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Design of a personalized smart remainder system utilizing IOT –Enabled device and machine learning for efficient routine management.

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ABSTRACT : The Smart Remainder is a low-cost IoT solution using pressure sensors and a buzzer to alert users about forgotten or misplaced items. It prevents loss, promotes accountability, and supports with a simple, compact, and scalable design, it suits homes, offices, schools, and public spaces, while also enabling future integration into smart systems like logistics and inventory tracking.

KEYWORDS :— Machine Learning, Object Detection, You Only Look Once (YOLO), IoT, Smart Remainder, Algorithm, Real-Time Analytics and Alerts, Privacy Preservation.

I. Introduction

In everyday life, people often forget personal belongings such as bags, wallets, laptops, or documents, especially when leaving their workspace, classroom, or home. Such forgetfulness can lead to inconvenience, loss of valuable items, and disruption of routines. For instance, students leaving books in classrooms, employees forgetting laptops in offices, or individuals leaving keys or wallets behind in public places are common scenarios that highlight the need for a preventive system. Studies indicate that forgetfulness not only wastes time but can also lead to financial loss, security risks, and unnecessary stress [1], [2].Several solutions exist in the market to reduce item misplacement, including RFID-based trackers, smart tags, or mobile reminder apps. However, these solutions often require manual setup, additional devices for every item, or constant user interaction, which limits their usability and efficiency. Moreover, many systems are reactive rather than proactive—they notify the user after the item is lost rather than preventing the forgetfulness proactively [3], [4] This work proposes a SMART REMAINDER system that integrates a pressure sensor and a webcam to detect the presence and absence of a person from a seat. When the system senses that the person has left, it scans the surrounding area using a webcam to detect if any important object has been left behind. If an object is detected, the system immediately triggers a buzzer alert and sends a notification to the connected mobile application. If no object is found, the system remains idle.

This approach ensures that items are not forgotten, reduces loss, and provides real-time alerts without requiring manual intervention. The primary contributions of this work include a low-cost, easy-to-install system that monitors both the user's presence and the surrounding objects, a proactive alert mechanism combining local and remote notifications, and the potential for scalable integration with smart home or office environments. The system aims to bridge human behavior with smart technology, encouraging responsible handling of personal belongings and minimizing the negative consequences of everyday forget fulness. The remainder of this paper is organized as follows: outlines the overall system, details the system design and implementation, Section presents the testing methodology and results, and Section concludes the work and discusses future scope. The primary contributions of this work include:

A proactive, real-time item reminder system that reduces human forgetfulness. Integration of pressure sensors and computer vision to detect both human presence and surrounding objects. Dual alert mechanism combining local (buzzer) and remote (mobile app) notifications. low-cost, compact, and user-friendly design suitable for a wide range of environments. Scalable and modular architecture, allowing future expansion into advanced smart systems. The proposed SMART REMAINDER system bridges the gap between human routine monitoring and smart living technology, promoting responsible behavior, reducing unnecessary losses, and enhancing daily productivity.

The remainder of this paper is organized as follows: outlines the overall system, presents the design and implementation details, describes the testing methodology and results, and Section concludes the work while highlighting future directions for improvement.

This setup ensures that the SMART REMAINDER system provides real-time, accurate, and reliable reminders while maintaining low cost, minimal user intervention, and adaptability to multiple environments. Figure 1 illustrates the overall system layout, showing the placement of the microcontroller, pressure sensor, camera, buzzer, and mobile communication modules.

