IOT Based Smart Conveyor and Liquid Filling System

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Abstract—**In modern industries, automation plays a crucial role in improving efficiency, accuracy and productivity. Traditional liquid filling systems often suffer from inconsistencies in volume control, operational inefficiencies and the need for continuous human supervision. To address these challenges, this paper presents an IOT-Based Smart Conveyor and Liquid Filling System that leverages automation and real time monitoring to enhance performance. The proposed system integrates various components including Node MCU ESP8266, Conveyor System, Motor Driver, Solenoid Pump, IR Sensor, Ultrasonic Sensor, Flow Sensor, 2.1 inches OLED Display, Power supply 12 adapter, Dual channel display, to ensure precise liquid filling and seamless material handling. The conveyor mechanism automatically moves containers into position, while smart sensors detect their presence and initiate the filling process. The system dynamically adjusts the liquid flow rate based on predefined parameters to minimize wastage and ensure uniform filling. IOT integration allows remote monitoring and control through a cloud-based platform, enabling predictive maintenance, data analysis and performance optimization. Operators can track system performance in real time using a web or mobile interface, reducing the need for on-site supervision. Additionally, data collected from the system can be analyzed to detect inefficiencies and improve overall operational effectiveness. Experimental results indicate that the proposed system significantly improves accuracy, reduces human intervention and optimizes resource utilization compared to conventional methods. By incorporating IOT technology, this research highlights the potential of smart automation in industrial liquid filling processes, paving the way for more efficient, cost-effective and scalable solutions in manufacturing.**

Keywords: IOT-based smart system, Smart conveyor, Liquid filling automation, IOT connectivity, Real-time monitoring, Cloud based platform, Precision liquid filling.
Novelty: this project introduces the budget friendly IOT based automatic bottle filling system it have the remotely controlled system , wireless data monitoring like features it uses IR sensor to detect the bottle, ultrasonic sensor to measure the water level in main tank. This improves the accuracy and the production performance of the industries like soft drink industries and drinkable water sellers

I. PROBLEM STATEMENT

In soft drink industries we need to feel the number of bottles every day and it did manually which is very time consuming also due to higher human involvement its higher chances of error in bottle filling like inconsistent filling, over filling and lack of monitoring etc.

II. INTRODUCTION

In today's fast moving industrial world, automation plays a huge role in making work faster, easier, and more efficient. One such area where automation is making a big difference is in manufacturing and packaging systems especially where products need to be filled, packed, and transported. Traditionally, these tasks were done manually or with machines that required constant supervision. However, with the rise of the internet of things(IOT), we now have smarter systems that can work more independently and accurately. The liquid filling and conveyor system is commonly used in industries such as food and beverage, chemicals and cosmetics. These systems are responsible for moving containers along a belt and filling them with specific amount of liquid. In the past, even the automation, these systems needed human operators to monitor and control the process. This often led to errors, wastage and downtime. By integrating IOT technology into these systems, we can create a more intelligent and self-aware setup. Sensors, controllers, and communication modules work together to monitor the system in real tie, detect problems, and even adjust operations automatically. This not only improves accuracy and speed but also reduces human involvement, which in turn brings down costs and increases safety. The IOT-based smart conveyor and liquid filling system presented in this paper aims to solve common challenges in industrial automation, such as overfilling, Inconsistent filling, delays, Maintenance, and manual errors. The goal is to build a system that is smart, efficient, and capable of real-time monitoring and control using modern IOT tools like microcontrollers,

sensors, and wireless communication. This paper explains the design, working, and benefits of such a system, highlighting how it can be used in real-world industries to improve productivity and ensure consistent quality.

III. OBJECTIVES

1. Make the pure automatic water filling system
2. Make the system accessible from anywhere
3. Send the important parameters to user remotely

IV. LITERATURE SURVEY

[1], Sutar and Patil designed an Arduino-based automated bottle filling system integrated with a conveyor belt mechanism. Their system emphasized cost-effectiveness and basic level automation using simple IR sensors and relay modules. However, the lack of IOT capabilities limited its real-time monitoring and remote operation features.

Mohsin et al. in [2] implemented an automated bottle filling system using a Programmable Logic Controller (PLC). The focus was on accurate control and precise filling, which demonstrated higher reliability and stability compared to microcontroller-based designs. Yet, the absence of IOT integration restricted data logging and remote diagnostics.

