that expands or retracts is attached to this nut.

Activation of Limit Switches:

In order to protect the motor from harm, built-in limit switches cease power when the actuator reaches its completely extended or retracted position.

Control of Direction:

When the power supply's polarity is switched, the motor rotates in the opposite direction, which causes the rod to move.

Example of Operation:
The rod extends when a positive voltage is applied, such as +12V to one terminal and 0V to the other.

Retracting the Rod:
The rod can be retracted by flipping the polarity, for example, by applying 0V to the first terminal and +12V to the second.

Options for Control

Manual Control: To regulate the movement's direction, use a DPDT (Double Pole Double Throw) switch.

Automated Control: To provide programmable motion, connect the actuator to a microcontroller (such as an Arduino or Raspberry Pi) via relays or an H-bridge motor driver.

Feedback Systems (Optional): Potentiometers, Hall effect sensors, or encoders providing position feedback are possible components of sophisticated actuators.

Tips for Safety and Use

Overloading: Don't go beyond the rated load of the actuator.

Duty Cycle: Permit cooling times as indicated (for example, a 10% duty cycle entails two minutes on and eighteen minutes off).

Wiring: Make sure all connections are correct to prevent polarity problems or short circuits.

Mounting: To accommodate both linear and angular motion, fasten both ends using pivoting brackets.

4.1.16 Block Diagram

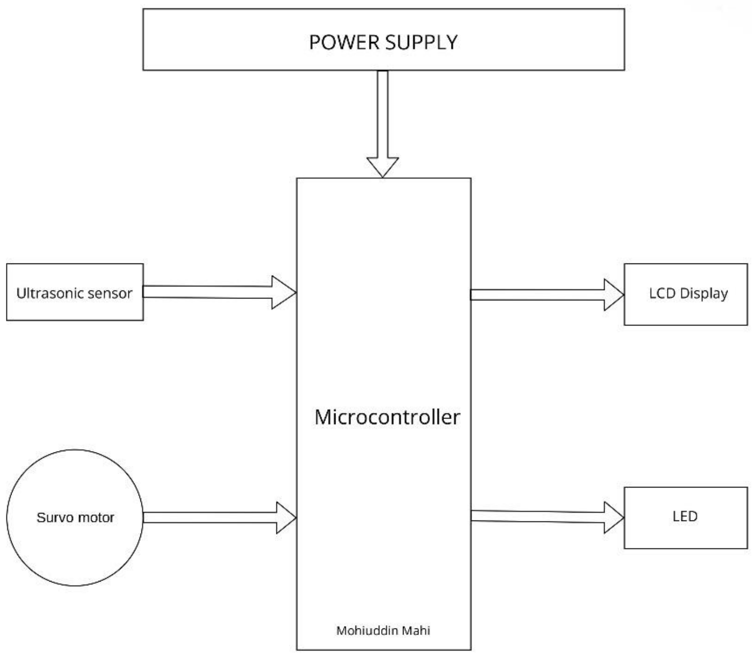

Figure 4.16: Block Diagram

A microcontroller-based system driven by a separate power source is depicted in the diagram. As the central processing unit, the microcontroller interfaces with other parts to carry out particular functions. The microprocessor is coupled with an ultrasonic sensor that can detect obstacles or measure distance. The system incorporates a servo motor, most likely for precisely regulated motion in response to sensor inputs or other commands. The system also has an LED for signaling or identifying particular system statuses and an LCD display for visual output, such as status updates or measurement values. This design demonstrates how the microcontroller can handle sensor input and regulate outputs, giving it a flexible platform for uses in robotics, automation, and smart devices. The modular design of the system guarantees effective operation by smoothly integrating input, processing, and output components.