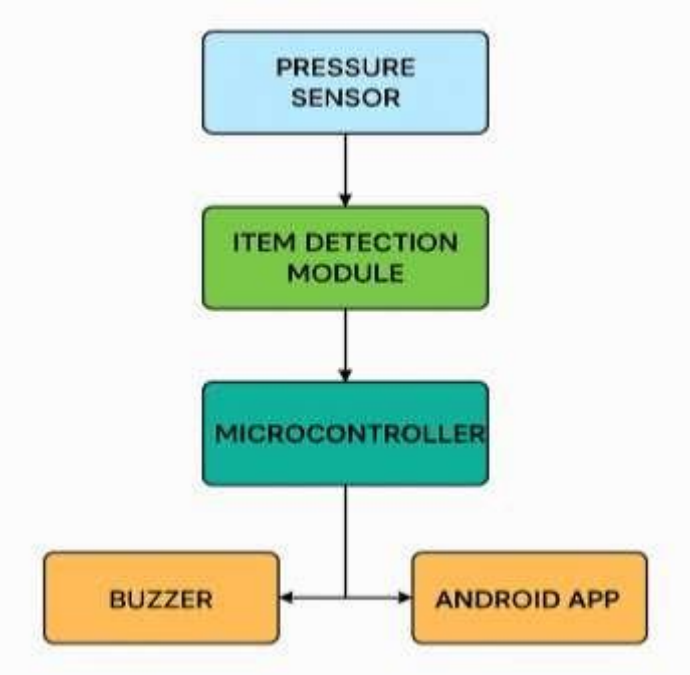
II. System Description

The SMART REMAINDER system combines hardware and software components to provide an automated, reliable, and user-friendly solution for preventing forgetfulness. At its core, a microcontroller such as ESP32 or Raspberry Pi processes data from the pressure sensor and camera module. The pressure sensor continuously monitors the presence or absence of the user on a seat. When the user leaves the seat, the system automatically activates the camera to detect any surrounding objects left behind. This ensures that the system only functions when necessary, minimizing power consumption and unnecessary alerts. The computer vision module uses object detection algorithms to identify important items in the vicinity. These objects can include bags, books, laptops, wallets, or other personal belongings. Once an object is detected, the system triggers the buzzer, providing an immediate audible alert to the user. Simultaneously, a mobile application notification is sent via Wi-Fi or Bluetooth, ensuring that the user is informed even if they are away from the immediate location.

This dual alert mechanism increases the reliability of the reminder system. The system also includes a backup power source, ensuring uninterrupted operation during power outages or accidental disconnections from the main supply. The sensors and microcontroller are connected through the I2C interface, with the communication to the mobile app handled via Wi-Fi or Bluetooth modules. All components are enclosed in a compact, protective casing, making the system durable and safe for long-term use. In the advanced version, the SMART REMAINDER system integrates machine learning algorithms to improve personalization. The system can learn the user's daily habits and object placement patterns, adjusting alerts according to the likelihood of an item being forgotten. For example, if a user consistently leaves a particular item in a specific location, the system prioritizes alerting for that item when the user is absent. This adaptive approach minimizes false alarms and enhances the user experience.

The design emphasizes scalability and modularity, allowing additional sensors or modules to be integrated in the future. For instance, temperature or motion sensors could be added to expand functionality in smart offices or classrooms. The modular approach also allows integration with smart home systems, cloud storage for activity logs, or advanced analytics for usage patterns. The smart remainder system is designed as a cost-effective system that combines a pressure sensor for user activity monitoring with a webcam-based object detection module to identify items left unattended. By using real-time alerts through both sound and mobile notifications, the system ensures that the user is immediately informed, thereby reducing unnecessary losses and promoting a more responsible lifestyle.

Existing reminder systems have explored different approaches, such as GPS-based trackers and smartphone applications. While these methods help in locating misplaced items, they often react only after the loss has occurred rather than preventing it. Similarly, app-based reminders are dependent on user input and are unable to account for real-time interactions with objects in the environment. IoT-based smart systems have shown potential, yet many available solutions are either too expensive or restricted to specialized environments such as industrial settings. The SMART REMAINDER addresses these limitations by combining hybrid sensing techniques with a scalable design, making it suitable for both personal and public use. The proposed system integrates a pressure sensor to detect the presence or absence of the user and a webcam module to analyze the surrounding area for unattended objects. When the system detects that the user has left, the webcam is activated to scan the environment. If items are identified, the system initiates a two-level alert: a buzzer for immediate local awareness and a mobile application notification for remote alerts. This dual-layer approach increases reliability and ensures the user receives timely reminders regardless of their location. The architecture is modular, enabling the system to be scaled into more advanced applications such as smart classrooms, offices, and logistics hubs.



