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Coffee Vending Machine

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ABSTRACT: From old historical strong brews to the newest different tastes like espressos, lattes, cold brews, and flavors, it symbolizes the popularization of the beverage for not only its flavor but also the energizing factor. In a fast-paced life, coffee vending machines have gained importance in helping people get access to freshly brewed coffee quickly, which is handy and productive in a busy world. This project demonstrates an automated coffee vending machine with the ESP32 microcontroller that dispenses two different types of coffee, sugar-added and without sugar. The machine has a dual-container system to maintain the best temperature possible and an intuitive user interface through the LCD screen and keypad. Upon coin validation by the coin acceptor, the ESP32 controls the motor-driven dispensing mechanism precisely to ensure quality consistency. It's quite an affordable solution in high-traffic areas, like construction sites or hotels, so it shortens the wait and gives them the satisfaction of coffee.

KEYWORDS: Coffee Evolution, Modern Coffee Styles, Coffee, ESP32Microcontroller, Automated Dispensing, Coin Acceptor, Dual-Container System, High-Traffic Areas, Convenience, Productivity

I. INTRODUCTION

Coffee is one of the most beloved beverages around the world, but its preparation and consumption have been transformed over the years. While it was originally a simple brew with a robust flavor and stimulating effect, nowadays, coffee can be enjoyed in a variety of tastes and styles, from rich espressos to smooth lattes, cold brews, and flavored varieties. These modern coffee creations cater to diverse preferences, providing options for various palates. People drink coffee not just for its taste but also for its ability to boost energy and enhance focus, making it a staple in many daily routines.

In this era of automation, coffee vending machines play a crucial role in enhancing convenience and efficiency. They provide quick and easy access to freshly brewed coffee, which is essential in today's fast-paced environment. Coffee vending machines ensure that individuals can enjoy a hot, satisfying cup of coffee at any time, promoting productivity and satisfaction. Additionally, they offer a cost-effective solution to provide catering to diverse locations with minimal maintenance. This automated coffee vending machine project utilizes the ESP32 microcontroller, allowing for efficient dispensing of two different types of coffee: one with sugar and one without. It consists of a two-chamber system, each intended to hold and maintain coffee hot at optimal temperature. The ESP32 microcontroller will then control the dispensing with good accuracy, giving fast and easy experiences through the available LCD screen interface and keypad component.

As soon as a valid coin is inserted, the coin acceptor recognizes and verifies the payment. The correct coin being accepted, the corresponding button on the keypad is pressed, and the ESP32 turns on the motor connected to the chosen coffee type. This motor-driven mechanism will ensure that the right amount of the chosen coffee, with or without sugar, is dispensed at the right time. Quality and taste will be consistent in every cup due to the machine's design.

It is cost-effective and very efficient in a place such as a construction site, hotels, and the like, because it helps avoid queuing up in the case of bill counters. By supplying freshly brewed coffee speedily and effectively, the vending machine presents an easy option for coffee consumers so that they get a hot, fulfilling cup of coffee without the hassle. With the aid of these technologies, the system can be designed to separate automatically. Forecast trends of waste and optimize collection All of these will lead to sustainable environmental development.

II. LITERATURE REVIEW

[1] V. S. Arumilli, A. K. Ghatta and R. K. Megalingam, "FPGA – Controlled Automated Coffee Maker using Verilog," 2024 Third International Conference on Electrical, Electronics, Information and Communication Technologies (ICEEICT), Trichirappalli, India, 2024, pp. 1-7, doi: 10.1109/ICEEICT61591.2024.10718631. Automatic coffee makers are the essentials in today's world to offer effective and refreshing beverage service. This paper introduces an innovative control algorithm that is specifically designed for coffee automation systems. The algorithm uses Verilog Hardware Description Language (HDL) for the operation of nine unique beverage modes, including caramel frappe, affogato, cappuccino, espresso, and milk. With programmable logic, the algorithm was created and verified by the Questa Sim software to exhibit improvement in the operation efficiency as well as the user experience. Using the finite state machine architecture, the algorithm is able to provide correct measurement of the ingredients and simple, user-friendly experiences. Module architectures of the system allow it to smoothly integrate supplemental features and scalability, thus there is no need to change the hardware. This paper highlights the conceptualization, implementation, and effectiveness of the automated coffee machine control system, which simplifies the process of making coffee in commercial and residential settings.

