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# Advanced Security System For Jewellery

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***Abstract - Jewellery stores have a large number of valuable items that can be stolen, handled improperly, and subjected to security lapses. Conventional security solutions like CCTV cameras, human supervision, and alarms do not offer instant detection and response when it comes to stealing. The paper introduces an Advanced Security System for Jewellery based on RFID technology, IR sensors, GSM communication, and logging in cloud system that enables to monitor the valuable jewellery in real-time and secure. RFID tags are mounted on jewellery pieces and authorized people have their RFID cards given to them. Jewellery items in display cases are continuously monitored by IR sensors. These devices feed data into the ESP32 microcontroller which detects unauthorized removal or suspicious activity. As soon as a security breach is detected, system buzzer alarm is triggered and SMS alert is sent to the shop owner via a GSM module. Also, all activities are documented in Google Sheets and monitored and inventoried. The proposed system enhances security by implementing automated monitoring, timely alerts, and maintaining accurate records. It is cost effective, easily scalable and appropriate for jewellery stores and other high value retail settings.***

***Keywords— ESP32, RFID, GSM, IR Sensor, Jewellery Security, IoT, Intrusion Detection.***

## *I. INTRODUCTION*

One of the most crucial issues is security in jewellery stores because of the high cost of ornaments like gold, diamonds and platinum that are stored in the shop by jewellers. These assets are extremely susceptible to theft, fraud and misuse. While traditional security systems such as alarm systems, locks, security guards, and CCTV cameras offer some level of protection, they are not always effective at detecting robbery as soon as it occurs .

There are many current systems that are highly reliant on human supervision. When it's time to get to work, it's hard to keep a close eye on it, and stealing can happen in a matter of minutes. Often incidents are not discovered until after using CCTV footage, which means that they are not responded to for a long time and can cost money. Advances in embedded systems, wireless communication and sensor technologies have given rise to the design of smart security solutions that can be monitored in real-time. Sensors, RFID technology, communication modules, and cloud services can bring together, enabling the automation of systems to immediately identify suspicious activities and alert users without manual intervention. This paper introduces an Advanced Security System for Jewellery with the combination of ESP32 microcontroller, RFID authentication, IR sensor, GSM communication, and logging to cloud system. The system constantly tracks jewellery pieces and discretionary messages are issued to the authorised staff member if it detects any unauthorised removal or suspicious activity.