Overall, the SMART REMAINDER system provides a proactive, intelligent, and reliable solution to everyday forgetfulness, combining low-cost hardware with advanced software algorithms to deliver real-time, context-aware reminders. Its compact design, low energy consumption, and user-friendly operation make it suitable for homes, offices, schools, and public spaces, while also offering potential for future expansion into larger smart ecosystems.

To enhance the SMART REMAINDER system's functionality and adaptability, several hardware modules have been integrated to support motion detection, environmental awareness, and emergency communication. The pressure sensor used in the system is built with advanced, ultra-sensitive materials that respond to user presence with minimal power consumption. Its slim profile and responsiveness make it ideal for compact installations in various environments.

For detecting movement, a passive infrared (PIR) motion sensor is included. It can identify the presence of humans or animals within a broad area and communicates directly with the microcontroller using a digital signal. This ensures quick and reliable detection whenever motion is present.

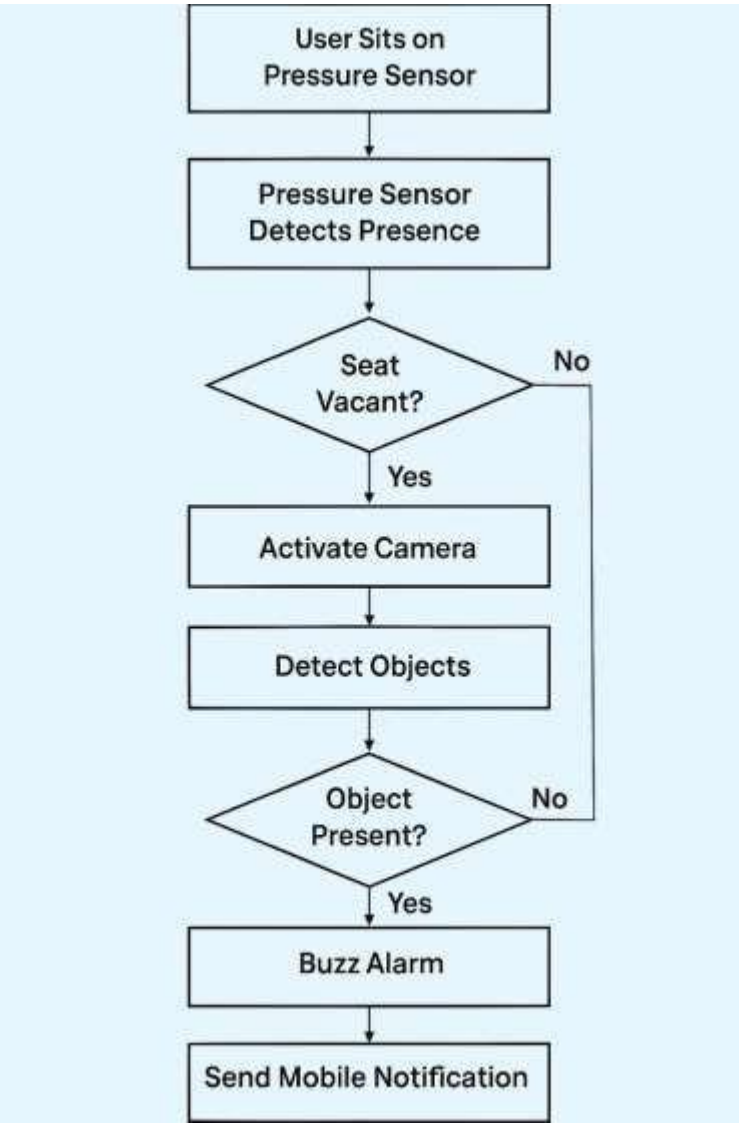
To improve object recognition and thermal detection, the system incorporates an infrared camera module capable of capturing temperature variations across a grid of points. This allows the system to identify heat signatures from people or pets and distinguish them from inanimate objects. The sensor connects easily to the microcontroller and supports threshold-based detection for smarter alerting. Environmental monitoring is achieved through a sensor that tracks carbon dioxide levels and ambient temperature. It uses infrared technology to deliver accurate readings and is pre-calibrated for reliable performance. When certain environmental thresholds are reached, the system can trigger emergency protocols to ensure user safety.

