WATER LEVEL CONTROLLER-FLEX SENSOR

Miniproject Report submitted to

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Submitted by

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CERTIFICATE

This is to certify that the report entitled ***"Water Level Controller-Flex Sensor"*** *is a bonafide record of project work done by* ***"BENSEN MATHEW (MUT20EC023)"*** *during the year 2022- 2023. This report is submitted to APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Electronics and Communication Engineering.*

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ABSTRACT

This abstract describes the development of a float sensor that incorporates a metal ball, electric contacts on both sides, and a pathway for the ball to move. When the metal ball makes contact with the electric contacts, it sends an on or off signal to an ESP (microcontroller). The float sensor can be used in various applications such as water level monitoring systems, liquid level detection, or as a simple switch for controlling electronic devices.

The float sensor consists of a cylindrical enclosure for the ball to move freely. Inside the enclosure, two electric contacts are positioned on opposite sides. The metal ball, chosen for its conductivity and weight, is free to roll within the enclosure. A small channel or pathway is provided to guide the movement of the ball between the contacts.

When the liquid level rises or falls, the float sensor responds accordingly. As the liquid level increases, the buoyancy lifts the float, causing the metal ball to move upward. Eventually, the ball comes in contact with the electric contact, completing the circuit and sending an "off" signal to the ESP. Conversely, when the liquid level decreases, the float lowers, and the ball rolls downward until it touches the lower electric contact, breaking the circuit and sending an "on" signal to the ESP.

The ESP, acting as a receiver, processes the on/off signals from the float sensor and performs the desired action based on the received signal. This action can range from activating an alarm, displaying the liquid level on an interface, or controlling a connected device.

Developing this float sensor requires basic electrical and mechanical knowledge. The materials required include a cylindrical enclosure, metal ball, electric contacts, wiring, and an ESP microcontroller. The enclosure is 3D-printed using suitable materials. Care has been taken to ensure that the electric contacts are securely positioned and well-insulated from the liquid to avoid any short circuits.

This float sensor provides a cost-effective solution for detecting liquid levels using a metal ball and electric contacts. By integrating it with an ESP, the sensor can send on/off signals for further processing and control. This float sensor design can be customized to suit specific applications and offers a practical and accessible solution for liquid level monitoring needs.

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CHAPTER 1

INTRODUCTION

The water level controller project utilizes the power of ESP2 microcontroller, acting as both transmitter and receiver, to create an efficient and wireless solution for monitoring and controlling water levels.The ESP32 modules are Wi-Fi enabled, allowing seamless communication between the transmitter and receiver units.Float sensor consisting of a metal ball running along a rail, making contacts at both the ends is the core component of the water level controller.

1.1 SCOPE AND MOTIVATION

The need to prevent water loss in the most convenient way . Communication between two esp 32 through wifi connections while the float sensor detects the water level is the solution. The need for a length adjustable and non-breakable float sensor emerged to offer maximum efficiency and durability. For large tanks with great turbulence , combining both these functionalities is necessary..

1.2 HISTORY

Early water level controllers were manual and relied on human intervention to monitor and regulate water levels. This was particularly common in agricultural irrigation systems, where farmers manually opened or closed gates to control the water coming to their fields. As technology progressed, mechanical water level controllers were introduced. The systems use mechanical components like floats, levers or valves to automatically maintain the water levels.

1.3 OBJECTIVE

The objective of the water level controller project is to design and implement a wireless monitoring and control system using ESP32 modules as a transmitter and receiver. We are using a length adjustable and non breakable float sensor.The project aims to achieve the following goals:

Water Level Monitoring: Develop a reliable and accurate water level monitoring. system that utilizes a length-adjustable float sensor. The float sensor will detect the water level by the movement of a metal ball along a rail. The length-adjustable feature ensures compatibility with different tank or reservoir depths, enabling precise water level measurements.Wireless Communication: Establish a robust Wi-Fi connection between the transmitter and receiver ESP32 modules. Enable seamless and real-time communication to transmit water level data from the transmitter to the receiver unit. This wireless connectivity eliminates the need for physical wiring, simplifying installation and allowing for flexible placement of the components.

Automatic Control: Implement an intelligent control mechanism that enables automatic water level control based on the received data. Upon reaching the desired water level, the receiver ESP32 module should initiate appropriate actions, such as activating or deactivating a water pump or triggering other devices or notifications. This automation ensures optimal water management and minimizes the need for manual intervention.

1.3 APPLICATIONS

The project can be employed in residential settings to monitor and control water levels in overhead tanks or underground reservoirs. It ensures a consistent water supply to households and prevents overflows or shortages. In agricultural settings, the water level controller can be utilized to automate irrigation systems. It enables farmers to maintain optimal water levels in tanks or ponds, ensuring proper irrigation for crops without wastage. Industrial Water Management: Industries that require precise water levels in their processes can benefit from this project. It can be implemented in manufacturing facilities, chemical plants, and power plants to regulate water levels in storage tanks or cooling systems, preventing damage to equipment and optimizing operations. It can be integrated into water treatment plants to monitor and control water levels in different stages of the treatment process. It assists in maintaining proper water levels for filtration, sedimentation, and disinfection, ensuring the plant operates efficiently.Fish farms and aquaculture facilities can utilize the water level controller to monitor water levels in ponds or tanks. It helps maintain suitable water conditions for fish growth and prevents water overflow or depletion.The project can be incorporated into municipal water supply systems to monitor water levels in storage tanks and reservoirs. It enables authorities to efficiently manage water distribution and anticipate maintenance requirements.

CHAPTER 2
LITERATURE REVIEW

2.1 HOW FLOAT SENSOR WORKS?

A float sensor, also known as a float switch, is a device used to detect the level of liquid in a container. It consists of a float, typically made of buoyant material such as plastic or foam, and a switch mechanism.

The basic principle behind a float sensor is the buoyancy of the float. When the liquid level rises or falls, the float moves up or down accordingly. The movement of the float triggers the switch mechanism to either open or close an electrical circuit.

Here's a step-by-step explanation of how a float sensor works:

1. Mounting: The float sensor is mounted inside a container or tank in such a way that the float can move freely with the liquid level.
2. Float and switch arrangement: The float is connected to the switch mechanism through a lever or an arm. The switch mechanism is typically housed in a sealed enclosure to protect it from the liquid.
3. Resting state: In the resting state, when the liquid level is below the desired level, the float rests at its lowest position, keeping the switch in its initial state (either open or closed).
4. Liquid level rise: As the liquid level in the container rises, it lifts the float along with it. When the float reaches a certain predetermined height, it triggers the switch mechanism.
5. Switch activation: When the float reaches the activation point, it causes the switch to change its state. For example, if the switch was initially open, it may close the circuit, completing an electrical connection. If the switch was closed, it may open the circuit, breaking the electrical connection.
6. Signaling: The change in the switch's state sends a signal to a control system, an alarm, or a pump, depending on the application. This signal can be used to trigger

actions like stopping or starting a motor, activating an alarm, or regulating the liquid flow.

7. Liquid level decrease: As the liquid level decreases, the float moves downward, and the switch returns to its initial state once the float reaches the lower level or the reset point.

