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Integrated IOT and cloud computing solution for advanced warehouse automation in security on android platform

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Abstract. In India, farming faces lots of problems like not selling products well and not storing them properly. This causes things like food going bad, getting bugs, being stolen, or wasted. Even though the Food Reserve Agency (FRA) is very important, it mostly uses old-fashioned ways of working and doesn't have good systems in place. This paper tries to solve these problems by bringing in new ways to detect if someone's trying to break into warehouses and to track grains in real-time. It's all about making the FRA work better and smarter. This paper introduces an all-encompassing ESP32-based system tailored for sophisticated warehouse automation, with a primary focus on security. By integrating IoT sensors, cloud computing infrastructure, and Android smart phones, this system streamlines warehouse management processes, ensuring safety and efficiency. Key components of this integrated system include real-time data collection by IoT sensors, cloud-based data storage and analysis platforms, and Android devices for user interaction and control. By leveraging these technologies, warehouse operators and management gain unprecedented control and insight into their operations, thus addressing critical challenges and fostering sustainable agricultural practices in India.

Keywords: A*gricultural sector, food quality, IOT, warehouse management, Food Reserve Agency, security.*

1 Introduction

1.1 Warehouse

Every nation must prioritize food security since food is an essential requirement for all humans. According to the Food Commission, when all people, at all times, can physically and economically obtain sufficient safe and nutritious food to meet their nutritional needs and food preferences for an active and healthy life, it is said to be food security. and Agriculture (FAO).By means of the FRA, the Indian government guarantees the long-term viability of the nation's food supply and provides small-holder farmers in rural areas with access to markets [1] . Produced domestically, such as the country's core crop, maize, benefits from FRA's macroeconomic stabilizing effects. An essential component of the "Internet of Things" (IoT) is the ability to link physical items, machines, cars, and other electrical equipment to a network, allowing for the easy transfer of data [2]. There are many more sectors outside of agriculture that might benefit from this idea. Within this framework, our objective is to provide a fresh approach to sophisticated warehouse automation that prioritizes safety and effectiveness. Because of their central role in the supply chain, warehouses must be run as efficiently as possible[3]. Using the Internet of Things (IoT) and cloud computing, our paper aims to build an innovative Android-based warehouse automation system with unmatched control and security features [4]. When looking at warehouse management as a whole, this project takes on further significance because of how crucial it is to achieve outstanding operational results via the effective use of resources and strong security standards.

Fig 1: Warehouse view

Establishing a connection between the ESP board and the humidity, gas, and air quality (CO2) sensors is the primary focus of this research [5]. Use Bluetooth to operate the exhaust fan, servo motor (for opening and closing windows), and infrared sensor (for counting various food grain packs).Ensure that the user receives the data necessary to measure the quality index. Warehouse tracking using GPS.

Fig 2: Warehouse aerial view

Fig 3: Food storage in warehouse

1.2 Internet of things (IOT)

Many industries have grown and improved their service offering because to technological advancements. The internet of things (IoT) is already in widespread usage across several industries, including healthcare, transportation, logistics, and retail. One industry that has embraced the Internet of Things is agriculture.

Moreover, specialized methods and equipment are useful for enhancing agricultural production. The Food and Agriculture Organization of the United Nations predicts that global food production would need to be 70% higher by2050 than in 2006 to meet the needs of the world's growing population. Internet of Things (IoT) analytics and enhanced manufacturing capabilities are attracting agricultural agencies and farmers as a means to fulfill this need. Improving efficiency, expanding into new international markets, and keeping tabs on agricultural developments are all areas where the Internet of Things (IoT) might be a game-changer.

The Internet of Things (IoT) is the network of interconnected computing devices, services, and things that enable data collection and exchange via the use of embedded software, sensors, and network connection [6]. When dealing with unique items, the Internet of Things employs a variety of protocols. According to related research, the Internet of Things (IoT) is a system of interconnected computing devices, appliances, clothing, and other commonplace items that can exchange data with one another and their surrounding environment. This gives these things intelligence, which in turn improves people's quality of life [7]. Through its networking capabilities, the Internet of Things (IoT) links physical objects, software programs, data, and people in order to facilitate administration, control, and interaction through the provision of integrated services. See Figure 1 for a quick rundown of what the Internet of Things.

Fig 4: IoT Definition/Concept

2. Literature studies

Ms. K. Gowri [1] Despite obstacles including legal restrictions and a lack of available workers, the logistics sector is quickly embracing Internet of Things (IoT) technologies to optimize digital supply chains and provide real-time monitoring, according to a recent poll. In the logistics industry, which is worth billions of dollars, integrating the internet of things has enormous potential to improve efficiency and save costs.

