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Development of an Automated Liquid Level Control System Using Arduino Microcontroller

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Abstract - This research presents the development of an automated liquid level monitoring and control system using an Arduino microcontroller. The system utilizes ultrasonic sensors to accurately detect the liquid level within a storage tank, providing real-time data for level indication and automated control. The Arduino serves as the central controller, processing sensor input and managing the operation of pumps and solenoid valves based on pre-defined threshold levels. This ensures efficient and automatic filling, monitoring, and distribution of liquids.

Designed for both residential and industrial applications, the system supports the handling of various liquids, including water, acids, and other chemical solutions. It offers a reliable and hands-free solution for managing liquid storage tanks, reducing human intervention and preventing overflow or dry-run scenarios. The system is scalable, cost-effective, and environmentally friendly, making it suitable for a wide range of fluid management needs.

***Key Words*:** Arduino Microcontroller, Liquid Level Control, Ultrasonic Sensor, Automated Pump Control, Solenoid Valve, Water Level Monitoring, Fluid Management System, Industrial Automation, Smart Tank System, Chemical Storage Monitoring.

1.INTRODUCTION

In modern industrial and domestic settings, automation plays a critical role in improving efficiency, safety, and resource management. The automation of liquid level monitoring and control is essential to reduce manual intervention, prevent wastage, and ensure the optimal operation of fluid-based systems. This project focuses on designing and implementing an automated liquid level control system using an Arduino microcontroller, which integrates various components such as sensors, relays, pumps, and solenoid valves.

The system operates by detecting the liquid level within a storage tank using ultrasonic sensors and transmitting the data to the Arduino. Based on the programmed threshold levels, the Arduino processes this data and triggers actions such as switching on/off pumps or opening/closing solenoid valves. This ensures consistent and efficient control of liquid levels without human supervision.

The proposed system is suitable for a wide range of applications, including industrial plants, schools, hospitals, hotels, pharmaceutical companies, and petroleum and chemical industries, where continuous fluid monitoring is essential. It also provides a cost-effective, scalable, and eco-friendly alternative to traditional manual systems.

1.1 Objective

The primary objective of this project is to develop a smart and automated system capable of: Monitoring real-time liquid levels in storage tanks. Automatically controlling pump and valve operations. Preventing overflow or dry-run conditions. Minimizing human involvement in fluid management processes. Supporting usage in environments where water, fuel, or chemical fluids are used and need to be conserved. This system is particularly beneficial for industries and public places where liquid misuse and wastage are common due to negligence or lack of monitoring personnel.

1.2 Block Diagram Description

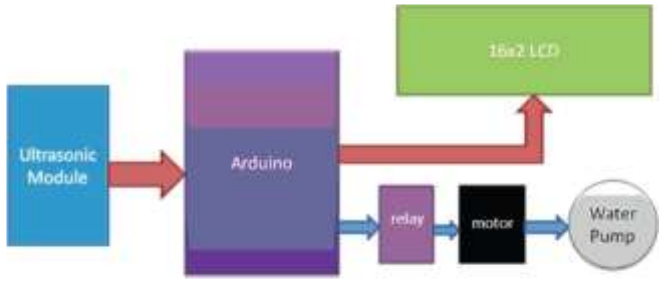

Fig -1: Block Diagram

Components and Data Flow: Ultrasonic Sensor: Detects the liquid level and sends distance data to the Arduino. Arduino Microcontroller: Processes input data and controls output devices LCD Display (16x2): Shows current tank level and system status. Relay Module: Acts as a switch to control high-voltage components like motors and valves. Motor Pump: Turns ON to fill the tank when the level is low. Solenoid Valve: Opens/closes to control liquid flow. LED & Buzzer: Indicate status or trigger alarms during overflow or dry run. Data flow starts from sensing to control, ensuring closed-loop feedback for reliable automation.

