IOT BASED SMART PETROL PUMPS

PROJECT PHASE 2 REPORT

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to

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In ELECTRONICS AND COMMUNICATION
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VIMAL JYOTHI ENGINEERING COLLEGE

CHEMPERI

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DECLARATION

We undersigned hereby declare that the main project PHASE 2 report "**IOT BASED SMART PETROL PUMPS"**, submitted for partial fulfillment of the requirement for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by us under the supervision of **Ms.ANUSHA CHACKO.**The submission represents our ideas in our own words and where the ideas or words of others have been included; we have adequately and accurately cited and referenced the original sources. We also declare and we have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in our submission. We understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other university.

Place: Chemperi
Date: 11-03-25

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BONAFIDE CERTIFICATE

This is to certify that the main project phase 2 report entitled "**IOT BASED SMART PETROL PUMPS**" , submitted by **ALANTA GEORGE, ANN MARIYA CHACKO, NAVYA T, VISMAYA C** to the A P J Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in **ELECTRONICS AND COMMUNICATION ENGINEERING** is a bonafide record of the Project work carried out by them under our guidance . This report in any form has not been submitted to any University or Institute for any purpose.

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ABSTRACT

This project emerges as a groundbreaking project poised to transform the landscape of fuel dispensing in Indian petrol pumps. With a resolute aim to combat prevalent fuel scams, improve dispense quality, and introduce real-time monitoring, our project holds the promise of reshaping the conventional fueling process. The critical motivation behind this initiative lies in the need for increased transparency, accuracy,and efficiency within the petrol pump industry. As fuel scams persist and customers demand a more reliable and secure experience, this project becomes an imperative solution for current challenges and a visionary project anticipating the inevitable shift towards alternative fuel sources.

A comprehensive literature survey forms the bedrock of our project, delving into existing challenges in fuel dispensing systems, inefficiencies, and potential solutions explored by other researchers. This survey not only provides valuable insights but also guides the decision-making process for the project's methodology and component selection.Informed by the literature survey, this project strategically selects components such as the ESP32 controller, DC motor pump, flow sensor,Rotary encoder, Ultra sonic range finder, LED indicators, LCDdisplay, buzzer, nozzle , and IOT blynk software app.

The methodology for implementing the project revolves around the seamless integration of these components, ensuring an intuitive and reliable fuel dispensing system. By addressing challenges identified in the literature survey, our project sets out to establish a robust foundation in the initial phase, creating a roadmap for subsequent developments. Through a meticulous approach to component selection and methodology, the project not only rectifies current challenges but also positions itself at the forefront of innovation in the fuel dispensing industry.

This project envisions a future where fuel dispensing is characterized by unprecedented efficiency, transparency, and control. Our goals include the seamless remote update of fuel prices across all pumps, ensuring competitiveness and responsiveness to market fluctuations. Precision in dispensing quantities, coupled with real-time monitoring, forms the cornerstone of our objectives, fostering trust between customers and petrol pump operators. Monitoring total fuel sold provides valuable insights for operational management. The implementation of area-based price setting within seconds eliminates manual interventions, promoting accuracy and speed.The integration of a smartphone application empowers users with control over the dispensing process, creating a user-friendly and secure experience.

CONTENTS

LIST OF FIGURES

ABBREVIATIONS

DC	-	Direct Current
ESP	-	Extra Sensory Perception
IoT	-	Internet of Things
LCD	-	Liquid Crystal Display
Wifi	-	Wireless Fidelity

CHAPTER 1

INTRODUCTION

In an era defined by technological advancements, this project emerges as a pioneering project aimed at redefining the traditional paradigm of fuel dispensing in Indian petrol pumps. Focused on addressing persistent challenges such as fuel scams, dispense quality inefficiencies, and the demand for real-time monitoring, this project stands as a testament to our commitment to technological innovation. By leveraging cutting-edge components and a strategic methodology, our project aspires not only to rectify current challenges but also to anticipate and adapt to the evolving landscape of alternative fuel sources.

This project encapsulates a comprehensive approach to revolutionizing the fuel dispensing experience. At its core, the project envisions an intelligent and transparent system that goes beyond the mundane task of delivering fuel. Through the integration of components like the ESP32 controller, DC motor pump, and advanced monitoring systems, this project seeks to introduce real-time data insights, empower customers with control, and significantly reduce operational inefficiencies. With a clear focus on technological excellence, this project aims to set new standards in the petrol pump industry, ensuring a secure, efficient, and customer-centric fueling process.The genesis of this project finds its roots in the persistent challenges faced by the Indian petrol pump industry. The prevalence of fuel scams, inconsistencies in dispense quality, and the lack of real-time monitoring mechanisms have underscored the need for a transformative solution. The project's motivation also stems from the increasing demand for secure, efficient, and technology-driven fuel dispensing experiences. As the automotive industry undergoes a shift towards alternative fuel sources, the project positions itself not only as a remedy to current challenges but as a visionary project prepared to meet the future needs of the evolving energy landscape.

1.1 OBJECTIVES

The primary objectives of the project are multi-faceted, addressing crucial aspects of the current fuel dispensing landscape. Foremost, our goal is to combat prevalent fuel scams through the implementation of a secure and transparent system. We aim to enhance dispense quality by introducing precise monitoring mechanisms, ensuring customers receive the accurate amount of fuel they pay for.Real-time monitoring forms a cornerstone objective, providing both customers and petrol pump operators with invaluable insights into dispensing activities.

Simultaneously,the project seeks to reduce operational dependency on human resources by introducing smart, automated features, thereby minimizing the need for excessive personnel. The implementation of area-based price settings within seconds, remote price updates, and prevention of unauthorized price configuration align with our overarching objective of creating an intelligent and responsive fuel dispensing system. Through these objectives,this project strives not only to rectify current challenges but to set new benchmarks for efficiency, security, and innovation in the fuel dispensing industry.

1.2 SCOPE

It introduces a smart, automated fuel dispensing mechanism designed to enhance transparency, accuracy, and efficiency at Indian petrol pumps. This system eliminates the need for manual operation and enables customers to manage the fuel dispensing process themselves through a smartphone application.Automated dispensing,Fuel Quality and Monitoring,Fuel Availability Alerts,Smartphone Integration are some key features.

