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Implementing a Mineral Water Gallon Counter Device Based on a Website Using Infrared Sensors

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Abstract

This research discusses the development of a mineral water gallon counter system using infrared sensors integrated into a website interface to increase the efficiency of distribution management in the company. This system uses infrared sensor technology to automatically detect the movement of gallons of mineral water at entry and exit points. The detection data is processed and presented via a web interface that can be accessed in real time, providing accurate information on the number of gallons entering and leaving. The research methodology involves the development of hardware and software and the results show that this system can increase the company's operational efficiency and provide easy online monitoring of mineral water distribution. The implications of this research are expected to make a positive contribution to the optimisation of the distribution process and the management of mineral water stocks in companies.

Keywords: infrared, sensors, water

INTRODUCTION

Advances in information technology and embedded systems in the digitalization era are increasingly leading to studies of control systems, automation, IoT, and artificial intelligence. (Siskandar, Santosa, et al., 2022) . Rapid technological advances have a significant impact on economic activities that develop within society. (Rahmani et al., 2021). Technological developments have transformed the manufacturing industry, requiring it to compete globally and adapt to the impact of the fourth industrial revolution.

This revolution is characterised by the convergence of information technology, humans, machines, and natural resources. Progress in the field of information technology and embedded systems in the era of digitalization is increasingly leading to the study of control and automation systems. (Siskandar, Fadhil, & Rifa Kusumah, 2020) . Progress in the field of embedded systems in the industrial world is leading to an increasing focus on the study of control systems and production

automation. (Siskandar, Indrawan, et al., 2020). The use of technology in communication media is crucial in the digital age. (Renaldi et al., 2023).

The internet has emerged as a crucial communication medium in the digital age. (Farras Fauzan et al., 2021). Industrial Era 4.0 serves as a bridge between the digital world and the industrial sector. The availability of digital infrastructure is a key factor supporting the implementation of Industry 4.0 (Sunata & Rino, 2020). The digitalization era's transformation requires actorsto utilize technology that leads to supply chain management 4.0. (Prayudha Hidayat et al., 2023). Automatization is the use of a control system and information technology to help reducethe need for manual labor in producing goods and services. (Irzaman, Siskandar, Nabilah, et al., 2018). The rapid development of technology and science has led to the birth of the 4.0 industrial revolution, which prioritizes communication between devices using IoT and AI. IoT is one of the main elements in the development of this revolution. (Siskandar et al., 2022).

The Internet of Things (IoT) allows for the connection of multiple devices through the internet. It is a concept that enables devices to communicate with each other. (Shubhi Maulana et al., 2021). The Internet of Things (IoT) is a network-connected tool that has been utilized in industry. It is a concept where objects can transfer data without requiring human-to-human or human-to-computer interaction (Parningotan & Mulyanto, 2020). An energy monitoring device integrating with the concept of the Internet of Things allows their measured data to be monitored and retrieved at any locations where internet is available. (Akbar et al., 2019). IoT is a system that connects devices directly orindirectly to the internet. (Siskandar, Fadhil, Kusumah, et al., 2020).

Water is an essential requirement for human survival and has various benefits, such as being a primary source of hydration. It is important to note that subjective evaluations have been excluded from this text. (Komang Angga Darmayasa et al., 2018) Drinking water requirements vary depending on body weight and physical activity. Water is the most essential component for the life of all living creatures. Every living creature requires and contains water. (Hatrinidinar Rasya et al., 2020). Water is a vital component of ecosystem health. Osman et al. (2018) suggest that the degradation of water quality can be attributed to urbanization, industrialization, and excessive exploitation of natural resources.(Damas Yoridho et al., 2020).

Large companies typically use manual conveyors operated and monitored by employees to produce gallons of mineral water. The production process involves washing and filling the gallon with water, installing the cover, checking the water quality, and delivering the product to consumers. Companies often face challenges when it comes to accurately recording the production and distribution of mineral water. Instances of missing gallons of mineral water that have already been sold to consumers can be particularly detrimental to larger companies. To prevent such losses, it is crucial for companies to take action. This system needs to continue to be developed following technological developments. (Wiyoto et al., 2023) . The author proposes a solution to address this issue. This tool can automatically calculate the amount of mineral water in gallons using the E18-D80NK sensor and ESP32 microcontroller.