## *II. EXISTING SYSTEM*

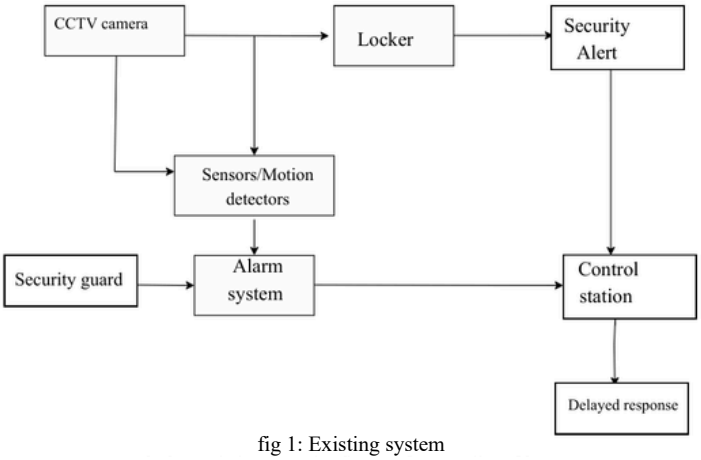


fig 1: Existing system

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Traditional security systems are employed to guard valuable jewellery in many jewellery stores.The precious items are as illustrated in the fig:1 Such systems primarily use techniques like CCTV. Manual monitoring, security guards, alarm systems and surveillance cameras. Although these methods provide a certain level of security, they are not always sufficient to prevent theft or unauthorized access effectively. Jewellery shops use many of the same security systems as other retail stores, such as CCTV cameras. Cameras Areas within and around the shop are fitted with are installed to observe activities and video footage is taken. While CCTV systems help in identifying suspects after a theft occurs, they do not actively prevent the theft from happening. Often, it is only after looking through the footage that the theft is discovered, making it difficult to catch the culprit. it difficult to take immediate action. Other traditional security techniques involve hiring physical security guards and using an alarm system. Security personnel to keep an eye on the shop environment and act on suspicious activities. But this technique is quite labor intensive and requires attention. Human errors, fatigue or negligence may reduce the effectiveness of manual monitoring. Some alarms are provided as well.May trigger false alarms or may miss certain type of theft in jewellery shops.Biometric authentication, keypad locks or motion sensors are used to improve some modern systems security. These technologies offer enhanced access control, but primarily concentrate on access control. Avoiding entry to the shop/lockers and not keeping track of individual jewellery pieces in display cases. This means that jewellery will not be removed from the display space without permission, and these systems are designed to prevent this.Automatic alarm to notify the shop owner in case of theft. When there are no real-time alerts,owner may not be made aware of the incident until after a substantial loss has been sustained. This limitation points to the necessity of a smarter security solution that is able to track jewellery items.Monitor these on a regular basis and alert to any suspicious activity.Thus, the existing systems like delayed detection, absence of real-time alerts, etc., have their own restrictions and dependency on manual monitoring create the need for a more advanced and automated security system. The proposed system aims to overcome these limitations by using sensors, RFIDGSM communication, technology and continuous monitoring for instant alert mechanisms

## III. PROPOSED METHOD

The suggested security system comprises of an ESP32 microcontroller, RFID module, IR sensors, a GSM module, an LCD display, a buzzer, LED indicators and security logging in the cloud using Google Sheets. The ESP32 is used as a central CPU unit, it coordinates the communication between all the modules. Jewellery items are tagged with RFID tags and Authorized employees are given RFID cards. The RFID reader performs a continuous scan of tags, and also validates the authentication request. IR sensors are placed around jewelry stands and display tables. Sensors are used to verify jewellery's presence and unauthorized removal. Each sensor has its output state change when an item is removed and sends data to the ESP32. The microcontroller processes the collected data and then decides if the removal is allowed or not. When the employee scans a valid RFID card first, then takes an item, it is considered as valid. If not, the system will recognize the activity as suspicious. SMS is sent to the shop owner when it is accessed without permission through the GSM module. At the same time, local alerts are given by a buzzer alarm and LED indicators. All activities are recorded on Google Sheets via WI-FI (remote monitoring/inventory).

