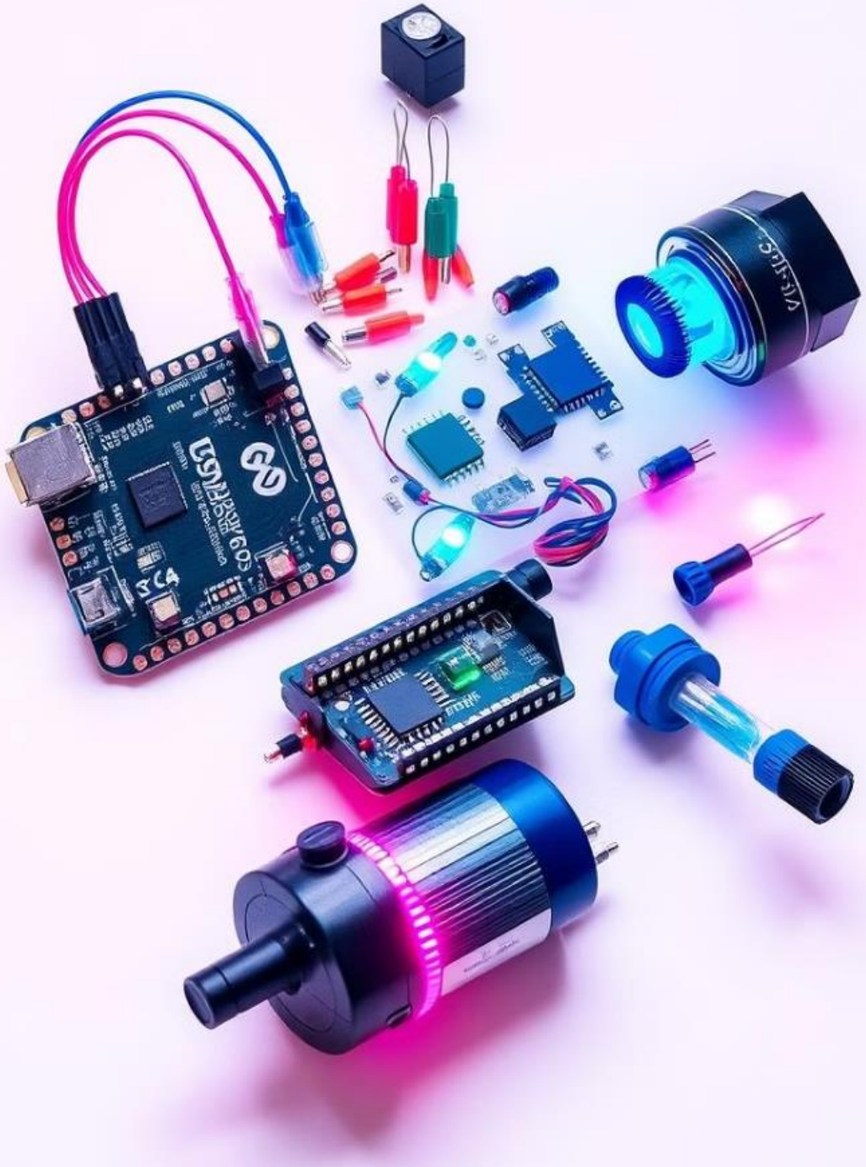
# Water Level Detection System: STM32F401 and Ultrasonic Sensor

This innovative project combines STM32F401 microcontroller with an ultrasonic sensor for precise water level monitoring. It features LED indicators, Bluetooth connectivity, and remote pump control for efficient water management.



# System Components

**1** **STM32F401 Microcontroller**

High-performance ARM Cortex-M4 core, ideal for real-time applications and sensor data processing.

**2** **Ultrasonic Sensor**

Measures water level using sound waves, providing accurate non-contact distance measurements.

