Domotics using Google Assistant

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***Abstract*— The integration of smart devices has brought significant improvements to home automation systems, enhancing safety and convenience. This paper presents a smart home automation system based on Google Assistant, which allows for the control and monitoring of home appliances such as lighting, air conditioning, and security systems. The system is implemented using an ESP32-CAM microcontroller integrated with sensors for gas, flame, motion, temperature, and humidity monitoring. The Blynk mobile application and IFTTT platform provide the backbone for remote control and automation. The results demonstrate that the proposed system offers an affordable, flexible, and user-friendly solution for enhancing home safety and automation.**

Keywords— ESP32-CAM, Sensors, Blynk App, IFTTT, Google Assistant

I. Introduction

The rise of smart home automation has significantly transformed the way individuals interact with their living spaces. Driven by advancements in the Internet of Things (IoT) and artificial intelligence (AI), smart systems aim to enhance comfort, security, and energy efficiency. Traditional home automation systems often relied on manual switches or standalone control systems. However, modern solutions integrate IoT devices with cloud-based platforms, enabling remote and voice-controlled operations.

This paper presents a smart home automation system using Google Assistant, built upon the ESP32-CAM microcontroller. The system incorporates a variety of sensors, such as gas, flame, motion, and temperature sensors, to monitor and manage household operations. Compared to earlier systems, this project emphasizes real-time monitoring, ease of control via voice commands, and integration with the Blynk mobile app for enhanced user experience.

Smart home automation systems not only contribute to convenience but also promote energy conservation and safety. By leveraging technologies like IFTTT (If This Then That), this project ensures a seamless user experience, enabling automatic responses to specific events, such as triggering alerts for gas leaks or fire hazards. The aim is to deliver a cost-effective, scalable solution that aligns with contemporary demands for smarter living.

II. RELATED WORK

Smart home automation has been a growing field of research and development. Several systems have been proposed and implemented to address specific challenges in home automation.

Rami Nahas [1] proposed a Smart Home Security System (SHSS) utilizing IoT to monitor and control devices through smartphones. This system, while effective in enhancing security, lacked integration with voice-controlled platforms like Google Assistant.

Deepa V. Ramane et al. [2] developed a system leveraging Google Assistant for controlling appliances. However, their approach was limited in its ability to monitor environmental parameters such as gas leaks or temperature variations. Such limitations necessitate a more comprehensive system, integrating diverse sensors to provide a holistic solution.

Another relevant work by Md. Sadad Mahamud et al [3] proposed a IoT based system in which a registered person can monitor his/her home electrical appliances. They created a custom-made private server for monitoring and controlling the system. The server communicates with the ESP32 Wi-Fi module. By assessing the server, the registered person can turn on/off his home appliances

However, these systems often lack the full integration of a wide array of sensors or rely on expensive hardware. Our system uses the ESP32-CAM microcontroller for its low cost and versatility, integrating multiple sensors to provide a comprehensive smart home solution. Furthermore, the inclusion of the Blynk app and IFTTT ensures that the system can deliver automated alerts and remote accessibility, making it more versatile than existing solutions. ESP32-CAM is linked with the Blynk application account with the IFTTT website which is connected to the Google Assistant cloud.

III. SYSTEM DESIGN

The architecture of the proposed system integrates hardware components with software platforms for seamless communication and control. The main elements include the ESP32-CAM microcontroller, sensors, and software platforms like Blynk, IFTTT, and Google Assistant. The proposed system uses an ESP32-CAM microcontroller for its central processing, with sensors connected to monitor gas leaks, fire hazards, and motion detection. The system architecture is shown in Figure 1, which includes:

- ESP32-CAM: A low-cost microcontroller with on board Camera, Wi-Fi and Bluetooth. The ESP32-CAM microcontroller functions as the central processing unit of the system. It receives data from sensors, processes it, and transmits the data to the cloud via Wi-Fi. The microcontroller's onboard UART (Universal Asynchronous Receiver-Transmitter) and GPIO (General Purpose Input/Output) interfaces enable connectivity with sensors and peripheral devices
- MQ2 Gas Sensor: The sensor outputs an analog signal corresponding to gas concentration levels. This signal is read by the ADC (Analog-to-Digital Converter) of the ESP32-CAM, which translates the analog voltage into a digital value for further processing.
- Flame Sensor: The flame sensor generates a digital signal that is directly fed into the GPIO pins of the ESP32-CAM.

