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Automatic Dam Shutter for Fish Breeding Pond using Arduino

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Abstract: This idea is about to improve the poor allocation of water, inefficient use, lack of adequate and integrated management of the water. Arduino is used to controlling the process of opening and closing the gate. This project aims to supply water from the dam to the fish breeding pond during the drought season. The automation of the dam is used by Arduino to control the different parameters such as level and flow with the real-time implementation of gate control. Automation or automatic control is the implementation of various control systems for running equipment, such as machinery, some processing procedures have been fully automated in factories, boilers and heat-treating ovens, telephone switching, ship steering and stabilization, aircraft and other applications with limited human interference . In this project, the water from the dam is supply to the fish breeding pond during the drought season. The sensor in the fish breeding pond detect the low level of water and the dam gate automatically open to refill the pond until it reaches the maximum level then the gate automatically closed. During rainy season, the spillway way gate that is installed inside the dam automatically open to supply the water out of the dam and avoid the damage on the dam.

Keywords: Dam, Spill Gate, Fish Breeding Pond

1. Introduction

Dam is a hindrance that stops or limits water stream or underground flooding. Dam-made supplies forestall flooding as well as give water to exercises like farming, human use, agrarian use, aquaculture and safety. Hydropower is frequently used to create power related to the dams. A dam can likewise be utilized for water protection or water stockpiling. Dams for the most part fill the essential need for water maintenance, while different structures, for example, conduits or levees are utilized to oversee or forestall the progression of water into explicit regions of land [2]. This research aims to create systematic water flow control system. Two Arduino is used in this project, First Arduino is to control the water supply to the fish breeding pond and another Arduino is used to control the spillway gate. C or C++ programming language is used in the development of this project that is suitable for the Arduino. The objectives are (1) to creates a systematic water flow system using Arduino, (2) to design dam

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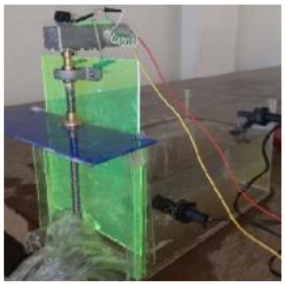
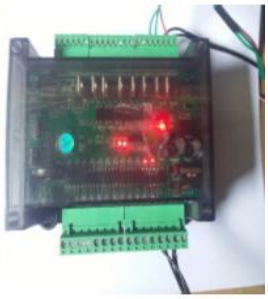
functions based on controlling various parameters such as water level and flow of the water using Arduino so the automatic dam will be able to supply enough amount of freshwater into the fish breeding pond effectively, and (3) to determines the effective flow of water from the dam to the fishpond, and to evaluate the spill gate of the dam safety feature. The automatic dam shutter system needed at least two Arduino circuit board to control the overflow gate of the dam and the gate to supply water to the fish breeding pond. The gate of the dam will open automatically when the sensor in the fish breeding pond detects a low level of water. The overflow gate of the dam will automatically open when the sensor detects the maximum height of the water. The prototype of the automatic dam shutter system should not be exceeded 60 cm long, 30 cm height and 60 cm wide. The project needed one dam prototype and one fish breeding pond prototype to demonstrate the water flow from the dam to the fish breeding pond.

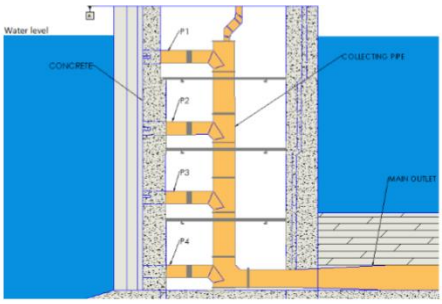
1.1 Literature review of automation dam shutter

A literature review talks about distributed data in a specific branch of knowledge, and now and then data in a specific branch of knowledge inside a specific timeframe.