1.3 APPLICATION

This project introduces an innovative smart, automated fuel dispensing mechanism designed to revolutionize the fuel dispensing process at Indian petrol pumps. This system prioritizes transparency, accuracy, and efficiency by eliminating the need for manual operation, empowering customers to take control of the fuel dispensing process directly through a smartphone application. Key features include automated dispensing for seamless fueling, real-time fuel quality and quantity monitoring for enhanced transparency and security, fuel availability alerts to keep customers informed, and seamless smartphone integration for a user-friendly experience. This system aims to redefine the fuel dispensing experience, offering customers greater convenience, control, and peace of mind.

CHAPTER 2

LITERATURE SURVEY

1.**IoT Based Smart Petrol Pump ,Punit Gupta, Sawan Patodiya, Digvijay Singh, Jasmeet Chabra,2016 Fourth International Conference on Parallel, Distributed and Grid Computing (PDGC)**

This paper explores the integration of Internet of Things (IoT) technologies in optimizing petrol station operations. It focuses on enhancing user experience and operational efficiency through automated fuel dispensing, real-time monitoring of fuel levels, and transaction management.The system utilizes sensors and connected devices to monitor fuel levels in real time, ensuring optimal stock management and preventing outages The proposed system aims to reduce human error, streamline services, and provide valuable data analytics for better decision-making, ultimately transforming traditional petrol pumps into smart, connected stations. Additionally, it features a mobile application for customers, enabling them to view pump availability, make cashless transactions, and receive notifications about promotions or loyalty rewards.The integration of data analytics allows operators to gather insights on fuel consumption patterns and customer behavior, facilitating informed decision-making for inventory management and marketing strategies. Overall, the paper highlights the potential of IoT to enhance operational efficiency, improve customer service, and modernize the traditional petrol station experience.

2.**Smart fuel station controlling system,Mohammed Saheed Hoseen,Naeemul Islam,Md Kosar IOP Conference Series Earth and Environmental Science, December 2020**

The authors propose a comprehensive smart system that leverages Internet of Things (IoT) devices to automate various processes within fuel stations. Key features of the system include automated fuel dispensing, which significantly reduces the need for manual intervention, and real-time monitoring of fuel levels, enabling timely refueling and preventing stockouts. Additionally, the system incorporates a user-friendly mobile application, allowing customers to view fuel prices, make cashless transactions, and receive updates on promotions or loyalty programs.The paper highlights the benefits of enhanced data analytics for fuel consumption tracking and customer behavior analysis, which aid in efficient inventory management and strategic planning for operators. Moreover, the authors discuss the environmental implications of the system, emphasizing its potential to integrate renewable energy sources and promote sustainable practices within the fuel industry. Overall, this smart fuel station system represents a significant step toward modernizing fuel distribution, improving customer experiences, and contributing to environmental sustainability.

3.**Fuel Monitoring on tanks for level detection and purity check,Vivek Patil,Yash Belgaonkar, Vaibhav Shirwadkar,Varun Deshpande;Journal of Research in Engineering and Applied Sciences,April 2019**

This paper provides on developing a reliable solution that utilizes sensors and IoT technology to provide real-time data on fuel levels, ensuring efficient inventory management and preventing issues related to overflows or shortages. In addition to level detection, the system is designed to conduct purity checks, which are crucial for maintaining the quality of fuel stored. This aspect is particularly important for identifying contamination or adulteration, which can affect engine performance and safety.The paper details the technical framework of the monitoring system, including the types of sensors used and the data transmission methods employed to ensure accurate and timely information retrieval. By integrating both level detection and purity monitoring, the proposed solution aims to enhance operational efficiency for fuel storage facilities, improve safety measures, and reduce the economic losses associated with fuel contamination.

4.**Design & Implementation of Intelligent System for Identification of Fuel Fraudulents and Near By Fuel StationsDr. M. Kathirvelu International Journal of Recent Technology and Engineering (IJRTE),2019**

The author presents an intelligent system that utilizes advanced algorithms and data analytics to identify fraudulent activities related to fuel sales, such as discrepancies in fuel dispensing and pricing anomalies. By leveraging real-time data from fuel stations and implementing machine learning techniques, the system aims to detect patterns indicative of fraud, thereby increasing transparency and trust within the fuel distribution network.Additionally, the system features a user-friendly interface that enables customers to locate nearby fuel stations, view fuel prices, and access information about the quality of service. This dual functionality not only helps in minimizing fraudulent transactions but also enhances the overall customer experience by providing essential information at their fingertips.

CHAPTER 3

PROBLEM DEFINITION

An IoT-based smart petrol pumps aims to revolutionize the fuel dispensing industry by addressing critical challenges such as manual operations, security vulnerabilities, and inefficient inventory management. By leveraging IoT technology, these systems enable real-time monitoring of fuel levels, flow rates, and sales data. Automated dispensing, secure payment processing, and remote control capabilities enhance operational efficiency and reduce human error. Additionally, predictive maintenance and fraud detection features contribute to cost savings and security. Ultimately, IoT-powered smart petrol pumps offer a sustainable solution that improves customer experience, reduces environmental impact, and boosts overall profitability.

The key challenges addressed are:

- Automating Operations: Automating fuel dispensing, payment processing, and inventory management.
- Enhancing Security: Implementing robust security measures to protect against theft, fraud, and unauthorized access.
- Enabling Real-time Monitoring: Providing real-time insights into fuel levels, sales, and operational metrics.
- Optimizing Inventory Management: Leveraging data analytics to optimize stock levels and reduce wastage.
- Promoting Environmental Sustainability: Reducing fuel spillage and monitoring emissions.