- DHT11 Temperature and Humidity Sensor: The DHT11 communicates via a single-wire protocol, sending temperature and humidity data in digital form to the microcontroller.
- IR Motion Sensor: This sensor uses a simple high/low digital output connected to the ESP32-CAM GPIO, indicating the presence of motion.,
- Relay switch to control Electrical appliance like bulb.
- Blynk acts as the user interface, displaying real-time sensor data and providing control over home appliances. The ESP32-CAM sends data to the Blynk cloud using the HTTP protocol, ensuring updates are reflected on the mobile app. Custom widgets like buttons, graphs, and notifications are configured within the Blynk app.
- IFTTT is used to create applets that automate specific tasks. For example, when the gas sensor detects a high concentration, IFTTT triggers an SMS alert to the user. The ESP32-CAM communicates with IFTTT via webhooks, sending trigger requests when certain conditions are met.
- Google Assistant enables voice control of appliances by linking IFTTT applets with voice commands. For instance, a command like "Turn on the lights" sends a webhook to the ESP32-CAM, which toggles the corresponding GPIO pin.

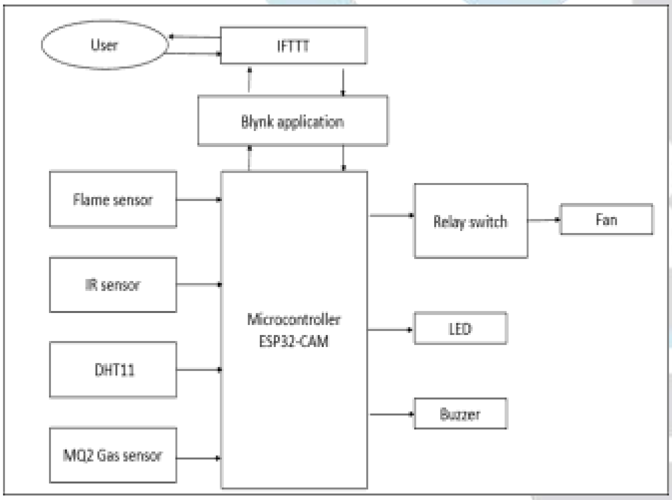

Fig. 1. Block diagram of Domotics using Google Assistant

The data flow in the system is as follows:

1. Sensors collect environmental data and send it to the ESP32-CAM via GPIO or ADC interfaces.
2. The ESP32-CAM processes the data and determines whether a threshold or condition is met.
3. If conditions are met:
   - Data is transmitted to the Blynk cloud for visualization on the mobile app.
   - Alerts are sent via Blynk to notify the user.
   - Commands from Google Assistant are executed via IFTTT and webhooks.
4. Users can interact with the system through the Blynk app or Google Assistant.

The hardware prototype is shown in figure 2.

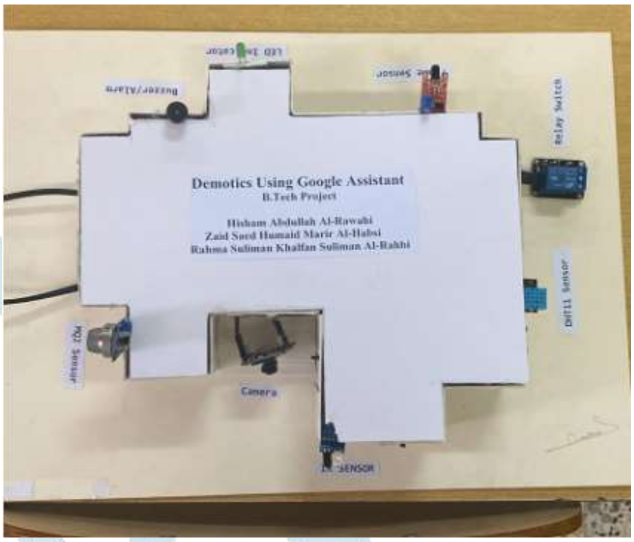

Fig. 2. Hardware prototype of Domotics using Google Assistant

IV. IMPLEMENTATION AND RESULTS

The hardware components were mounted on a prototype board to simulate a real-world environment. The connections between sensors and the ESP32-CAM were established as follows::

- **MQ2 Gas Sensor**:

  Connection Type: Analog
  Interface: The analog output of the MQ2 sensor was connected to the ADC pin of the ESP32-CAM.
  Operation: The ESP32-CAM continuously sampled the analog signal, converting it into a gas concentration reading.
- **Flame Sensor:**

  Connection Type: Digital
  Interface: The flame sensor's digital output was connected to a GPIO pin configured as an input.
  Operation: When a flame was detected, the sensor output dropped to a low state, triggering an alert.
- **DHT11** Temperature and Humidity Sensor:

  Connection Type: Digital (Single-wire protocol)
  Interface: The data pin of the DHT11 was connected to a GPIO pin.
  Operation: The ESP32-CAM library polled the DHT11 at predefined intervals to fetch temperature and humidity readings.
- **IR Motion Sensor:**

  Connection Type: Digital
  Interface: The sensor output was connected directly to a GPIO pin.
  Operation: The output was monitored for high/low transitions indicating motion detection.
- **Relay Switch:** Along with Google Assistant controls the Electrical Appliance like bulb using voice commands.
- **On board Camera Module:** To monitor the premises which can be checked on the mobile using Blynk App.