Table 1: Comparison of projects

No	Title of the project	Implementation	Comments
1	Gate Control System of Dam using Programmable Logic Controller [3]	▪ Controller: - PLC FX2N20MR ▪ Input Devices: - Level Switch Sensor ▪ Output Devices: - Motor - Alarm - Control Relays ▪ Operation: - It controls the opening of the gates and the feedback signal provides continuous monitoring of the exact water level in the reservoir - The feedback signals are compared with threshold values of the main program which is used to open - close gate of reservoir for flood control ▪ Programming Software: - Ladder Diagram  	▪ PLC is used to control the flow of water so that it can be effectively used in the irrigation system. ▪ The level of water in the dam is controlled effectively there by opening and closing the gates of the dam.
2	Ultrasonic Sensor - Based	▪ Hardware Requirement: - Microcontroller	▪ The report objective is

	Automated Water Dam Shutter [1]	- Ultrasonic Sensor - Rotor - GSM Module - LCD Screen - LEDs - Buzzer	to design a microcontroller based. ▪ Monitoring the level of water in dams is necessary to ensure optimal operation and safety.
3	Automation of Gates of Water Reservoir Using Programmable Logic Controller (PLC) [4]	▪ Controller: - PLC SIMATIC S7-300 ▪ Input: - Mechanical float level sensors ▪ Output: - Floodgate - Water Flow ▪ Operation: - The reservoir consists of three level sensors at the entry point of the water from the reservoir to the floodgates. - The water flow out depends on the water level in the reservoir. ▪ Programming Software: - Ladder Logic Programming	▪ The automation of gates has been implemented in Simulation Mode using PLC SIEMENS-S7300. ▪ The system is automated keeping in mind several factors such as level of water in reservoir, irrigation, time of the day and also of human beings near the gates.
4	Automatic Dam Shutter Senses The Water Level And Control The Dam Door Using Servo Motor [5]	▪ Hardware Components: - Microcontroller AT89s8253 - Servo Motor - LCD - Power Supply Block ▪ Operation: - The water level at different levels is sensed according to which the gate is closed or open That is when the water is filled to level 3 the closed dam shutter is fully opened, for level 2 gate is partially	▪ Can in implanted to modernize irrigation chimes. ▪ Easy to install and reliable. ▪ Requires less maintenance.

		closed while for level 1 the gate is fully closed.	
5	Smart Weather Station and Automatic Dam Shutter System [6]	▪ System Operation and Design - This system consists of a set of switches connected to stepper motor through an 8- bit microcontroller. - Based on the feedback from the switches used, the level of dam gate can be automatically controlled using a stepper motor. Moreover, it also provides weather condition in and around the dam hence acting as smart weather station.	▪ The microcontroller which is the heart of the system, managing the overall operation of the system. ▪ When the water level reaches the required height the water level sensor senses it and turns off the water inlet valve.
6	Design of an automated dam shutter control system: Case study [7]	▪ Hardware Components: - PLC - DC Servo Motor - Limit Switch ▪ Design Requirement: - The generated design concepts were evaluated for suitability by considering parameters such as functionality, efficiency, quality, reliability and cost before settling for screw stem design mechanism.  	▪ In this report we need to design the dam shutter control system ▪ The right components are needed for the design.
7	Auto Controlled DAM with SMS Warning System [8]	▪ Control strategy - Here there are two distinctive water levels L1 and L2.L1 is the lower level and L2 is the upper level. In the event that the water level is beneath L1, at that point there is no compelling reason to	▪ The dam shutter can sent warn messages to the people in that area

		open the shutter. If the water level increments above L1 then the GSM module is activated and cautioning message is sent to the close by individuals. On the off chance that the water level increments above L2, at that point the caution circuit is activated and alert sound is created to make individuals mindful about the opening of the dam.	
8	A System for Remote Monitoring and Controlling of Dams [9]	▪ Embedded Dam Gate Control System: - Sensor with Amplifier - Indication of Water Level to Operator - Controller Kit with Power Supply - Motor Driver Circuit - Dam Gate Arrangement with Motor - Operator Control Panel	▪ In this project the microcontroller kit is used with power supply
9	Autonomous Flood Gate Control using Arduino UNO with GSM Technology [10]	▪ Hardware requirements: - Pump Unit - Switch - Buzzer - Level Indicator Sensor - Power Supply - GSM - Arduino	▪ This system is capable of sensing drain water and tidal water, it controls a pump to irrigate excessive water, and DC motors are also used to control the movement of dam gates.
10	IoT based Disaster Monitoring and Management System for Dams (IDMMSD) [11]	▪ Hardware Design of The System: - Sensor Node - Control and Communication Module - Network Node ▪ Sensor Used: - Temperature Sensor - Rainfall Sensor - Gate Level Sensor - Flow Sensor - Water Level Sensor and Humidity	▪ The project system uses different sensors for real time monitoring data.