4.1.17 Circuit Diagram of the Project

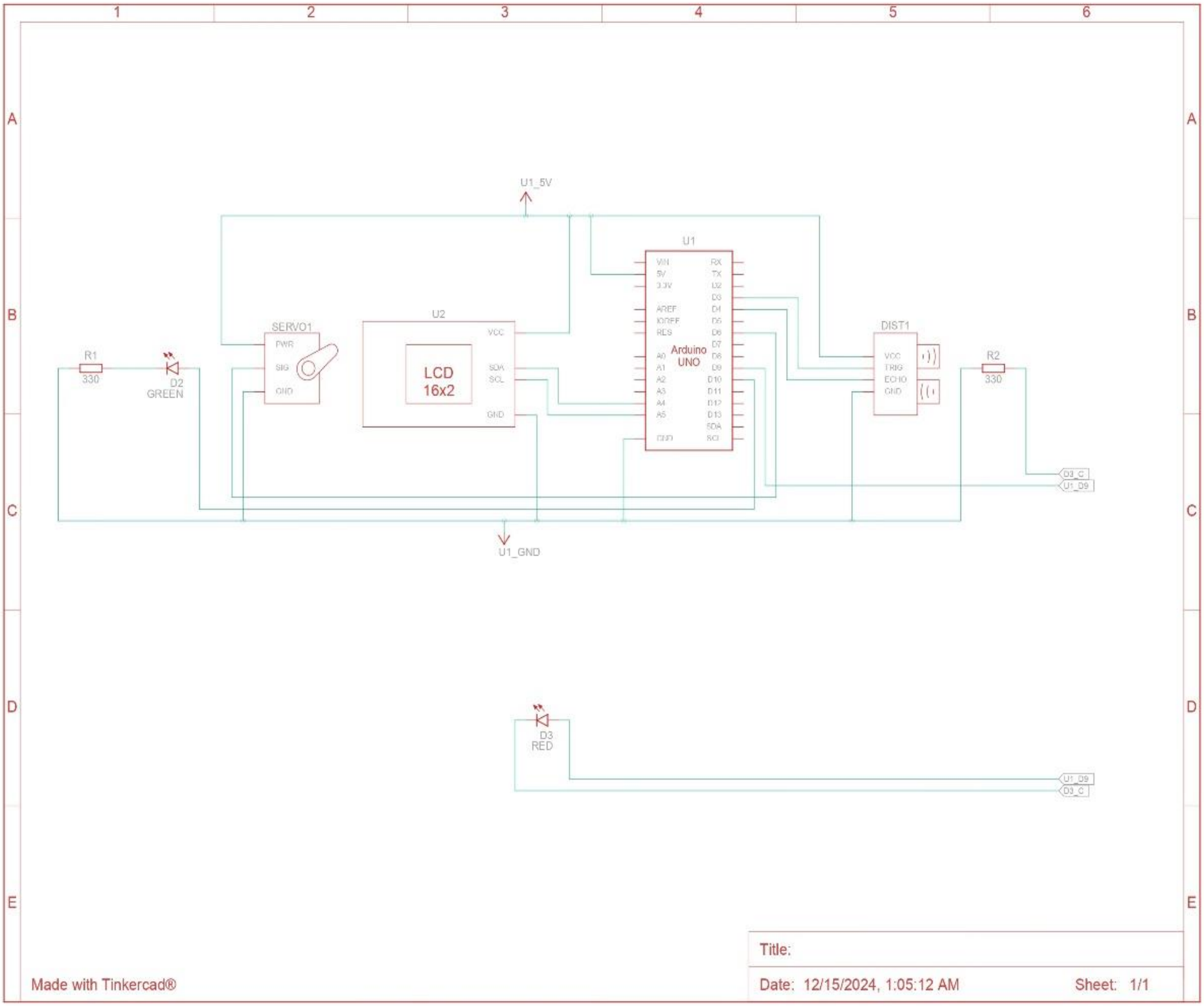

Figure 4.17: Circuit Diagram of the Project

Circuit Explanation:

1. Arduino Uno (U1):

Relationships:

- Power (5V and GND): A 5V DC supply powers the Arduino Uno, and GND serves as the reference point for every component.
- Digital Pins:
- D10 (PWM): Attached to the servo motor's (SERVO1) control pin.
- D2 (TRIG): Provides the ultrasonic sensor (DIST1) with a trigger signal.
- D3 (ECHO): Gets the ultrasonic sensor's reflected signal, or echo.
- D12 (SDA) and D13 (SCL): Use I2C to connect to the LCD module.
- Other Pins: Resistors are used to connect the LEDs (D2 and D3) and regulate their states.
- Goal: The Arduino acts as the primary controller, processing ultrasonic sensor inputs and sending outputs to the LCD display, LEDs, and servo motor.