The purpose of this research is to facilitate the production of mineral water gallons for companies by developing a mineral water gallon counter. The aim is to address the issues of lost gallons of mineral water and human error within the company. The workers simply need to monitor the conveyor belt, which will trigger the tool to automatically detect and count the gallons of mineral water.

Monitoring is crucial for successful production of water activities. (Wiyoto et al., 2022) . The function of this technology tool is to enhance the accuracy of mineral water gallon production by storing data on the web. (Kusumah et al., 2021) . Additionally, it facilitates the recording of mineral water gallon production. It can also track the production history of mineral water gallons and prevent fraud. In the future, this device is expected to have a good impact on company in the era of increasingly developing technology.(Siskandar, Wiyoto, et al., 2022).

In large companies, manual calculations can lead to errors or human mistakes due to the speed at which various types of work are carried out. The optimal number of suppliers is a solution to maintain a balance of supply and demand in supply chain activities. (Santosa et al., 2021) . Stock management is currently a company problem because fluctuations in demand often cause a buildup of

products in the warehouse. (Husen Santosa et al., 2023) . This tool aims to assist employees by automating calculations, resulting in more accurate results. Additionally, it can help

reduce losses resulting from fraud experienced by companies by tracking the production history of gallons of mineral water.

An information system can be defined as a collection of interconnected elements or subsystems that manage data to make it meaningful and useful for decision-making, both presently and in the future. (Fakhiratunisa et al., n.d.) . Distribution involves a series of activities that play a crucial role in delivering production outcomes to consumers. (Hidayat et al., 2022). Quality rate is a measuring tool to see the machine's ability to produce quality products. (Santosa et al., 2022).

Demand uncertainty can affect consumer expectations of product purchases and production processe. (Santosa et al., 2023). To address the issues discussed earlier, one potential solution is to develop an automation system. (Aprilianti et al., 2023) . Automation involves using technology to perform tasks with minimal human involvement. This can include mechanizing processes in various sectors, such as manufacturing, customer service, or even household functions. (Kusumah et al., 2020). The internet and other information and communication technologies have led to the development and widespread use of websites in various aspects of life, both personal and institutional. (Kharismatunnisaa et al., 2023). Technology is a tool that can reduce the burden on humans to meet their unique needs. (Wicaksono et al., 2023) . The ESP32 microcontroller is a versatile and user- friendly device that can be used to control a variety of modules, sensors, and supporting hardware, including relays. It enables remote monitoring of the load current of electronic devices in the home,
even when out of reach, by connecting Android and Arduino the network ESP32.

The ESP32 also facilitates internet connectivity for microcontroller devices such as Arduino through WiFi (Bayu et al., 2021). Nowadays, it is well known that microcontroller is the brain of a digital electronicsystem that used for coordinating a system to workia as desired. (Irzaman, Siskandar, Aminullah, et al., 2018). The electronic circuit is built from input and output modulesprocessed using the NodeMcu V3 microprocessor module. (Irzaman et al., 2022). In that case,the microcontroller (as a processor) will analyze the sensor reading value data and instruct the output section. (Siskandar et al., 2023b).

A sensor is a device that measures physical quantities and converts them into a signal that can be read and utilized. This technology applies a sensor quality reading system. (Siskandar, Wiyoto, et al., 2023). It is important to note that all evaluations presented are objective and free from bias. One example of such a sensor is the infrared sensor, specifically the E18-D80NK infrared sensor used in this research. This sensor has an adjustable bolt that can change the object detection distance and requires a 5V DC voltage. The E18-D80NK sensor will be configured to detect objects that are less than 21 cm away. This sensor's small size makes it suitable for use in industrial applications (Wijanarko & Hariyanto, 2022). Overall LCD display remains constant and clearly monitored. (Kusumah et al., 2022).

Alga Aris Prasetio (2020) defines the infrared proximity sensor as a distance sensor that emits and captures infrared light. The sensor captures the reflection of the emitted infrared light when an object is in front of it. The knob on the sensor regulates the detection range. The infrared type proximity sensor is commonly used and is recommended for use with the E18-D80NK series. The sensor was released in 2017 and boasts impressive specifications. It has a detection range of 3cm to 80cm, with both input and output rated at 5V. Additionally, it has a response time of less than 2ms and an output current of 100mA.