11	Microcontroller Based Dam Gate [12]	▪ Hardware Requirements: - AT89S52 Microcontroller - 7805 Regulator - ULN2003 driver - Stepper motor-1Kg Torque - Serial port communication- MAX 232 & RS 232 - Transformer- 12-0-12 - IC 7404 - IC 7408 - DB9 connector - Piezo-Buzzer	▪ The hardware is wired on PCB. ▪ The programming software that is used is C language.
12	Distant Monitoring and Controlling of Gated Dams using PLC and SCADA [13]	▪ Operation Method: - PLC is utilized as the fundamental processor. Volumetric water level sensors are utilized to distinguish water level as Automotive Lock Actuator is utilized to open or close the entryway, the two of which are provided by redressed DC supplies. 	▪ PLC and SCADA are used for controlling and monitoring actions.

1.2 Summary of Literature Review table

Based on the Table 1 above, PLC and various of Microcontroller is widely used to control the opening and closing on the dam gate. In this project Arduino Mega R3 is chosen over PLC is because Arduino Mega R3 can easily run-on Mac, Windows, and Linux. Planners and engineers manufacture

intuitive models, artists and specialists use it for establishments and to try different things with new instruments. Arduino is a key instrument to learn new things. Anybody can begin dabbling simply adhering to the bit-by-bit directions of a unit, or sharing thoughts online in Arduino community while PLC is extremely expensive compared to microcontrollers and it does not use C or C++ programming language. Other than that, PLC has less follower in its community which is hard for the user to seek for guidance. Other than that, Arduino Mega R3 is chosen over Arduino Uno R3 because it can support more connections such as to LCD, buzzer, ultrasonic sensor, motor and switch at the same time. Furthermore, ultrasonic sensor is chosen in this project because it has sensing capability to sense all types of material include water level. Ultrasonic sensor also has higher sensing distance compared to inductive proximity sensor. Its sensing ability does not affect by atmospheric dust and rain. Lastly, both Arduino Mega R3 and Ultrasonic sensor can be easily programmed using C or C++ language.

2. Materials and Methods

2.1 Block Diagram of Dam Spill Gate

When the water level is reaching the max level, the ultrasonic sensor will detect it and send the signal to Arduino microcontroller that is used as the interface of the hardware and software. The buzzer will turn on to indicate the water is at max level and the LCD will display "MAX LEVEL WATER". The motor driver is used to bring enough power supply to the servo motor. Figure 1 shows the overall block diagram of the Dam Spill Gate.

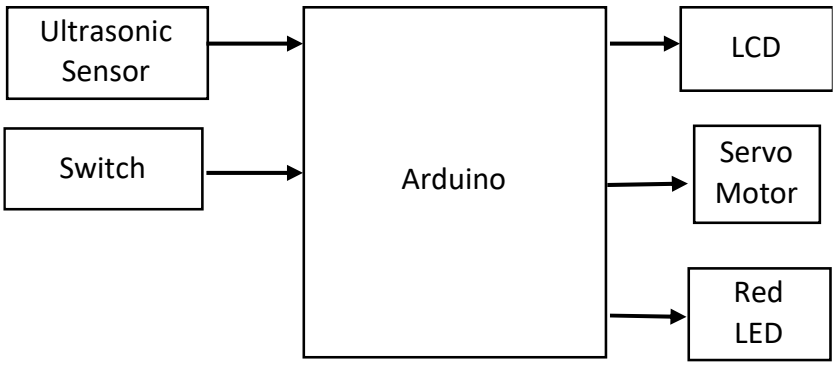


Figure 1: Block diagram of dam spill gate

2.2 Block Diagram of Fish Breeding Pond

The ultrasonic sensor is used to detect the water level. It will send the signal to the Arduino microcontroller then it will open the gate until the water in the fish breeding pond reaches its max level. Block Diagram in Figure 2 below shows the working principle of the fish breeding pond.