Float sensors are commonly used in various applications, such as liquid level monitoring in tanks, sump pumps, washing machines, water heaters, and more. They provide a simple and reliable method to detect and control liquid levels.

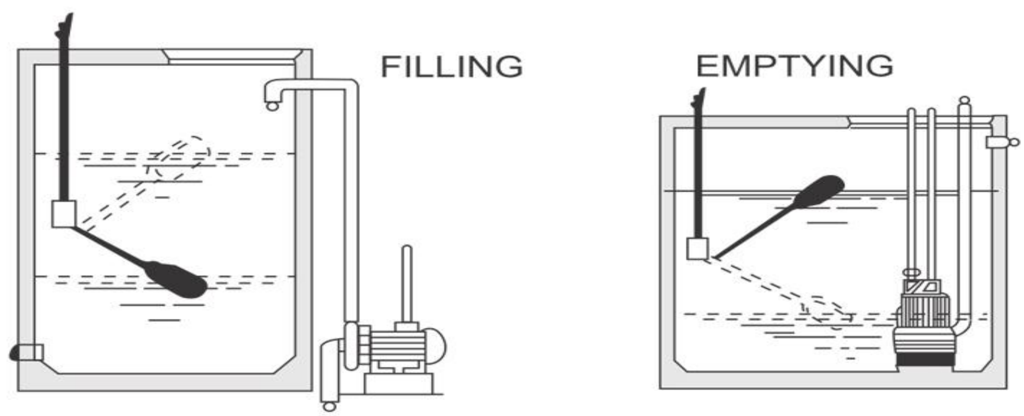

Fig 2.1 Float sensor mechanism

2.2 TYPES OF FLOAT SENSORS

There are several types of float sensors or float switches available, designed to suit different applications and liquid level detection needs. Here are some common types:

1. Vertical Float Switch: This is the most basic type of float switch. It consists of a float attached to a vertical rod or stem. As the liquid level rises or falls, the float moves up or down along the stem, activating the switch at the desired level.

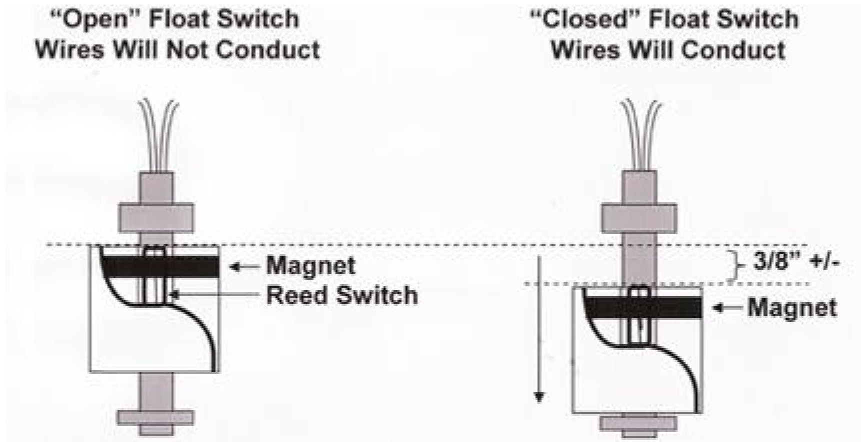

Fig 2.2 Vertical float switch

2. Horizontal Float Switch: In this type of float switch, the float is positioned horizontally. As the liquid level changes, the float tilts or pivots, triggering the switch. Horizontal float switches are often used in narrow or shallow tanks where vertical movement may be restricted.

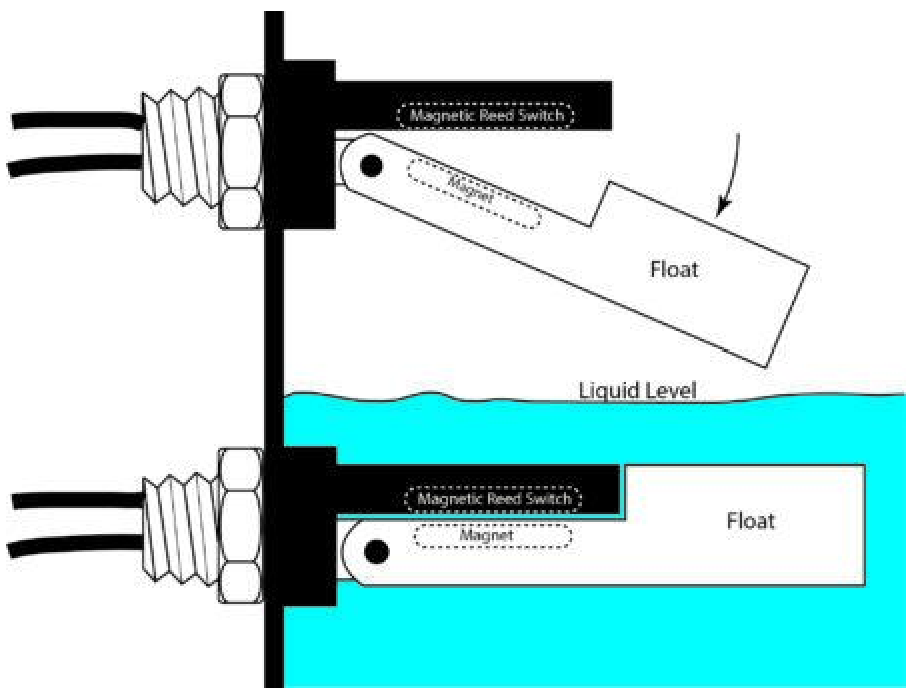

Fig 2.3 Horizontal float switch

3. Cable Float Switch: A cable float switch utilizes a float connected to a flexible cable or wire. The cable is wound on a spool, and as the liquid level changes, the float moves, causing the cable to unwind or wind up. This movement activates the switch mechanism.
4. Electronic Float Switch: Electronic float switches use sensors or probes instead of mechanical switches. These sensors detect the presence or absence of liquid by measuring changes in conductivity or capacitance. Electronic float switches provide precise level sensing and can be more versatile than mechanical switches.
5. Magnetic Float Switch: Magnetic float switches use a magnet within the float and a magnetic reed switch or Hall effect sensor outside the float chamber. As the float moves with the liquid level, the magnetic field activates the switch, signaling the level change.
6. Optical Float Switch: Optical float switches utilize infrared or optical sensors to detect the liquid level. These sensors emit a beam of light, and when the liquid reaches a certain level, the light is refracted or reflected, triggering the switch.