2. Ultrasonic Sensor (DIST1):

Relationships:

- VCC: The Arduino provides 5V power.
- GND: Connected to the GND of the Arduino.
- To measure the distance, the digital pin D2, or TRIG, sends a pulse to the sensor.
- ECHO (Digital Pin D3): After receiving the echo, it transmits a signal back to the Arduino.
- Type of Connection: Parallel to the Arduino; • Goal: Uses the time it takes for a sound wave to reach the water and return to determine the distance to the water level.3. Servo 3

3.Motor (SERVO1):

Connections:

- Control Pin (PWM D10): This pin controls the sluice gate's position by receiving PWM (Pulse Width Modulation) signals from the Arduino.

- VCC: Driven by the Arduino's 5V output.
- GND: Attached to the GND of the Arduino.
- The Arduino is connected in parallel.
- Function: Modifies the sluice gate's position (open/close) in accordance with commands from the Arduino.
- 16x2 LCD Display (U2):

Connections:

- SDA (D12) and SCL (D13): Use the I2C protocol to communicate with the Arduino.
- VCC: Runs on a 5V supply.
- GND: Attached to the GND of the Arduino.
- The Arduino is connected in parallel.
- Goal: Shows system status, including sluice gate position and water level.

5. LEDs (D2 and D3):

Connections:

- D2 (Green): Attached to an Arduino digital output pin via a 330-ohm resistor (R1).
- D3 (Red): Using a 330-ohm resistor (R3), they are connected in the same way.
- Via their individual resistors, both LEDs share the same GND.
- The connection type is parallel.
- Goal: o Green LED: Signals regular operation.
- Red LED: Indicates important circumstances like elevated water levels or malfunctions in the system.

6. Resistors (R1, R2, and R3):

- Connections: o Every resistor and matching LED are connected in series.
- Goal: Prevents damage to LEDs by limiting the current.

Circuit Connection Type:

Parallel Connections:

- The Arduino is connected in parallel with the majority of components, including the servo motor, LCD, LEDs, and ultrasonic sensor.
- Justification: By using parallel connections, each component is guaranteed to get the necessary voltage without affecting the others.
- Series Connections: o LEDs and resistors are linked in series.
- Reason: To control the current flowing through the LEDs, protecting them from high current.

The Circuit's Activities:

1. System Initialization:

   - The Arduino sets up all components.
   - The LCD shows welcome messages and system status.

2. Water Level Monitoring:

   - The Arduino delivers a pulse to the ultrasonic sensor's TRIG pin.
   - The sensor delivers an echo signal to the ECHO pin when it detects water surface.
   - The Arduino determines water level using the time delay between TRIG and ECHO signals.

3. Sluice Gate Control:

   - Depending on the water level: The servo motor maintains the sluice gate closed if the water level falls below a threshold.
   - The servo motor opens the gate to let out extra water if the water level is high.

4. LED Indicators:

   - During regular functioning, the green LED stays on.
   - The red LED illuminates to indicate an alarm if the water levels above crucial criteria.

5. LCD Display:

   - Shows current data like:
   - Water level (e.g., in cm or %).
   - Conditions of the sluice gate (such as "OPEN," "CLOSED").
   - Warnings or alerts.

4.1.18 Complete Physical rendering of the project in Tinkercad

Dam shutter gate open:

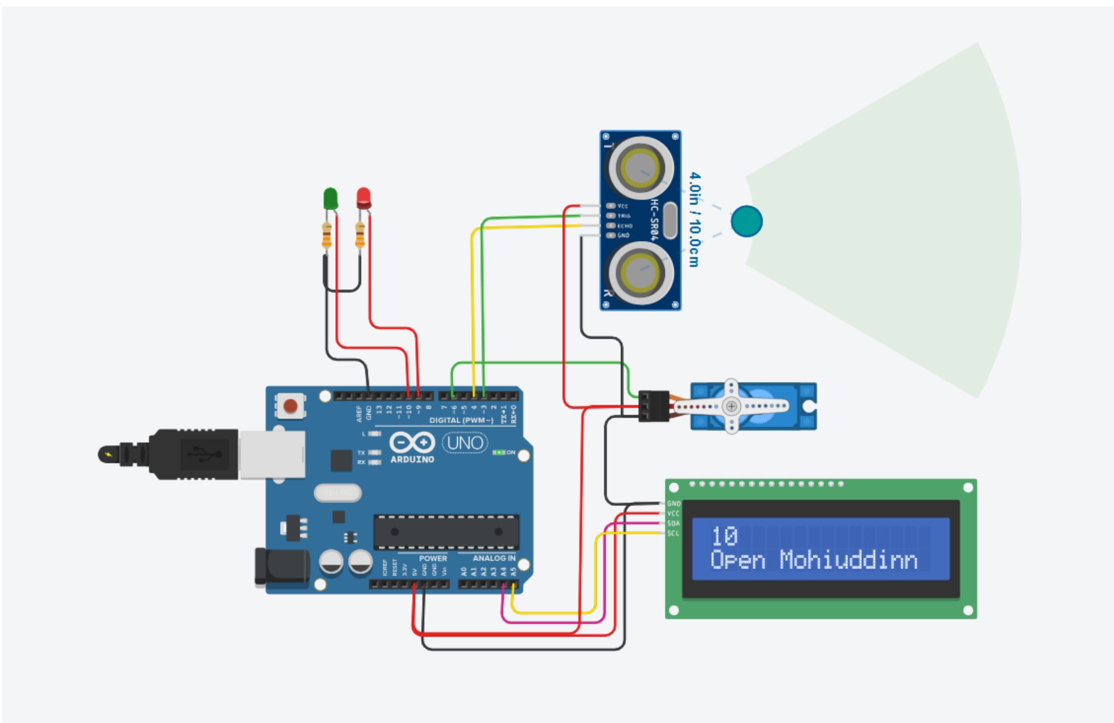

Figure 4.18: Dam shutter gate open

Dam shutter gate close:

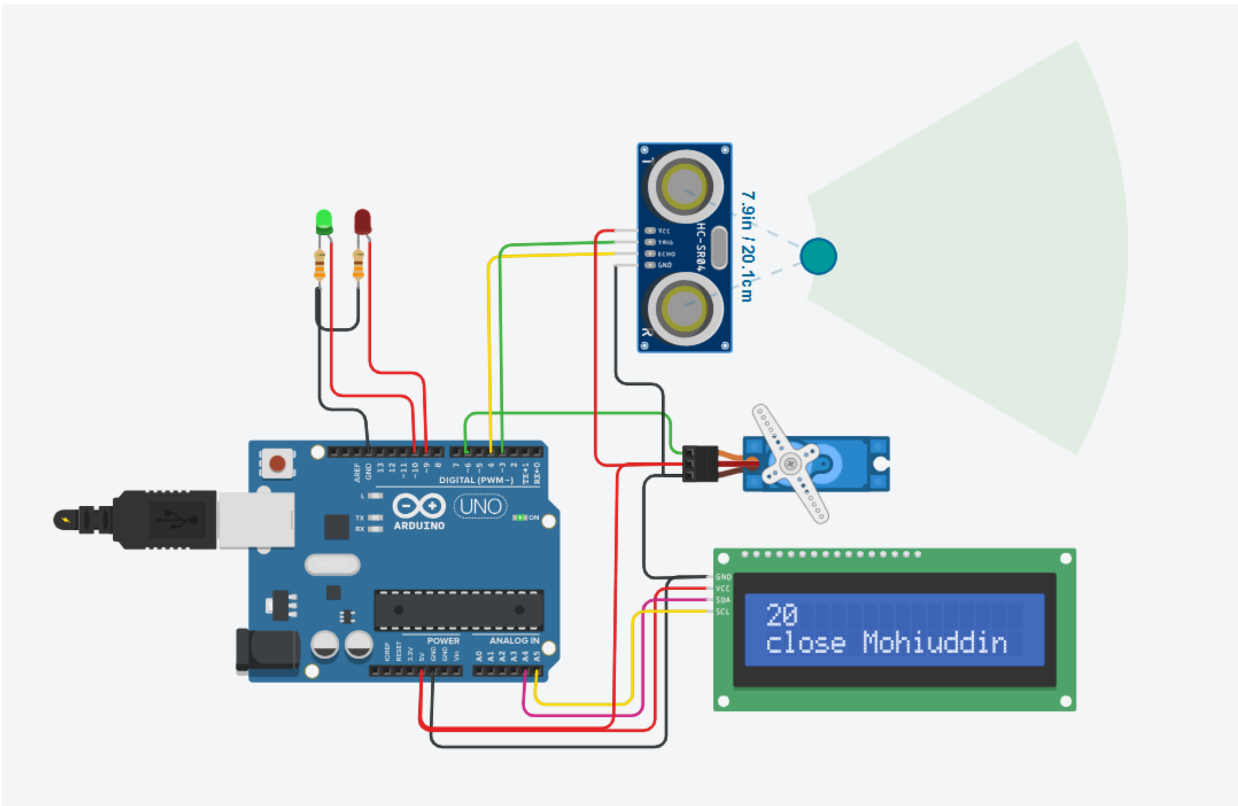

Figure 4.19: Dam shutter gate close

The circuit where the dam shutter gate automation system is intended to function in response to the water level as determined by the ultrasonic sensor has been rendered and simulated in Tinkercad. The location of the servo motor and the LCD panel show when the water level reaches 10 cm, at which point the gate opens. To ensure effective water management and safety, the gate also shuts off when the water level reaches 20 cm. With real-time LCD feedback and LED-based visual indications, the simulation successfully illustrates how the system works.

CHAPTER 5: PROJECT MANAGEMENT

5.1. Task, Timetable, and Milestones

We needed a strong project plan in order to successfully finish our project on time. Each team member was given an equal share of the many tasks that needed to be completed promptly in order to complete the project. The project plan is shown in the table below.

S. No.	Task		Start	End	Duration (Day)
1	Chapter 1: Introduction		9/4/2024	9/14/2024	10
2	Chapter 2: Literature Review	Introduction	9/15/2023	9/25/2024	10
		Related Works			
		Compare& Constant			
		Summery			
3	Chapter 3: Materials and Methods	Methods and Materials	9/26/2024	10/30/2024	5
4	Chapter 4: Result and Discussions	Introduction	10/1/2024	10/20/2024	20
		Design Specifications. Standards and Constraints			
		System Analysis			
		Implementation			
		Results			
		Discussions			
		Task, Schedule and Milestones			

5	Chapter 5: Project Management	Resources and Cost Management	10/21/2024	7/25/2024	5
		Lesson Learned			
6	Chapter 6: Conclusion & Recommendation	Conclusions	11/3/2024	11/11/2024	8
		New Skills and Experiences			
		Future Recommendations			
7	Design of Prototype		11/12/2024	11/13/2024	2
8	Parts Purchase		11/14/2024	11/20/2024	5
9	Manufacturing		11/21/2024	11/5/2024	15
10	Testing		12/6/2024	12/10/2024	4

5.2. Table: Assigned Members for Tasks

S. No.	Task	Assigned Members
1.	Chapter 1: Introduction	
2.	Chapter 2: Literature Review	
3.	Chapter 3: Materials and Methods	
4.	Chapter 4: Results and Discussions	
5.	Chapter 5: Project Management	
6.	Chapter 6: Conclusion& Recommendation	

5.3. Cost of the Project

S/L	Component	Quantity	cost
1	Arduino Uno R3 With USB Cable	1	800
2	Green LED	1	10
3	Red LED	1	10
4	Positional Micro Servo	1	200
5	MCP23008-based, 32 (0x20) LCD 16 x 2	1	200
6	I2c LCD module	1	100
7	330 Ω Resistor	2	10
8	Ultrasonic Distance Sensor (4-pin)	1	100
9	Wires (feet)	5	200
10	Linear Actuator	1	6300
Total Project Cost			7930

5.2. Feasibility Analysis:

a. Technical Feasibility

- Technical Viability: Actuators, sensors, and controls that are required are readily available.
- Integration Complexity: Although integrating with existing dam infrastructure may be challenging, it is possible with the right information.
- There is a demand for engineers with knowledge of automation, hydrology, and the Internet of Things.

b. Economic Feasibility

- Initial Cost: A substantial outlay of funds for equipment, installation, and integration.
- Operational Cost: Because less physical labor is required, operational costs are reduced.
- Long-term Benefits: Effective flood protection and water management can result in significant cost savings.