CHAPTER - 4

METHODOLOGY

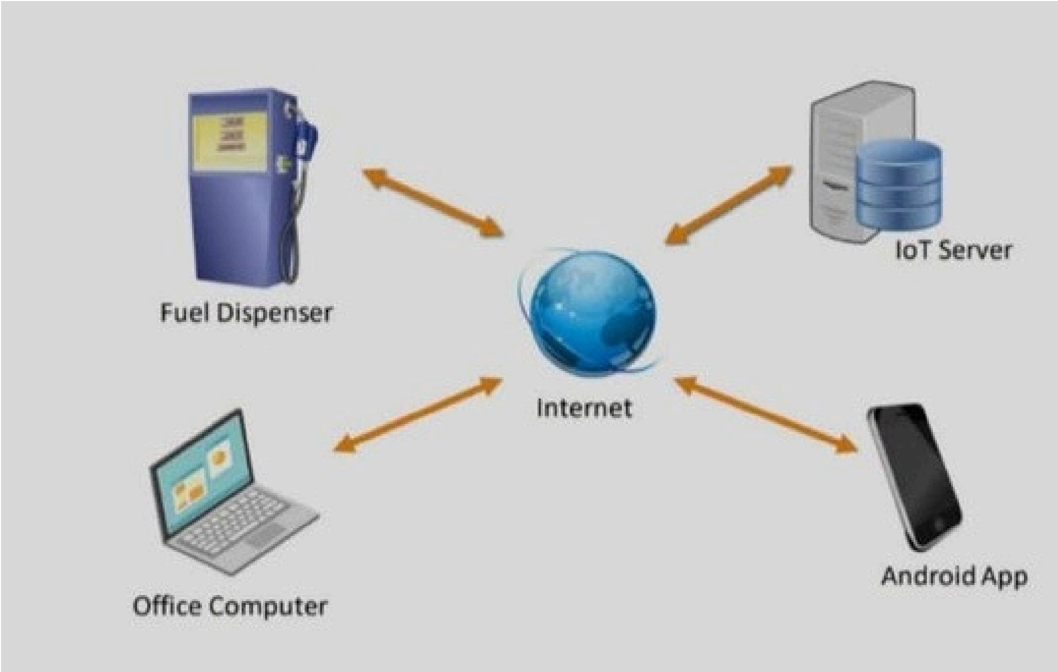

Fig :4 Methodology

The image illustrates the methodology of an IoT-based smart petrol pump system. This system leverages the power of the Internet of Things (IoT) to streamline fuel management and provide valuable insights for efficient operations.

At the heart of the system lies the fuel dispenser, equipped with sensors to monitor fuel levels, flow rates, and other relevant parameters. These sensors collect real-time data on fuel usage and inventory. The collected data is then transmitted wirelessly over the internet to the IoT server.

The IoT server acts as a central hub for data processing and storage. It receives and analyzes the incoming data to generate valuable insights, such as fuel consumption patterns, inventory levels, and sales reports. These insights empower station owners and managers to make informed decisions regarding fuel procurement, pricing, and operational optimization.

The processed data is accessible through two primary interfaces:

1) Office Computer: The office computer displays real-time data and generates detailed reports, providing a comprehensive overview of the fuel station's operations. This enables station staff to monitor fuel levels, track sales, and identify potential issues.
2) Android App: The Android app offers a mobile-friendly interface for authorized personnel to remotely monitor and control the fuel station. It provides access to real-time data, generates reports, and enables remote management of the fuel dispenser.

By integrating IoT technology, this smart petrol pump system enhances efficiency, reduces operational costs, and improves overall fuel management. It provides real-time monitoring, accurate inventory management, remote control capabilities, data-driven decision-making, and enhanced security measures. This innovative approach empowers station owners and managers to optimize their operations and deliver better services to their customers.

CHAPTER 5

WORKING PRINCIPLE

The automated fuel dispensing system operates by integrating various sensors, a microcontroller, and IoT functionality to enhance the efficiency and automation of fuel supply stations. The process begins when a user inputs the desired fuel quantity using a keyboard, which is then processed by the Arduino Uno microcontroller. This input is communicated to the ESP32 Wi-Fi client, which facilitates IoT connectivity for remote monitoring and control. Once the input is received, the system activates the fuel dispensing nozzle, allowing fuel to flow while a flow sensor continuously measures the dispensed volume and displays the real-time flow rate on an LCD screen. To ensure precise dispensing, the system monitors the fuel volume in real-time and automatically stops the nozzle when the specified quantity has been reached, preventing wastage and inaccuracies. Additionally, a turbidity sensor is integrated into the system to assess fuel quality, detecting any potential contamination and ensuring that only clean fuel is supplied to customers. To further enhance automation, an ultrasonic sensor is placed within the storage tank to continuously monitor fuel levels. When the fuel volume drops below a predefined threshold, the system automatically triggers notifications to fuel suppliers, ensuring timely replenishment and preventing stock shortages. Through IoT integration, users can access a dedicated application to check the real-time location of fuel stations and the current fuel stock availability, providing convenience and operational transparency. The incorporation of these technologies streamlines the fuel dispensing process, minimizes human intervention, enhances accuracy, and ensures efficient fuel management, making it a highly effective solution for modern fuel supply stations.

CHAPTER 6

COMPONENTS REQUIRED

In order to implement any product, there are some tools required to do it. And the tools that used to implement a product are called the implementation tool. The software and hardware tool can be pointed out as:

6.1 HARDWARE REQUIRED

6.1.1 ESP32 MODULE

The ESP32 is a powerful ,low -cost microcontroller module that has revolutionized the landscape of IoT and embedded systems.Processes user commands received from the Android app or touch screen display ,orchestrating the entire fuel dispensing process .Wifi module facilitates seamless communication with the external devices ,enabling real time data exchange monitoring and control.