1.3 System Layout Description

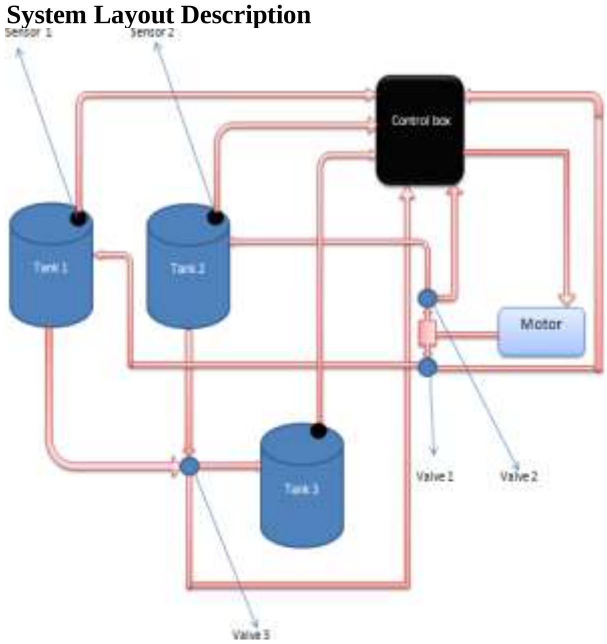

Fig -2: System Layout

Physical Arrangement: Storage tank connected to the motor and solenoid valve. Ultrasonic sensor mounted at the top of the tank. Arduino board interfaced with sensors, relays, LCD, LEDs, and buzzer. Relay module wired to control motor and solenoid valve. LCD and buzzer installed for real-time monitoring and alerts. This layout ensures clear communication between components and compact installation for both small and large setups.

1.4 List of Equipment

Ultrasonic Sensor (HC-SR04): For distance measurement of fluid level. Relay Board (4/8 Channel): To control motor and solenoid valve. Arduino UNO: Main controller for the system. LED Indicators: Show system status visually. Buzzer: Audible alarm for alert conditions. Connecting Wires: For circuit interconnection. 16x2 LCD Display: Real-time level indicator. Motor Pump: Controls water or fluid flow into the tank. Solenoid Valve: Controls fluid output or transfer.

1.5 Features of the System

- Easy to Implement: Straightforward setup with basic components.
- Highly Reliable: Accurate control and monitoring with minimal errors.
- User-Friendly: Visual and sound indicators make it easy to operate.
- Affordable: Cost-effective compared to industrial-grade systems.
- Accurate and Sensitive: Reliable sensor readings.
- Low Maintenance: Durable components require minimal servicing.
- Scalable Design: Can be expanded for multiple tanks or higher capacities.

2. LITERATURE REVIEW

Baihaqi Siregar, Krisna Menen, Syahril Efendi, Ulfi Andayani, Fahmi Fahmi [1], "*Monitoring Quality Standard of Waste Water using Wireless Sensor Network Technology for Smart Environ"*, Water is a vital natural resource essential for sustaining life, and its quality is significantly affected by the presence of wastewater in the environment. To ensure environmental safety, wastewater must comply with regulatory quality standards. Conventional laboratory-based testing methods for monitoring water quality are often time-consuming and costly. To address this, the present study introduces a real-time, cost-effective wastewater monitoring system based on a wireless sensor network. The system integrates a Waspmote microcontroller board with a smart water sensor module comprising pH, conductivity, dissolved oxygen, and temperature sensors. For data transmission to the server, a 3G communication module is utilized. The collected sensor data is stored in a database and visualized through a web-based dashboard. During a 12-hour testing period, average pH values at upstream, midstream, and downstream points were recorded as 7.5, 7.7, and 7.0 respectively. Corresponding conductivity values were 201.5 mmhos/cm, 122.6 mmhos/cm, and 866.5 mmhos/cm, while dissolved oxygen levels averaged 56.5%, 64.9%, and 36.1%. Water temperature readings were relatively stable at 30.7°C, 30.6°C, and 30.8°C. The system also includes an alert feature that notifies users when parameter values exceed predefined thresholds, enabling prompt corrective action. This smart monitoring approach offers an efficient solution for maintaining wastewater quality within acceptable limits [1].

