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Smart Product Expiry Tracker and Efficient Customer Notification

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Abstract—In order to maintain safety and stop unnecessary losses, keeping an eye on product expiration dates is crucial in the retail and medical industries. This procedure is still done by hand in many places, which may be laborious and frequently results in errors. This paper suggests a smart product expiry tracking system that uses an Arduino Uno, an RTC module, a keypad, an LCD display, and a GSM module to solve this problem. The system monitors the validity of products and alerts users before and after they expire. Overall accuracy is increased and manual labor is decreased. Pharmacies, hospitals, and retail stores can all use the system with success. IoT features and mobile-based monitoring could be added in the future to improve access and control.

Keywords—Product Expiry Tracking, Arduino Uno, Real-Time Clock (RTC). GSM Module, IOT, Smart Monitoring System, Inventory Management, Customer Notification.

I. INTRODUCTION

Keeping Keeping track of product end dates is important, particularly in settings where safety is a priority, such as pharmacies, medical centers, and shops. This procedure is still frequently carried out by hand, which can be laborious and error-prone. This paper presents a straightforward and intelligent solution that uses an Arduino Uno as part with parts like an RTC module, keypad, LCD display, and GSM module to address this issue. Products' time limits are regularly tracked by the system, which also sends out alerts before and after they do. This increases the process's stability and lessens the cost of physical labour. All things considered, the system is simple to operate and can be helpful in various settings. IoT-related and mobile-based monitoring could be added in the future to make it better. IoT tools and mobile-based monitoring could be included in the future to increase access and control. By implementing IoT- based systems, product expiry tracking can be automated, reducing human effort while improving accuracy and reliability, as the system continuously monitors product information and generates alerts when items approach their expiry dates. In this work, an intelligent product expiry tracking system integrated with an efficient customer notification mechanism is proposed, which provides timely alerts to users, allowing them to take necessary actions in advance and thereby enhancing overall safety, reliability, and operational efficiency. The system's purpose is to keep an eye on product expiration dates and alert users in advance. In tracker and manages data using a microcontroller in conjunction with sensors and communication devices. Alerts are produced by buzzer indicators, display messages, or mobile notifications when a product hits its expiration threshold this keeps consumers from using out- of-date products and enables them to respond appropriately. Reducing manual labour, increasing accuracy, and improving product management safety are the primary goals of this endeavour. The suggested system is easy to use, affordable, and suitable for usage in supermarkets, pharmacies, hospitals, and even homes. An IoT-based smart inventory system is proposed for real-time monitoring of product expiry [1] The Internet of Things-based medication expiry detection system keeps track of product expiration in real time and notifies users automatically. IoT-based product monitoring systems help track expiry and storage conditions efficiently [2]. RFID tags are used by the RFID-based food expiry monitoring systems to precisely track product expiration dates. An automated drug expiry detection system improves safety by providing timely alerts [3] temperature and past data are used by the dynamic expiry date prediction system to precisely estimate the shelf life of products. Reminder systems using SMS notifications improve user awareness about product expiry [4].

II. RELATED WORK

In recent years, different techniques have been introduced to handle product expiry and improve inventory control, especially in medical and retail applications. The main goal of these systems is to avoid the use of expired products and reduce unnecessary losses. Some of the earlier systems use technology like barcode, QR code, and RFID to store product details such as manufacturing and expiry dates. These methods make it easier to identify products, but they usually require additional devices for scanning or tagging. This increases both cost and complexity, A smart shelf management system using IoT enables automatic tracking of product validity [5], while an IoT-based inventory system reduces manual effort in identifying expired products [6]. A smart pharmacy system detects expired medicines and notifies users effectively [7], and an IoT-based pharmacy management system improves medicine tracking and reduces wastage [8]. In addition, embedded systems are designed to monitor medicine expiry and prevent the usage of outdated drugs [9].and in many cases, the process is not

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fully automatic. With the growth of IoT, newer systems have been developed using sensors and micro controllers to monitor product information. Mobile-based applications provide expiry reminders through timely notifications [10], while IoT-based alert systems enable real-time notifications for monitoring applications [11]. GSM-based systems are also widely used for sending automatic alerts in embedded applications [12]. Furthermore, IoT-based food expiry monitoring systems track freshness using sensor data [13], and sensor-based systems are developed to monitor food shelf life and reduce wastage [14]. Intelligent storage systems also improve food quality monitoring using IoT technologies [15]. These notifications may be sent through messages, emails, or mobile apps. These alarm systems help users in reducing waste and taking proper steps, which is crucial while handling medications. Nevertheless, a lot of current solutions are poorly integrated. While some systems focused solely on sending notifications, others just keep track of expiration dates. likewise, some solutions are more costly and less stable since they need additional hardware or a continuous internet connection. By mixing both expiry tracking and automated customer alerts into a single, user-friendly system, the suggested method offers simple and practical solution to both problems.

III. EXITING METHOD

The current approach to handling product expiry at retail stores is mostly manual, as shown in Fig. 1. Suppliers supply products, which are later stored and put on shelves for buyers. Shopkeepers must routinely check expiration dates, spot things that are about to expire, and take proper steps, such giving discounts, replacing stock, or getting rid of old products. But it takes a lot of time, and it's easy to overlook some things. Improper automation and real-time monitoring frequently result in inefficiencies, delayed product expiration detection, increased waste, and possible risks to consumer safety.