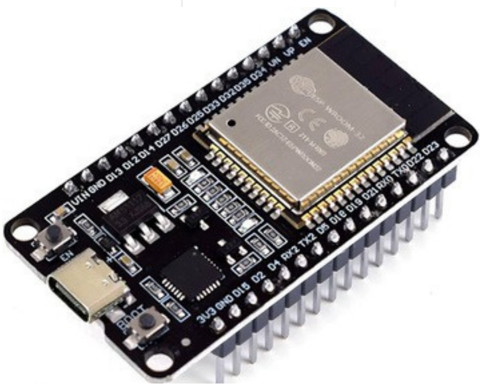

Fig : 6.1.1 ESP32 MODULE

Specifications

- Input Voltage: 5VDC
- Operating voltage: 2.3 ~ 3.6V
- Operating current: 80mA
- Clock Frequency: 80 ~ 240MHz
- Flash memory: 2MB
- Data Rate: 54Mbps
- SRAM Memory: 512KB
- Length: 49.5mm

6.1.2 ARDUINO UNO

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

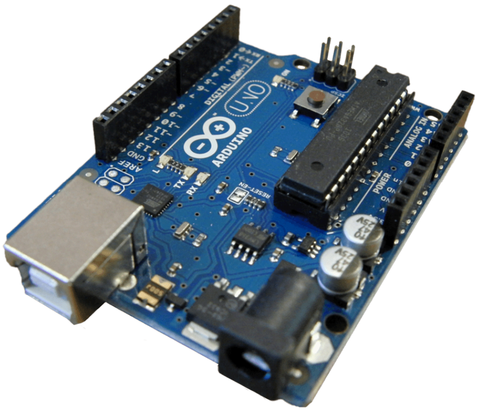

Fig :6.1.2 ARDUINO UNO

Specifications

- Microcontroller :ATmega 328P
- Operating Voltage:5V
- Input Voltage:7-12V
- Digital I/O Pins:14
- Analog Input Pins:6
- Flash Memory:32KB
- SRAM:2KB
- EEPROM:1KB
- Clock Speed:16 MHz
- Weight:25 grams

6.1.3 LCD DISPLAY

An 16x2 LCD display is a versatile component that simplifies the integration of alphanumeric displays into microcontroller projects; it offers a compact solution with only two I2C pins required for communication, significantly reducing wiring complexity and allowing for more efficient use of microcontroller resources. This type of display is widely used in various applications, from hobbyist projects to industrial systems, enabling clear and concise information presentation.

Fig :6.1.3 16×2 LCD Display

Specifications

- Model: LCD1602
- Characters: 16
- Interface Type: I2C
- I2C Address: 0x27
- Character Color: White
- Backlight: Green
- Input Voltage: 5V
- Length: 36 mm
- Width: 80 mm
- Height: 18 mm
- Weight: 35 gm
- Arduino IIC/I2C interface was developed to reduce the IO port usage on Arduino board
- I2C adapter allows flexibility in connections
- I2C Reduces the overall wirings.

6.1.4 LIQUID FLOW SENSOR

Measures the rate of a liquid flowing through it. The YF-S401 water flow sensor consists of a plastic valve body, flow rotor and hall effect sensor. It is usually used at the inlet end to detect the amount of flow. When liquid flows through the sensor, a magnetic rotor will rotate and the rate of rotation will vary with the rate of flow.

Fig :6.1.4 Liquid Flow Sensor

Specifications

- Model: YF-S401
- Voltage Range: 5 ~ 12VDC
- Operating Current: 15 mA (DC 5V)
- Insulation Resistance: >100 MΩ
- Accuracy: ±5% (0.3-3L/min)
- Inner Diameter: 4 mm
- Outside diameter: 7 mm
- Proof Water Pressure: <0.8 MPa
- Water Flow Range: 0.3-6 L/min
- The Output Pulse High Level: >4.5 VDC (DC input voltage 5 V)
- The Output Pulse Low Level: <0.5 VDC (DC input voltage 5 V)
- Output Pulse Duty Ratio: 50% ± 10%
- Water-flow Formula: 1L = 5880 square waves
- Working Humidity Range: 35% ~ 90% RH (no frost)

6.1.5 ACTIVE BUZZER MODULE

A 5V Active Alarm Buzzer Module for Arduino is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric.. Using top quality material, it is durable in use. What is more, an active buzzer rings out as long as it is electrified. Compared with a passive buzzer, it is a bit expensive but easier to control.

Fig :6.1.5 Active Buzzer Module

Specifications

- Transistor drive module uses 8550
- With a fixed bolt hole- easy installation- 2.6mm aperture.
- Operating voltage 3.3V-5V
- PCB Dimensions: 34.28 mm (L) 13.29 mm (W) 11.5 mm (H)
- Wire length: 20.5cm
- Weight: 7 g

6.1.6 4×3 KEYBOARD

This 4×3 keypad is a 12 Button Keypad switch, ideal for code or data entry. Each key is rated for up to 1,000,000 life-stroke and also features a durable high-quality material contact surface for the best environmental resistances. This 3×4 Keypad Matrix lets you quickly add controls to your electronics projects. It offers 0-9 numerals and standard star() and hash(#) symbols.

Fig :6.1.6 4×3 Keypad

Specifications

- Easy communication with any microcontroller
- Standard Header Pin Connector
- Tactile type switches
- Over 1,000,000 operations per key
- Key Type: 3×4
- Mounting Hole Diameter: 2mm
- Mounting Hole Center Distance: 60x60mm
- Color: Black
- Pad Size in: mm
- Length: 64mm
- Width: 50mm
- Height: 10mm
- Weight: 18mm

6.1.7 TURBIDITY SENSOR

A turbidity sensor is a device that measures the cloudiness or suspended solids in a liquid, such as water or wastewater. It works by emitting a light beam into the liquid and detecting the scattered light, which is proportional to the turbidity. Turbidity sensors are commonly used in water quality monitoring, industrial processes, and environmental monitoring.

Fig :6.1.7 Turbidity Sensor

Turbidity Sensor Specifications
- Measurement Range: 0-4000 NTU
- Resolution: 0.01-1 NTU
- Accuracy: ±5% of the reading
- Operating Temperature: 0°C to 50°C
- Storage Temperature: -10°C to 60°C
- Power Supply: 5-12 VDC
- Power Consumption: 40 µA (standby), 820 µA (average)
- Sensor Dimensions: Diameter: 27 mm, Length: 170 mm
- Weight: 300 g
- Material: PVC, DELRIN, Quartz, PMMA, Polyamide
- Maximum Pressure: 5 Bars
- Connection: 9 armoured connectors
- Environmental Protection: IP68
- Warranty: 1 year

6.1.8 FUEL MOTOR PUMP

This is a Kamoer 12V 3.5A 4000ml/min Liquid Diaphragm Pump. KLP40 series diaphragm pumps from Kamoer are based on a simple principle of the oscillating displacement pump, which is remarkably simple in design. The rotational power from the motors is converted into vertical movement by an eccentric gearbox. This motion is then transferred to a diaphragm by means of a connecting rod which is in conjunction with an inlet and outlet valve creates a pumping action.
The KLP40 type liquid pumps can be mounted in any position and can deliver up to 4000ml/min operated on 12V

