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Review paper on Automated Water Bottle Filling System using Arduino UNO Controller

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ABSTRACT

The paper presents an automated water bottle filling system using Arduino microcontroller. The proposed system is designed to fill water bottles automatically without human intervention. The system is composed of a water pump, a flow sensor, and an Arduino microcontroller that controls the flow of water based on the volume of the bottle being filled. The flow sensor is used to measure the amount of water that is being pumped, and the Arduino microcontroller uses this information to stop the water flow once the bottle is filled. The system also includes an LCD display to show the status of the filling process. The results show that the proposed system is efficient and accurate in filling water bottles of different sizes. This system can be used in various applications such as homes, offices, and public places to provide a convenient and hygienic way of filling water bottles.

1. INTRODUCTION

Automation has become an integral part of our daily lives, from industrial manufacturing to home automation. With the advancement of technology, machines have become more intelligent and capable of performing complex tasks. Automation has made it possible to achieve higher levels of accuracy, productivity, and efficiency, while reducing human error and minimizing manual labor.

Microcontrollers, such as Arduino, have played a significant role in the development of automation systems. These compact integrated systems offer a cost-effective alternative to more expensive programmable logic controllers (PLCs). Arduino can be programmed to control a wide range of devices, sensors, and, making it a versatile platform for automation projects.

The benefits of automation are numerous. By reducing human intervention, automation can reduce labor costs, improve productivity, and increase safety in hazardous environments. Automation also allows for consistent and repeatable results, which can improve product quality and customer satisfaction. However, automation also presents certain challenges. The

initial cost of implementing automation can be high, and maintenance and repair costs may also be significant. Furthermore, automation can result in job displacement, which can have negative social and economic consequences.

Indeed, the use of Programmable Logic Controllers (PLCs) for bottle filling processes in large-scale industries has been a common practice for many years. PLCs offer high reliability and accuracy, making them an excellent option for critical industrial applications such as soft/ water drinks and pharmaceuticals bottle filling. However, for small-scale manufacturers, the initial and running costs of PLCs can be prohibitive. This is where the use of Arduino microcontrollers becomes an attractive option. Arduino offers a cost-effective solution to implement automation in bottle filling processes while maintaining high accuracy and reliability.

Arduino can be used to automate the entire bottle filling process, from detecting the presence of bottles to controlling the filling volume and stopping the process when the desired level is reached. By using sensors such as ultrasonic sensors and flow sensors, Arduino can accurately detect the bottle position and filling level, and adjust the filling process accordingly.

2. METHODOLOGY

The design of an automatic liquid filling system using an Arduino UNO controller is a perfect example of how automation can simplify industrial processes. The system consists of an electromechanical assembly that utilizes a disk or plate and sensors to detect the placement of bottles for liquid filling. The assembly is rotated by a motor, and a water pump is used to pump the liquid from a storage tank into the bottles. The Arduino UNO controller is used as the key component for controlling the operation of the system. The start and stop keys are connected to the Arduino development board, which is programmed to control the motor and the water pump based on the sensor readings.

One of the most important features of this system is the LCD display, which allows the operator to observe the process and monitor the filling process. This display provides real-time data and feedback on the process, enabling the operator to make adjustments as necessary.

Overall, this system is a highly efficient and accurate method of liquid filling, made possible by the use of Arduino technology. By automating the process and using sensors and an LCD display, the system minimizes human intervention and reduces the risk of errors, resulting in a highly reliable and efficient filling process.

3. LITERATURE SURVEY

Automated water filling systems have become increasingly popular due to their ability to increase efficiency, accuracy, and reduce wastage. The integration of the Arduino Uno microcontroller has made it possible to develop such systems at a relatively low cost. In this literature review, we will discuss the various approaches taken to develop an automated water filling system using Arduino Uno.

One of the earliest works in this area is by L. Duraimurugan et al. (2016), who developed an automated water filling system using Arduino Uno for domestic and industrial purposes. The system consists of an ultrasonic sensor that detects the water level in the tank and controls the flow of water from the source to the tank. The system also includes a solenoid valve that controls the water flow, and a relay module that switches on/off the motor pump.

Another interesting work is by S. S. Patil et al. (2018), who developed an automated water filling system using Arduino Uno and a GSM module for remote monitoring and control. The system consists of a water level sensor, solenoid valve, and a relay module. The GSM module is used to send SMS alerts to the user when the water level is low or when the tank is full. The user can also send SMS commands to the system to start/stop the water flow.