Park et al. [3] proposed an IOT-enabled smart factory framework tailored for bottling processes. Their system allowed remote access and control via cloud platforms, thus enhancing scalability and flexibility. The work highlighted the potential of IOT to streamline industrial processes but lacked detailed implementation of conveyor-based systems.

Khan et al. [4] presented a smart manufacturing system that integrated PLCs with IOT platforms. The system successfully achieved real-time monitoring, alert generation, and control of automated processes. Their study underlined the importance of merging traditional control systems with modern IOT frameworks for increased efficiency.

Umbarkar and Kamat [5] explored low-cost IOT-based solutions for implementing Industry 4.0 in manufacturing environments. They utilized Raspberry Pi and open-source platforms for creating a modular automation system. While the system was cost-effective and scalable, it required optimization for industrial-grade liquid filling tasks. Kumbhar and Ghorpade [6] developed an IOT-based real-time automation system for industrial applications. Their architecture incorporated sensors, actuators, and cloud services for data visualization and control. Although general-purpose, their approach serves as a strong foundation for specific applications like conveyor and filling integration.

V. COMPONENTS USED

Components Used
- Hardware
  1. Node MCU ESP8266.
  2. Conveyor System.
  3. Motor Driver(L298N).
  4. Submersible Pump.
  5. IR Sensor.
  6. Ultrasonic Sensor.
  7. Power Supply 12 Adapter.
  8. Dual Channel Relay
- Software
  1. Blynk application
- Selection of components:
1. NodeMCU

Specifications	NodeMCU v1.0	Arduino Pro Mini
MCU	32 bit Tensilica L106	8bit ATmega328P
Frequency	80/160 MHz	16 MHz
Input-Output	17xDIO	14xDIO
ADC Pin	1x10 bit (1V)	6x10 Bit (3V3)
Operating Voltage	3.0~3.6V	3.0~3.6V
Program Memory	4MB	32kB
WiFi	IEEE 802.11 b/g/n	-

2. Motor driver

Feature	L298 N	L293D	TB6612FNG	VNH2SP30
Voltage range	5V-35V	4.5V-36V	4.5V-13.5V	5.5V-24V
Current per channel	2A	600m A	1.2A	14A
Number of motors	2	2	2	2
cost	low	high	medium	Very high

3. Ultrasonic sensor

Feature	HC-SR04	VL53L0X	IR sensor
range	2cm-400cm	2mm-2m	2cm – 50cm
accuracy	Medium(±3mm)	High (±1mm)	low
Work in darkness?	yes	yes	no
cost	low	high	low

- Technical specifications

Components	Specifications
Micro-controller	NodeMCU ESP8266 (Wi-Fi enabled, 32- bit, 80 MHz, 4MB Flash memory)
Conveyor motor	DC Gear Motor (12V, 100–300 RPM, high torque, continuous operation)
Motor Driver	L298N Dual H-Bridge (5–35V DC Motor Control, 2A per channel)
Pump	Solenoid Pump (12V DC, 2–4 L/min flow rate, 3W–6W power rating)

IR Sensor	IR Obstacle Detection Sensor (3.3V–5V logic level, <20 cm detection range)
Ultrasonic Sensor	HC-SR04 (2–400 cm range, 5V operation, 15° detection angle)
Relay Module	2-Channel 5V Relay (10A max current, opto-isolated)
Power supply	12V DC Adapter (1A– 2A, regulated)

- Cost of components

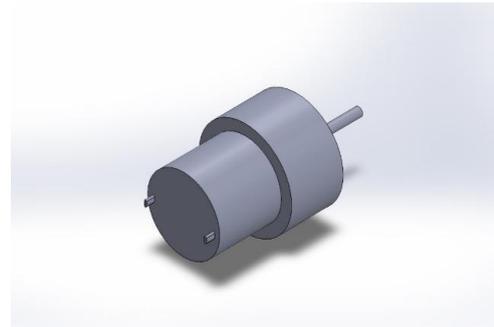| Sr. no.	Name of component	QTY	cost
1.	Node MCU ESP8266	1	150
2	Conveyor with motor and pulleys	1	300
3	Motor driver	1	120
4	Solenoid pump	1	200
5	IR sensor	1	100
6	Ultrasonic sensor	1	120
7	12v adapter		160
8	Dual channel relay module	1	150
	Total		1300

- 3D models of components and setup

Fig. 5.1. Drawing of Motor Driver.