Fig 6.1.8 Fuel Motor pump

Specifications :

- Rated voltage (VDC) - 12
- Flow rate(ml) - 4000
- model - KVP12 - 4000
- Operating current (A) - 3.5
- Operating temperature (deg) - 0 to
- Noise level (dB) - 60

6.1.9 ULTRASONIC SENSOR

The waterproof ultrasonic sensor is a versatile distance-measuring sensor with high accuracy and reliability, suitable for various applications including robotics, industrial automation, and more .The sensor is capable of measuring distances from 20 centimeters to 450 centimeters with a high level of accuracy, making it ideal for robotics, industrial automation, and distance sensing applications

Fig: 6.1.9 Waterproof Ultrasonic Sensor

Specifications

- Operating Voltage: 3.3 to 5 volts
- Average Current: Less than 8 milliamps
- Blind Zone Distance: 3 centimeters
- Detecting Range: 3 to 450 centimeters with an accuracy of ±1 centimeter
- Output: UART
- Response Time: 100 milliseconds
- Operating Temperature: -15 to 60 degrees Celsius
- Reference Angle: 60 degrees
- Waterproof Grade: IP67

6.2 SOFTWARE REQUIRED;

6.2.1 ANDROID APP

The Android App represents the user interface and interaction point for customers and operators of the smart petrol pump system. It enables users to initiate fueling, monitor transactions, and access real-time information through a user-friendly application on their Android devices or computers. The Android app or user computer interface is designed with a user-friendly layout, ensuring ease of navigation and a seamless experience for customers and operators. Intuitive design elements contribute to positive user interaction. The Android app or user computer enables real-time monitoring of the fuel dispensing process. Users can observe the fueling progress, confirm transaction details, and receive alerts or notifications related to the fueling status. For customer convenience, the application integrates secure payment options. Users can make digital payments through the app, promoting a cashless and efficient transaction process. Operators and administrators can use the application on their computers for remote monitoring and control of multiple smart petrol pump systems. This feature enhances operational efficiency and allows for quick response to system events.

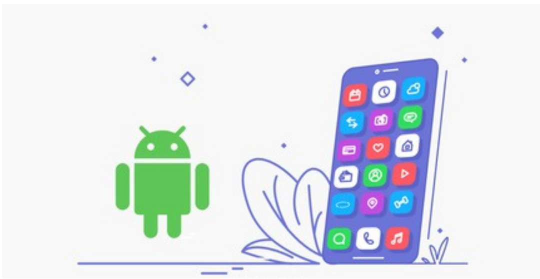

Fig 6.2.1 Android App

6.2.2 BLYNK

Blynk is a versatile Internet of Things (IoT) platform that simplifies the development and management of smart applications through a user-friendly mobile interface available on iOS and Android. It features a drag-and-drop dashboard that allows users to integrate various widgets—such as buttons, sliders, and graphs—to interact with hardware in real time. Blynk supports multiple hardware platforms, including Arduino and Raspberry Pi, and offers connectivity via Wi-Fi, Ethernet, Bluetooth, and cellular networks. Users can choose between a cloud-based or local server setup for data management, ensuring flexibility and control. With robust APIs, extensive security measures, and powerful data visualization tools, Blynk caters to a wide range of applications, from home automation and health monitoring to industrial automation and environmental tracking, making it accessible for both beginners and experienced developers looking to bring their IoT projects to life.

CHAPTER 7

CIRCUIT DIAGRAM

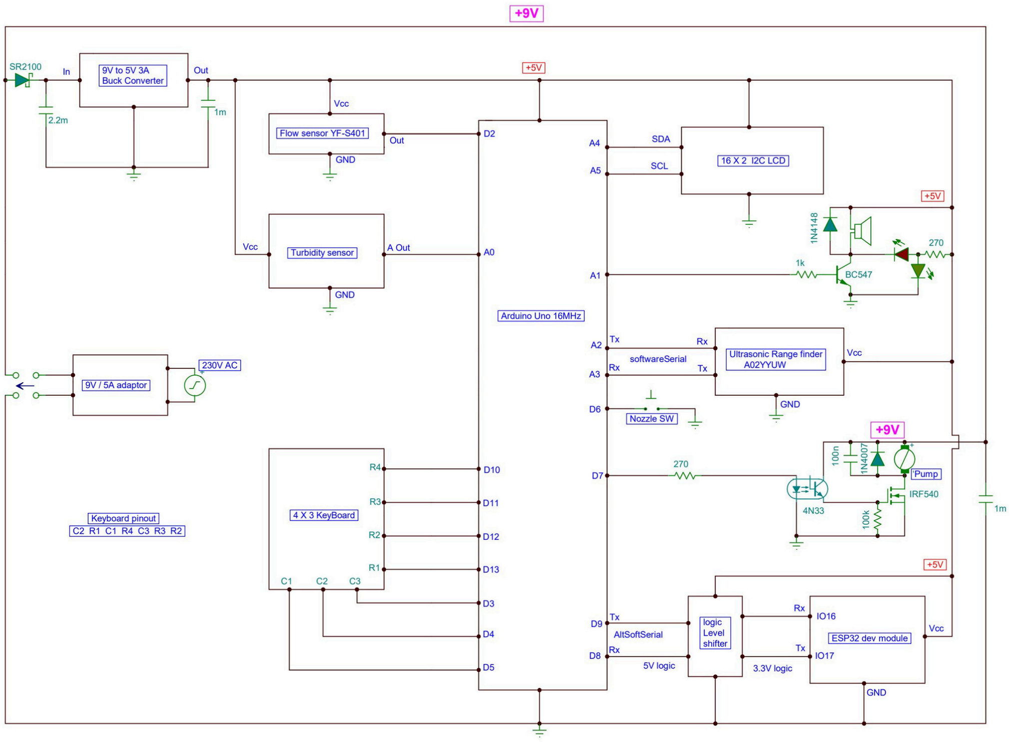

Fig: 7.1 Circuit Diagram

The provided image appears to be a basic circuit diagram of an IoT-based smart petrol pump system. The diagram illustrates a power supply unit, likely connected to the main power source, which feeds electricity into the system. There are several components labeled as "Sensors" which could be used to detect various parameters like fuel level, flow rate, and possibly even temperature. These sensors are likely connected to a microcontroller or microprocessor (labeled "Microcontroller") which acts as the "brain" of the system. The system also includes a controller with inbuilt wifi which enables it to connect to the internet or a local network. This could be used for remote monitoring, control, and data transmission to a central server.

