

Smart Dispenser System For Grocery Shopping

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Abstract—In modern grocery shopping, the challenge of precisely measuring loose items, especially grains like wheat, is persistent. It is still done manually and time is wasted in checking the right amount before billing. A fresh approach to tackle this challenge is done through the implementation of a specialized dispenser system. This system aims to revolutionize the weighing process for grains and other loose commodities ensuring smooth grocery shopping. Highlighting the growing demand for precise measurements, the proposed system aims to control the dispenser without direct human intervention, ensuring efficiency in both time and user experience. It focuses on creating a suitable mechanical design for the regulated flow of loose items. The goal is to enhance convenience and accuracy in dispensing products.

Keywords—grocery shopping, precision weighing, dispenser system, loose items, grains

I. INTRODUCTION

Dispenser systems are incorporated in many areas like vending machines [1][2], industry and automation, healthcare [3] and many more. In the field of modern grocery shopping, achieving precise measurements for loose items, particularly grains like wheat, poses a recurring challenge. The current ration shop system has drawbacks such as low processing speed, insufficient manpower, and inaccurate product weighing. A paper proposes an automatic filling machine that uses load cell feedback for high weight accuracy, ensuring customers receive the correct product amounts and reducing service time per customer [4]. Acknowledging the requirement for precise measurements with items of varying weights, our solution implements a dispenser system which is autonomous, user-friendly and reliable. By

leveraging components such as the Arduino Nano microcontroller for control, a load cell for accurate weight sensing, and a servo motor for dispensing, [5][6] this system offers a technologically advanced solution. Researching upon the complexities, functionality, and potential impact of the dispenser system, it can contribute significantly to the discourse on innovative solutions in the grocery retail sector. The paper seeks to showcase how this technology is aimed to provide grocery shopping, providing consumers with greater accuracy and convenience in their purchases.

II. LITERATURE REVIEW

A diverse array of innovative solutions leveraging advanced technologies to address supermarket ecosystem are seen. The design of a high-tech vending machine to significantly reduce waiting times in food outlets by 75% to 83% is created. The machine incorporates fingerprint sensors and advanced security features to address challenges such as hacking and vandalism [7]. Smart refrigerator and cabinet modules, employing cameras and load cell sensors with HX711 modules respectively are also seen which to monitor food quantities and store data [8]. A food-dispensing machine that exchanges waste plastic bottles for packed food, money, or grains. This initiative tackles hunger and plastic waste simultaneously. The machine's design includes a counting mechanism, ensuring fair food distribution based on the number of bottles deposited [9]. A smart grocery management system using IoT, which employs sensors to monitor grocery levels and automatically notifies users through a mobile application when items need reordering. The system aims to simplify grocery tracking and reordering, enhancing convenience for users with busy schedules [10].

In recent years, the automatic ration vending machine using RFID has become increasingly popular in many countries. The machine uses RFID to automatically identify and vend ration to the user [11]. Increasing prevalence of coin-operated water dispensing machines due to their convenience is seen. It aims to provide insights into the organized implementation of coin-based water dispensers in various public places, such as railway stations and shopping malls. The findings contribute to the advancement of this technology by addressing uses, constraints, and potential future developments in coin-based water dispenser systems [12]. A paper introduces an innovative approach to enhance the transparency and efficiency of the Ration Distribution system. The proposed system streamlines data updating and suggests potential extensions through IoT and additional security measures like face identification [13]. Automatic Ration Material Distribution system using RFID and GSM technologies to replace traditional ration cards, aiming to reduce human intervention, enhance transparency, and prevent corruption in the distribution of government-issued commodities. The system involves customers using RFID tags for authentication, entering material requirements through provided keys, and storing dispensed details in a database [14]. Another paper addresses specific design issues related to automatic packaging machines, focusing on the potential use of electric linear motors. The paper introduces a specialized software tool designed for motor selection, providing a systematic approach for defining parameters in high-speed packaging machines, with examples of its application in a wrapping machine and a box-forming machine [15].

Exploring the potential of IoT in automating the dispensing of medicines, aiming to enhance efficiency and reduce the need for human intervention. The system utilizes a dispenser connected to a cloud app or mobile application that schedules and delivers medicines. Additionally, an alert system ensures timely consumption by providing reminders and records the timings when an individual has taken their medication along with a glass of water [16]. A flash microcontroller with an LCD and keyboard was used to create an automated pill dispenser that allows the user to manually arrange their tablets on a plate. Also, in the rare instance that the medication is not taken, an SMS is sent to the caretaker phone number [17][18][19]. It is easily extended by connecting this type of systems to cloud and connecting multiple real-time monitored dispensers [20].

III. METHODOLOGY

This Smart Dispenser System for grocery shopping begins its operation by initializing the power supply to ensure that all components receive the necessary 5V DC power. The core of the system's measurement capability is the load cell, which is connected to the HX711 analog-to-digital converter (ADC) module. The load cell detects the weight of the material, producing an analog signal that the HX711 module then amplifies and converts into a digital signal. This digital signal is essential for precise weight measurement and subsequent processing by the system. Calibration of the load cell is a crucial step to ensure accuracy. This process involves placing a known weight on the load cell and recording the corresponding digital output from the HX711. The calibration factor (CF) is calculated using the formula $CF = W_{known} / D_{known}$, where W_{known} is the known weight and D_{known} is the digital output. This factor translates the raw digital output into meaningful weight measurements. The calibrated digital weight data is then transmitted from the HX711 module to the NodeMCU 8266 microcontroller for further processing. The NodeMCU 8266, equipped with WiFi capabilities, connects to the Blynk Cloud, enabling remote monitoring and control through a mobile application.