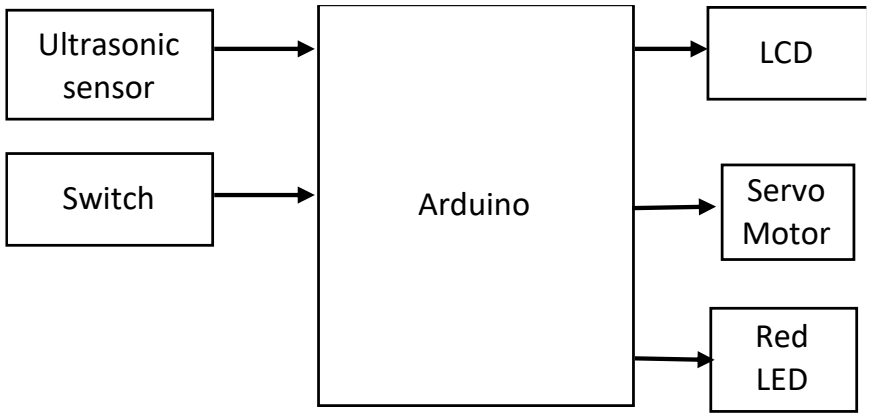


Figure 2: Block diagram of the fish breeding pond

2.3 Circuit Diagram of Dam Spill Gate

The reenactment was actualized by utilizing the Proteus proficient plan programming. This apparatus is giving a ground-breaking, incorporated and simple to utilize instruments suite for training and expert plan. Figure 3 shows the simulation of dam spill gate using Proteus software.

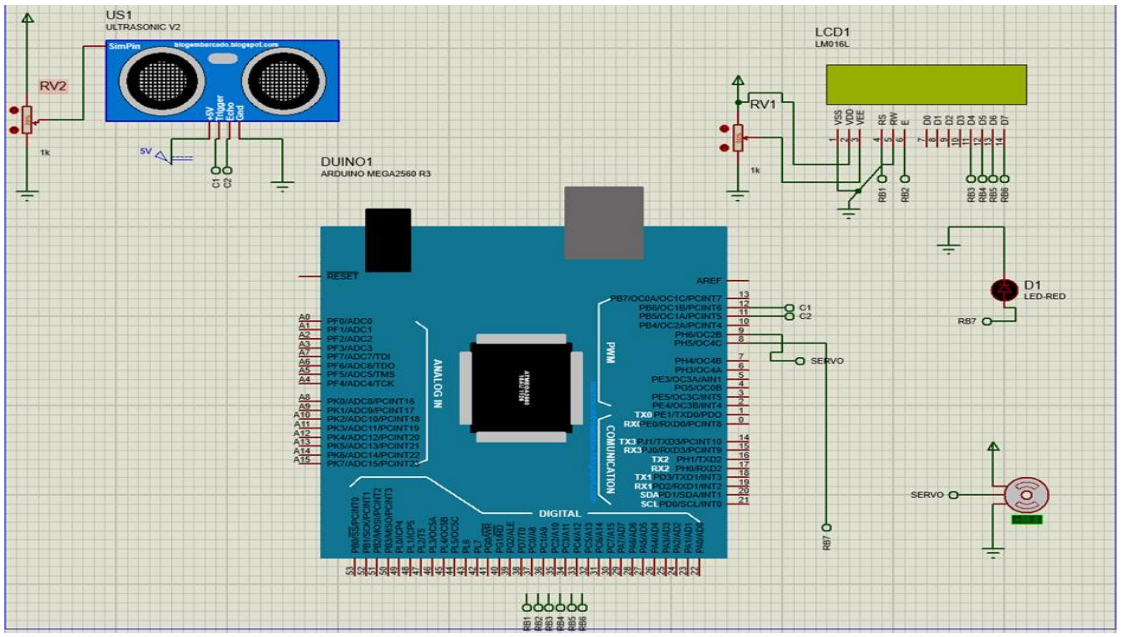


Figure 3: Proteus circuit diagram of dam spill gate

2.4 Circuit diagram of fish breeding pond

Figure 4 shows the simulation of circuit diagram testing of fish breeding pond gate. The process of developing the gate of fish breeding pond with the flowchart and simulation before proceeding with the electrical installation.