JanakBorwankar, SanikaPandit, Vilok Patel, J. H. Nirmal [2] In this poll, we highlight, This article discusses how a smart warehouse tracking system that uses the internet of things (IoT) may help with post-harvest losses and better food storage via real-time condition monitoring. It offers a cost-effective way to manage warehouses efficiently, which is important for keeping up with the growing demand for food.

Niraj K. Nagrale; Vishakha N. Nagrale; AtulDeshmukh [3] In this poll, we highlight, Grain shortages have a substantial impact on India's economy since 70% of the population works in agriculture. In this study, we present an Internet of Things (IoT) smart grain storage system that uses ultrasonic rodent repellant technology to reduce rodent populations, monitor environmental conditions, and fight food waste.

3. Proposed system block diagram and description

In the proposed system, the system consists the esp32 and Arduino combination to optimize and regulates the actuation system by the sensing data sets. The system diagram is given in figure where large range of sensing unit are enabled with proper maintenance of the system

For the current research the following block diagram system is used and the details of components are discussed below

Fig 5: Block diagram of the study

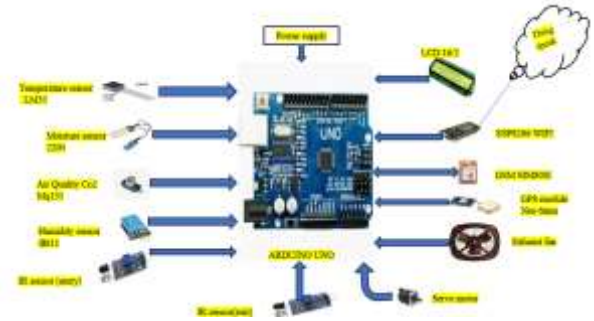

Fig 6: Basics system connection view

The Wireless Warehouse Automation Security System is designed to enhance security and automation within warehouse environments. At the core of this system is the Arduino UNO microcontroller board, which acts as the central processing unit. The Arduino UNO features a 16MHz ceramic resonator, providing precise timing for various operations within the system. Additionally, it offers numerous I/O (input/output) pins, allowing for seamless integration with a variety of sensors and actuators used in the system [8]. Power supply units play a critical role in ensuring the safe operation of electronic circuits within the system. By reducing mains electricity voltage to a safer level, these power supply units protect the components from damage due to overvoltage or electrical faults.

Sensors such as the LM35 temperature sensor and the DHT11 humidity sensor provide vital environmental data within the warehouse. The LM35 sensor measures ambient temperature and produces analog temperature readings, while the DHT11 sensor offers digital humidity readings with high accuracy. These sensors enable the system to monitor and regulate environmental conditions, ensuring optimal working conditions within the warehouse.

The LCD 16x2 display allows for real-time data visualization, providing users with instant access to information regarding temperature, humidity, and other parameters monitored by the system. This display enhances situational awareness and facilitates quick decision-making by warehouse personnel.The system also includes specialized sensors such as the moisture sensor (2200) and the MQ135 gas sensor, which are crucial for detecting soil humidity levels and harmful gases within the warehouse environment, respectively. The moisture sensor is essential for automated watering systems, ensuring that plants receive the appropriate level of hydration. Meanwhile, the MQ135 gas sensor enhances warehouse safety by detecting gases such as ammonia and sulfur, which pose potential health hazards to personnel [9].

The integration of wireless communication modules such as the ESP8266 Wi-Fi module and the GSM SIM800L module enables remote monitoring and control of the system. These modules facilitate IoT (Internet of Things) applications, allowing users to access real-time data and receive alerts regarding critical events within the warehouse, even when they are not on-site.

Furthermore, the NEO 6m GPS module provides real-time location data, enabling asset tracking and logistics management within the warehouse. This module enhances security by allowing warehouse personnel to monitor the movement of assets and track their whereabouts at all times.Finally, servo motors are employed to ensure precise control over security mechanisms within the warehouse. DC servo motors, in particular, are highlighted for their compactness and high torque output, making them ideal for controlling gates, doors, and other security features [10].

In summary, the integration of various sensors, actuators, and communication modules within the Wireless Warehouse Automation Security System enhances security, improves operational efficiency, and enables remote monitoring and control. The system's ability to collect, analyze, and act upon data in real-time contributes to the overall safety and productivity of the warehouse environment [11].

4. Results and analysis

Figures 7 and 8 depict the hardware implementation of the suggested real-time system. Figure 8 illustrates the working mode, with LEDs on sensors blinking to indicate activity. The temperature and humidity values within the warehouse are collected and transmitted to the Thing Speak server platform for analysis. These values play a crucial role in optimizing the system to maintain optimum conditions. Through Arduino connections, the system adjusts the speed of the exhaust fan to regulate the internal environment of the warehouse effectively.