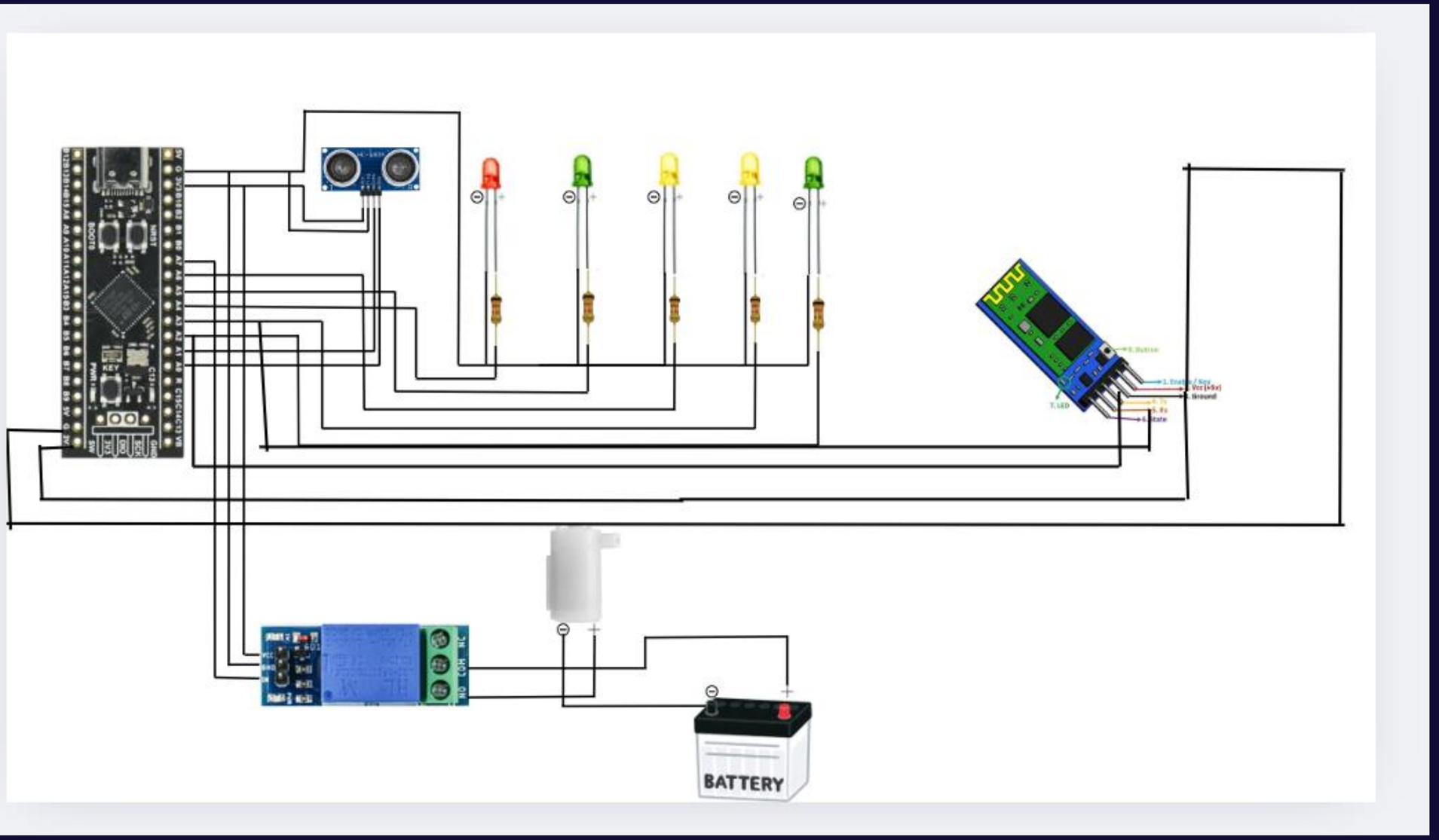
**3** **LED Indicators**

Five LEDs (2 yellow, 2 green, 1 red) visually represent different water levels.