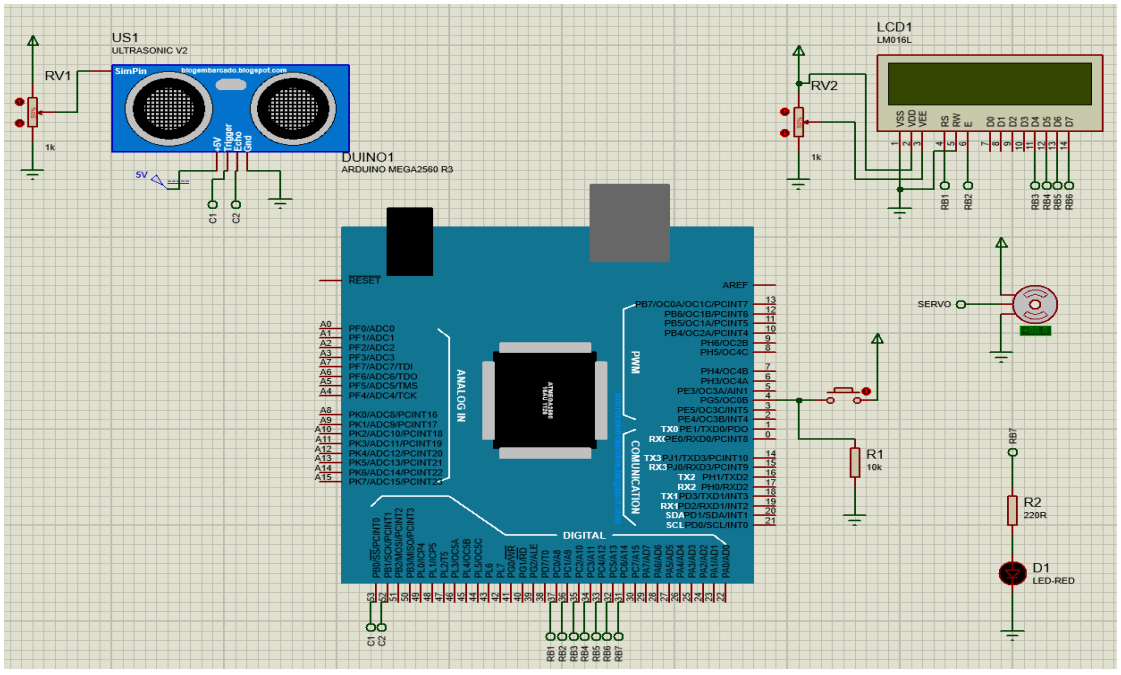


Figure 4: Proteus circuit diagram of fish breeding pond

2.5 Flowchart of Spill Gate

The program starts with port initialization. Then sensor scan the water level. If the sensor detects maximum water level, 16 x 2 LCD will display ‘MAX WATER LEVEL’. In this project the average maximum water level is taken before the gate to open is 7.33 cm. Red LED and servo motor turn on then the process will end. If the sensor does not detect maximum water level the process automatically ends.