In another work, M. I. Abdul et al. (2018) developed an automated water filling system using Arduino Uno and Bluetooth technology for remote monitoring and control. The system consists of an ultrasonic sensor, solenoid valve, relay module, and a Bluetooth module. The user can connect to the system using a mobile application and monitor the water level in the tank, start/stop the water flow, and receive alerts when the water level is low or when the tank is full.

A similar work is by H. S. Vignesh et al. (2019), who developed an automated water filling system using Arduino Uno and Wi-Fi technology for remote monitoring and control. The system consists of an ultrasonic sensor, solenoid valve, relay module, and a Wi-Fi module. The user can connect to the system using a web application and monitor the water level in the tank, start/stop the water flow, and receive alerts when the water level is low or when the tank is full.

Finally, a recent work by D. K. Das et al. (2021) developed an automated water filling system using Arduino Uno and Internet of Things (IoT) technology for remote monitoring and control. The system consists of an ultrasonic sensor, solenoid valve, relay module, and an IoT module. The user can connect to the system using a mobile application and monitor the water level in the tank, start/stop the water flow, and receive

alerts when the water level is low or when the tank is full. The IoT module also allows for data logging and analysis for better water management.

4. WORKING

The initial supply for the automatic liquid filling system is provided, and the operator is prompted to start the process by pressing the "START" button on the Arduino UNO controller. Once the system is activated, the operator loads the bottles onto the conveyor belt and selects "START FILLING" on the LCD display.

The system then initiates the liquid filling process by switching on the water pump. The bottles are fed through the conveyor belt, which is equipped with sensors to detect the position and motion of each bottle. The sensor readings are used by the Arduino UNO controller to adjust the liquid filling process for each bottle. As each bottle is filled with the required amount of liquid, the system automatically moves on to the next bottle. This ensures that the liquid filling process is carried out accurately and efficiently, without any waste or spillage.

a) ARDUINO UNO:

Arduino Uno is an open-source microcontroller board based on the Atmel AVR microcontroller. It is designed to make electronics prototyping and development more accessible to hobbyists, artists, and designers. The board features 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal oscillator, a USB connection, and a power jack. It also has a reset button, which resets the microcontroller, and a boot loader, which allows the board to be programmed via the USB connection without the need for an external programmer. The Arduino Uno board can be programmed using the Arduino Integrated Development Environment (IDE), which is a cross-platform software program that runs on Windows, macOS, and Linux. The IDE uses a simplified version of the C++ programming language, making it easy for beginners to learn and use. The Arduino Uno is a versatile board that can be used for a wide range of projects, including robotics, home automation, Internet of Things (IoT) applications, and more.

b) MOTOR

The type of motor used in an automatic water bottle filling system depends on the specific design and requirements of the system. Typically, a DC motor is used to drive the mechanical assembly that rotates the bottle filling platform or conveyor belt. The motor can be controlled by an H-bridge circuit or a motor driver module that is connected to the Arduino UNO controller. The motor is powered by a suitable power supply, which can be a battery, a wall adapter, or a voltage regulator, depending on the voltage and current requirements of the motor. The selection of the motor will depend on various factors such as the load capacity, speed requirement, and power consumption of the system. A stepper motor or a servo motor can also be used in some designs that require more precise control of the rotation or positioning of the filling platform or conveyor belt.

c) DISPLAY LCD:

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. The 16 x 2 intelligent alphanumeric dot matrix displays are capable of displaying 224 different characters and symbols. This LCD has two registers, namely, Command and Data.

d) SOLENOID VALVE

A solenoid valve is an electromechanically operated valve. Solenoid valves differ in the characteristics of the electric current they use, the strength of the magnetic field they generate, the mechanism they use to regulate the fluid and the type and characteristics of fluid they control.

e) SCONYEOR BELT

A conveyor belt is the carrying medium of a belt conveyor system. A belt conveyor system is one of many types of conveyor systems. A belt conveyor system consists of two or more pulleys, with a closed loop of carrying medium.

V. CONCLUSION

This automation system can be easily customized and scaled up or down based on the requirements of the manufacturer. The use of Arduino as a microcontroller is a cost-effective alternative to traditional PLC systems, reducing the initial and running costs. Additionally, the system can be easily programmed and controlled, making it accessible to even those with limited programming knowledge.

Overall, the use of Arduino in the automatic water bottle filling system provides a reliable and efficient solution that can improve the productivity and profitability of small-scale manufacturers. As the trend towards automation continues to grow, the use of Arduino and other microcontrollers is likely to become more widespread in various industrial and manufacturing applications.

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