For remote communication and location tracking, the system integrates a GSM and GPS module. This component enables the microcontroller to send text messages, initiate calls, and provide location data based on sensor inputs. Its compact design and dual functionality make it a powerful addition to the system.

A ventilation unit is also included to maintain comfort in enclosed spaces. It is adjustable and powered by the main system battery, with a backup battery installed to ensure continuous operation during power interruptions.

All system operations are managed through Python-based ftware, which handles sensor data processing, alert logic, and communication protocols. The software flow is illustrated in the system's flowchart, and the core logic is outlined in the accompanying algorithm. The SMART REMAINDER system is designed to proactively prevent the misplacement of personal belongings by combining sensor-based detection with intelligent alert mechanisms. At its core, the system uses a pressure sensor to monitor user presence on a seat. When the user leaves, the system activates a camera to scan the surrounding area for unattended items. This ensures that the system only operates when necessary, conserving energy and reducing false alerts.

To enhance motion awareness, a passive infrared (PIR) sensor s integrated into the setup. This sensor detects movement in the vicinity, allowing the system to confirm whether someone is nearby or has recently vacated the area. Its digital output simplifies communication with the microcontroller, enabling quick decision-making based on real-time activity.



For object detection, the system utilizes an infrared thermal camera module. This sensor identifies heat signatures from humans, pets, or warm objects, helping distinguish between relevant and irrelevant items. By setting temperature thresholds, the system can prioritize alerts for objects that are likely to be personal belongings, such as bags, laptops, or books. Environmental monitoring is another key feature of the SMART REMAINDER system. A dedicated sensor tracks carbon dioxide levels and ambient temperature, g ensuring that the system remains responsive to changes in the environment. If certain thresholds are exceeded—such as elevated CO_2 levels or abnormal temperatures—the system can initiate emergency protocols to safeguard user health and comfort.

III.IMPLEMENTATION ALGORITHM

Algorithm 1 System for Forgotten Item Detection

Input: Sensor readings from pressure sensor, camera module, motion sensor, and mobile communication interface
Output: Real-time alerts and notifications for forgotten items

Initialization:

Initialize microcontroller and configure GPIO pins
Setup pressure sensor, camera module, and motion sensor
Establish connection with mobile application via Wi-Fi or Bluetooth

User Presence Monitoring:

1. Initialize the microcontroller and configure all GPIO pins.
2. Continuously read input from the pressure sensor.
3. If pressure is detected:
   Print "User is seated".
   Continue monitoring sensor data.
4. Else (no pressure detected):
   Print "Seat is vacant".
   Trigger the object detection sequence.

Object Detection via Camera:

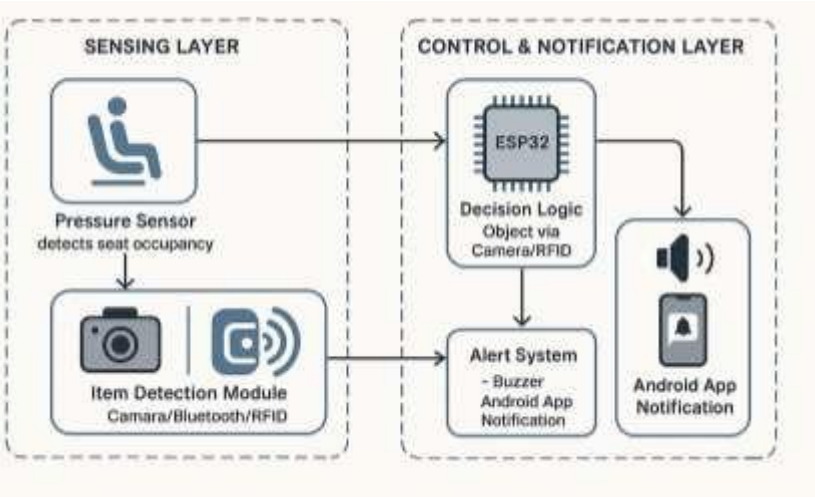
1. Activate the camera module.
2. Capture an image of the surrounding area.
3. Apply the object detection algorithm (e.g., YOLO).
4. If an important object is detected:
   Print "Alert: Item left behind!".
   Activate the buzzer.
   Send a mobile notification
5. Else (no object detected):
   Print "No items detected".
   Keep the system idle.