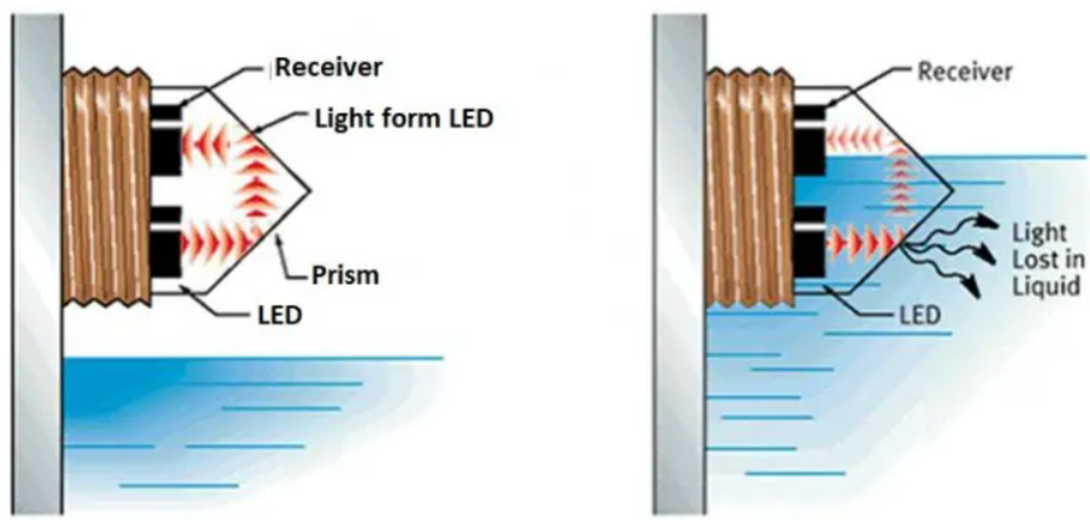

Fig 2.4 Optical float switch

7. Displacer Float Switch: Displacer float switches operate based on the principle of buoyancy and weight displacement. The float contains a displacer, which is a

solid object with a density different from that of the liquid. When the liquid level changes, the displacer moves, causing the switch to activate.

These are some of the commonly used types of float sensors. The selection of the appropriate type depends on factors such as the application, the characteristics of the liquid being monitored, space limitations, and desired level accuracy.

2.3 POSSIBLE EXPLANATIONS

2.3.1 CONCEPT OF BUOYANCY

Buoyancy is a fundamental principle in physics that explains the upward force exerted on objects immersed in fluids, such as liquids and gases. It is the force responsible for objects floating or sinking in a fluid medium.

The concept of buoyancy is closely related to the density of the fluid and the object's volume. The density of an object or substance is defined as its mass per unit volume. If an object or substance is less dense than the fluid it is immersed in, it will experience a buoyant force that is greater than its weight, causing it to float. Conversely, if the object or substance is denser than the fluid, the buoyant force will be less than its weight, leading to sinking.

The buoyant force is a result of the pressure difference between the top and bottom of an object immersed in a fluid. When an object is placed in a fluid, it displaces an amount of fluid equal to its own volume. According to Archimedes' principle, the buoyant force is equal to the weight of the fluid displaced by the object. This force acts in the opposite direction to gravity, pushing the object upward.

The magnitude of the buoyant force can be calculated using the formula:

Buoyant force = Density of the fluid × Volume of the displaced fluid × Acceleration due to gravity

where the density of the fluid is the density of the fluid medium, and the volume of the displaced fluid is the volume of the object submerged in the fluid.

The concept of buoyancy has practical applications in various fields, such as shipbuilding, aviation, and even everyday activities like swimming and hot air ballooning. It is also a crucial concept in understanding phenomena like the floating of icebergs, the behavior of submarines, and the rise of helium-filled balloons.

In summary, buoyancy is the upward force exerted on objects immersed in fluids due to the difference in pressure between the top and bottom of the object. It is determined by the density of the fluid and the volume of the object submerged, and it explains why objects float or sink in fluids.

2.4 EXPERIMENTAL WORK

A search of the patents for float level sensors and float switches will uncover a number of patents dated back to the late 1800's. One invention references a magnetic float used to induce movement of needles that will give an indication of the liquid level. Like everything else, float switches have progressed much through the years.The first flow switch using a piston, without connection passage between water and electrical section , appears to be the Walker type, where the metallic piston displacement is measured by two electromagnetic coils located outside the pipe.

It was not until 1936 and the reed switch invention by the American engineer W. B. Ellwood of the Bell Telephone Laboratories (U.S. Patent 3,310,863) that freed paddle, piston or turbine flow sensors from gaskets and seals and allowed them to miniaturize.

The reed switches are now used in thousands of different applications, and the annual world production is counted in hundreds of millions of pieces.

2.5 PROS AND CONS OF FLOAT SENSOR

Float sensors offer several benefits that make them a popular choice for level detection in various applications. Their simple design and construction contribute to their ease of installation and operation. They typically consist of a buoyant float attached to a switch or sensor mechanism, making them straightforward to understand and maintain. In addition, float sensors are cost-effective compared to more complex level sensing technologies, making them a budget-friendly option for many industries. Their reliability is another advantage, as they are less prone to electronic or software failures and can function in a wide range of temperatures, pressures, and fluid types. Float sensors find versatile application in industries such as manufacturing, food and beverage, wastewater management, and automotive.

However, float sensors have some limitations. They may not provide high precision compared to more advanced sensors, introducing a level of error in measurements. The mechanical components can be subject to wear and tear over time, and rapid changes in liquid level can affect their accuracy. Float sensors also require adequate space within the container for the float's movement, and they can be sensitive to the properties of the liquid being measured.

Considering these pros and cons is crucial when deciding whether a float sensor is suitable for a specific application or if an alternative level sensing technology may be more appropriate. Each application's requirements and constraints should be carefully evaluated to determine the best fit for reliable and accurate level detection.

2.6 MESSAGE TRANSMISSION BETWEEN ESP32

Message transmission between an ESP32 microcontroller and a float sensor involves establishing communication and transmitting data wirelessly. The ESP32, a powerful microcontroller board equipped with Wi-Fi and/or Bluetooth capabilities, serves as the central component for data processing and wireless connectivity.

The float sensor, responsible for detecting fluid levels, generates an output signal based on the position of the float. This signal can be either a discrete on/off signal or a continuous signal, depending on the float sensor's design and purpose.

To enable message transmission, the output signal from the float sensor is connected to one of the General Purpose Input/Output (GPIO) pins of the ESP32 microcontroller. This connection allows the ESP32 to receive and interpret the signal from the float sensor. Programming languages like C++ or Python, along with suitable development environments such as the Arduino IDE or ESP-IDF, are used to program the ESP32.

Upon receiving the output signal, the ESP32 processes the data according to the desired logic or requirements. This processing stage involves converting the signal into meaningful information, such as determining the fluid level based on the on/off signal or scaling the continuous signal to appropriate values. The ESP32's programming capabilities and computational power allow for flexible and customized data processing.

Once the data from the float sensor has been processed, the ESP32 leverages its built-in Wi-Fi or Bluetooth capabilities to wirelessly transmit the data. It establishes a connection to a remote device or a network, enabling seamless communication. Protocols such as MQTT (Message Queuing Telemetry Transport), HTTP (Hypertext Transfer Protocol), or TCP/IP (Transmission Control Protocol/Internet Protocol) are often utilized for reliable and secure message transmission.

On the receiving end, another device or system is configured to receive and process the transmitted data from the ESP32. This device can be a computer, a smartphone, a server, or any other compatible device capable of receiving and handling data. The received data can then be utilized based on the specific requirements of the application. It can be logged for record-keeping purposes, displayed on a user interface for real-time monitoring, used to trigger control actions, or integrated into a larger monitoring or automation system.