CHAPTER 8

RESULTS AND DISCUSSION

The IoT-Based Smart Petrol Pump system optimizes fuel dispensing through automation, real-time surveillance, and advanced security features. It guarantees precise fuel measurement and facilitates seamless transactions. IoT automation enables accurate fuel level measurement and display, minimizing errors. Ultrasonic sensors continuously monitor storage tanks, preventing fuel shortages, while the Blynk app allows users to regulate fueling, receive alerts, and make digital payments. The system also dynamically updates fuel prices based on location, reducing fraud risks and enhancing efficiency by minimizing human intervention. In essence, this smart petrol pump offers a secure, efficient, and modern solution, rendering fuel management more transparent and convenient. The project's results demonstrate the proposed system's effectiveness in augmenting the efficiency and automation of petroleum fuel supply stations. The system's capability to empower users to independently dispense fuel has been successfully tested, with users able to input the desired fuel quantity via the keyboard and the nozzle automatically dispensing the specified amount, ceasing when the target volume is reached. The flow sensor accurately measures and displays the dispensed fuel flow rate on the LCD, while the turbidity sensor effectively monitors fuel quality. Furthermore, the IoT-based application provides users with real-time information on the fuel station's location and current fuel stock. The ultrasonic sensor continuously monitors fuel levels in the storage tank, triggering automatic notifications to fuel suppliers when levels fall below a critical threshold. Overall, the results demonstrate the proposed system's potential to revolutionize the fuel retail industry, providing a more efficient, convenient, and sustainable fueling experience for customers. The system's automation of fuel dispensing, fuel quality and level monitoring, and real-time information provision has the potential to reduce waiting times, enhance customer satisfaction, and increase operational efficiency. Additionally, the system's IoT-based application and ultrasonic sensor enable real-time monitoring and control of fuel levels, reducing the risk of stockouts and improving supply chain management. However, further testing and refinement are necessary to fully realize the system's potential and address any technical or operational challenges. Nevertheless, the project's results demonstrate the feasibility and effectiveness of the proposed system, highlighting its potential to significantly impact the fuel retail industry.

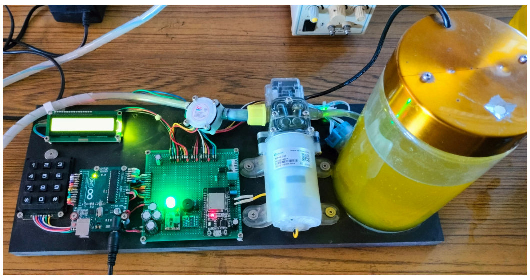

Fig 8(a):Hardware Setup

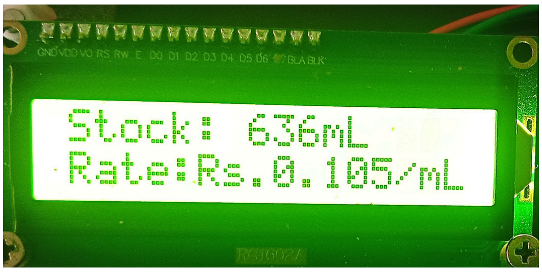

Fig8(b)LCD screen showing the quantity and rate of fuel

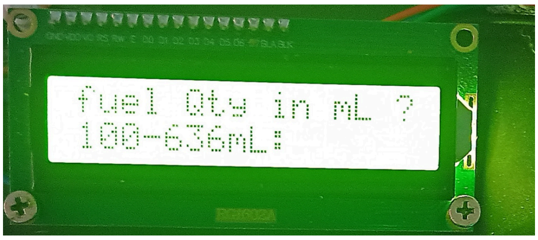

Fig 8(c)Asking about the required amount of fuel

Fig 8(d) User dispensing the fuel

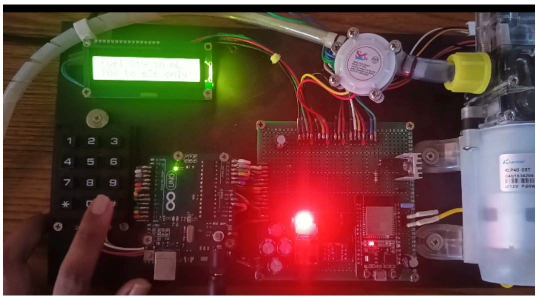

Fig 8(e) Blinking of red light when user enters more than avalaible

Fig 8.Results

CHAPTER 9

CONCLUSION

The "IoT Based Smart Petrol Pumps" project presents a transformative approach to modernizing fuel retail operations by integrating Internet of Things (IoT) technologies. By automating fuel dispensing, real-time monitoring of fuel levels, and implementing cashless transactions, the project significantly enhances operational efficiency and customer convenience. The data analytics capabilities enable better inventory management and strategic decision-making, while the user-friendly interface improves the overall customer experience. Furthermore, this smart system reduces the potential for human error and fraud, ultimately fostering a more secure and transparent fuel distribution process. As the fuel industry increasingly moves towards automation and smart solutions, this project exemplifies the potential benefits of IoT integration, paving the way for a more efficient and customer-centric future in fuel retailing

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APPENDICES

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <Keypad.h>
#include <SoftwareSerial.h>
#include <AltSoftSerial.h>

#define TURBIDITY A0
#define FLOW 2
#define BUZZER A1
#define PUMP 7
#define TRIGGER 6