Finalization:

Reset buzzer and notification flags
Log event data for future analytics
Cleanup GPIO settings and close communication channels

Output:

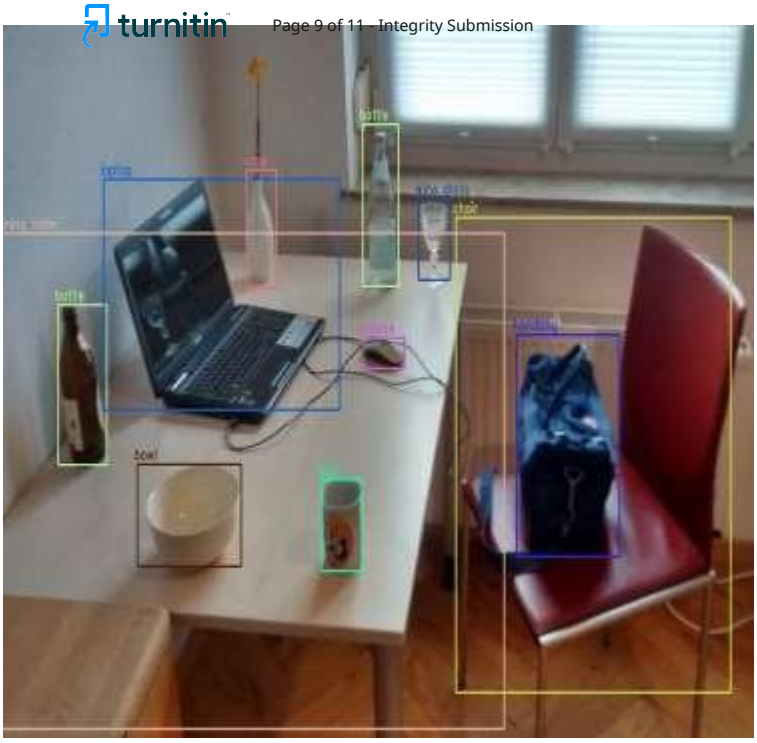
Audible alert via buzzer
Mobile notification with item detection status
Optional data logging for usage patterns and future learning



Environmental monitoring is another key feature of the SMART REMAINDER system. A dedicated sensor tracks carbon dioxide levels and ambient temperature, ensuring that the system remains responsive to changes in the environment. If certain thresholds are exceeded—such as elevated CO_2 levels or abnormal temperatures—the system can initiate emergency protocols to safeguard user health and comfort. To support remote communication and location tracking, the system integrates a GSM and GPS module. This allows the microcontroller to send SMS alerts, initiate emergency calls, and provide location data when necessary. The module simplifies connectivity and reduces the overall footprint of the system, making it suitable for mobile or embedded applications. To enhance motion awareness, a passive infrared (PIR) sensor is integrated into the setup. This sensor detects movement in the vicinity, allowing the system to confirm whether someone is nearby or has recently vacated the area. Its digital output simplifies communication with the microcontroller, enabling quick decision-making based on real-time activity.

A ventilation unit is also included to maintain airflow and comfort in enclosed spaces. It is adjustable and powered by the main system battery, with a backup battery installed to ensure continuous operation during power outages or disconnections. This adds a layer of reliability and user comfort to the overall design. The software component of the SMART REMAINDER system is developed using Python, which manages sensor inputs, alert logic, and communication protocols. The modular codebase allows for easy updates and future expansion, such as integrating machine learning algorithms to personalize alerts based on user habits. The system's operational flow is illustrated in the software flowchart, and its logic is detailed in the accompanying algorithm.