[2] K. Kim, D. -H. Park, H. Bang, G. Hong and S. -i. Jin, "Smart coffee vending machine using sensor and actuator networks," 2014 IEEE International Conference on Consumer Electronics (ICCE), Las Vegas, NV, USA, 2014, pp. 71-72, doi: 10.1109/ICCE.2014.6775913. This paper focuses on how technologies contribute to making our daily life be more convenient. A lot of people buy coffee from coffee vending machines without knowing how clean they are. To know the cleaning status of them, we develop a sensor and actuator network and install it inside a vending machine. The network monitors the indoor environment of the machine and adjusts the taste of coffee according to personal preference of a customer. A customer uses a smartphone to see the environmental data as well as to control the amount of coffee, sugar, and powered coffee creamer which are mixed into a cup of coffee. The machine and the phone exchange their data via Bluetooth. This system supports the better personalized service.

[3] A. Kavale, S. Shukla and P. Bramhe, "Coin Counting and Sorting Machine," 2019 9th International Conference on Emerging Trends in Engineering and Technology - Signal and Information Processing (ICETET-SIP-19), Nagpur, India, 2019, pp. 1-4, doi: 10.1109/ICETET-SIP-1946815.2019.9092251. Accuracy with speed has always been challenging in counting currency coins for any bank or stores and even a consumer. A good number of such machines are being marketed with very weak systems: sometimes, on detecting the coin, it makes the wrong decision as to the coin's value; this error comes out in its result in form of calculation. In this proposed work, a coin operated machine which can differentiate between coins accurately and automatically is implemented. An automatic coin counting and sorting machine prototype is developed by using ARDUINO-UNO as the main controller. This work included design the display panel to show total quantity of each coin and total amount. The coin acceptor has been used because it acts as a coin selector to determine the denomination of coins in the sorting system, designed by using a DC motor to hold and distribute coins to the corresponding slot.

[4] Aditi Mohan, Niyati Tiwari, Rajdeep Ghosh, and Prof. A.A.Shinde, "Coin Operated Water Dispenser," International Research Journal of Engineering and Technology (IRJET), ISSN: 2395 -0056, Volume: 04, Issue: 05, May-2017. www.irjet.net. This paper presents the description of Coin Operated Water Dispenser. The water dispensing machine dispenses water on the detection of the right coin (correct denomination).The dispenser is designed using At mega controller. It can be used in public places like Roads, Railway stations, shopping Malls etc. It can prove to be of great use and comfort for people.

[5] Parulekar, A., Shinde, A., Rath, S., Shriyan, P., Raut, T., & Bhonsale, A. V. (2016). Design and development of mini tea and coffee machine. International Journal of Engineering Research & Technology (IJERT), 5(3), 453-457. The aim of this project is to cater to the specific requirement of the consumer especially of small scale sector with the intention of providing the consumer with the option of selecting the types of tea/coffee he/she wants and also providing them option to select a suitable reservoir of water such as a 1 litre mineral water bottle thereby moving a step further of the machines which are available in the market for small scale organisations/industries/offices

[6] Ndjene, J., & Francis, S. (2022). The design of an intelligent coffee machine. Global Journal of Engineering and Technology Advances, 11(01), 052-057.This paper presents the design, testing and implementation of a GSM-based embedded system installed on an off-shelf non-programmable coffee machine. The intelligent system designed uses a water sensor, a coffee sensor and a Global System for Mobile (GSM) modem. An off-the-shelf coffee machine was adapted for this. The heart of the system is an Arduino Uno microcontroller acting as the intelligence in the machine processing and communicating messages.