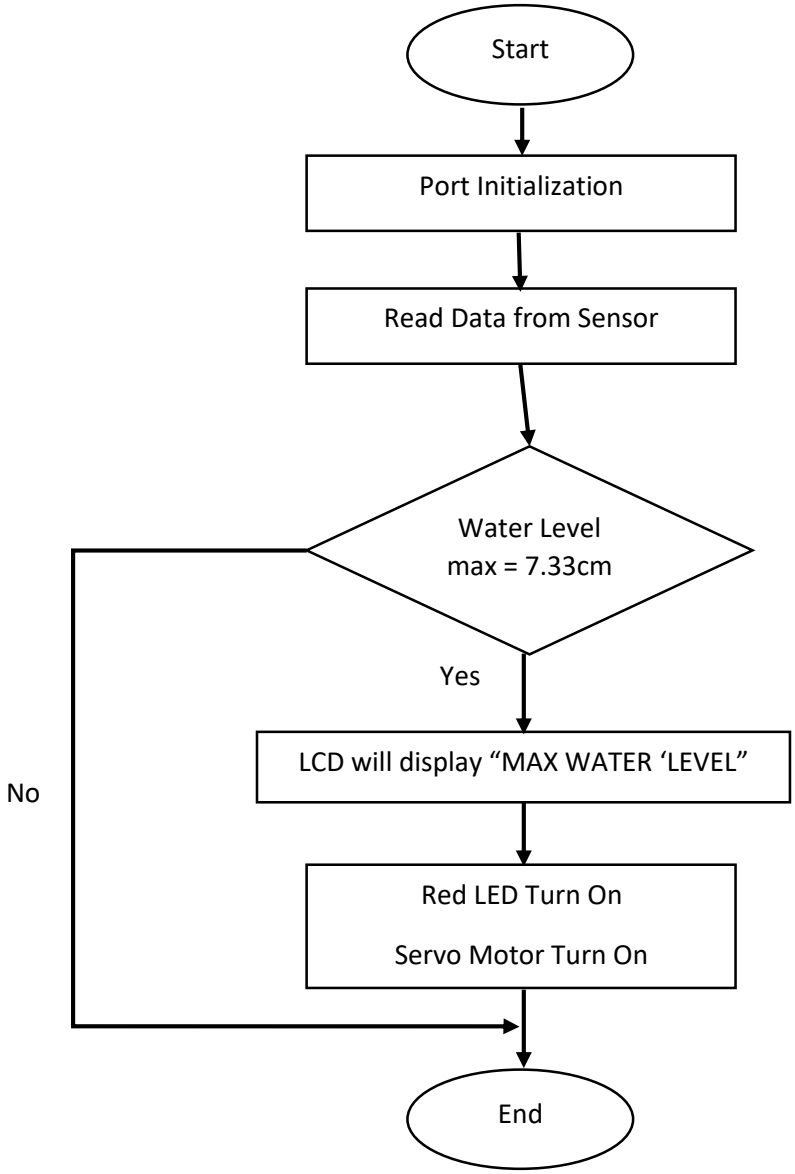


Figure 5: Flowchart of Dam Spill Gate

2.6 Flowchart of Fish Breeding Pond

The program starts with port initialization. Then sensor scan the water level. If the sensor detects low water level, The LCD will display ‘LOW WATER LEVEL’. The low water level is 0 cm. Red LED and servo motor turn on then the process will end. If the sensor does not detect maximum water level the process automatically ends. If the sensor detects maximum water level, The LCD will display 'MAX WATER LEVEL’. In this project the average maximum water level is taken before the gate to open is 6.33 cm. Red LED and Servo motor turn off then the process will end. When the sensor does not detect high water level the, the process is repeated.