Jailsingh Bhookya, M. Vijaya Kumar, J. Ravi Kumar, A. Seshagiri Rao [2], *"Implementation of PID controller for liquid level system using mGWO and integration of IoT application."* Industrial automation is a dynamic and interdisciplinary field that continues to advance rapidly. This study presents an IoT-enabled solution for real-time monitoring and control of liquid levels in a single-tank system. A Proportional-Integral-Derivative (PID) controller is employed to regulate the liquid level, with its parameters (Kp, Ki, and Kd) optimally tuned using a modified Grey Wolf Optimization (mGWO) algorithm. The controller is implemented on an ESP32 microcontroller, and an Android-based user interface is developed using the Blynk platform to facilitate remote control and monitoring. The mGWO algorithm is executed in MATLAB to determine the optimal PID gains, while the Arduino IDE is used for programming the microcontroller and integrating it with the mobile application. Experimental results demonstrate that the proposed system using mGWO-based tuning achieves superior control performance when compared to conventional Ziegler–Nichols and SIMC methods. Additionally, the incorporation of IoT technology enhances the system's flexibility and accessibility, offering an efficient approach for intelligent process control [2].

Sathish Pasika, Sai Teja Gandlar [3], "*Smart water quality monitoring system with cost-effective using IoT*.", Advancements in wireless communication are significantly enhancing the capabilities of sensor-based technologies. These innovations play a vital role in environmental monitoring, particularly in the context of water quality assessment. The Internet of Things (IoT) facilitates seamless interaction among diverse devices, enabling real-time data collection and exchange. Beyond industrial automation, IoT—under the umbrella of Industry 4.0—has extended its impact to critical environmental challenges. Given that access to clean water is essential for human health, with nearly 40% of global deaths linked to waterborne diseases, there is an urgent need for reliable systems to monitor and ensure safe water supply in both urban and rural areas. This study presents a cost-effective IoT-based Water Quality Monitoring (WQM) system aimed at continuously evaluating drinking water standards. The system integrates multiple sensors to monitor key parameters such as pH level, turbidity, water level, ambient temperature, and humidity. A microcontroller processes the sensor data, which is then transmitted to a cloud platform using the Think Speak IoT application. This approach allows for remote, real-time tracking of water quality, supporting timely interventions and improved public health outcomes [3].

Sai Sreekar Siddula, Phaneendra Babu, P.C. Jain. Panayiotou, and Marios M. Polycarpou [12], "*Water Level Monitoring and Management of Dams using IoT*", India's historical, cultural, and socioeconomic development has long been intertwined with its water resources, particularly those managed through dams. These structures are vital for supplying water to industries, agriculture, livestock, and domestic use. Ensuring the safety and optimal management of water levels in dams is crucial in the face of both natural disasters and human-induced risks. This study presents a conceptual framework for an IoT-based Water Level Management System aimed at enhancing the efficiency and security of dam operations. The proposed system utilizes a network of sensors to collect real-time water level data, which is transmitted via long-range communication to a centralized control center. Based on the received data, the control center can make informed decisions regarding the operation of dam gates—whether to release or retain water—thereby centralizing and automating dam management across the nation. This approach not only improves response time but also supports sustainable water resource management and disaster mitigation [12].

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3. SYSTEM DESIGN AND METHODOLOGY

3.1 Hardware Components

- **Arduino Microcontroller**: Serves as the central processing unit, handling sensor data and controlling actuators.
- **Ultrasonic Sensor (HC-SR04)**: Measures the distance to the liquid surface, providing real-time level data.
- **Solenoid Valve**: Controls the flow of liquid into the tank based on level readings.
- **Relay Module**: Acts as an interface between the Arduino and the solenoid valve, enabling safe control of the valve.
- **LCD Display**: Displays the current liquid level for user monitoring.

3.2 Software Implementation

The system is programmed using the Arduino IDE, employing the following logic:

- **Sensor Calibration**: Calibrate the ultrasonic sensor to ensure accurate distance measurements.
- **Level Detection**: Continuously monitor the distance to the liquid surface to determine the current level.
- **Control Logic**: Activate the solenoid valve when the liquid level falls below a predefined threshold and deactivate it when the desired level is reached.
- **Display Update**: Regularly update the LCD display to reflect the current liquid level.