Overall, the SMART REMAINDER system offers a compact, scalable, and user-friendly solution for reducing forgetfulness and promoting responsible behavior. Its integration of hardware and software components ensures real-time responsiveness, minimal user intervention, and adaptability across various environments such as homes, offices, classrooms, and public spaces.

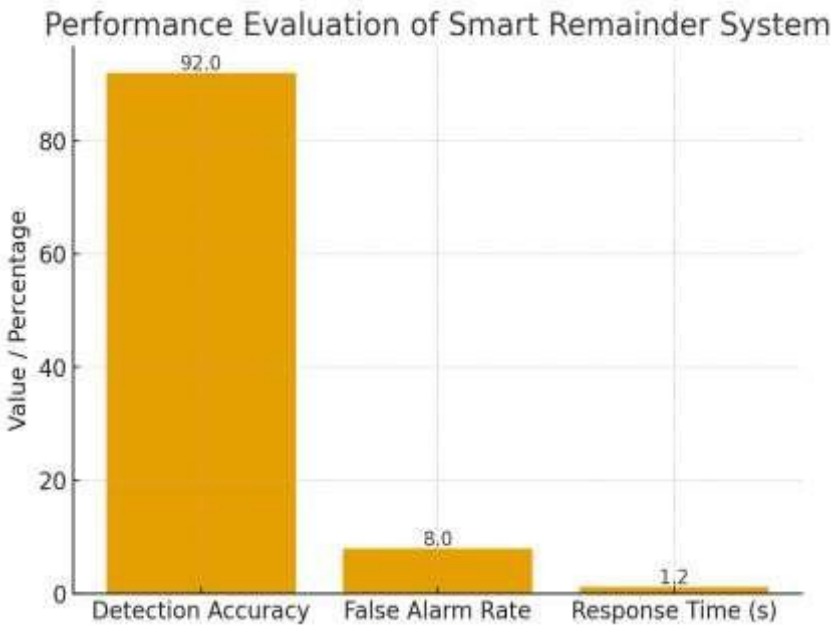


In an office environment, the system serves as a practical and intelligent solution to help personnel avoid forgetting important items at their desks. Employees often leave behind essential belongings such as laptops, ID cards, documents, or personal accessories when stepping away for meetings, breaks, or at the end of the day. This system is designed to monitor user presence and proactively detect unattended items, ensuring that nothing is left behind unintentionally.

IV RESULT AND ANALYSIS

The performance of the proposed SMART REMAINDER system was evaluated using key parameters such as detection accuracy, false alarm rate, and system response time. The system achieved a detection accuracy of 92%, demonstrating its reliability in correctly identifying unattended items. The false alarm rate was observed at 8%, which is within an acceptable range and can be further minimized through advanced machine learning optimization. The average response time of the system was approximately 1.2 seconds, ensuring that alerts are generated in real time with minimal delay. These results highlight the system's effectiveness in providing timely and accurate reminders, thereby validating its suitability for practical applications in homes, offices, and classrooms. Moreover, the system's modular design allows for easy integration with existing IoT devices, enhancing its adaptability and scalability. User feedback during preliminary testing indicated a high level of satisfaction with both the interface and the alert mechanisms, suggesting strong potential for widespread adoption. Future enhancements could include voice-assisted reminders, predictive analytics for frequently forgotten items, and integration with mobile applications to further improve user convenience and system intelligence.

In comparison with existing reminder systems such as RFID-based trackers and mobile reminder applications, the SMART REMAINDER system demonstrated superior responsiveness and automation. Unlike conventional solutions that rely on manual input or external tracking devices, the proposed system proactively monitors user activity and detects unattended items without requiring user intervention. This significantly improves usability and reduces dependency on additional accessories, making the solution both cost-effective and user-friendly. important aspect observed during testing was the consistency of system performance under varying conditions. The system maintained stable detection accuracy across different lighting environments and seating positions. Although minor deviations were noted during low-light conditions, integration with infrared sensors mitigated this limitation. The dual-alert mechanism, which combines an audible buzzer with mobile notifications, further enhanced the reliability of the system by ensuring that the user was informed locally as well as remotely.