c. Environmental Feasibility

- Water Resource Management: Optimal water discharge can improve the water supply for metropolitan areas and downstream farmland.
- Flood Risk Reduction: Lessens the risks associated with extreme weather.

d. Social Feasibility

- Community Impact: There will be a safer community downstream.
- Public Acceptance: It is likely to be adopted if it demonstrates specific benefits and operational openness.

e. Risk Assessment

- System Failures: Sensors or actuators may fail, potentially leading to grave consequences.
- Cybersecurity is crucial to prevent hacking and unlawful access.
- Weather Dependence: Unpredictable weather might affect system dependability.

5.3 **Discussion**

Automated dam shutter control systems are critical in modern water management because they ensure that dam function properly to control water flow, minimize floods, and maximize water utilization. As a result, these systems automate dam shutter operations without the need for direct human intervention by utilizing advanced sensors, controls, and algorithms. The system automatically opens and closes dam shutters using real-time data and preset algorithms. reduces the likelihood of flooding by making it possible to respond quickly to changes in water levels or flow conditions. reduces the need for human work, especially in remote or hazardous locations. maintains reservoir levels at optimal levels for energy, irrigation, and drinking water. integrates meteorological forecasts with hydrological models for proactive management.

CHAPTER 6: CONCLUSION & Recommendation

6.1 Conclusion and recommendation

The automated dam shutter control project clearly demonstrates how automation technology may be utilized to improve dam operations' effectiveness and efficiency. The system integrates sensors, actuators, and a programmable control system to offer autonomous management of the dam shutters as well as real-time water level monitoring. This guarantees the best possible management of water resources, lowers the need for human involvement, and improves safety. The final product also demonstrates the substantial advantages of automation in terms of accuracy, dependability, and responsiveness. The technology can lessen dangers like flooding and water shortages by actively managing water levels. Additionally, the incorporation of IoT capabilities for remote monitoring offers data-driven decision-making and an extra degree of operational flexibility.

6.2 Future Scope

I. Initial Setup Costs: Exorbitant initial expenses may hinder widespread adoption.

II. Cybersecurity: Protecting automated systems from malicious attacks or hacking is crucial.

III. Development of Skills: Training employees to use and maintain state-of-the-art systems is essential.

IV. Regulatory Barriers: Ensuring compliance with both domestic and foreign regulations may prove challenging

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APPENDIX

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A Programming Codes for Proposed Project

```
// C++ code
//
#include <Adafruit_LiquidCrystal.h>

#include <Servo.h>

int ULTRASONIC = 0;

long readUltrasonicDistance(int triggerPin, int echoPin)
{
  pinMode(triggerPin, OUTPUT);  // Clear the trigger
  digitalWrite(triggerPin, LOW);
  delayMicroseconds(2);
  // Sets the trigger pin to HIGH state for 10 microseconds
  digitalWrite(triggerPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(triggerPin, LOW);
  pinMode(echoPin, INPUT);
  // Reads the echo pin, and returns the sound wave travel time in microseconds
  return pulseIn(echoPin, HIGH);
}

Adafruit_LiquidCrystal lcd_1(0);
```

```
Servo servo_6;

void setup()
{
  Serial.begin(9600);
  lcd_1.begin(16, 2);
  servo_6.attach(6, 500, 2500);
  pinMode(9, OUTPUT);
  pinMode(10, OUTPUT);
}

void loop()
{
  ULTRASONIC = 0.01723 * readUltrasonicDistance(3, 4);
  Serial.println(ULTRASONIC);
  lcd_1.setCursor(0, 0);
  lcd_1.print(ULTRASONIC);
  if (ULTRASONIC <= random(10, 20 + 1)) {
    lcd_1.setCursor(0, 1);
    lcd_1.print("Open Mohiuddin");
    servo_6.write(0);
    digitalWrite(9, HIGH);
    digitalWrite(10, LOW);
  } else {
    lcd_1.setCursor(0, 1);
    lcd_1.print("close Mohiuddin");
```

```
    servo_6.write(120);
    digitalWrite(9, LOW);
    digitalWrite(10, HIGH);
  }
  delay(10); // Delay a little bit to improve simulation performance
}
```