3.3 Description of Block Diagram

a. Ultrasonic Sensor:

The sonic waves emitted by the transducer are reflected by an object and received back in the transducer. After having emitted the sound waves, the ultrasonic sensor will switch to receive mode. The time elapsed between emitting and receiving is proportional to the distance of the object from the sensor.

b. Relay Board:

It is an electrically operate switch. Many relays use an electromagnet to operate switching operation mechanically. It is 5 terminal devices consisting of one coil. When coil is energized then a slit is moves from one to another point. It use as a tripping device to give analog command.

c. Led:

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode, which emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons**.**

d. Buzzer:

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

e. 16x2 Lcd Display:

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

f. Arduino:

Arduino is easily useful as hardware and software; it is open-source electronics. It is created interactivity with objects or environments for interesting peoples like artists, designers, hobbyists etc. It is mostly useful for automation with variety of sensors to give input from environment, and it can control equipment. The programming is required for operated Arduino with programming language (based on wiring) and development environment (based on processing).

The board can be made by ourselves or purchased; the software easily available (free download).

g. Motor:

A DC motor is any motor within a class of electrical machines whereby direct current electrical power is converted into mechanical power. Most often, this type of motor relies on forces that magnetic fields produce. Regardless of the type, DC motors have some kind of internal mechanism, which is electronic or electromechanical. In both cases, the direction of current flow in part of the motor is changed periodically.

h. Connecting Wire:

The different types of wire are needed like telephone wire, male-female wire for arduino and relay connection.

i. Solenoid Valve:

The solenoid assembly consists of a coil, plunger, and sleeve assembly. In a normally closed valve, a plunger return spring holds the plunger against the orifice, preventing flow through the valve. When the coil is energized, a magnetic field is produced, raising the plunger and allowing flow through the valve.

3.4 Component Description

a. Ultra-Sonic Sensor:

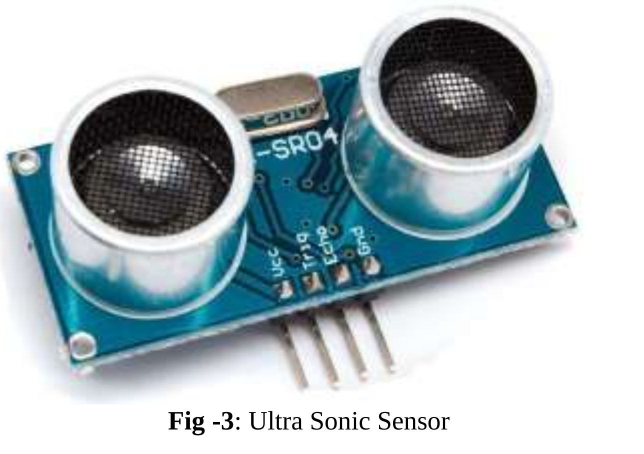

Fig -3: Ultra Sonic Sensor

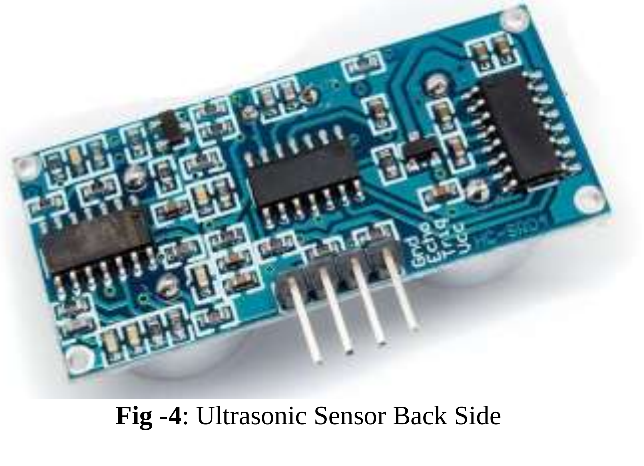

Fig -4: Ultrasonic Sensor Back Side

The ultrasonic sensor sends out a high-frequency sound pulse and then times how long it takes for the echo of sound to reflect back. The sensor has 2 opening on its front. One opening transmit ultrasonic wave like a speaker the other receive them like a microphone.
The speed of sound is approximately 341 meters (1100 feet) per second in air. The ultrasonic sensor uses this information along with the time difference between sending and receiving the sound pulse to determine the distance to an object. It uses the following mathematically equation distance = time X speed of sound divided by 2 times= the time between when and ultrasonic wave is transmitted and when it is received you divide this number by 2 because the sound wave has to travel to the object and back.

b. Relay Board:

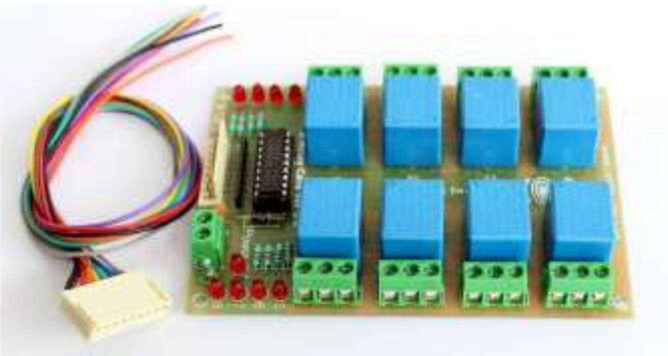

Fig - 5.: Relay board

It is an electrically operate switch many relays use an electromagnet to operate switching operation mechanically. It is five terminal device is consisting of one coil. When coil is energized then a slit is moves from one point to another point. It uses as a tripping device to gives analogy command. As per the requirement of load relay are used.

Features:

1. Input high level voltage 2 to 5 volt.
2. Hysteresis input to improve noise immunity.
3. Ideal for ATMEL, AVR, PLC, PHILLIPS, Intel based microcontroller.
4. Switching 12-volt relay

c. Solenoid Valve:

Fig - 6: Solenoid Valve

A solenoid valve is an electromechanical control valve. The valve features a solenoid, which is an electrical coil with a movable ferromagnetic core in its center. This core is called the plunger. In rest position, the plunger closes off a small orifice. An electrical current through the coil creates a magnetic field. The magnetic field exerts a force on the plunger. As a result, the plunger is pulled towards the center of the coil so that the orifice opens. This is the basic principle that is used to open and closed solenoid valve.

"A solenoid valve is an electromechanical actuated valve to control the flow of liquid or gases."

d. Buzzer:

Fig - 7: Buzzer

A buzzer is a mechanical, electromechanical, magnetic, electromagnetic, electro-acoustic or piezoelectric audio signal device. A piezoelectric buzzer can be driven by an oscillating electronic circuit or other audio signal source. Buzzer gives the notification that the tank is ready to use.

Application:

1. Alarm device
2. Timer
3. Confirmation of user input
4. Household application

e. Led:

Fig – 8: Led

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a PN junction diode, which emits light when activated. When a suitable voltage is applied to the lead's electrons are able to recombine with electron holes with in the device, releasing energy in the photons in the form of photons. This effect is called electro luminescence, and the colour of the light is determined by the energy band gap of the semiconductor.
A LED is regularly little In area (<1mm2) and coordinated optical parts might be utilized to shape its radian design. Driven where regularly utilized as indicator lamps for electronic device replacing little in candescent bulb.

f. 16x2 LCD display:

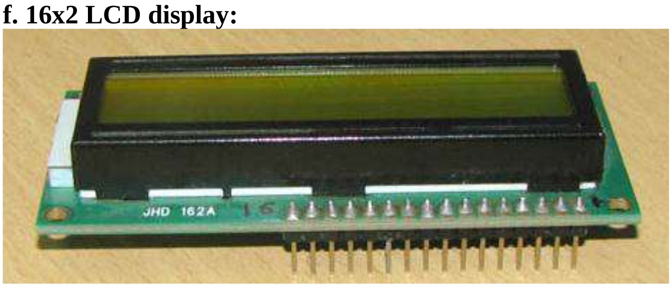

Fig -9: 16x2 LCD display

LCD (liquid crystal display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is a very basic module and is a very commonly used in very devices and circuit. This module are preferred more over 7 segment. The reasons being LCD are economical; easily programmable; have no limitation of displaying special and even custom characters unlike in seven segments animation.

A16x2 LCD means it can display 16 character or line and there are such 2 lines. In LCD each character is displayed in 5x7 pixel matrix this LCD has 2 resistors mainly command and data.

G. Motor:

Fig -10: Motor

Motor is an electrical device which is used for transmission of water from lower level to higher level. Its require dc power supply for their operation. Its absorb water from one side and throughout water from other side. Small DC water pumps push fluid to the surface as opposed to jet pumps having to pull fluids.