Fig. 5.2. Drawing of liquid dispensing nozzle.
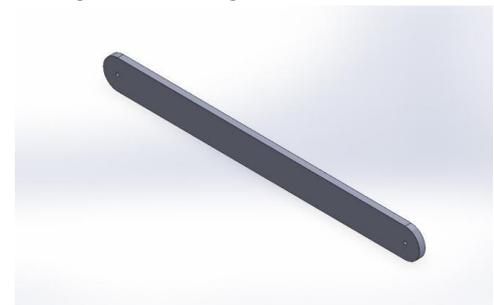

Fig. 5.3. Drawing of a standard bottle.

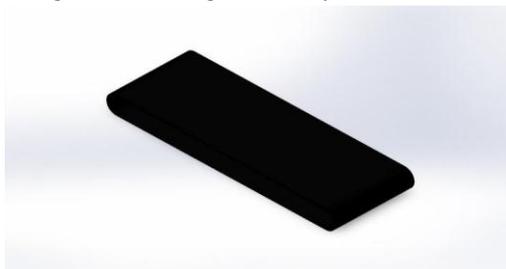
Fig. 5.4. Drawing of Conveyor Side Frame.

Fig. 5.5. Drawing of Conveyor Belt.

Fig. 5.6. Drawing of Bottle Filling System Assembly.

VI. WORKING

1. System starts
   - Initialization
   - Connect to blynk and wifi
2. System ON via BLYNK application
   - Start conveyor motor via a relay module
3. Bottle detection
   - If bottle detected stop the conveyor
   - If bottle not detected run the conveyor until bottle detected
4. Pump ON and OFF
   - If bottle detected turns on the pump for 4 sec
5. Increment in bottle count
   - Increase bottle count by one in BLYNK application
6. Loop back to step 4

- Working flow chart
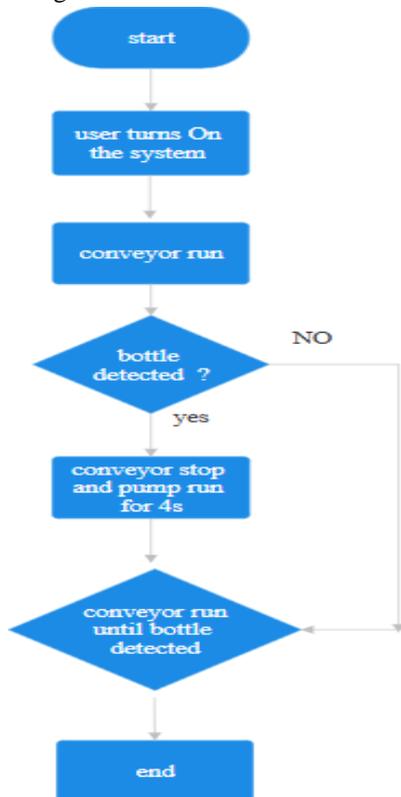
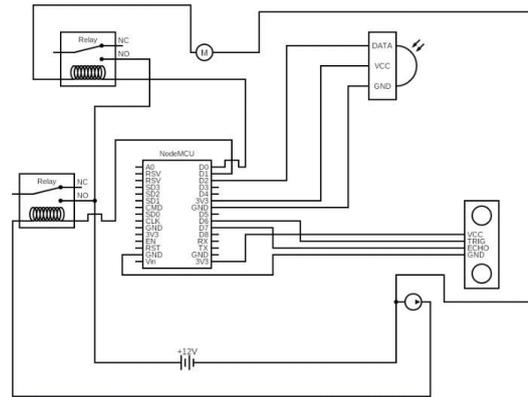Fig. 6.1 working flow chart