#define LOCATION "Chemperi ----------- 12.093744, 75.549042"

void pulseCounter(void);
int getTurbidity(void);
int getStock(void);
void requestRefill(void);
void resetRequest(void);
void sendToEsp(String);

char keys[4][3] = {
              {'1', '2', '3'},
              {'4', '5', '6'},
              {'7', '8', '9'},
              {'*', '0', '#'}
             };
byte rowPins[4] = {13, 12, 11, 10};
byte colPins[3] = {5, 4, 3};
Keypad keypad = Keypad(makeKeymap(keys), rowPins, colPins, 4, 3);

int stock = 500;        // stores total fuel stock in storage-tank.
int usStock = 0;      // stores stock fuel measured by US sensor.
int quantity = 0;     // stores fuelQuantity requested by user.
int Lprice = 105;     // price of fuel per litter
float price = Lprice / 1000.0;  // price of fuel per mL
int radius = 53;      // radius of storage tank measured as 53mm.
int turbidity = 0;    // measured turbidity of fuel in storage tank.
int quality = 1;      // quality of fuel; 1=correct turbidity; 0=lighter or darker
char inputBuffer[5];  // Buffer to store the 4-digit number (plus null terminator)
////////////////
```

```
int digitIndex = 0;   // Keeps track of the current digit being entered
int sensorInterrupt = 0;  // interrupt 0
float calibrationFactor = 90.5;
volatile byte pulseCount =0;
float flowRate = 0.0;
unsigned int flowMilliLitres =0;
unsigned long totalMilliLitres = 0;
unsigned long oldTime = 0;
unsigned char data[4] = {0};   // to store serial data from US sensor
int distance = 0;              // to store distance measured by US sensor
unsigned char CS;              // to store checkSum
int refilRequested = 0;        // flag to avoid frequent refil-requests

LiquidCrystal_I2C lcd(0x27,16,2);
SoftwareSerial usSerial(A3, A2);  //Rx,Tx
AltSoftSerial espSerial(8, 9);    //Rx,Tx

/*/
void setup()
{
  pinMode(PUMP , OUTPUT);
  pinMode(BUZZER, OUTPUT);
  pinMode(TRIGGER, INPUT_PULLUP);
  pinMode(FLOW, INPUT_PULLUP);
  pinMode(TURBIDITY, INPUT);
  analogWrite(PUMP, 0);
  Serial.begin(9600);
  espSerial.begin(9600);
  lcd.init();
  lcd.backlight();
  lcd.clear();
  lcd.noBlink();
sendToEsp(String(0) + String(LOCATION)); // Sending pump's location
to blynk via ESP32
  sendToEsp(String(2) + String(Lprice)); // Sending price rate of fuel per
liter to Blynk via ESP32.

  stock = getStock();
  sendToEsp(String(1) + String(stock));

  if(stock < 200)
    while(stock < 200 || stock > 1300) //measure stock continuously until
refill. neglect error reading ie. above 1300
```

```
{
    if(stock < 0)
      stock = 0;
    lcd.setCursor(0,0);
    lcd.print("Refill storage !");
    lcd.setCursor(0,1);
    lcd.print("Stock: ");
    lcd.print(stock);
    lcd.print(" mL   ");
    stock = getStock();
    sendToEsp(String(1) + String(stock));
    if(refilRequested == 0)
      requestRefill();
    delay(2000);
   }

  sendToEsp(String(1) + String(stock));

  // If more than 600ml found in tank initially, then cancel the pending request
  // because now refill has done and restarting the pump.
  if(stock > 600)
    resetRequest();

  attachInterrupt(sensorInterrupt, pulseCounter, FALLING);
}
 //

void loop()
{
/* below lines is only for calibrating Turbidity sensor for maching fuel's turbidity
while(1)
{
  turbidity = getTurbidity();
  lcd.setCursor(0,0);
  lcd.print(turbidity);
  delay(1000);
  lcd.setCursor(0,0);
  lcd.print("         ");
}
*/
  turbidity = getTurbidity();     //  clear-water=90%, normal-fuel=80%, Contaminated-
fuel=below 60%
  sendToEsp(String(3) + String(turbidity));
    while((turbidity < 60) || (turbidity > 90)) // read turbidity continuously if it is
abnormal
```

```
{
   turbidity = getTurbidity();
   lcd.clear();
   if(turbidity > 90)
     lcd.print("Water in fuel     ");
   if(turbidity < 60)
     lcd.print("Mud/Rust in fuel");
   lcd.setCursor(0,1);
   lcd.print("or adultration !");
   delay(4000);
   lcd.clear();
   lcd.print("   TURBIDITY:   ");
   lcd.setCursor(0,1);
   lcd.print("Nor:80 Found:");
   lcd.print(turbidity);
   sendToEsp(String(3) + String(turbidity));
   delay(4000);
  }
 usStock = getStock();

/* Tis section sometimes malfunctions because the US sensor resonates in the small tank

  while(abs(stock - usStock) > 500)  //if stock measured appears abnormal
  {
   lcd.clear();
   if(stock - usStock > 500)
     lcd.print("Fuel leak from  ");
   else if(usStock - stock > 500)
        lcd.print("Water ingress to");
   else
     break;
   lcd.setCursor(0,1);
   lcd.print("  Storage Tank !");
   delay(4000);
   lcd.clear();
   lcd.print("Measured:");
   lcd.print(usStock);
   lcd.print("mL");
   lcd.setCursor(0,1);
   lcd.print("Calculated:");
   lcd.print(stock);
   delay(4000);
   lcd.clear();
   lcd.print("CHECK & RESTART.");
```

```
delay(1000);
    usStock = getStock();
  }
*/

  if(stock < 200)
  {
    lcd.clear();
    lcd.print("OUT OF STOCK !");
    lcd.setCursor(0,1);
    lcd.print("Refil & restart ");
    requestRefill();
    while(1)
      delay(5000);
  }
if((stock < 500) && (refilRequested == 0))  // request refill if stock below 
500mL
    requestRefill();

  lcd.clear();
  lcd.print("Stock: ");
  lcd.print(stock);
  lcd.print("mL    ");
  lcd.setCursor(0,1);
  lcd.print("Rate:Rs.");
  lcd.print(price, 3); // printing price with 3 decimal points
  lcd.print("/mL");

  unsigned long startTime = millis();
  unsigned long startTime2 =millis();
  while(1)
  {
if(millis() - startTime >= 2000)
    {
      startTime = millis();
      usStock = getStock;
      turbidity = getTurbidity();
      sendToEsp(String(3) + String(turbidity));
    }
    char key = keypad.getKey();
    if(key)
      break;
  }
```