A BreadBoard, also known as a project board, serves as the foundation for constructing an electronic circuit prototype that has not yet been soldered, allowing for changes to the schematic or components.Breadboards are classified according to the number of holes they have, such as 400-hole and 170-hole breadboards. To use a breadboard, it is important to first understand the connections between the holes (Yusup et al., 2020). The circuit was made byfirst making aprototype using a breadboard. A breadboard was used to make it easier toconstruct circuit prototype. (Irzaman, Suryana, et al., 2022).

The Internet of Things (IoT) refers to the interconnection of physical devices, vehicles, buildings, and other items embedded with electronics, software, sensors, and network connectivity,

which enables these objects to collect and exchange data. This data can be transmitted over the internet, allowing for remote monitoring and control of the devices. Sensor reading data is transmitted via the internet and requires a user-friendly presentation to facilitate information exchange between the sensor's analog language and the digital language of the server or application. (Nalendra & Mujiono, 2020).

Arduino is designed for beginners who may not have a strong grasp of the C++ programming language. It offers many conveniences due to its library. The Arduino Integrated Development Environment (IDE) is a user-friendly tool that guides enthusiasts through the seas of embedded systems. This brief exploration will traverse the IDE's interface and its tools. (Andre et al., 2020) . Arduino uses Processing Software, which is a combination of C++ and Javaprogramming languages, to write programs.The installation of Arduino software is straightforward and it can run on various operating systems, including LINUX, Mac OS, and Windows. Arduino is a combination of hardware, programming language, and a sophisticated Integrated Development Environment (IDE). (Siskandar et al., 2023)

The Arduino program code is created using the Arduino IDE software. (Siskandar, Indrawan, et al., 2020). The IDE is a software that plays a crucial role in writing programs, compiling them into binary code, and uploading them into microcontroller memory. The Arduino IDE software consists of three parts: a program editor for writing and editing programs in processing languages. The program listing on Arduino is referred to as a sketch. The compiler module is responsible for converting the processing language (program code) into binary code, which is the only programming language that the microcontroller can understand. The uploader module is responsible for transferring the binary code into the microcontroller's memory (Yusup et al., 2020).

METHODS

The implementation of the design and construction method begins with the Analysis stage. (Dardanella et al., 2022). This involves assessing the agency's needs and conducting literature studies from various journals on the use of microcontrollers and sensors as detectors. A list of the tools and materials required to design this security system should then be created. The analysis is performed by examining the problem information, which involves searching for and developing information. (Ayu Nandita Pangesti et al., 2022).

After completing the analysis stage, the next step is to design the hardware, including the circuit schematic and tool design. Following this, design the software, including use case diagrams, and proceed to test the security system. The purpose of this study is to provide an easy approach to obtaining precise data or providing condition notifications from the measurement process for each sensor.(Siskandar et al., 2023).

In collecting data using literature study and observation methods. Literature study is collecting and analyzing various information about companies that produce gallons of mineral water. (Nelvi et al., 2023).

The program was developed using the Arduino IDE with C language. It involves input and output operations, which are performed by two components: a proximity sensor and a push button. The program also includes three output components: an LCD, an LED, and a website. The proximity sensor serves as the initial input, which is then processed by the Arduino Uno ATmega. The LED output illuminates, and the LCD displays the corresponding text.

The method for counter research on gallons of mineral water, which aims to estimate the number of sales per day, involves careful time series analysis. Firstly, historical data on sales of gallons of mineral water over a certain period of time, usually several months to a year, will be collected. This data will include information such as the number of gallons sold each day, as well as factors that influence sales, such as seasons, weather, holidays, and other relevant factors. Once the data has been collected, the next step is to select an appropriate time series model based on the data's characteristics and the analysis's purpose.

Common models include the ARIMA (AutoRegressive Integrated Moving Average) model or

the SARIMA (Seasonal ARIMA) model. The selected model should then be adjusted and tested for accuracy using techniques such as cross-validation or dividing the data into training and test sets. Once a suitable model has been found, researchers can use it to forecast sales of gallons of mineral water for a certain period in the future, taking into account external factors that influence sales. This method provides a detailed view of mineral water gallon sales patterns, enabling entrepreneurs to make better decisions in inventory planning, marketing, and sales strategies.