III. IMPLEMENTATION

The coffee vending machine project is designed with the use of ESP32, a microcontroller, as the brain of the machine. Main components and functions include the following:

- ESP32 Microcontroller: Deals with the logic to dispense coffee, validation of coin inserted, and manages the user interface.
- LCD Screen: Shows menu options and requests from the user to enter preferences.
- Keypad: It gives an option for users to enter their favorite coffee with sugar or without sugar.
- Coin Acceptor: Validates the inserted coins to ensure proper payment.
- Dual-Container System: Stores and keeps the coffee hot at optimal temperatures.
- Motors and Dispensing Mechanism: Controlled by the ESP32 to accurately dispense the selected type of coffee.
- Power Supply: Provides the necessary power to all components.

The development of the proposed coffee vending machine includes several steps as discussed above.It involves integrating a lot of hardware components, including an ESP32 microcontroller, LCD screen, keypad, coin acceptor, a dual-container system, DC motors, and motor driver powered by reliable power supply. Interfacing all of these components is facilitated using specific libraries within the Arduino IDE for programming the ESP32. It contains an initialization section that shows options for menu to the LCD display, input to read user keypad input, validate coins, control motor-driven dispensing mechanism for ensuring quality coffee is dispensed from the machine, with user-friendly interfaces and minimized contact by man-to-man. Automated dispensing maintains temperatures within an ideal range, with one maintained at high and the other low. Testing and calibration are important processes to ensure the proper functioning, adjustment of the settings, and simulation of real-life situations. After testing, the machine is then installed in an office or on a construction site where it would be able to provide easy access to freshly brewed coffee. Periodic maintenance allows the machine to be kept in good working order, addressing all problems and cleaning it. Generally, these implementations are made to maximize a cost-effective, efficient, and user-friendly coffee vending machine that further offers convenience to enhance productivity in myriad environments.
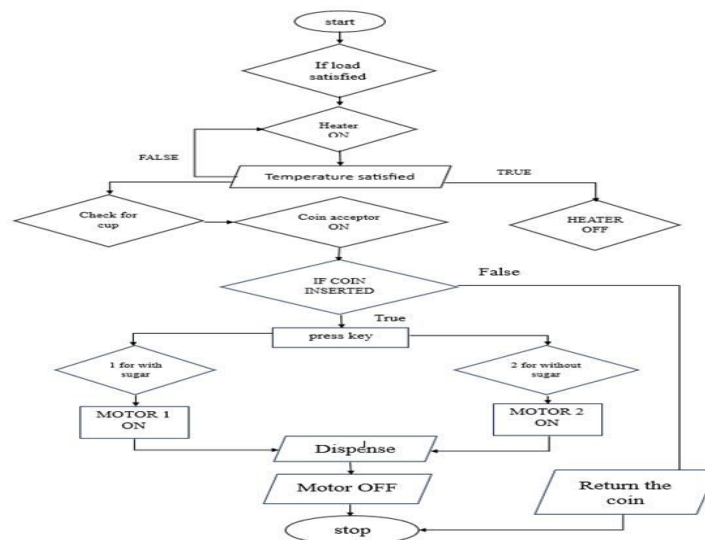

Fig 3.1: Flowchart of the proposed working model User

IV. RESULTS AND DISCUSSIONS

The coffee dispensing machine successfully integrates various components to automate the coffee selection and dispensing process. An IR sensor detects the load of two types of coffee—coffee with sugar and coffee without sugar—ensuring that coffee is only dispensed when it is available. When a 5rs coin is inserted, the coin acceptor accepts the coin and displays the selection options on an LCD screen. A 1x4 keypad allows the user to choose between option 1 for coffee with sugar and option 2 for coffee without sugar. The DS18B20 temperature sensor monitors the temperature of the coffee to serve hot coffee, and if it falls below a set threshold, a PTC heater is activated to maintain the required temperature. Further, If coffee is unavailable, "coffee not available" message will be displayed on the LCD display.