To ensure a robust and secure message transmission between the ESP32 and the float sensor, best practices for programming, data handling, and error handling should be followed. This includes implementing appropriate data encryption, authentication, and error correction mechanisms. Regular maintenance and updates to both the ESP32 firmware and the float sensor's hardware are also recommended to ensure reliable and accurate data transmission over time.

CHAPTER 3

DESIGN AND FABRICATION

3.1 DESIGN CALCULATIONS

We have designed a float sensor for a 500 litre tank.

1. To determine the desired range: We have decided the minimum and maximum liquid levels required to measure using the float sensor as follows:

   Minimum liquid level= 30% (500) = 150L

   Maximum liquid level=90% (500) = 450L

2. Pipe Dimensions:

   Vertical pipe: We have assumed a height of 40.5cm for the vertical pipe with a diameter of 1.5 inches.

   Horizontal pipe: We have assumed a length of 26cm for the vertical pipe with a diameter of 1.15 inches.

3. Design dimension of metal ball pathway: We have taken pathway dimensions as:

   Length: 15cm

   Height: 10mm

   Depth of half cylindrical path: 8mm

   Ripple height: 4mm

3.2 DIMENSIONS

The following dimensions were taken for the fabrication.

Vertical Pipe	Height adjustable from 40.5cm to 80.5cm	1.5 inches diameter
Horizontal Pipe	26cm length	1.15 inches diameter
Reducer Base	9.9cm height	4 inch to 2 inch reducer
Metal ball Pathway (half cylindrical path)	15cm length	Depth of 8mm

