

MULTI-PURPOSE LIQUID FILLING MACHINE USING ATMEGA328P

Dr.S.Venkatesan(Prof.EEE)¹, Mr.M. Jeyamurugan,AP(Sr.Gr)²,
R. Dinesh karthick³,C J Balakumaran⁴, B. Karthick Raja⁵

¹ Prof/EEE, Department Of Electrical and Electronics Engineering, K.L.N. College Of Engineering, Tamil Nadu, India

² Prof/EEE, Department Electrical and Electronics Engineering, Velammal College Of Engineering And Technology Tamil Nadu, India

^{3,4,5} UG Scholar, Department Of Electrical and Electronics Engineering, K.L.N. College Of Engineering, Tamil Nadu, India

Abstract:

This paper presents Multi-Purpose Liquid Filling Machine, a sophisticated hybrid liquid filling system designed for versatility and user-friendliness. Leveraging advanced technology including an ATmega328P microcontroller and a suite of carefully selected components, the Multi-Purpose Liquid Filling Machine offers precise control over liquid filling operations in various industrial settings. This paper outlines the system architecture, key components, operational sequence, and user interface design, highlighting its potential applications and contributions to the field of automated liquid handling.

Keywords:

Multi-Purpose Liquid Filling Machine, liquid filling, hybrid system, microcontroller, user interface, automation.

1.INTRODUCTION

Liquid filling systems play a crucial role in numerous industries, ranging from pharmaceuticals to food and beverage production. Efficient and precise liquid handling is essential for maintaining product quality, optimizing production processes, and ensuring regulatory compliance.

However, conventional liquid filling machines often lack the flexibility and user-friendliness required to meet the diverse needs of modern manufacturing environments.

In response to these challenges, we introduce Multi-Purpose Liquid Filling Machine, a state-of-the-art hybrid liquid filling system designed to address the limitations of traditional filling machines. By integrating cutting-edge technology with intuitive user interface features, Multi-Purpose Liquid Filling Machine offers unparalleled versatility and performance in liquid handling applications.

2.SYSTEM ARCHITECTURE

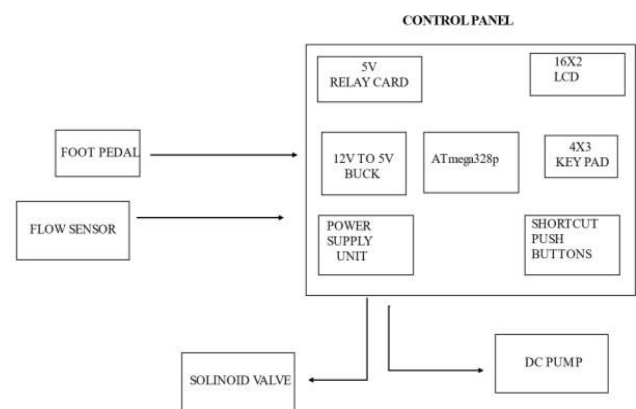


Fig.1.Blockdiagram of control system

The core of the Multi-Purpose Liquid Filling Machine system is built around an ATmega328P microcontroller, which serves as the central processing unit responsible for coordinating the operation of various components. As shown in Fig.1 Key elements of the system architecture include:

1. Microcontroller: The ATmega328P microcontroller provides computational power and real-time control capabilities, facilitating precise coordination of liquid filling operations.
2. Components: Multi-Purpose Liquid Filling Machine incorporates a range of high-quality components, including a 12V solenoid valve, food-grade liquid pump, Hall effect flow sensor, 16x2 LCD display with I2C interface, 4x3 matrix keypad, foot pedal switch, reset push button, and free flow button.
3. Control Panel: The control panel serves as the user interface, allowing operators to input parameters such as liquid type and desired fill volume.

It features all necessary controls and indicators for seamless operation.