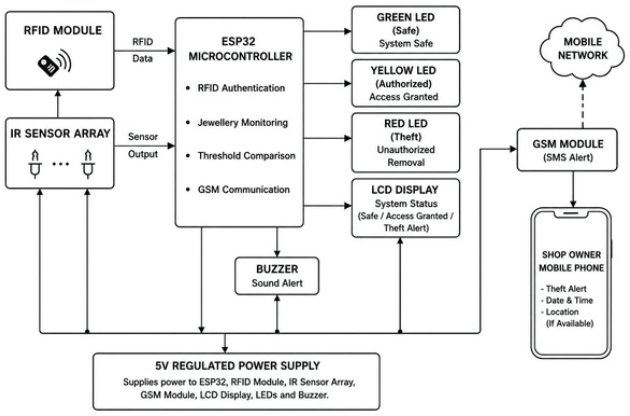


fig 2: Block diagram

## IV . DESIGN AND WORKING

### A .Circuit Diagram

In the fig. 3 shows the circuit diagram which illustrates the physical connections and interaction between the hardware to be used for the proposed jewellery Security System. The ESP32 microcontroller is used as the central processing unit of the system which is responsible for coordinating communication between sensors, GSM module and RFID module.The components are module, and output devices. Power is supplied by the power supply unit (5V, 2A adapter) to power the required electrical power forAll the components of the system are checked to ensure stable and continuous operation.The ESP32 is connected to an IR sensor, which is used to detect the presence or movement of an object in the vicinity of the protected. it Uses RFID RC522 module for authentication so that only legal users with valid RFID cards can be authenticated.Access the jewellery locker/storage by tags. The ESP32 receives the data from the scanned RFID card, extracts the necessary information and activates the corresponding relay switch Gets tag info and checks with a database.The GSM module communicates with the ESP32 using the serial communication to send SMS alerts and sending alerts to the shop owner if someone accesses the store illegally or if there's some form of suspicious behavior. A 16×2 LCD Display is was added to the circuit to display system messages, like access granted, access denied, or intrusiondetected.A buzzer and LED indicators are connected as output devices to give audible and visual alerts. The ESP32 senses the values of the sensors and the RFID modules using the GPIO pinsprocesses the data, and activates the respective outputs based on programmed conditions.Overall, by using the circuit design, it is possible to monitor in real-time, detect intrusions, and generate alerts.

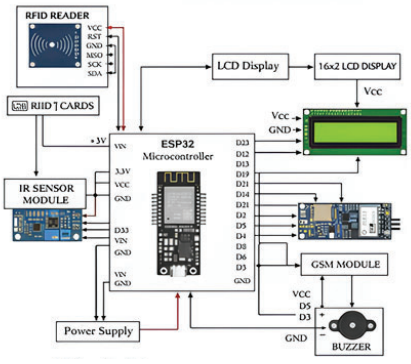


fig 3: Circuit diagram

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**B .Working**

The proposed jewellery security system is based on the coordinated working of the ESP32 microcontroller, RFID RC522 module, IR sensor, GSM module, LCD display and alert devices. When the system is powered by the 5V power supply, the ESP32 initializes all modules connected to it and then goes into the monitoring mode.When operating normally, the RFID RC522 module scans the tags that are placed near the reader continuously.The employee gets assigned a unique RFID tag to be authenticated. When a tag is detected, the ESP32 reads the tag's.It reads unique ID from the SPI communication and checks it against the authorized IDs in the system memory. IfWhen the scanned RFID tag is the same as in the database, the system allows the user to proceed and writes "Access Granted" on the display on the 16×2 LCD display. An attempt to access an unauthorized tag ID is detected if the tag ID is not the same as the one stored.Under this condition system activates buzzer and LED indicators, GSM module sends an SMS alert to the user.When an employee accesses jewellery it will be recorded in the system by the employee ID, jewellery and the date and time of the access.Identification, and when and how they were accessed. These details are automatically sent via the internet and saved in a Google Sheets database. The Google Sheet serves as a cloud based storage location for the shop owner to be able to access. Checks records, including jewellery item taken, employee who accessed it, and date and time accessedof the transaction. This feature will add some transparency and keep inventory tracking in check.The IR sensor is not only used for authentication, but also constantly scans for any motion or object in the environment. The voltage value outputted by the sensor is compared with a threshold value set to about 2.5 V. When If the output signal is greater than this threshold value, the ESP32 will consider it to be a motion detection event. This indicates that something or someone exists in the area that is being monitored.When the sensor output value exceeds the given value, the buzzer alarm and LED are turned on immediately.At the same time, the GSM module sends an SMS message to the shop owner, stating that an intrusion has been detected. The LCD too displays the system status, indicating that "Intruder Detected" or not .So, the system can do employee authentication, jewellery access logging, intrusion detection, alert generation, etc.and cloud storage at the same time. The integration of Threshold based sensing and real-time Google map is one of the most impressive features.Data logging capabilities of sheets allow for accurate monitoring, timely response to suspicious activities and efficient records.security management and security in jewellery shops