Table 3.1 Dimensions

3.3 BLOCK DIAGRAM

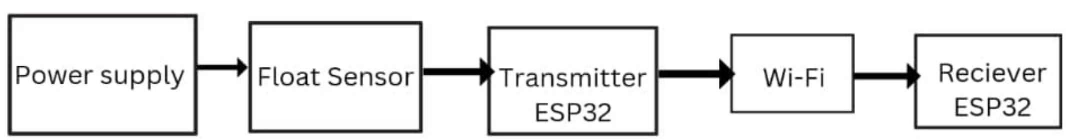

Fig 3.1 Block Diagram

3.3.1 CIRCUIT DIAGRAM

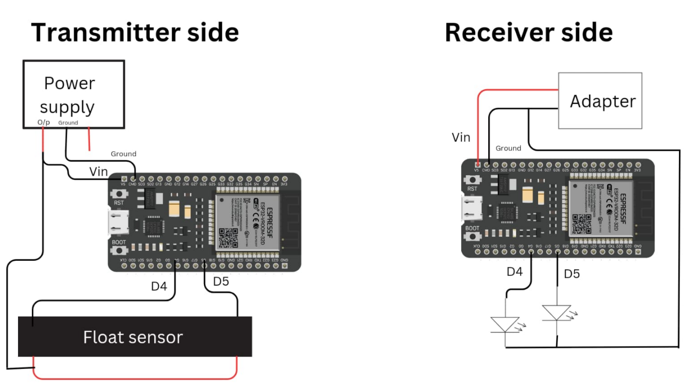

Fig 3.2 Circuit Diagram

3.3.2 3D SKETCH OF FLOAT SENSOR

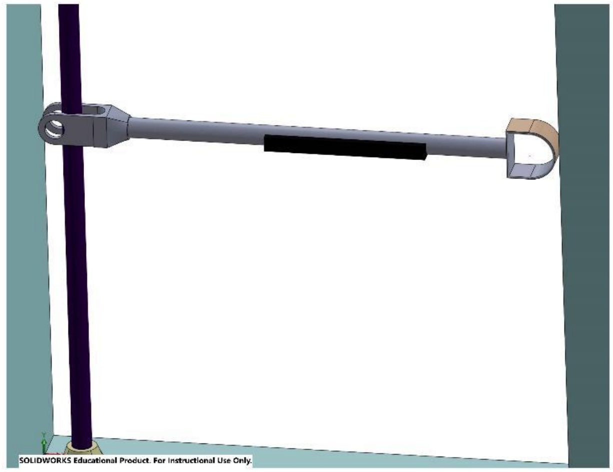

Fig 3.3 Front view

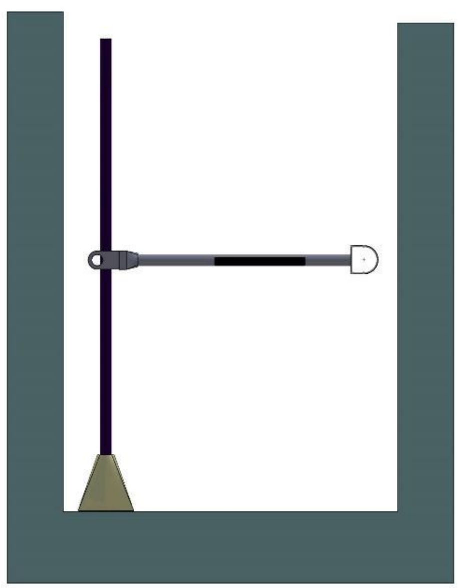

Fig 3.4 Front view of float sensor

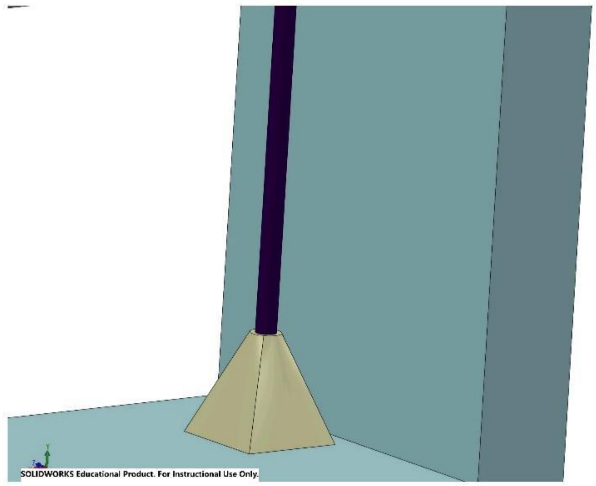

Fig 3.5 Side view

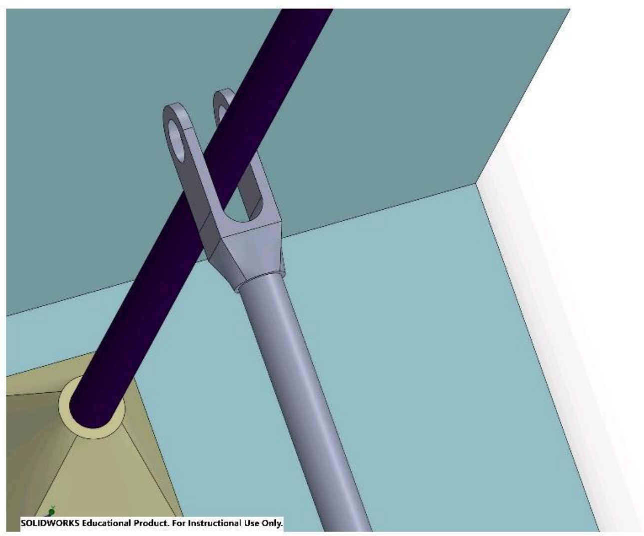

Fig 3.6 Top view

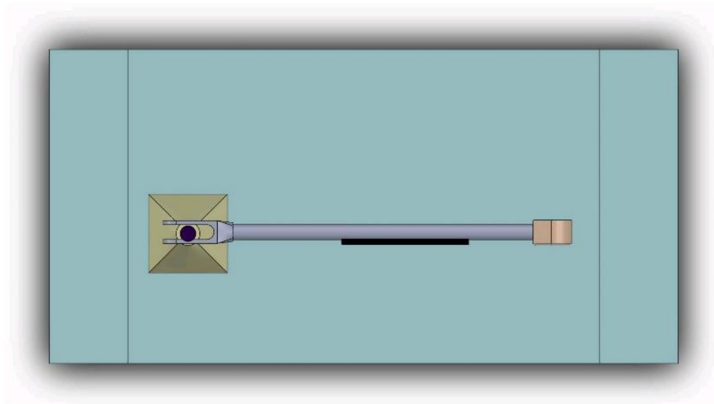

Fig 3.7 Top view of float sensor

3.3.3 3D DESIGN OF METAL BALL PATH

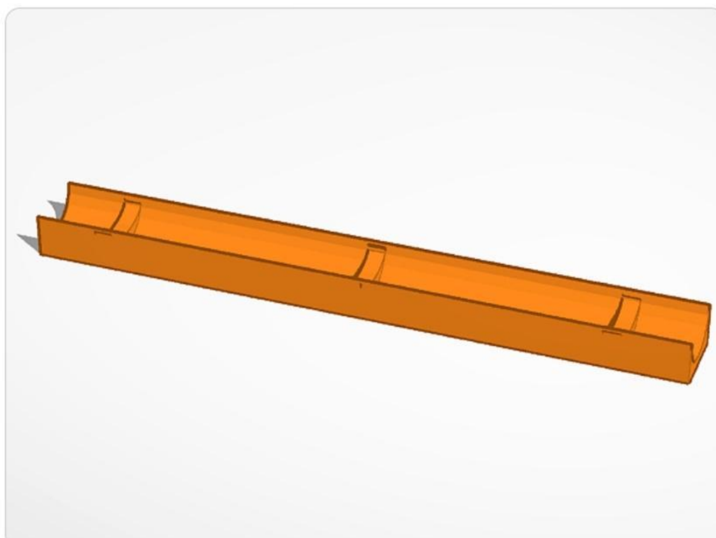

Fig 3.8 3D design of metal ball pathway

3.4 FABRICATION

Using 3D printing for the design and fabrication of a float sensor offers several advantages, including rapid prototyping, customization, and the ability to create complex geometries. Here's a general overview of how 3D printing can be used in the design process for a float sensor:

1. Design the float sensor:Utilize computer-aided design (CAD) software to create a 3D model of the float sensor. Take into account the desired dimensions, shape, and features required for the sensor's functionality.

Consider factors like buoyancy, weight, and size, ensuring the float is appropriately designed to provide accurate level detection.

2. Select a suitable 3D printing technology:There are various 3D printing technologies available, such as fused deposition modeling (FDM), stereolithography (SLA), selective laser sintering (SLS), or digital light processing (DLP).

Choose a 3D printing technology that suits your requirements in terms of material compatibility, resolution, mechanical properties, and cost.

3. Choose appropriate materials: Select a 3D printing material that is compatible with the liquid or substance to be detected and can withstand the environmental conditions.Common materials used for float sensor fabrication include various plastics like ABS, PLA, or nylon.

4. Prepare the 3D model for printing:Ensure the 3D model is properly prepared for printing. This involves tasks such as orienting the model, adding support structures if necessary, and optimizing the design for 3D printing.

5. Print the float sensor:Set up the 3D printer with the chosen material and load the 3D model.Initiate the printing process and allow the printer to create the float sensor layer by layer, following the instructions from the 3D printing software.

Using 3D printing for float sensor design allows for faster iteration cycles, cost-effective prototyping, and the ability to create intricate and customized designs. However, it's essential to consider the material properties, resolution, and limitations of the chosen 3D printing technology to ensure the final float sensor meets the required specifications.

Fig 3.9 3D printed metal ball pathway

This particular float sensor has a length of 15cm, a depth of 8mm, and a ripple height of 4mm. The 3D printed float is buoyant and floats on the surface of the water. The 15cm length allows for precise detection over a considerable range of water levels. The 8mm depth ensures stability and proper positioning of the float within the water. The 4mm ripple height accounts for any minor fluctuations or disturbances on the water surface, ensuring accurate measurements even in turbulent conditions.

3.4.1 FLOAT SENSOR FRAME

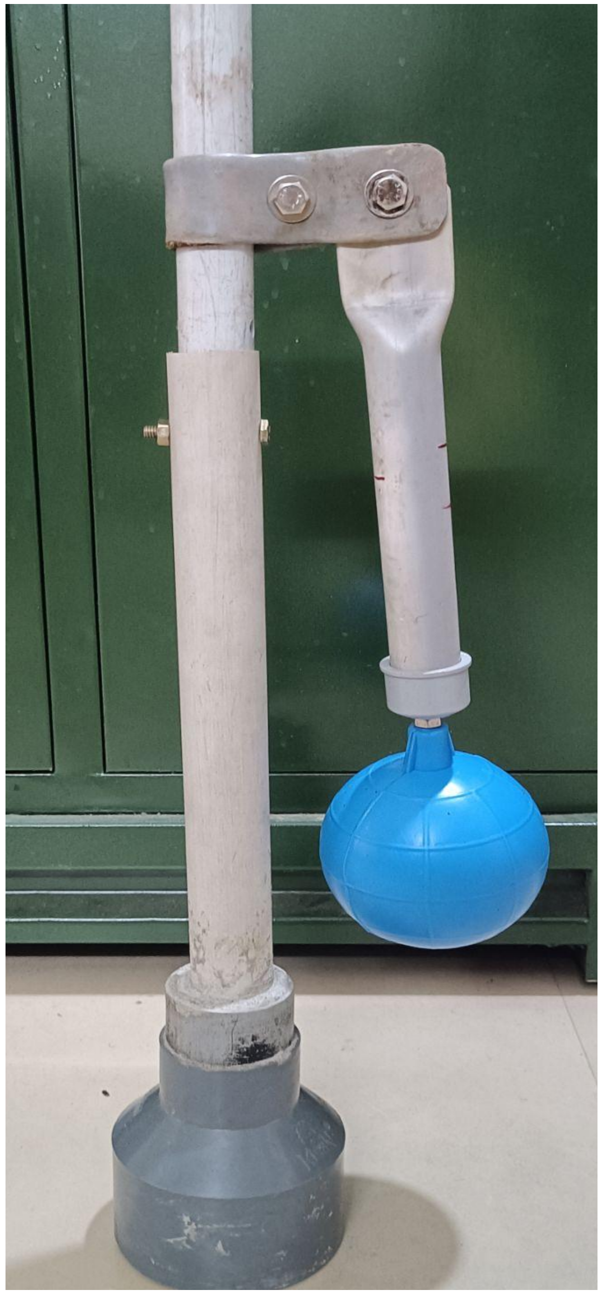

Fig 3.9.1 Float sensor frame

A float sensor frame made of PVC pipe and reducer is a practical and cost-effective solution for mounting and securing float sensors in water level monitoring systems. This type of frame provides a sturdy structure that holds the float sensor in place, ensuring accurate and reliable measurements.