VII. CIRCUIT DIAGRAM

Fig. 7.1 circuit diagram
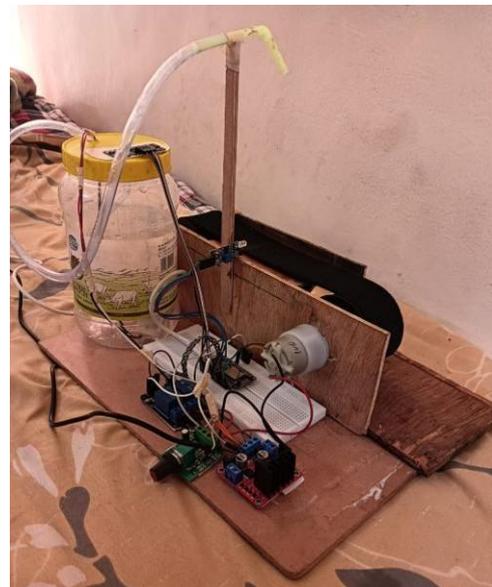
VIII. RESULTS

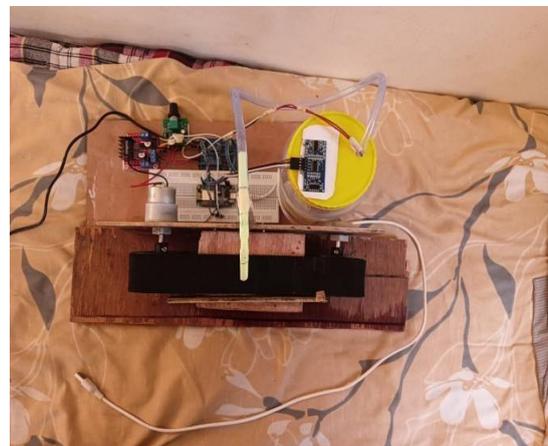- Model

Fig. 8.1 side view

Fig. 8.2 top view
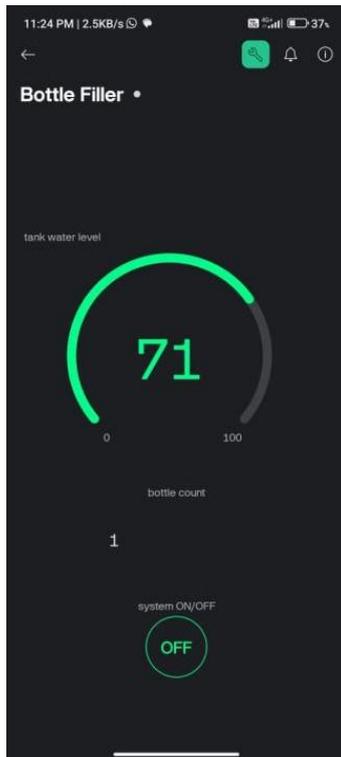
Fig. 8.3 front view

- BLYNK interface

Fig. 8.4 BLYNK interface

- Performance evaluation
 1. Bottle filling accuracy

$$\text{Accuracy (\%)} = \frac{\text{Actual volume filled}}{\text{set volume}} * 100$$

$$= \frac{140}{160} * 100$$

Accuracy (%) = 87.5 %

 2. Efficiency (in over test)

$$\text{Efficiency (\%)} = \frac{\text{bottle filled correctly}}{\text{total bottles processed}} * 100$$

$$= \frac{1}{1} * 100$$

Efficiency (%) = 100 %

IX. FUTURE SCOPE

1. Automatic volume adjustment: By using the smart camera the system can adjust the volume of water fill in the bottle I enable flexibility to different size of bottle
2. Machine learning integration: By using the trained AI models we can make the system more smart like self-maintenance ability, fault detection etc.
3. Multiple bottle filling at once : by using the multiple water nozzles we can fill the more than one bottle at a time
4. Solar power integration : by implementing the renewable energy sources like the solar we can also decrease the production cost for the industries

X. CONCLUSION

The IOT based Smart Conveyor and Liquid Filling System proved to be reliable and efficient solution for automating the bottle filling process. By using sensors, microcontroller through IOT, the system was able to move bottles accurately along the conveyor and fill each one with the right amount of liquid. This reduced the need for manual work and helped minimize errors and waste.

The use of IOT also allowed remote monitoring and control which makes the system smart and flexible for future improvements. It can be easily updated or adjusted depending on the needs of production. Overall, this project shows how simple technology and automation can help make industries work faster, safer, and more accurately. It also highlights how IOT can play a big role in building smart factories and improving traditional systems.

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