Time series analysis is a statistical method used to analyse data arranged in a regular time sequence. The main goal is to identify patterns, trends, and behaviours associated with that data over time. The analysis involves several steps, including data visualisation, stationarity testing, modelling, and prediction. The first step is to visualise the data using time series graphs to identify trends, seasonality, and other patterns. Next, stationarity testing is performed to ensure that the statistical properties of the data remain constant over time. Following this, statistical models such as ARIMA (AutoRegressive Integrated Moving Average) or SARIMA (Seasonal ARIMA) can be applied to model and predict time series data. Time series analysis finds application in various fields such as economics, finance, meteorology, and manufacturing to make decisions based on a better understanding of data behavior patterns over time.

The tools and materials required for creating the tool are as follows:

Table 1 Tools and Materials

Tools & Materials	Function	Amount
ESP 32	As a microcontroller that runs programs	1
E18-D80NK Sensor	As input or sensor	1
LCD 16x2	As output to show information	1
Breadboard	As a board for designing electronic circuits	1
LED	As output to indicate that gallons are detected	1
Push Button	As input to reset the calculation amount	1
Adapter	As a power source for the circuit	1

The analysis stage involves observation, which is achieved by testing each component to determine its suitability for the required needs. (Lutfi Yustisyia et al., 2023). Design is the stage that is carried out after obtaining and discussing the analysis needs with the company. Design is a process of planning and problem-solving to find solutions to existing problems. (Lintar Balle et al., 2021). The Hardware Design Process includes flowcharts, block diagrams, schematic circuits, and tool designs. Software design involves creating a website that aligns with the analysis and has been discussed with the agency.

The implementation phase is the realisation phase of the design phase.(Abiyaksa et al., 2020). This includes assembling components, creating program code, and preparing the web to connect the tool with the database. The mineral water gallon counter can then proceed to the next stage, which is testing. Testing is used to identify and resolve errors or bugs in software. Error testing helps ensure that the software runs smoothly, without problems that could disrupt users.(Saputra et al., 2023).

In the final stage, a project report will be created. This report will include comprehensive documentation of all stages that have been completed, the results of testing, and a thorough evaluation of the project. (Ardelia Wirastuti et al., n.d.) . This report will include comprehensive documentation of all stages that have been completed, the results of testing, and a thorough evaluation of the project. Defining the problem and determining the type of knowledge sought. (Hidayat et al., 2021). The report will be a crucial document for project documentation and accountability purposes.

RESULTS AND DISCUSSION

The design stage is a stage that aims to provide an overview of the monitoring system to be created, consisting of block diagrams, flow diagrams, circuit diagrams, 3D tool designs. In the figure below there is a block diagram that explains the input, processing and output processes by showing what components are used. The first input is the E18D80NK sensor. This sensor has a sensing distance of 3-80cm, which can be adjusted as required by turning the potentiometer on the rear, and is easy to install and use. The second input is a push-button that is used to reset the gallon count per day.

Moving on to the process, the ESP32 is used as a microcontroller to process the data. Later, the ESP32 will be connected to the company's wifi or internet, and the ESP32 will use a 5V power adapter. The next is the first output via the LCD. The function of the LCD is to display information on the number of gallons detected. The second output is an LED to indicate whether the gallon has been detected or not. The final output is a web page that functions to display data on the number of gallons entered per day. literacy is knowledge and understanding of scientific concepts and processes needed to solve problems. (Lestari et al., 2021).

The image below is a flowchart that shows the overall workflow of the system and explains the sequence of events in the system. A flowchart is a diagram that illustrates the steps in a system. Flowcharts are designed to demonstrate the functionality of the website being created.(Alwahdi et al., 2023).

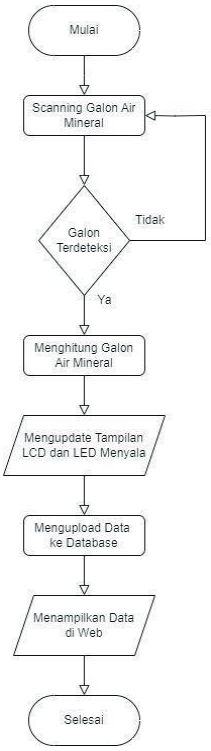

Figure 1 Flowchart

This tool will start when it is connected to a power supply, if it is switched on then this tool will start scanning gallons of mineral water. If it successfully detects the gallon, it will upload the data to the database and display the data on the web.