The frame consists of vertical and horizontal PVC pipes, along with reducers that connect and join them together. The PVC pipes offer durability, resistance to corrosion, and affordability, making them an ideal choice for constructing the frame. The reducers, which are used to connect pipes of different sizes, provide a secure and snug fit, ensuring stability and proper alignment of the float sensor.

The vertical PVC pipes serve as the main supports for the frame. They are typically attached to a mounting surface, such as a wall or a tank, using screws or other appropriate fasteners. The horizontal PVC pipes are connected to the vertical pipes using the reducers, creating a framework that holds the float sensor at the desired height and position.By using PVC pipes and reducers, the frame can be easily customized and adjusted to accommodate different float sensor sizes and mounting requirements. The flexibility of PVC pipes allows for cutting and joining to achieve the desired dimensions and angles. The reducers enable the connection of pipes with varying diameters, ensuring compatibility with different float sensor models.The PVC pipe and reducer frame provides stability and support for the float sensor, minimizing movement or displacement caused by water flow or other external factors. This enhances the accuracy and reliability of water level measurements, crucial for effective water management and control.

Overall, a float sensor frame made of PVC pipe and reducer offers a practical and efficient solution for mounting and securing float sensors in water level monitoring systems. Its use of PVC pipes and reducers provides durability, customization options, and ease of installation. This type of frame ensures the float sensor remains stable and properly positioned, facilitating accurate water level detection and enabling effective water management practices.

CHAPTER 4

METHODOLOGY AND EXPERIMENT ANALYSIS

The methodology for designing and implementing a float sensor can be broken down into several steps:

1. Define Requirements: Determine the specific requirements of the float sensor, such as the type of liquid it will be used with, the desired accuracy, the range of liquid levels to be detected, and any environmental factors that may impact its performance.

2. Sensor Selection: Choose the appropriate type of float sensor based on the requirements. Common types of float sensors include mechanical floats, magnetic reed switches, and capacitive or ultrasonic level sensors. Consider factors such as cost, reliability, accuracy, and compatibility with the liquid being monitored.

3. Sensor Placement: Determine the optimal location for installing the float sensor in the liquid container or tank. Consider factors such as the desired detection range, accessibility for maintenance or cleaning, and the avoidance of any obstructions or interference.

4. Mounting and Installation: Install the float sensor according to the manufacturer's instructions. Ensure that it is securely mounted and properly aligned to achieve accurate and reliable readings. Make sure any cables or wires connected to the sensor are properly routed and protected.

5. Electrical Connection: Connect the float sensor to the appropriate electrical circuit or interface. This may involve connecting wires or cables to a control unit, data acquisition system, or other monitoring devices. Follow the recommended electrical connections and consider factors such as voltage levels, signal conditioning, and grounding requirements.

Remember to refer to the specific guidelines and recommendations provided by the float sensor manufacturer throughout the entire process.

4.1 SWITCHING METHOD

The float sensor consists of a pipe with a ball inside and a lever mechanism. The pipe is positioned vertically in the fluid or container whose level needs to be detected.

When the water level goes down, the ball inside the pipe moves downward due to gravity. As the ball moves down, it pushes the lever mechanism attached to it, causing the lever to move down as well. This downward movement of the lever is translated into a signal indicating a high value or an "on" state.

Conversely, when the water level rises, the ball inside the pipe moves upward. As the ball moves up, it releases the pressure on the lever mechanism, allowing the lever to move upward. This upward movement of the lever is also translated into a signal indicating a high value or an "on" state.

Essentially, the switching method relies on the position of the ball inside the pipe to determine the fluid level. When the water level is below a certain point, the ball and lever mechanism are in a position that provides a high output value. As the water level rises and surpasses that point, the ball moves up, and the lever mechanism changes its position, resulting in a different output value.

This switching method is based on the principle of mechanical contact between the ball, lever mechanism, and the electrical switch or sensor that detects the position of the lever. It offers a simple and reliable way to determine fluid levels, particularly in applications where discrete on/off signals are sufficient.

It's important to note that the sensitivity and accuracy of this switching method may depend on the design and dimensions of the float sensor, as well as the specific positioning and characteristics of the ball and lever mechanism. Calibration and testing should be conducted to ensure accurate and consistent operation of the float sensor based on the desired fluid level detection range.

4.2 ASSUMPTIONS

During the working of the project,various assumptions were taken.This is to reduce the complexity regarding working and calculation of float sensor.

I. The fluid level is linearly related to the position of the float.
II. The buoyancy effects on the float are negligible or accounted.Top of Form
III. Float sensors typically assume a single point of measurement.
IV. Float sensors assume that there is no interference or obstruction that hinders the movement of the float.
V. Float sensors assume that the fluid being measured is static or relatively calm.

CHAPTER 5

RESULTS AND DISCUSSIONS

5.2 WORKING IN A TANK

An automated water tank controller using a float sensor is designed to monitor and regulate the water level in a tank. The float sensor is a simple device that consists of a float attached to a lever arm. As the water level rises or falls, the float moves up or down, respectively, causing the lever arm to tilt.

Here's a step-by-step explanation of how the automated water tank controller using a float sensor typically works:

1.Float sensor placement: The float sensor is installed inside the water tank at a predetermined height. When the tank is empty, the float sensor is positioned at the lowest level.

2.Sensor detection: The float sensor detects the water level in the tank based on the position of the float. When the tank is empty, the float sensor is in the lowest position, indicating a low water level.

3.Controller unit: The float sensor is connected to a controller unit, which is responsible for processing the sensor's input and controlling the water supply.

4.Set water levels: The user sets the desired water levels in the tank. Typically, there are two set points: a minimum level (when the water supply should start) and a maximum level (when the water supply should stop).

5.Monitoring: The controller continuously monitors the water level in the tank by receiving input from the float sensor.

6.Low water level detection: If the water level detected by the float sensor falls below the minimum set point, the controller activates the water supply mechanism. This could be a pump or a valve connected to a water source.

7.Water supply activation: The controller sends a signal to start the water supply mechanism, allowing water to flow into the tank. The supply continues until the water level reaches the maximum set point.

8.High water level detection: Once the water level reaches the maximum set point, the float sensor signals the controller to deactivate the water supply mechanism.

9.Water supply deactivation: The controller stops the water supply, preventing further water from entering the tank.

10.Repeat monitoring: The controller continuously monitors the water level in the tank using the float sensor, repeating steps 5 to 9 as necessary to maintain the desired water levels.