Application:

1. Drainage
2. Sewage pumping
3. General industrial pumping
4. Slurry pumping

3.5 Operation of Component

a. Ultrasonic sensor:

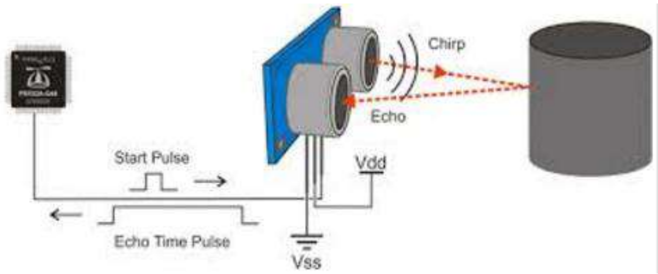

Fig -11: Operation of ultrasonic sensor

Operation and configuration of ultrasonic sensor an uncommon sonic transducer is utilized for the ultrasonic proximity sensor which takes into account exchange transmission and gathering of sound waves. The sonic wave discharged by the transducer are reflected by an item and got back in the transducer.

After having emitted the sound wave the ultrasonic sensor will switch to received mode the time slipped by among emanating and getting is relative to the distance of the article from the sensor.

b. Arduino:

Arduino is an open-source project that make micro controller-based kit for building digital device and interactive object that can sense and control physical device. The project is based micro controller board design, produce by few merchants utilizing various micro controller. These systems provide set of digital and analog input output pins that can interface to various expansion board and other circuit. The boards feature serial communication interface, including serial bus on some models, for loading programs from personal computers. For programming micro controller, the Arduino project provides an integrated development environment based on a programming language named processing, which a support language c and c++.

Its take analog signal from ultrasonic sensor and gives digital output to relay board for controlling valve and motor. It's works on the basis of different programming at the requirement of places. The programming is required for operated arduino with programming language based on wiring.

c. Relay Board:

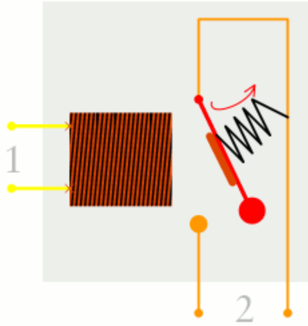

Fig -12: Operation of relay

When power flow through the first circuit 1. it activates the electromagnet, generating a magnetic field that attract a contact and activates the second circuit 2. When the power is switched off a spring pules the contact backup to its original position, switching the second circuit off again.

This is an example of normally open relay. The contact in the second circuit is not connected by default, switched on only when a current flow through the magnet. Other relay is normally closed and switched off only when the magnet is activated, pulling or pushing the contact apart. Normally open relay is most common.

d. Solenoid Valve:

Solenoid valve is an electro mechanical device. Which contain solenoid coil the coil is energized and de-energized whenever energy source are applied across to the coil. When coil is energized valve would be open and coil is de-energized then valve is closed. It's is used to control the flow of liquid or gases in a positive, fully closed or fully open mode. The valve is commonly used to replace a natural valve or were remote-control desirable. A solenoid is operated by opening and closing and orifice in a valve body that permits or prevents flow through the valve.

d. Led:

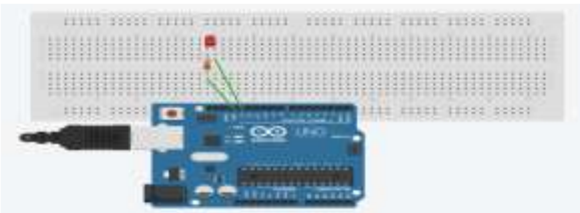

Fig -13: LED blinking

As shown in figure we can show LED blink is easily done programming for blinking LED.

```
Void setup ()
{
PinMode (13, OUTPUT);
}
Void loop ()
{
digital write (13, HIGH);
```

```
delay (1000);
digitalwrite (13, LOW);
delay (1000);
}
```

e. 16 x 2 Lcd Display:

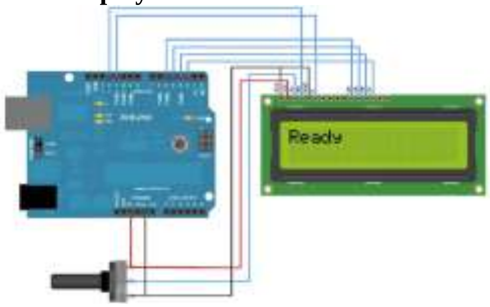

Fig -14: LCD interface

As shown in we can interface LCD display. Programming for LCD:

```
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
void setup ()
{
lcd.begin(16, 2);
lcd.print("Ready"); }
void loop()
{
lcd.setCursor(0, 1);
lcd.print(millis() / 1000);
}
```

f. Buzzer:

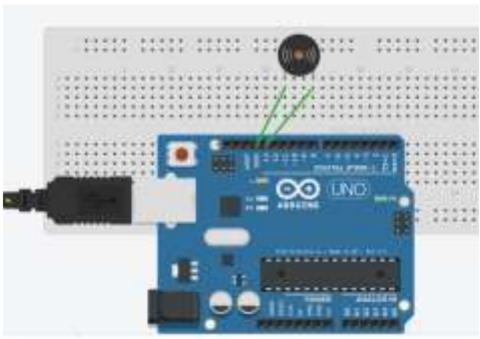

Fig -15: Buzzer interface

Programming for buzzer:

```
Int buzzer = 13;
void setup()
{
pinMode (buzzer, OUTPUT);
}
void loop ()
{
digitalWrite (buzzer, HIGH);
delay (1000);
digitalWrite (buzzer, LOW);
delay (1000);
}
```

3.6 Arduino Controller

a. At Mega-328:

Arduino is easily useful as hardware and software; it is open-source electronics. It is created interactivity with objects or environments for interesting peoples like artists, designers, hobbyists etc. It is mostly useful for automation with variety of sensors to give input from environment, and it can control lights, fans and other actuators. The programming is required for operated Arduino with programming language (based on wiring) and development environment (based on processing). The board can be made by ourselves or purchased; the software easily available (free download). The hardware reference designs (CAD files) are available under an open-source license.

b. Pin Description:

Let's take a quick tour of the Uno. Starting at the left side of the board, you'll see two connectors

This connects the board to your computer for three reasons:

1) to supply power to the board

2) to upload your instructions to the Arduino

3) to send data to and receive it from a computer

- At the lower middle is the heart of the board: the microcontroller. The microcontroller is the "brains" of the Arduino. It is a tiny computer that contains a processor to execute instructions, includes various types of memory to hold data and instructions from our sketches, and provides various avenues of sending and receiving data.
- Just below the microcontroller are two rows of small sockets. The first row offers power connections and the ability to use an external RESET button. The second row offers six analog inputs that are used to measure electrical signals that vary in voltage. Pins A4 and A5 can also be used for sending data to and receiving it from other devices.
- Along the top of the board are two more rows of sockets. Sockets (or pins) numbered 0 to 13 are digital input/output (I/O) pins. They can either detect whether or not an electrical signal is present or generate a signal on command. Pins 0 and 1 are also known as the serial port, which is used to send and receive data to other devices, such as a computer via the USB connector circuitry. The pins labelled with a tilde (~) can also generate a varying electrical signal, which can be useful for such things as creating lighting effects or controlling electric motors.
- Next are some very useful devices called light-emitting diodes (LEDs). The Arduino board has four LEDs: one on the far right labelled ON, which indicates when the board has power. The LEDs labelled TX and RX light up when data is being transmitted or received between the Arduino and attached devices via the serial port and USB. The L LED is for your own use (it is connected to the digital I/O pin number 13). The little black square part to the left of the LEDs is a tiny microcontroller that controls the USB interface that allows your Arduino to send data to and receive it from a computer. And, finally, the RESET button as with a normal computer, sometimes things can go wrong with the Arduino, and when all else fails, you might need to reset the system and restart your Arduino. This simple RESET button on the board is used to restart the system to resolve these problems

Features

- High Performance, Low Power AVR® 8-Bit Microcontroller
- Advanced RISC Architecture
  - 131 Powerful Instructions – Most Single Clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Fully Static Operation
  - Up to 20 MIPS Throughput at 20 MHz
  - On-chip 2-cycle Multiplier
- High Endurance Non-volatile Memory Segments
  - 32K Bytes of In-System Self-Programmable Flash program memory (ATmega328P)