```
lcd.clear();
  lcd.print("fuel Qty in mL ?");
  lcd.setCursor(0,1);
  lcd.print("100-");
  lcd.print(stock);
  lcd.print("mL: ");

  sendToEsp(String(1) + String(stock));
  sendToEsp(String(3) + String(turbidity));

   while(quantity < 100 || quantity > stock) // get order from user until he orders a
valid quantity
   {
    char key = keypad.getKey();
    if (key)    // If a key is pressed
    {
      digitalWrite(BUZZER, HIGH);
      delay(2);
      digitalWrite(BUZZER, LOW);

        if (key >= '0' && key <= '9' && digitIndex < 4)        // If the key is a digit and
morethan 3 dits not entered
      {
        inputBuffer[digitIndex] = key;
        digitIndex++;
        lcd.print(key);
      }
      else if (key == '#' && digitIndex > 0)      // Use '#' as an Enter key
      {
inputBuffer[digitIndex] = '\0';     // Null-terminate the string
        quantity = atoi(inputBuffer); // Convert the input to an integer
        digitIndex = 0;     // Reset for the next input
        memset(inputBuffer, 0, sizeof(inputBuffer));
        if(quantity < 100 || quantity > stock)
        {
 digitalWrite(BUZZER, HIGH);
          lcd.setCursor(0,1);
          lcd.print("100 to ");
          lcd.print(stock);
          lcd.print(" only!");
          delay(1000);
```

```
digitalWrite(BUZZER, LOW);
     lcd.setCursor(0,1);
     lcd.print("                ");
     lcd.setCursor(0,1);
     quantity = 0;
    }
    else
    {
     lcd.clear();
     lcd.print("order : ");
     lcd.print(quantity);
     lcd.print("mL");
     lcd.setCursor(0,1);
     lcd.print("pay Rs. ");
     lcd.print(quantity*price);
    }
}
   else if (key == '')      // Use '' to cancel
   {
    lcd.setCursor(0,1);
    lcd.print("                ");
    lcd.setCursor(0,1);
    digitIndex = 0;
    memset(inputBuffer, 0, sizeof(inputBuffer));
    quantity = 0;
    break;
   }
  }
 }
while(quantity >= 100)   // Do below steps until customer pumps out complete volume he ordered
 {
  if(digitalRead(TRIGGER) == HIGH)  // If customer releases nozzle trigger while pumping fuel
  {
   analogWrite(PUMP,0);
   digitalWrite(BUZZER, 0);
  }
  else  // if customer keep squeezing nozzle trigger
  {
   analogWrite(PUMP,150);
   if((millis() - oldTime) > 500)    // Only process counters once per half second
   {
```

```
detachInterrupt(sensorInterrupt);
            flowRate = ((500.0 / (millis() - oldTime)) * pulseCount) /
calibrationFactor;
      oldTime = millis();
      flowMilliLitres = (flowRate / 60) * 1000;
      totalMilliLitres += flowMilliLitres;
      lcd.setCursor(0,0);
      lcd.print("flow: ");
      lcd.print(flowMilliLitres,DEC);
      lcd.print(" mL/Min  ");
      lcd.setCursor(0,1);
      lcd.print("Volume: ");
      lcd.print(totalMilliLitres,DEC);
      lcd.print(" mL   ");
      pulseCount = 0;
      attachInterrupt(sensorInterrupt, pulseCounter, FALLING);
     }
if (totalMilliLitres >= quantity)
     {
      analogWrite(PUMP, 0);
      lcd.clear();
      lcd.print(quantity);
      lcd.print("mL Filled.");
      stock = stock - quantity;
      quantity = 0;
      totalMilliLitres = 0;
      flowMilliLitres = 0;
      flowRate = 0;
      if(stock < 500 && refilRequested == 0)  // request refill if stock below
500mL
        requestRefill();
      lcd.setCursor(0,1);
      lcd.print("press any key...");
      keypad.waitForKey();
      lcd.clear();
     }
   }
  }


}
 void pulseCounter()
{
  pulseCount++;
}
```

```
int getTurbidity()
{
  int reading = analogRead(TURBIDITY);
  // in clear water, reading will be 760
  // in petrol like liquid, reading will be 700 to 750
  // in much darker liquids, reading will be below 700
  int result = map(reading, 765, 600, 100, 0);  // converting that to percentage.
  // clear water -> 100%
  // petrol -> 70% to 90%
  // dark liquid -> below 60%
  if(result > 100)
    result = 100;
  if(result < 0)
    result = 0;
  if(result>69 && result<91)  //for consistancy general petrol range is unified as 80%
    result = 80;
  if(result < 50 || result > 95)  //pumping will be disabled if fuel is too bad
    quality = 0;
  else
    quality = 1;
  return(result);
}
int getStock()
{
  usSerial.begin(9600);
  while(usSerial.available() <= 0);
  delay(4);
  while(1)
    if(usSerial.read() == 0xff)
      break;
  data[0] = 0xff;
  for(int i = 1; i < 4; i++)
    data[i] = usSerial.read();
  usSerial.end();
  CS = data[0] + data[1] + data[2];
  if(CS == data[3])
  {
distance = (data[1] << 8) + data[2];
    distance = distance * 1.14;    // calibration needed due to sensor mmodification.
    //return(distance);
     long qmm = 3.14 * radius * radius * distance; // air volume in qubic mm below
the full line
    int mL = qmm / 1000;  // air volume in mL.
```

```
return(1650 - mL);  // full capacity = 1650mL.
  }
}
void sendToEsp(String msg)
{
  espSerial.print("starting");
  espSerial.print('|');
  espSerial.print(msg);
  espSerial.print('|');
  Serial.println(msg);
  delay(100);
}

//////////////////////////////////////////////////////////////

void requestRefill()
{
  sendToEsp(String(4) + String(1));
  refilRequested = 1;
}
void resetRequest()
{
  sendToEsp(String(4) + String(0));
  refilRequested = 0;
}
```