3. OPERATIONAL SEQUENCE

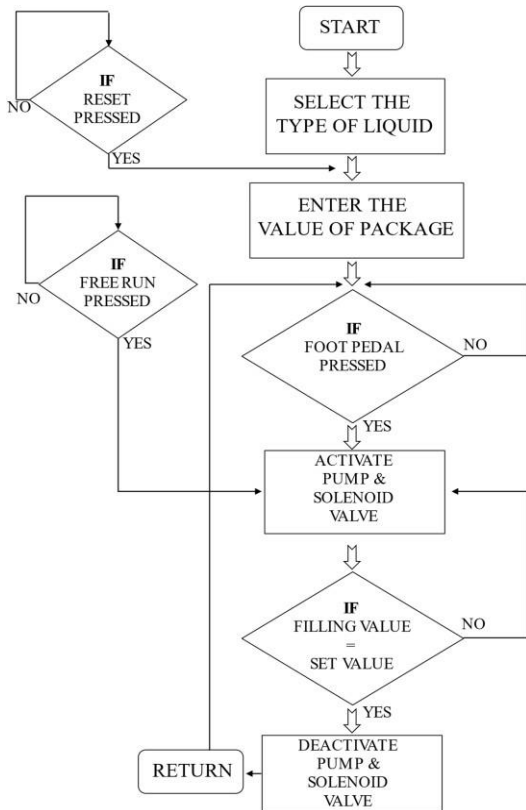


Fig.2.Flowchart of operational sequence

The operation of Multi-Purpose Liquid Filling Machine follows a well-defined sequence to ensure efficient and accurate liquid filling:

1. Initialization: The system is initialized, and the user selects the type of liquid to be used.
2. Parameter Input: The operator enters the desired fill volume in milliliters using the keypad.
3. Cycle Initiation: Upon pressing the foot pedal switch, the filling cycle begins, and the system activates the solenoid valve and liquid pump.
4. Cycle Completion: The system fills the container with the specified volume of liquid, as detected by the Hall effect flow sensor.
5. Repeat or Reset: If the user wishes to fill the same volume repeatedly, they can simply press the foot pedal switch again. To change the set volume, the reset push button is pressed, prompting the user to re-enter the desired fill volume. As shown in Fig.2

4.USER INTERFACE DESIGN

The user interface of Multi-Purpose Liquid Filling Machine is engineered to optimize user interaction and streamline

operational efficiency. Featuring a prominent 16x2 LCD display with I2C integration, operators benefit from clear, real-time feedback and intuitive navigation prompts.

A tactile 4x3 matrix keypad enables seamless parameter input, ensuring precision in liquid type selection and fill volume determination. Dedicated control buttons, including the foot pedal switch for cycle initiation and the reset push button for parameter adjustments, enhance user control.

LED status indicators offer visual cues for cycle progress and error conditions, facilitating timely intervention. An intuitive menu navigation system simplifies access to system settings, minimizing downtime and maximizing productivity.

Robust error handling mechanisms promptly alert operators to anomalies, ensuring smooth operation for hobbyists, engineers, and designers seeking efficient control of high-power loads in their projects or systems.

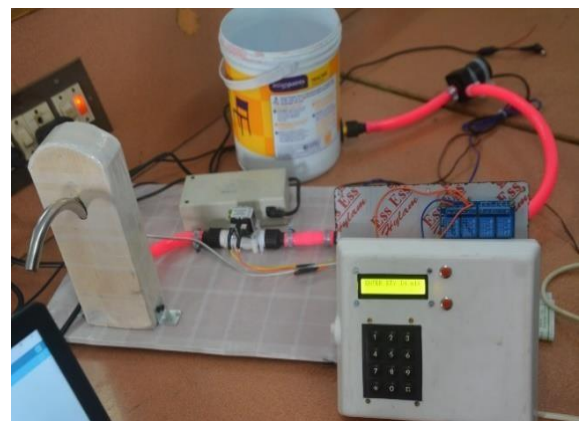
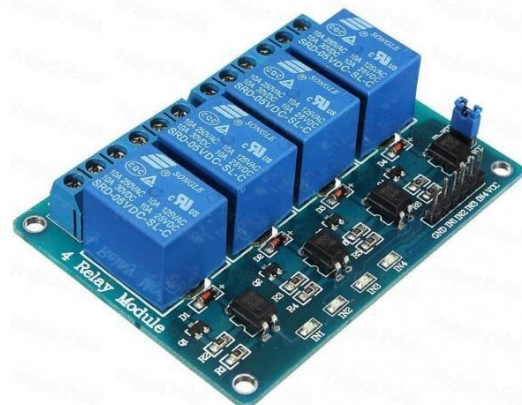