By using a float sensor and an automated controller, this system ensures that the water tank remains within the specified water level range. It eliminates the need for manual monitoring and intervention, providing a convenient and efficient solution for maintaining water levels in various applications such as domestic water tanks, industrial storage tanks, or agricultural irrigation systems.

5.3 MESSAGE TRANSFERRING USING ESP32

To facilitate message transferring between ESP32 devices using MAC addresses, you can utilize the ESP32's Wi-Fi capabilities and implement a custom communication protocol. Here's a high-level overview of how you can achieve this:

1. Obtain MAC addresses: Each ESP32 device has a unique MAC address that serves as its identifier on the network. You can retrieve the MAC addresses of the ESP32 devices involved in the message transfer.

2. Set up Wi-Fi: Configure the ESP32 devices to connect to the same Wi-Fi network. This allows them to communicate with each other on the local network.

3. Establish connections: On each ESP32 device, establish a network connection to the others using the MAC addresses. This can be achieved by establishing socket connections using TCP/IP or UDP protocols.

4. Custom message format: Define a custom message format that includes the source MAC address, destination MAC address, and the actual message content. This format allows ESP32 devices to identify the intended recipient and handle the messages accordingly.

5. Send messages: On the sender ESP32, construct a message using the custom format and specify the MAC address of the recipient ESP32. Send the message over the established network connection.

6. Receive and process messages: On the recipient ESP32, listen for incoming messages. When a message arrives, check if the destination MAC address matches the recipient's MAC address. If it does, process the message content accordingly.

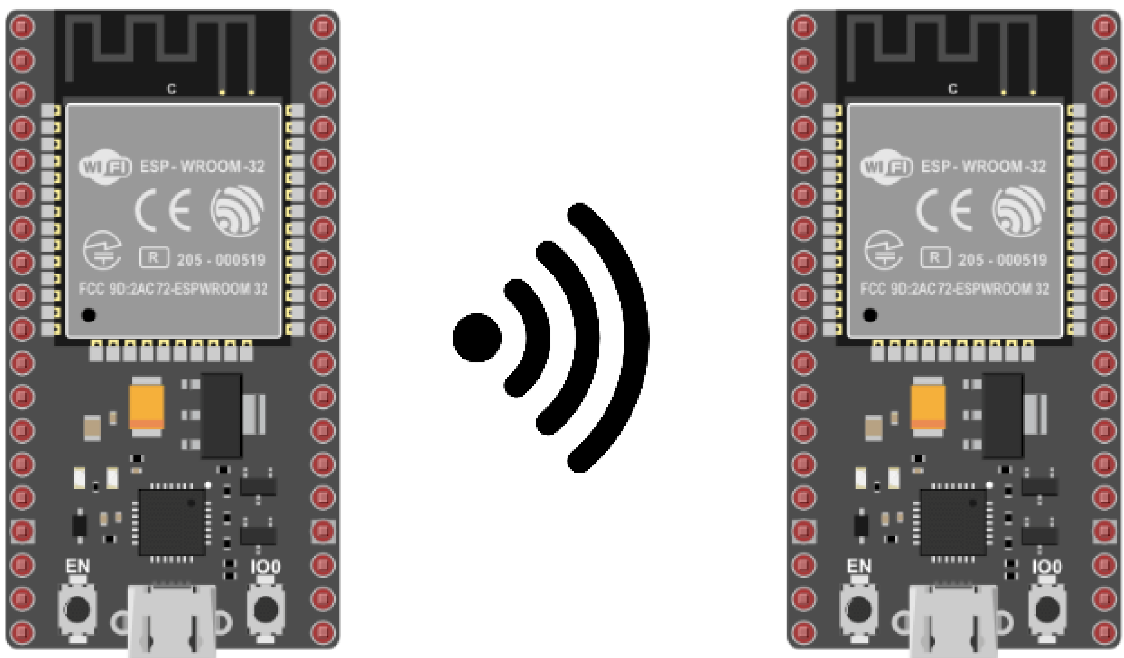

Fig. 5.1 One way communication

Code of transmitter

```
// Include Libraries

#include <esp_now.h>

#include <WiFi.h>

// Variables for test data

// MAC Address of responder

uint8_t broadcastAddress[] = {0x3C, 0x61, 0x05, 0x11, 0xD0, 0x00};

// Define a data structure

typedef struct struct_message {

  int b;

  int a;

} struct_message;

// Create a structured object

struct_message myData;

// Peer info

esp_now_peer_info_t peerInfo;

// Callback function called when data is sent

void OnDataSent(const uint8_t *mac_addr, esp_now_send_status_t status) {

  Serial.print("\r\nLast Packet Send Status:\t");
```

```
  Serial.println(status == ESP_NOW_SEND_SUCCESS ? "Delivery Success" : "Delivery Fail");
}
 void setup() {
  // Set up Serial Monitor
  Serial.begin(9600);
  pinMode(4,INPUT);
  pinMode(5,INPUT);
  // Set ESP32 as a Wi-Fi Station
  WiFi.mode(WIFI_STA);
  // Initilize ESP-NOW
  if (esp_now_init() != ESP_OK) {
    Serial.println("Error initializing ESP-NOW");
        return;
  }
  // Register the send callback
  esp_now_register_send_cb(OnDataSent);
  // Register peer
  memcpy(peerInfo.peer_addr, broadcastAddress, 6);
  peerInfo.channel = 0;
```

```
  peerInfo.encrypt = false;

  // Add peer

  if (esp_now_add_peer(&peerInfo) != ESP_OK){

    Serial.println("Failed to add peer");

          return;

  }

}

void loop() {

  // Create test data

  // Generate a random integer

  // Format structured data

  myData.a =digitalRead(4);

  myData.b =digitalRead(5);

  // Send message via ESP-NOW

      esp_err_t result = esp_now_send(broadcastAddress, (uint8_t *) &myData, sizeof(myData));

  if (result == ESP_OK) {

    Serial.println("Sending confirmed");

  }

  else {
```

```
    Serial.println("Sending error");
  }
  delay(2000);
}
```

Code of receiver

```
// Include Libraries
#include <esp_now.h>
#include <WiFi.h>
bool c,d;
// Define a data structure
typedef struct struct_message {
  int a;
  int b;
} struct_message;
// Create a structured object
struct_message myData;
// Callback function executed when data is received
void OnDataRecv(const uint8_t * mac, const uint8_t *incomingData, int len) {
  memcpy(&myData, incomingData, sizeof(myData));
  Serial.print("a: ");
```

```
  Serial.println(myData.a);
 // c=a;
   digitalWrite(4,myData.a );
  Serial.print("b: ");
  Serial.println(myData.b);
// d=b;
  digitalWrite(5, myData.b);
}
void setup() {
  // Set up Serial Monitor
  Serial.begin(9600);
  pinMode(4, OUTPUT);
  pinMode(5, OUTPUT);
  // Set ESP32 as a Wi-Fi Station
  WiFi.mode(WIFI_STA);
  // Initilize ESP-NOW
  if (esp_now_init() != ESP_OK) {
    Serial.println("Error initializing ESP-NOW");
        return;
  }
```

```
  // Register callback function
  esp_now_register_recv_cb(OnDataRecv);
}
void loop() {
}
```

5.5 DISCUSSIONS

5.5.1 EFFECT OF TURBULENCE OF INCOMING WATER

The turbulence of incoming water can have an impact on the performance of a float sensor. Here are some effects that turbulence can have on a float sensor:

1. False readings: Turbulence in the incoming water can cause erratic movements or vibrations of the float, leading to false readings. The irregular flow patterns can make it difficult for the float sensor to accurately detect the actual water level. This can result in incorrect measurements and affect the overall reliability of the sensor.