Existing System
There are existing coffee vending machines that differ in their complexity and features. Some of the common types of existing systems include:

- Basic Coffee Machines: These machines provide limited options and rely on manual operation for dispensing coffee.
- Semi-Automatic Vending Machines: These machines offer some level of automation but require manual intervention for certain functions, such as refilling coffee containers or cleaning.
- Fully Automatic Vending Machines: These machines provide a variety of coffee selections and fully automate the dispensing process. Often, they have advanced features like touchscreens, multiple beverage choices, and advanced payment systems.

Proposed System
The proposed coffee vending machine system includes the following features and functionalities:

- Dual-Container System: Maintains optimal temperature for two types of coffee, with and without sugar, ensuring freshness.
- User-Friendly Interface: Intuitive LCD screen and keypad for user-friendly selection of preferred coffee type.
- Coin Validation: A reliable coin acceptor ensures secure and accurate payment processing.
- Precise Dispensing: The ESP32 microcontroller controls the motor-driven mechanism accurately to dispense the selected type of coffee.
- Hygienic Design: Automated dispensing reduces human-to-human contact, thus promoting hygiene.
- Customizable Options: It allows for sugar-added and sugar-free coffee according to personal choice.
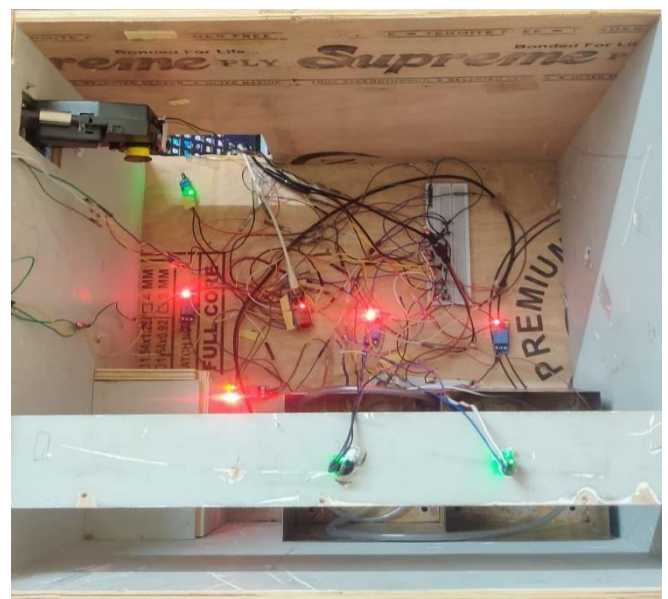

Fig 4.1 Overall Front View of Project   Fig 4.2 Top view of the project

V. CONCLUSION AND FUTURE ENHANCEMENTS

The Design and Implementation of a Coffee Vending Machine using Embedded System project was successfully implemented by the integration of multiple components to automatically dispense the coffee. It used the ESP32-WROOM-32 as the main controller, which would coordinate the work of different modules. The system used an IR sensor to sense two types of coffee: sugar and no sugar. A coin acceptor recognizes a 5 INR coin. Once the payment is made, an LCD display will ask for a choice of type of coffee to be dispensed. The user will make a choice by keying '1' for coffee with sugar or '2' for coffee without sugar using a 1x4 keypad. In addition, the DS18B20 temperature sensor checks the coffee's temperature. When it gets lower than the threshold set, the PTC heater turns on automatically to maintain the warmness of the coffee. The system displays "Coffee Not Available" in case the coffee is not available. The machine, however, can be enhanced by having a cashless payment method such as an RFID card for easy payment. Integrating the IoT features would enable operators to remotely monitor the status of the machine; temperature and levels of coffee, so the system is always working correctly. Improvements in such aspects would make the coffee dispensing machine efficient, user-friendly, and responsive to diverse customer needs.

REFERENCES

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