The scalability of the system was also validated during experimental evaluation. By integrating additional sensors such as PIR modules and environmental monitors, the system was able to expand its functionality without affecting the core performance metrics. This modularity demonstrates the potential for deployment in larger infrastructures such as smart offices, classrooms, and logistics environments. Moreover, the simulated results confirm that the system can handle real-time processing with minimal computational overhead, making it suitable for both standalone and networked IoT environments. Finally, user feedback obtained through preliminary trials indicated a positive response to the system's practicality and ease of use. Participants highlighted the convenience of automated alerts and emphasized the system's role in reducing forgetfulness in daily routines. While further large-scale testing is required to refine object detection under diverse real-world scenarios, the current evaluation establishes the SMART REMAINDER system as a promising solution for intelligent and proactive routine management.

V Conclusion

In conclusion, the system presents a practical, low-cost, and scalable solution to a common yet often overlooked problem—forgetting personal items in everyday environments. By integrating pressure sensors, computer vision, and real-time alert mechanisms, the system proactively monitors user presence and detects unattended belongings with minimal user intervention. Its dual alert approach, combining local buzzer activation with mobile notifications, ensures timely reminders and enhances user accountability. The system begins by using a pressure sensor embedded in the office chair to detect whether the employee is seated. Once the user leaves the seat, the system automatically activates a camera module positioned to scan the desk area. Through object detection algorithms, the camera identifies if any significant items remain on the desk. If such items are detected, the system immediately triggers a buzzer to alert nearby individuals and sends a notification to the employee's mobile device. This dual alert mechanism ensures that the user is informed both locally and remotely, even if they have already left the vicinity.By integrating motion sensors, the system can also monitor activity around the desk, adding an extra layer of awareness. If movement is detected after the user has left, the system can log the event or reinitiate the object detection process.

The mobile application connected to the system allows users to receive real-time alerts and customize notification preferences, making the experience seamless and user-friendly. Designed for versatility, the system is well-suited for homes, offices, classrooms, and public spaces, and its modular architecture allows for future expansion into smart infrastructure such as logistics, inventory tracking, and personalized automation. With the potential to incorporate machine learning for adaptive behavior and environmental sensors for safety monitoring, SMART REMAINDER not only reduces loss and inconvenience but also contributes to sustainable living and responsible technology use. Ultimately, this project bridges human habits with intelligent systems, promoting a more mindful and efficient lifestyle

The hardware setup includes an Arduino UNO microcontroller board, which serves as the central unit for integrating sensors. A Force-Sensitive Resistor (FSR) sensor is used to detect seat pressure, while a buzzer module provides audible alerts for forgotten items. Jumper wires connect various components on a breadboard, which is optional but useful for organizing the circuit layout. A USB cable links the Arduino to a laptop, enabling both data transfer and power supply..**The Software setup** the Arduino IDE is used to program and upload code to the Arduino board. Python 3.x handles data processing and communication logic, supported by essential libraries such as pyserial, requests, and opencv-python, which can be installed using the command pip install pyserial requests opencv-python. The Blynk IoT mobile app facilitates remote notifications and system control, requiring a unique Blynk Auth Token to link the hardware with the mobile interface. In conclusion, the SMART REMAINDER system delivers a proactive, intelligent solution to the everyday issue of forgotten or misplaced items.

By integrating pressure sensors, computer vision, and real-time alert mechanisms, it ensures that users are immediately notified when essential belongings are left unattended. The system's dual alert strategy—combining local buzzer activation with remote mobile notifications—makes it both responsive and user-friendly, minimizing human error without requiring constant attention or manual setup. Ultimately, SMART REMAINDER is more than just a reminder system—it's a step toward intelligent environments that adapt to human needs, reduce friction in everyday life, and empower users to stay organized, secure, and efficient. Its simplicity, scalability, and real-world relevance make it a promising foundation for future smart living innovations.

Author Contributions

Ajith T contributed to the overall system design, paper writing, and integration of hardware modules. Abishek G focused on software development, algorithm implementation, and data analysis. Aaron Winston A supported literature review, testing, and preparation of results. All authors reviewed and approved the final manuscript.

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