The ESP32-CAM was powered via a 5V USB supply, and all sensors shared a common ground connection with the microcontroller.

The system's performance was evaluated based on detection accuracy. Testing was conducted in a controlled environment using simulated scenarios for each sensor.

The sensors were calibrated to ensure accurate detection thresholds

DHT11 Sensor: Recorded temperature and humidity readings with an error margin of ±2%. Fig. 3 shows the temperature monitoring process.

MQ2 Gas Sensor: Calibrated to detect propane, methane, and smoke within the range of 200–1000 ppm. Fig. 4 shows the gas detection setup, highlighting the placement of the sensor near the gas source and the ESP32-CAM on the breadboard.

Relay Switch: Fig. 5 shows the control of bulb using voice commands via Google Assistant

Flame Sensor: Successfully detected flames within a 1.5-meter radius, with an accuracy of 95% under ideal conditions. A lighter was used to simulate fire at varying distances. Fig. 6 depicts the flame sensor's active detection.

IR Sensor: Detected motion with 90% reliability in a 120° field of view and up to 5 meters. The IR sensor was tested in an environment with controlled motion events to minimize false triggers. Fig. 7 captures the setup, showing the detected movement.

On Board Camera module: Fig. 8 shows the monitoring of the premises on the mobile phone via the Blynk App.

Table 1 below summarizes the sensor responses during testing:

TABLE I. SENSOR RESPONSE AND CONTROL SYSTEM OVERVIEW

Sensor	Input Condition	Sensor Reading	System Response	User Notification
Flame Sensor	No fire detected	Low	No action	None
	Fire detected	High	Activate buzzer, send notification	Immediate alert
MQ2 Gas Sensor	No gas leak	Low	No action	None
	Gas leak detected	High	send notification	Immediate alert
DHT11 Sensor	Normal temperature and humidity	Temp: 20°C, Hum: 50%	No action	None
	High temperature	Temp: 45°C	Can trigger fan via relay switch if applicable	Temperature alert
IR Sensor	No movement detected	Low	No action	None
	Movement detected	High	Turn on lights in the area	Movement detected alert

The system successfully detected fire, gas leaks, and movement, and performed the appropriate actions (e.g., turning on lights or activating the buzzer). Users received notifications through the Blynk app for critical events such as fire or gas leaks.

The Figures below show the testing of each sensor:

Fig. 3. Testing of DHT11 sensor

Fig. 4. Testing of MQ2 gas sensor

Fig. 5. Testing Google Assistant with Relay switch

Fig. 6. Testing Flame sensor

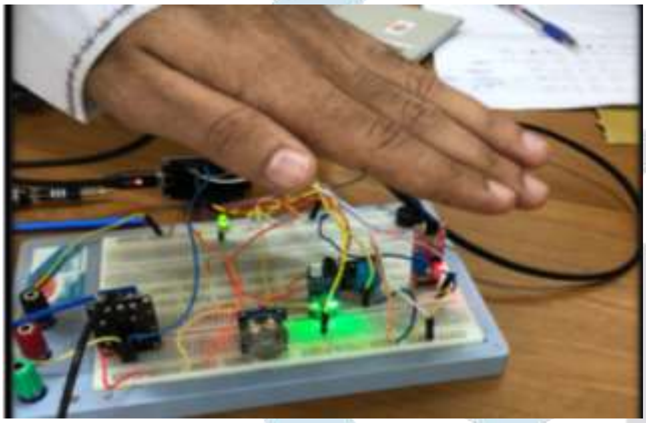

Fig. 7. Testing IR sensor with LED

Fig. 8. Testing the Camera

V. CONCLUSION AND FUTURE WORKS

This paper presents a smart home automation system that integrates Google Assistant with ESP32-CAM and various sensors to monitor and control home appliances remotely. The system demonstrated significant potential in terms of safety and energy efficiency. While the current implementation focuses on basic home automation, future enhancements could include integrating additional sensors, predictive maintenance and intelligent automation using Machine Learning, facial recognition for enhanced security, renewable energy integration, and more advanced AI-based decision-making to further automate the home environment. While the current system supports Google Assistant, future iterations could include support for Amazon Alexa and Apple Siri, increasing accessibility for users with different ecosystems.

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