Fig.3.Overview of prototype

4.RELAY MODULE



Two channel relay module is an electronic device that provides control over two separate electrical circuits using electromechanical relays as shown in fig.no.4 , Each channel typically consists of a relay switch capable of independently controlling the flow of current to a connected load, such as lights, motors, or appliances. These modules are widely used in automation, robotics, home automation, and industrial control systems to switch high-power loads with lowpower signals from microcontrollers or other control devices. The relay module typically consists of two relays, each with a coil, contacts, and terminals for connecting external devices. When an electrical signal is applied to the coil of a relay, it generates a magnetic field that pulls the relay's contacts, Fig.no.4. Relay module 22 causing them to either make or break the connection between the relay's terminals. This action effectively controls the flow of current through the connected load, turning it on or off.

One of the key advantages of a 4-channel relay module is its versatility and ease of use. By providing two independent relay channels on a single board, it allows for the control of multiple devices or circuits using a single control signal. This simplifies wiring and reduces the number of components required in a system. Additionally, relay modules are compatible with a wide range of input voltages and can switch high-current loads, making them suitable for a variety of applications. They also offer isolation between the control signal and the load, providing protection to the control circuitry from potential voltage spikes or fluctuations in the load circuit. Overall, a 4-channel relay module is a versatile and reliable solution for controlling multiple electrical circuits in a wide range of applications. Its simplicity, flexibility, and robustness make it a popular choice for

5 FLOW RATE SENSOR [YF-S201]



The YF-S201 flow sensor features pulse outputs that are generated as the fluid flows through the sensor. These pulses are typically square wave signals with a frequency directly proportional to the flow rate of the fluid passing through the sensor. The sensor usually provides two output pins shown in fig no.5, one for the signal output (often labeled "OUT" or "SIGNAL") and another for ground connection (labeled

"GND").Pin details for the YF-S201 flow sensor typically include:

- Signal Output (OUT): This pin provides the pulse signal output that corresponds to the fluid flow rate. The frequency of the pulses is determined Fig.no.5 Flow rate sensor 26 by the rate of rotation of the turbine inside the sensor, which is directly proportional to the flow rate.
- Ground (GND): This pin is connected to the ground or negative terminal of the power supply to complete the circuit. In addition to these pins, the sensor may also have power supply pins for connection to a voltage source. The exact pinout and specifications may vary depending on the manufacturer and model of the sensor. Proper wiring and connection of these pins are essential for the accurate operation of the flow sensor within a project.

6. 12V SOLENOID VALVE



A 12V solenoid valve is an electromechanical device used to control the flow of a fluid, typically a gas or liquid, in a system. It operates by using an electric current to energize a coil (solenoid), which generates a magnetic field. This magnetic field then moves a plunger or piston within the valve, either opening or closing the valve mechanism to allow or stop the flow of fluid. One of the key advantages of a 12V solenoid valve is its compatibility with 12- volt direct current (DC) power sources, making it suitable for use in a wide range of applications where such power is readily available. These valves are commonly used in automotive systems, irrigation systems, pneumatic systems, and water treatment systems, among others.

The 12V solenoid valve typically consists of a valve body, solenoid coil, plunger or piston, and seals. When the solenoid coil is energized by applying 12V DC power, it creates a magnetic field that pulls the plunger or piston into the solenoid coil, thereby opening or closing the valve mechanism. This action allows the fluid to flow through the valve or stops its flow, depending on the design and configuration of the valve. These valves come in various configurations, including normally closed (NC), normally open (NO), and proportional control valves, providing flexibility to suit different application requirements. They may also feature options such as manual override, pressure and temperature ratings, and different types of fluid compatibility.

Overall, a 12V solenoid valve offers efficient and reliable fluid control capabilities in a compact and versatile package. Its compatibility with 12V DC power sources, combined with its wide range of applications and configurations, makes it a popular choice for fluid control in diverse industries and systems.