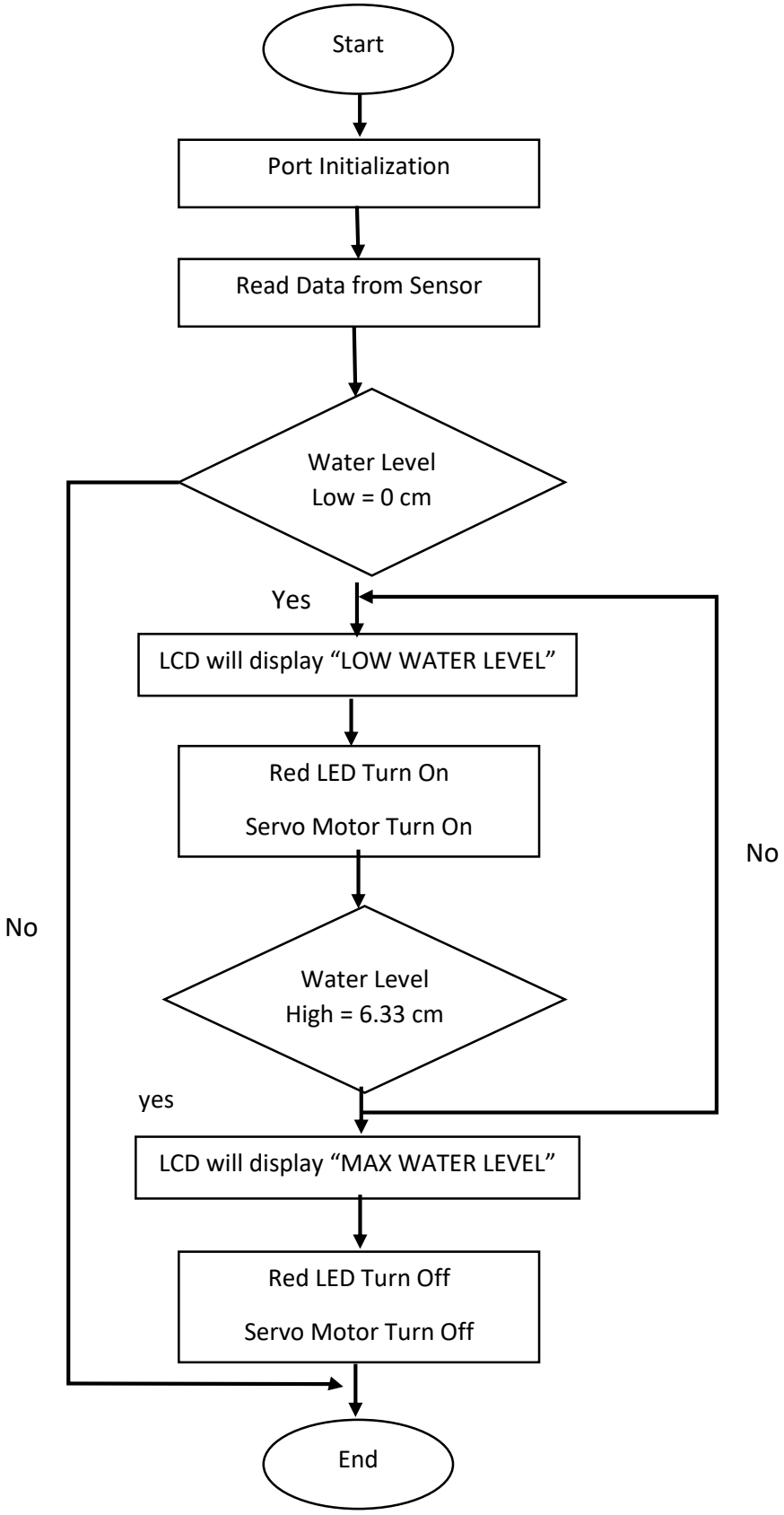


Figure 6: Flowchart of Fish Breeding Pond

3. Result and Discussion

3.1 Technical parameter of the system

Power bank is used to power up both Arduino, Dam spill gate and Fish breeding pond. The bottom container is the dam, and the top container is fish breeding pond. Both of the container is connected to each other with a tube.