2. Float stability: Turbulent water flow can create disturbances and eddies that can destabilize the float. The turbulent motion can cause the float to sway or move inconsistently, making it challenging for the sensor to determine the precise water level. This instability can introduce fluctuations in the readings and reduce the accuracy of the sensor.

3. Delayed response: Turbulence can cause delays in the response time of the float sensor. The turbulent water flow can create turbulence around the float, affecting its movement. This delay in the float's response to changes in the water level can result in a lag in the sensor's readings, making it less responsive to rapid or short-term fluctuations in the water level.

4. Increased wear and tear: The turbulent flow of water can subject the float sensor to increased stress and wear. The continuous impact of turbulent water on the float and sensor components can cause mechanical fatigue, leading to premature aging or

degradation of the sensor. This can result in reduced accuracy and a shorter lifespan of the float sensor.

5. Maintenance requirements: Turbulence in the incoming water can introduce additional maintenance requirements for the float sensor. The turbulent flow can increase the likelihood of debris, sediments, or contaminants being carried along with the water. These particles can accumulate on the float or sensor components, affecting their movement or interfering with the electrical signals. Regular cleaning and maintenance may be necessary to ensure proper functioning of the float sensor in such conditions.

To mitigate the effects of turbulence on a float sensor, you can consider the following measures:

1. Proper positioning: Ensure that the float sensor is installed in a location where the incoming water turbulence is minimized. Positioning the sensor away from turbulent zones or using baffles or flow regulators can help reduce the impact of turbulence on the float's movement.

2. Design considerations: Choose a float sensor design that is specifically designed to handle turbulent flow conditions. Some float sensors may have features like stabilizing fins or weighted floats to enhance stability and accuracy in turbulent water.

3. Maintenance and cleaning: Regularly inspect and clean the float sensor to remove any accumulated debris, sediments, or contaminants that may affect its performance. Follow the manufacturer's guidelines for maintenance and cleaning procedures.

By considering these factors and taking appropriate measures, you can minimize the impact of turbulence on the performance of a float sensor and ensure more accurate and reliable water level measurements.

5.5.2 DISCUSSION ON DEVELOPING SENSORS TO ACCOMMODATE TANKS OF VARIOUS DIMENSIONS

Developing a float sensor that can accommodate tanks of various dimensions requires careful consideration of the design and flexibility of the sensor. Here are some discussions on how to approach the development of such a float sensor:

1. Adjustable mounting mechanism: Design the float sensor with an adjustable mounting mechanism that allows it to be securely installed in tanks of different sizes. This can involve using adjustable brackets, sliding mechanisms, or modular components that can be customized to fit different tank dimensions.

2. Float size and buoyancy: Create a float that can be easily adjusted or modified to match different tank sizes. The size and buoyancy of the float should be adaptable to the specific requirements of each tank. This can be achieved by using interchangeable float sections or modular float designs that can be configured to accommodate different tank depths and volumes.

3. Calibration options: Provide calibration options that allow the float sensor to be calibrated or programmed for different tank dimensions. This can involve incorporating user-adjustable settings or automated calibration procedures that adapt the sensor's sensitivity and reference points based on the specific tank dimensions.

4. User-friendly configuration: Design the float sensor with a user-friendly interface or configuration mechanism that allows users to input or select the tank dimensions during installation or setup.

5. Testing and validation: Perform rigorous testing and validation across a range of tank sizes and configurations to ensure the accuracy and reliability of the float sensor in different scenarios. This includes testing under varying liquid levels, turbulence conditions, and real-world environmental factors to verify the sensor's performance and adaptability.

By considering these discussions and incorporating flexibility, adjustability, and adaptability into the float sensor design, you can develop a solution that can accommodate tanks of various dimensions and provide accurate and reliable water level measurements across different applications.

CHAPTER 6

CONCLUSION AND SCOPE FOR FUTURE WORK

In conclusion, an automated water tank controller offers significant advantages in managing water resources efficiently and effectively. By incorporating intelligent sensors and control systems, it optimizes water usage, ensures timely refilling, and minimizes wastage. The key benefits of an automated water tank controller include:

1. Water Conservation: The controller monitors water levels and intelligently regulates the filling and emptying of the tank. This ensures that water is used only when necessary and prevents overfilling or unnecessary wastage.

2. Convenience and Efficiency: Manual monitoring and control of water tanks can be time-consuming and prone to human error. With an automated controller, the system handles the entire process automatically, providing convenience and accuracy in managing water levels.

3. Cost Savings: By avoiding water overflows, leaks, or underutilization, an automated controller helps reduce water bills and overall operational costs. It maximizes the efficiency of water distribution and minimizes unnecessary expenses.

4. Environmental Impact: Effective water management is crucial for environmental sustainability. An automated water tank controller promotes responsible water usage, contributing to the conservation of this valuable resource and reducing the ecological footprint.

In summary, an automated water tank controller streamlines water management, enhances efficiency, reduces costs, and promotes responsible water usage. With its numerous benefits, it is a valuable tool for both residential and commercial applications, contributing to sustainable water resource management in an increasingly water-conscious world.

6.1 FUTURE SCOPE

The scope for future work in the field of automated water tank controllers is vast and presents several opportunities for innovation and improvement. Here are some potential areas of focus:

1. Enhanced Sensor Technology: Develop more advanced and accurate sensors to measure water levels, temperature, and quality within the tank. This would enable more precise monitoring and control of water resources.

2. Smart Leak Detection: Integrate leak detection systems into automated controllers to promptly identify and address any leaks or abnormalities in the water tank or associated pipelines. This would help prevent water wastage and reduce potential damage.

3. Integration with IoT and Data Analytics: Combine automated water tank controllers with Internet of Things (IoT) technology and data analytics to enable intelligent decision-making and predictive maintenance. This integration can provide insights into water consumption patterns, optimize refill cycles, and identify potential issues before they occur.

4. Water Quality Monitoring: Expand the capabilities of automated controllers to monitor water quality parameters such as pH levels, turbidity, and chemical composition. This would ensure the supply of clean and safe water and enable early detection of contamination events.

5. Mobile Applications and Remote Control: Develop user-friendly mobile applications that allow users to monitor and control their water tanks remotely. This would provide convenience and accessibility, enabling users to manage their water resources from anywhere.

6. Energy Efficiency: Explore ways to improve the energy efficiency of automated water tank controllers, minimizing power consumption while maintaining optimal performance. Overall, the future of automated water tank controllers lies in further innovation, integration with advanced technologies, and a holistic approach towards water resource management. These advancements have the potential to revolutionize the way we manage water, promoting sustainability and ensuring a more efficient and responsible use of this vital resource.

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