7. 12V /8W PUMP



A 12V/8W pump is a type of electric pump designed to operate on a 12-volt direct current (DC) power supply and consume 8 watts of electrical power during operation. These pumps are commonly used in a variety of applications, including automotive cooling systems, aquariums, water circulation systems, and smallscale irrigation. One of the key advantages of a 12V/8W pump is its compatibility with low-voltage DC power sources, making it ideal for use in mobile or off-grid applications where access to mains electricity may be limited. Additionally, the relatively low power consumption of 8 watts ensures efficient operation, minimizing energy costs and reducing environmental impact.

These pumps typically feature a compact and lightweight design, making them easy to install and integrate into existing systems as shown in fig.no.7. They often utilize brushless DC motor technology, service life, and low maintenance requirements.

Despite their modest power rating, 12V/8W pumps can deliver sufficient flow rates and pressure levels for many applications. They may incorporate features such as adjustable flow control, self-priming capabilities, and built-in thermal protection to enhance versatility and reliability. In summary, a 12V/8W pump is a versatile and energy-efficient solution for various pumping needs, offering compatibility with low-voltage DC power sources, compact design, and reliable performance. Whether used in automotive, aquatic, or agricultural applications, these pumps provide efficient fluid handling capabilities with minimal power consumption.

8. 4X3 MATRIX KEYPAD



A 4x3 matrix keypad is a common input device used in various electronic systems, providing a convenient interface for users to input numerical and functional commands. Comprising four rows and three columns of buttons, it offers a total of 12 keys arranged in a grid formation. Each key represents a unique combination of row and column connections, allowing for the detection of specific button presses through a matrix scanning technique.

In electronic projects, the 4x3 matrix keypad serves various purposes, such as password entry, menu navigation, and data input. Its compact size and simple wiring make it suitable for integration into a wide range of applications, including security systems, industrial control panels, and consumer electronics devices. Additionally, the keypad's

versatility allows for customization, with each button capable of being programmed to perform specific functions based on the requirements of the project or application. Overall, the 4x3 matrix keypad provides an intuitive and efficient means of user interaction, enabling seamless input of commands and data in electronic systems across diverse domains. Its simplicity, reliability, and versatility make it a popular choice for designers and hobbyists alike, enhancing the usability and functionality of their projects.

9. 16X2 LCD WITH I2C



A 16x2 LCD (Liquid Crystal Display) with I2C (Inter-Integrated Circuit) interface is a versatile and widely used display module in electronics projects. It consists of a 16-character wide and 2-line tall alphanumeric display, capable of presenting text and basic symbols. The I2C interface simplifies the connection and communication between the LCD module and a microcontroller or other control device.

The I2C protocol allows for serial communication between multiple devices using only two wires: a data line (SDA) and a clock line (SCL). This simplifies the wiring and conserves GPIO (General Purpose Input/Output) pins on the microcontroller, making it ideal for projects with limited I/O resources.

To use a 16x2 LCD with I2C, the module typically includes an integrated I2C controller, which translates commands and data from the microcontroller into signals that control the display. This controller manages tasks such as initializing the display, positioning the cursor, and writing characters to specific locations on the screen.

In electronic projects, the 16x2 LCD with I2C interface serves a variety of purposes, such as displaying sensor data, status information, and user prompts. Its compact size, low power consumption, and compatibility with popular microcontroller platforms make it suitable for integration into diverse applications, including embedded systems, IoT (Internet of Things) devices, and DIY electronics projects.

By leveraging the combined benefits of a 16x2 LCD and the I2C communication protocol, designers and hobbyists can easily incorporate visual feedback into their projects, enhancing user interaction and overall functionality. Its versatility and ease of use make it a popular choice for displaying information in a wide range of electronic applications

10. APPLICATIONS

Multi-Purpose Liquid Filling Machine is suitable for a wide range of liquid filling applications, including but not limited to:

- Pharmaceutical manufacturing
- Food and beverage production
- Chemical processing
- Cosmetics and personal care products

Its versatility, precision, and user-friendly design make it an ideal choice for industries that demand reliable and efficient liquid handling solutions.

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