   - 1K Bytes EEPROM (ATmega328P)
   - 2K Bytes Internal SRAM (ATmega328P)
   - Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
   - Data retention: 20 years at 85°C/100 years at 25°C
   - Optional Boot Code Section with Independent Lock Bits
   - In-System Programming by On-chip Boot Program True Read-While-Write Operation
   - Programming Lock for Software Security
- Peripheral Features
   - Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode
   - One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
   - Real Time Counter with Separate Oscillator
   - Six PWM Channels
   - 8-channel 10-bit ADC in TQFP and QFN/MLF package Temperature Measurement
   - 6-channel 10-bit ADC in PDIP Package Temperature Measurement
   - Programmable Serial USART
   - Master/Slave SPI Serial Interface
   - Byte-oriented 2-wire Serial Interface (Philips I2C compatible)
   - Programmable Watchdog Timer with Separate On-chip Oscillator
   - On-chip Analog Comparator
   - Interrupt and Wake-up on Pin Change
- Special Microcontroller Features
   - Power-on Reset and Programmable Brown-out Detection
   - Internal Calibrated Oscillator
   - External and Internal Interrupt Sources
   - Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and Extended Standby
- I/O and Packages
   - 23 Programmable I/O Lines
   - 28-pin PDIP, 32-lead TQFP, 28-pad QFN/MLF and 32-pad QFN/MLF
   - Operating Voltage:
   - 1.8 - 5.5V for ATmega328P
- Temperature Range:
   - -40°C to 85°C
- Speed Grade:
   - 0 - 20 MHz @ 1.8 - 5.5V
   - Low Power Consumption at 1 MHz, 1.8V, 25°C for ATmega328P:
   - Active Mode: 0.2 mA
   - Power-down Mode: 0.1 µA
   - Power-save Mode: 0.75 µA (Including 32 kHz RTC)

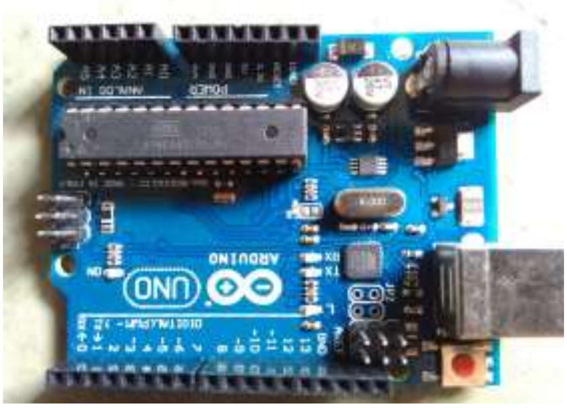

Fig -16: ARDUINO AT mega 328

c. Pin Diagram of At Mega-328:

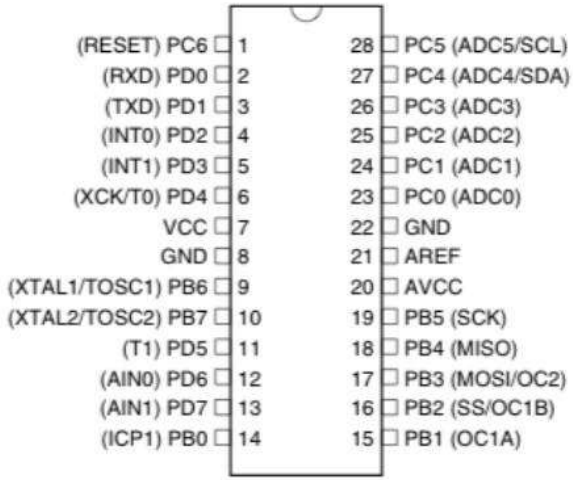

Fig -17: Pin diagram of AT mega-328

4. Results and Discussion

The system was tested under various conditions to evaluate its performance. Preliminary results indicate that the system accurately detects liquid levels and effectively controls the solenoid valve, maintaining the tank at the desired level. The LCD display provides real-time feedback, enhancing user interaction. Challenges encountered included sensor calibration and ensuring reliable valve operation under varying voltage conditions. Future improvements will focus on enhancing sensor accuracy and integrating wireless communication for remote monitoring.

5. Conclusion

This research demonstrates the feasibility of using an Arduino-based automated liquid level control system for efficient tank management. The integration of ultrasonic sensors and microcontroller technology provides a cost-effective and reliable solution for liquid level monitoring and control. The system's scalability allows for adaptation across various applications, from domestic water tanks to industrial chemical storage.

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