**4** **HC-05 Bluetooth Module**

Enables wireless communication between the system and a smartphone for remote monitoring.

# CIRCUIT DESIGN



# Water Level Indication

1

**Level 1**

First yellow LED lights up, indicating the lowest water level detected.

2

**Level 2**

Second yellow LED activates as water rises to the next threshold.

3

**Level 3**

First green LED illuminates, showing water at mid-level in the tank.

4

**Level 4**

Second green LED lights up, indicating the tank is nearly full.

5

**Level 5**

Red LED blinks, signaling the tank has reached maximum capacity.

# Ultrasonic Sensor Operation

1

### Emit Signal

Sensor transmits high-frequency sound pulses towards the water surface.

2

### Receive Echo

Sound waves bounce off the water surface and return to the sensor.

3

### Calculate Distance

Microcontroller measures time between emission and reception to determine water level.

4

### Update Display

Calculated level triggers appropriate LED indicator and updates Bluetooth data.

# Bluetooth Connectivity

### Real-Time Monitoring

HC-05 module transmits live water level data to a paired smartphone.

### Remote Control

Users can activate or deactivate the water pump from their phone.

### Data Logging

Smartphone app stores historical water level data for analysis and trends.

# Automatic Pump Control

### Level Detection

System continuously monitors water level using the ultrasonic sensor.

### Pump Activation

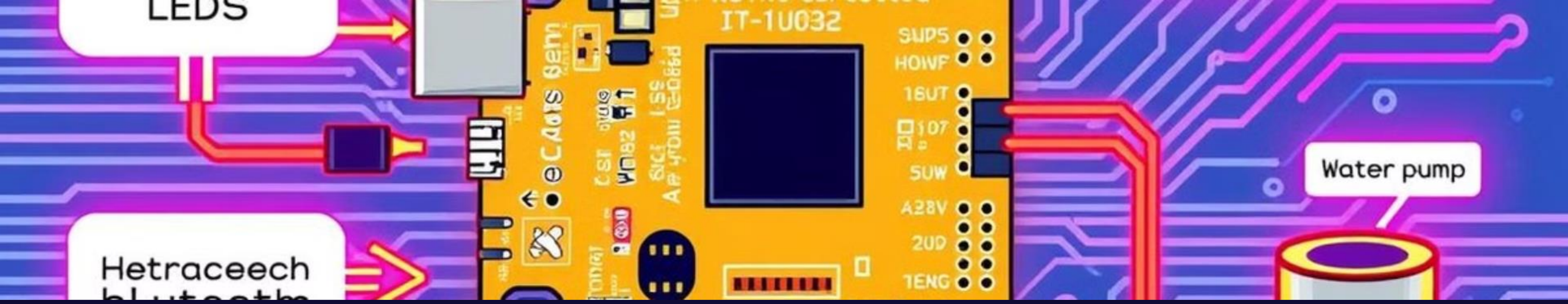
Water pump can be turned on manually via smartphone or automatically when levels are low.

### Full Capacity

When water reaches the fifth level, red LED blinks and pump automatically shuts off.

### Safety Feature

Prevents overflow by ensuring pump stops at maximum capacity, even if remotely activated.




# System Integration

| Component | Connection to STM32F401 |
| --- | --- |
| Ultrasonic Sensor | ECHO: PA0, TRIG: PA1 |
| LEDs | Yellow: PA7, PB1; Green: PA4, PA5; Red: PA6 |
| HC-05 Bluetooth | TX: PA2, RX: PA3 |
| Relay Module | Control: PB0 |

# Applications and Future Enhancements

### Smart Homes

Integrate with home automation systems for efficient water management.

### Agriculture

Monitor and control irrigation systems for optimal crop watering.

### Industrial Use

Implement in manufacturing processes requiring precise liquid level control.

### Cloud Integration

Future update to include cloud storage for data analysis and remote access.