The NodeMCU acts as a communication bridge between the user and the Arduino Nano, which is the main processing unit responsible for controlling the servo motor. Users input the desired weight of the material to be dispensed through the Blynk app. This desired weight (W_d) is transmitted to the NodeMCU, which then communicates it to the Arduino Nano. The NodeMCU 8266, equipped with WiFi capabilities, connects to the Blynk Cloud, enabling remote monitoring and control through a mobile application. The NodeMCU acts as a communication bridge between the user and the Arduino Nano, which is the main processing unit responsible for controlling the servo motor. Users input the desired weight of the material to be dispensed through the Blynk app. This desired weight (W_d) is transmitted to the NodeMCU, which then communicates it to the Arduino Nano. The Arduino Nano continuously receives weight data from the HX711 via the NodeMCU and compares the current weight (W) with the target weight (W_d). The difference ($\Delta W = W_d - W$) is monitored, and as the weight approaches the desired value, the Arduino sends a signal to the TowerPro SG90 Mini Servo Motor to stop dispensing. The servo motor, controlling the flow of material from the dispenser, ensures precise dispensing. Once the target weight is

reached, the motor stops, achieving accurate and consistent dispensing.

container, load cell, servo motor, and a microcontroller (NodeMCU or Arduino) for control. The load cell, calibrated with a known weight of rice, provided precise weight measurements.

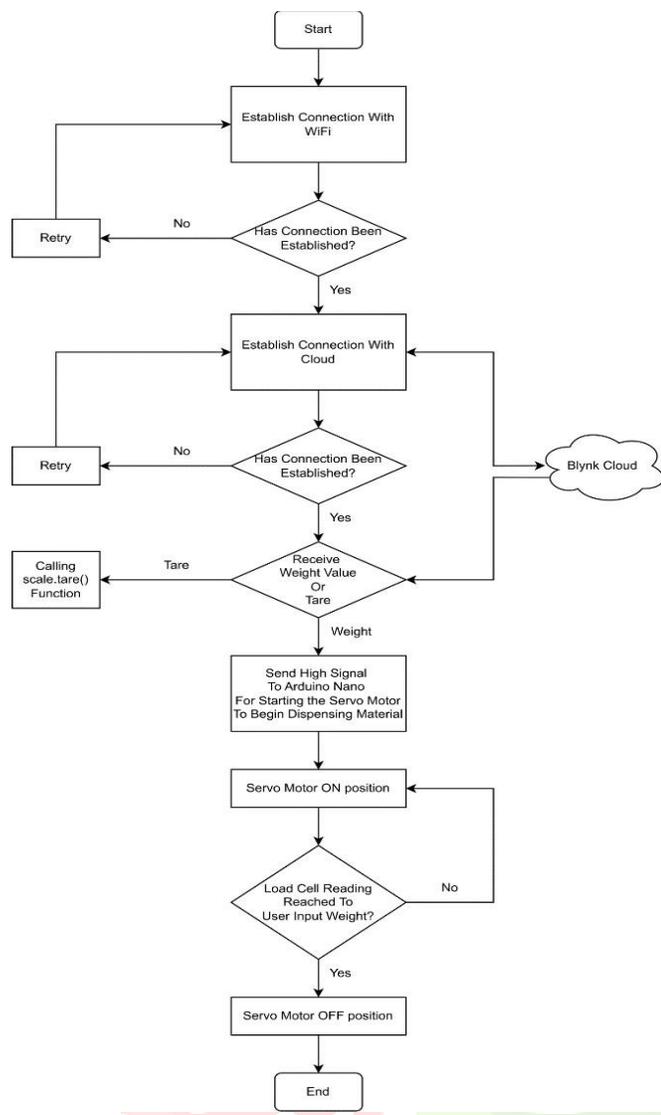


Fig.1 Execution Flow

Throughout this process, the system's status, including the current weight and dispensing progress, is updated in real-time on the Blynk app. This feature provides users with the ability to remotely monitor and control the dispensing operation, enhancing convenience and efficiency. By integrating sensor accuracy, microcontroller processing, and IoT connectivity, the Dispenser System offers a reliable and user-friendly solution for precise grocery material dispensing.

IV. RESULTS AND DISCUSSIONS

This prototype successfully demonstrated its ability to accurately dispense materials, using rice for testing. The system, shown in the image, includes a



Fig.2 Project Demonstration

The NodeMCU, connected to the Blynk app via WiFi, enabled users to input desired weights and monitor the process remotely. The servo motor accurately dispensed rice until the target weight was reached, then closed the flap to stop dispensing. Overall, the system's integration of accurate sensors, microcontroller processing, and IoT connectivity ensured reliable and user-friendly operation. While the physical structure could be more robust, the dispenser effectively reduced manual intervention and provided precise control. Future improvements could enhance stability and add features like multiple dispensing modes or smart home integration.

V. CONCLUSION

The persistent issue of inaccurate and time-consuming weighing of loose grocery items, such as grains, was the primary focus of this research. The proposed Smart Dispenser System effectively addresses this challenge by automating the dispensing process through precise sensor calibration, microcontroller coordination, and IoT integration. Testing confirmed its ability to deliver accurate measurements while enhancing user convenience and minimizing manual intervention. The system demonstrates a significant step toward modernizing grocery retail experiences. Key takeaways include improved efficiency, reliability, and scalability, with future potential for structural enhancement and smart technology integration to

support broader, more intelligent retail environments.

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