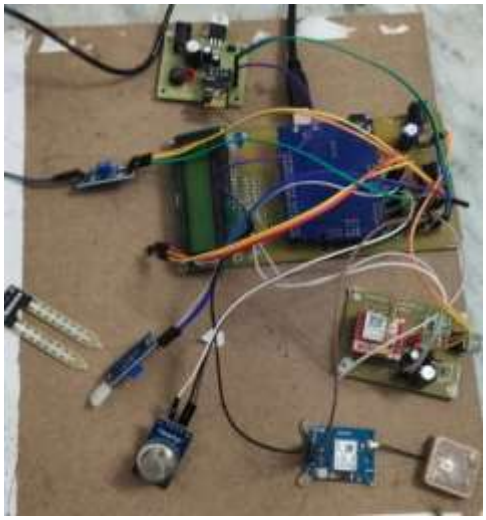

Fig7: Final View of proto type model

Fig 8: Final View of proto type model in working condition

Fig 9: Temperature sensor results

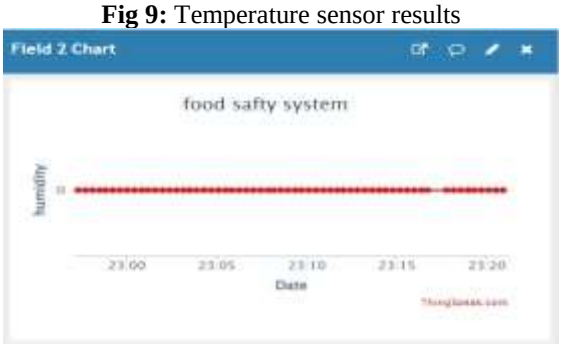

Fig 10: Humidity sensor result

Moreover, the soil moisture sensor serves as a sensitive tool for measuring moisture levels in various food items stored within the warehouse. As depicted in Figure 10, the moisture values obtained from the sensor are relayed to the exhaust unit, ensuring it operates in an appropriate manner to maintain optimal temperature levels and other environmental parameters within the warehouse.

Additionally, Figure 12 presents a graph illustrating the variation in gas intensity within the warehouse. Real-time monitoring of gas levels is essential for detecting any harmful elements present. The measured gas values trigger actions such as opening windows through the relaying system and other units to ensure proper ventilation and safety measures are implemented promptly. This real-time data analysis and response mechanism are crucial for maintaining a safe and controlled environment within the warehouse, thereby mitigating potential risks associated with gas emissions.

Fig 11: Soil moisture sensor result

Fig 12: Gas sensor result

4.1 Location tracking

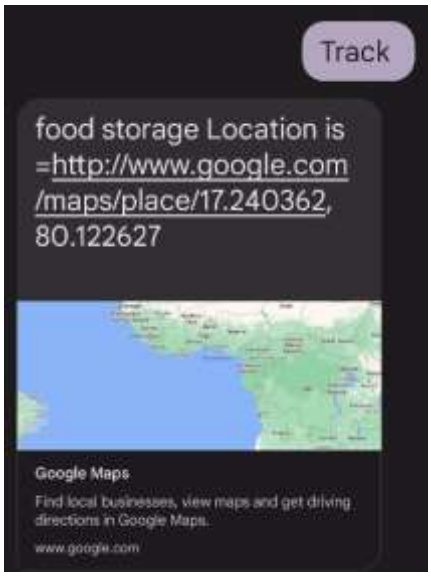

Fig 13: GPS location tracking

Figure 13 introduces another intriguing feature incorporated into the system: GPS tracking. This feature allows for the tracking of the warehouse, particularly if it is mobile. In scenarios where there are multiple warehouses, this capability enables the monitoring of their positions and facilitates the addition of new warehouses to the system. Such functionality proves highly effective, especially in situations where there is a need to optimize the density of warehouses within a specific region. Moreover, by connecting the warehouse locations to the main monitoring center, this feature enhances overall supervision and management efficiency.

5. Conclusions

A proposal for improving agricultural practices, food safety, and the internet of things (IOT) was laid forth in this article. By analyzing the food's image and comparing it to the reference picture, a mobile app for the sensing layer of the IOT technology was built, allowing users to explore the food's freshness.

The food store's relative humidity, temperature, and light intensity could all be detected by the food quality monitoring system, which could also identify the presence of gasses with an ethanol composition. Additionally, it could gather data from each sensor, send it to an LCD for display, and then visually monitor the data online.

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