**C . Algorithm**

**Step 1: System and Hardware Initialization**
1.Start the system.
2.Initialize the ESP32 microcontroller.
3.Initialize all connected modules including RFID reader, IR sensors, LCD display, GSM module, and Wi-Fi.
4.Set all IR sensors to detect whether jewellery items are present on the stand.
**Step 2: System Monitoring**
1.Check the status of the IR sensors continuously.
2.If all IR sensors are HIGH, it means all jewellery items are present.
3.Display the message "SYSTEM SECURE – ALL ITEMS PRESENT" on the LCD display. 4.Update the system status as SAFE in Google Sheets
**Step 3: Item Removal Detection**
1.If any IR sensor becomes LOW, detect that an item has been removed from the stand.
2.Record the timestamp and identify which item was removed.
**Step 4: RFID Verification**
1.Check whether the staff RFID card is scanned first. If YES:
2.Display "WELCOME [NAME] – ACCESS GRANTED" on the LCD.
3.Log the details to Google Sheets including time, staff ID, and item information.
4.Mark the item status as OUT FOR DEMO.
If NO:
5.Display "UNAUTHORIZED – PLEASE SCAN ID" on the LCD.
6.Activate the buzzer to beep at intervals.
7.Start a 60-second timer to allow the user to scan a valid RFID card.
**Step 5: Authorization Time Check**
1.Check whether a valid RFID card is scanned within 60 seconds. If YES:
2.Cancel the alarm.
3.Display "VERIFIED – LOG UPDATED" on the LCD.
4.Update the activity in Google Sheets.
If NO:
5.Detect the situation as THEFT.
6.Activate the high-decibel alarm or siren.
7.Display "POLICE NOTIFIED" on the LCD.
8.Send an SMS alert using the GSM module to the owner and nearest police station.
9.Update the status in Google Sheets as STOLEN
**Step 6: Item Status Check**
1.Check whether the item is returned or sold.
If Returned:
2.Detect the item using the IR sensor again.
3.Update the status in Google Sheets as RETURNED with time.
4.Resume monitoring for the next event.
If Sold:
5.Scan the jewellery RFID tag.
6.Update the status in Google Sheets as SOLD.
7.Disable the IR sensor monitoring for that particular slot.
**Step 7: Continuous Monitoring**
1.Resume system monitoring.
2.Wait for the next RFID scan or item movement.
3.Repeat the process continuously

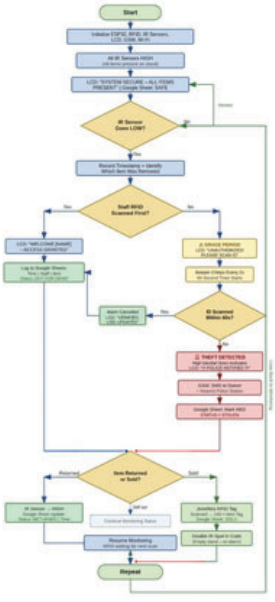

fig 4: Algorithm

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## V. EXPERIMENTAL RESULTS

The proposed system is able to integrate RFID authentication, intrusion detection, GSM communication and cloud logging in a single security platform successfully.The RFID module assures reliable authentication and guards jewellery products from unauthorized handling. Continuous monitoring of the display areas using IR sensors and detection of removal events in real time. The ESP32 chip was able to handle the data from the sensors efficiently and alert without significant delay.The GSM module provides improved security by alerting the shop owner right away of any suspicious activities. Using the Google Sheets cloud-based logging system increases transparency and records all access events.The proposed solution is faster than the traditional CCTV based monitoring because of its ability to detect the alarm and respond immediately. Autentication and monitoring greatly decrease manual supervision.This system is also an economical and scalable one. There is no difficulty to integrate additional sensors and readers to accommodate larger jewellery stores and storage units.But there are some restrictions with the system. RFID tags can be damaged or lost, causing tag identification errors. GSM communication relies on network connectivity and installation is technical. These are the limitations of the system, however, it proves to be more secure and is a viable solution for jewellery assets protection