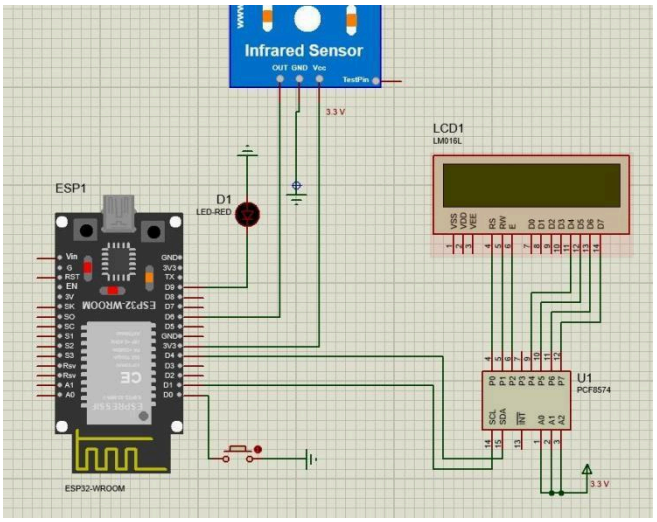

Figure 2 Schematic Circuit

Wiring schematic circuit can be created using the software Proteus 8 Professional. The microcontroller is the brain of the system, processing data from the infrared sensor. (Salma Salsabilla Fardani et al., 2022). Infrared sensor module to detect gallons of mineral water produced. Internet connection to transfer data to the server and access the web platform. Server to manage mineral water gallon data and database to store mineral water gallon data.

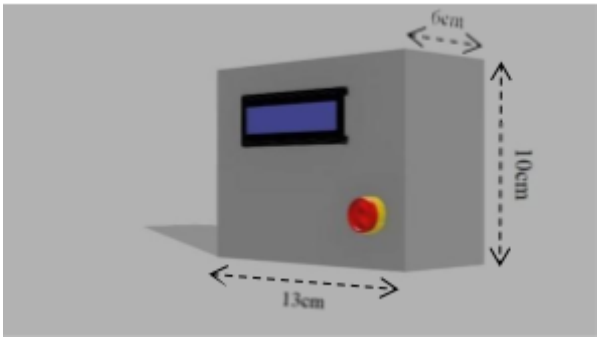

Figure 3 Front View Design

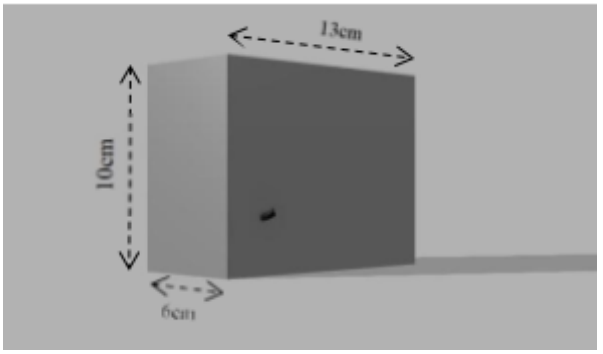

Figure 4 Back View Design

This tool has ben designed using Fusion software. This tool is used to place components. For the mechanical design drawing of the tool to be made. This metallic contact layer becomes a pathway for electrons to flow faster toward the holes.(Irzaman et al., 2024). This design is made ergonomic and uncomplicated so that it is easy to install in companies. The design tool measures is 10cm in height, 13cm in length, and 6cm in width.

CONCLUSION

Using the tools created, the author can find out the history of the production of gallons of mineral water. This tool will later help to record the results of the production of gallons of mineral water and also to prevent fraud in the production of gallons of mineral water. The author proposes a solution to address this issue. This tool can automatically calculate the amount of mineral water in gallons using the E18-D80NK sensor and ESP32 microcontroller. The purpose of this tool is to enhance the accuracy of mineral water gallon production by storing data on the web. Additionally, it facilitates the recording of mineral water gallon production. It can also track the production history of mineral water gallons and prevent fraud.

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