Fig. 1. Exiting Product Tracker [15]

IV. PROPOSED METHOD

The Arduino Uno, which serves as the primary control unit and controls all of the related components, is the base of the suggested smart product expiry tracking system. The Arduino and other modules in the system receive the necessary voltage from a controlled power supply. A DS3231 Real-Time Clock (RTC) module is connected, as seen in Fig. 2, to maintain perfect time and date, which is important for determining when a product expires.Product details, including manufacturing and expiry dates, are entered using a 4x4 keypad. Using this information along with the current time from the RTC module, the Arduino continuously checks the status of each product. Users can easily grasp the condition of products thanks to a 16x2 I2C LCD display that displays real-time details such product information, expire status, and system alerts.. The GSM 800L module automatically notifies the user or shopkeeper when a product is about to expire or has already expired. This provides that notifications are received on time and eliminates the need for routine manual inspection. All factors considered, the system simplifies the tracking procedure, cuts human labour, and boosts output by delivering timely and quick alerts.

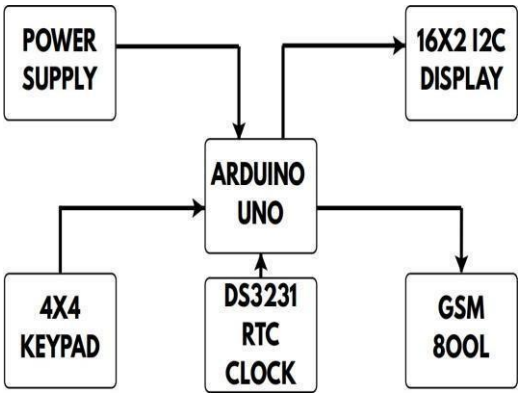

Fig. 2. Block diagram of proposed circuit

V. METHODOLOGY

The suggested system follows to a clear and well-organized method to verify that product expiration dates are properly noted and users are informed on time. At first, a keypad is used to input product details such the name and expire date, which are then saved in the system. A Real-Time Clock (RTC) module is then used by the Arduino controller to continuously monitor the current date and verify each product's status. The system restores the product status on the LCD display during routine operation by regularly comparing the current date with the recorded expiration information. The system provides a warning notice when a product is about to expire and a critical alert when it is about to expire, allowing for quick action. The process is more dependable and requires less manual testing thanks to this ongoing monitoring and alert system. Data tracking and storage can be improved in the future with the addition of technologies like IoT and cloud support.

VI. HARDWARE IMPLEMENTATION

The main part of the system is the Arduino Uno, which links to each component to control and communicate with the circuit.

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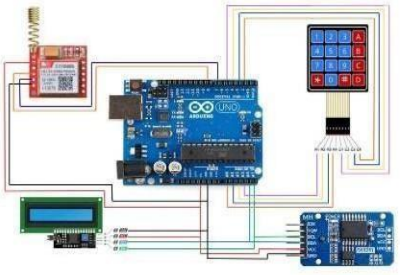
Digital pins D10 and D11 are used to interface the GSM module. In addition to standard VCC and GND connections, the module's TX pins is linked to Arduino D10 and RX to D11. To detect user input, a 4x4 keypad is attached to digital pins D2 through D9, which four utilized for rows and four for columns.

The Arduino's 12C pins are used to connect the 12C LCD display; SDA is connected to A4, SCL to A5, and power is attached. Similarly, for real-time clock transmission, the RTC module uses the same 12C lines (A4 and A5) shows in fig 3. Input, processing, display, and GSM-based notifications are all coordinated by the Arduino, which serves as the central hub.



Fig, 3. smart product expiry tracker circuit

VII. RESULT AND DISCUSSION

The developed system was tested to evaluate its performance in tracking product expiry and providing early product expiry and providing early notifications. The Arduino continuously compares the current date from the RTC with the stored expiry dates of products. Similar real-time monitoring and detection approaches are discussed in [18]. During testing, the system accurately identified products approaching expiry and generated an alert message to the customer exactly three days before the expiry date using the GSM module. This early notification helps users taken timely action. The LCD also displays the current status of the product, making the system easy to monitor.

When the product reaches or exceeds its expiry date, the system generates a final alert indicating that the product should not be used. The transition between normal, pre-alert (3-day warning), and expired states was observed to be smooth and reliable. improves safety by ensuring that customers are informed in advance about product expiry. Furthermore, advanced systems discussed in [20].The overall performance confirms that the system works efficiently, reduces manual effort, and improves safety by ensuring that customers are informed in advance about product expiry.

TABLE I. Performance Comparison of Existing and Proposed System [20]

Parameter	Existing System	Proposed System
Monitoring Method	Manual / periodic checking	Continuousautomatic monitoring
Expiry Detection	Human-dependent	RTC-basedtime comparison
Pre-Expiry Notification	Not available	Alert before 3 days
Communication Method	None	GSM-based SMS notification
Response Time	Delayed	Immediate (real-time)
Accuracy	Moderate	High
System Automation	Low	Fully automated
User Interaction	High manual effort	Minimal user input
Reliability	Less reliable	More reliable
Safety Level	Basic	Enhanced safety

Fig, 4. Alert message to customer moblie

your medicine ABC 250mg is nearing its expiry date. The product was manufactured on January 15, 2023, and its expiry date is February 10, 2024. Please take the necessary action before the medicine expires to ensure safety and effectiveness

VII. CONCLUSION

The Smart Product Expiry Tracker systems was successfully designed and implemented to monitor product validity and provide timely customer notifications. By using an RTC module for real-time tracking and a GSM module for communication, the systems is able to send alert messages to users three days before product expiry. By allowing customers to take quick action, this early message lowers the risk of using expired products and increase awareness in general. Safety is ensured by the system's constant monitoring of product status with minimal human intervention. It is helpful to applications like medication management and smart inventory systems since it reduces manual labour and increases safety. IoT connectivity and mobile apps can be added to the system in the future improve access and control.

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