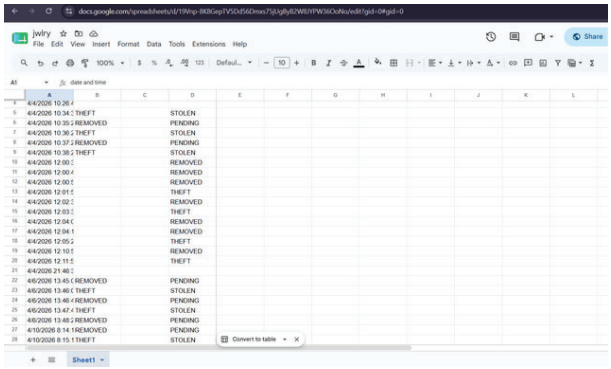

fig 5 : google sheets

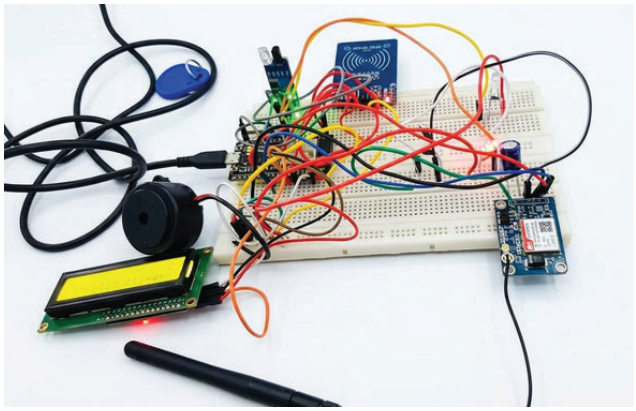

Fig 6: Module when theft detected

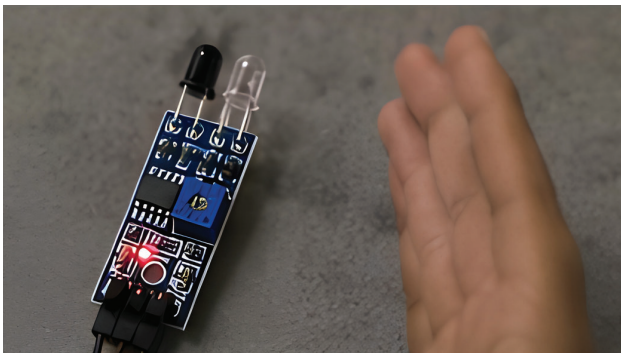

fig 7 : IR Detects movement

fig 8 : RFID not Authorized

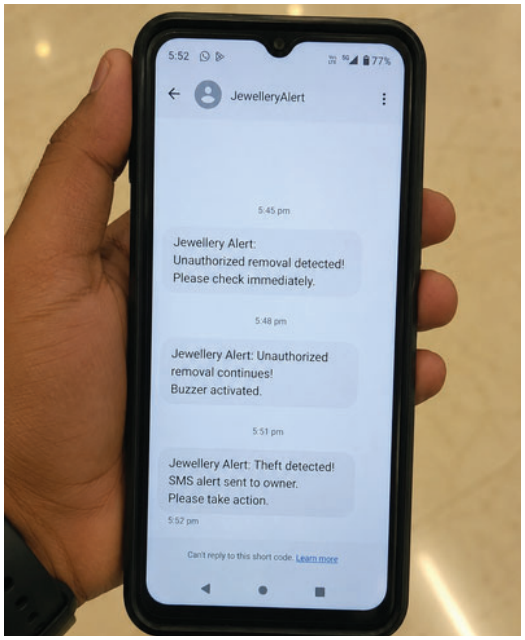


fig 9 : SMS Alert received

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## VI . ACKNOWLEDGEMENT

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## VII. CONCLUSION

In this paper, we have introduced an Advanced Security System for Jewellery using ESP32, RFID technology, IR sensors, GSM communication and cloud based data logging. The system is constantly tracking jewellery objects, checking if access is authorised, alerting on suspicious activity and notifying instantly. Combined with RFID authentication, the sensor-based monitoring system offers a reliable theft prevention mechanism. GSM-based notifications allow for timely response when security breaches happen and cloud logging helps inventory and track activities.Some future improvements that could go into the devices include AI based behaviour analysis, facial recognition, CCTV integration, mobile application support, and cloud storage platforms. These enhancements can further boost the intelligence, reliability and effectiveness of the system to stop theft

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