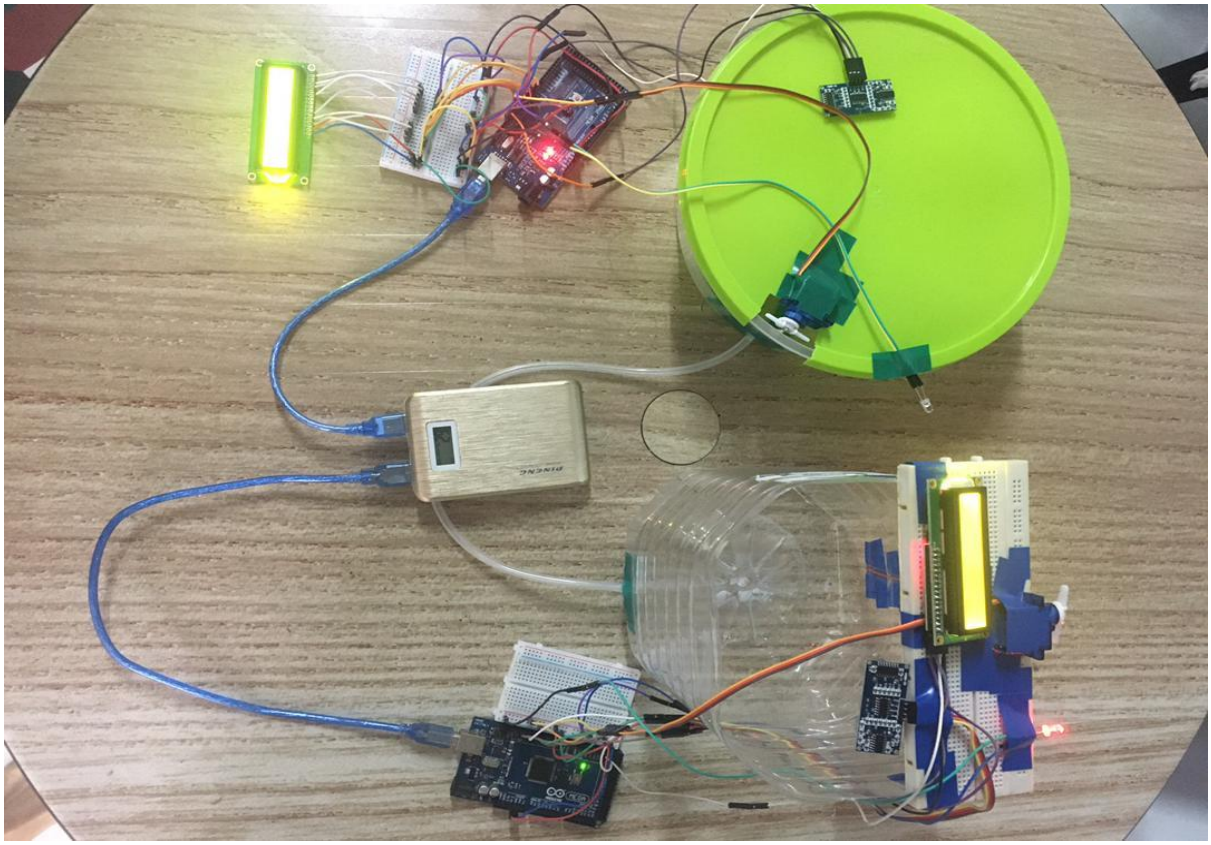


Figure 7: Overall system of Automatic Dam Shutter

Table 2: Parameter of the project

Dimension	• 22 cm (height) x 12 cm (width) x 12 cm (length) for spill gate • 10 cm (height) x 11cm (radius) x π for fish breeding pond
Voltage consumption	5 volts
Component	• 2 unit of ultrasonic sensors • 2 unit of LED • 2 unit of Arduino mega • 2 unit of 16 x 2 LCD • 2 unit of continuous servo motors
Maximum depth	• Fish breeding pond = 10 cm • Spill Gate = 20 cm
Material (body)	Plastic

An experiment is conducted to determine the time taken for the gate of fish breeding pond and spill

gate shutter to fully open and fully closed. Before proceed to the testing 5 volts of power supply from the power bank is connect to the Arduino. The ultrasonic sensor connects as a switch for both of the system. The time taken from the dam spill gate and fish breeding pond is collected using stop watch.

3.2 T ime taken for the opening and closing of the gate

Table 3 and Table 4 that are shown below are time taken for the gate of to fully open and fully closed. Table 3 Dam spill gate average time taken for it to fully open is 7.36 s and the time taken for the gate to fully close is 5.22 s. Table 4 Fish breeding pond average time taken for the to fully open is 7.12 s and for the gate to fully closed is 5.78 s. To obtain an accurate value, the average time taken was took from the sum up of three trials. This is because there might be human error when taking the time taken for the gate to fully open and fully close.

Table 3: Dam spill gate

	Trail 1	Trail 2	Trial 3	Average
Time taken for the gate to fully open	7.48 s	7.63 s	6.98 s	7.36 s
Time taken for the gate to fully close	5.11 s	4.82 s	5.74 s	5.22 s

Table 4: Fish breeding pond

	Trail 1	Trail 2	Trail 3	Average
Time taken for the gate to fully open	6.92 s	7.43 s	7.01 s	7.12 s
Time taken for the gate to fully close	5.21 s	6.28 s	5.86 s	5.78 s

3.3 Sensor range detection

Table 5 and Table 6 shows the measurement of Dam spill gate and Fish breeding pond taken by ultrasonic sensor. Table 5 Dam spill gate, the average length of the full depth of the container is 20 cm and average length of water level when the gate open is 7.33 cm. Table 6 Fish breeding pond, the average length of the full depth of the container is 10.00 cm and the average length of water level when the gate open is 7.33 cm.

Table 5: Dam spill gate

	Trial 1	Trial 2	Trail 3	Average
Full depth of the container.	21 cm	19 cm	20 cm	20 cm
Water level when the gate open	9 cm	10 cm	10 cm	7.33 cm

Table 6: Fish breeding pond

	Trail 1	Trail 2	Trail 3	Average

Full depth of the container.	10 cm	10 cm	10 cm	10 cm
Water level when the gate open.	6 cm	7 cm	6 cm	6.33 cm

3.4 sensor range detection compared with distance value measured by ruler

Based on Table 7 ultrasonic sensor versus ruler, ruler indicate more accurate value compared to ultrasonic sensor. Based on the table depth of the container using ultrasonic sensor and ruler is not the same. This is because ultrasonic sensor works by discharging beats of ultrasonic sound, which at that point ricochet back to the sensor. With some liquid medium, in some case the ultrasonic waves are absorbed into the water instead of reflecting it back to the sensor.

Table 7: Ultrasonic sensor versus ruler

	Spill gate shutter system	Fish breeding pond
Depth of the container using ultrasonic sensor	20cm	10 cm
Depth of the container using ruler	20 cm	9 cm

4. Conclusion

It was an extraordinary encounter to make the Automatic Dam Shutter system conceivable as The Final Year Project. The venture has accomplished all the recorded undertaking targets. The product prerequisites for the robotized dam shutter have been explored and described by executing the use of Arduino IDE stage. This product use two Arduino mega as the microcontroller of the system. With using two Arduino mega the troubleshooting when the system breakdown is easier. The type of servo motor that has been used in this project is continuous servo motor which make it hard to code because the servo motor does not have initial state angle. The initial state of the servo motor keeps changing based on the rotation of the servo motor.

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