InnoCookMate

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Abstract : Kitchen is very essential part of our life. The InnoCookMate is a smart IoTbased solution for efficient kitchen management. The problem of having or not having various items while cooking causes a lot of suffering, as well as when cooking something, it is difficult to bring the necessary things at that same time. For the blind and older persons these make so harassment. To solve these problems, the project provides individual boxes for storing items in the same place, auto quantity tracking system, automated ordering system, notification system with order with low quantity, alarming system for gas leakage, fire detection , voice detection and speaker.

Project Overview: The InnoCookMate is a smart storage and monitoring solution that enhances modern kitchen management. It uses six boxes arranged in a 2×3 format to store daily-use items such as rice, sugar, salt, oil, and pulses. Each box is equipped with a load cell sensor to measure the quantity of stored items in real time. An ESP32-CAM with camera recognition identifies items automatically when placed inside a box. Users can give voice commands to know the type and quantity of items, and the system responds with audio output. If the quantity of an item falls below a predefined threshold, the system provides alerts and smartphone notifications. The system also offers automated ordering from a supershop, based on user confirmation. Ultrasonic sensors detect hand movement, enabling automatic box lid opening and closing. Additionally, gas and fire sensors ensure safety by triggering alarms and warnings in case of hazards.

Component List:

ESP32 , ESP32-CAM

HX711 , Load Cell

Ultrasonic sensor , gas sensor, flame sensor

Microphone / Voice Recognition Module, Speaker Module, Buzzer

Servo Motor, 5V/3.3V Power Supply Unit, Jumper Wires.

ESP32:

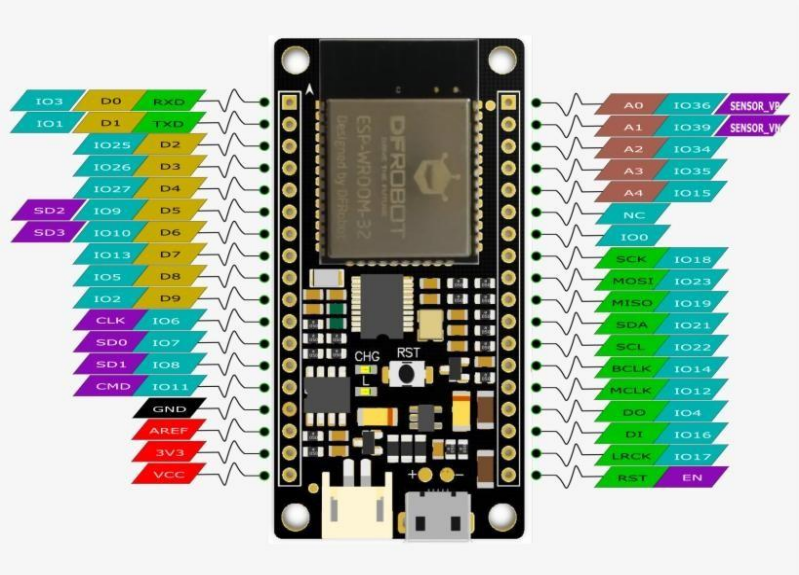
The ESP32 is an open-source microcontroller board developed by Espressif Systems. It is well-known for its built-in Wi-Fi and Bluetooth features, making it very popular in IoT projects, smart devices, and automation systems. Because of its low cost, high performance, and wide community support, the ESP32 is used by both beginners and professionals.

Overview: The ESP32 operates at 3.3V, and is powered by a dual-core 32-bit LX6 processor that runs up to 240 MHz. It provides many digital and analog pins, with support for advanced communication protocols. The board can be programmed using the Arduino IDE or ESP-IDF, making coding flexible and beginner-friendly. With wireless connectivity, ESP32 is widely used in IoT, home automation, and modern embedded systems.

Features:

1. Microcontroller (Tensilica Xtensa LX6)

   The ESP32 is built around a dual-core 32-bit processor with clock speeds up to 240 MHz. This gives it much higher performance compared to 8-bit boards like the Arduino Uno. It can handle multitasking, real-time operations, and complex applications easily.



2. Digital Input/Output Pins
   The board provides around 30–36 GPIO pins (depending on the module).

- Can be configured as input or output.
- Many pins support PWM output, useful for motor control, LED dimming, and other analog-like tasks.
- Some pins can also act as capacitive touch sensors, allowing touch-based input.Analog Input and Output Pins
- ADC (Analog-to-Digital Converter): 12-bit resolution, used to read sensor values with greater accuracy.
- DAC (Digital-to-Analog Converter): Can generate true analog output, which is not available in Arduino Uno.

3. Memory (Flash, SRAM) ○ Flash Memory (usually 4 MB): Stores the program code.
   ○ SRAM (520 KB): Temporary memory for program execution.
   - Some models also support external memory expansion.
4. Communication Interfaces
   ESP32 supports many communication protocols:
   - UART (Serial Communication) → for debugging and serial data transfer. ○ I2C → for connecting multiple sensors and displays.
   - SPI → for high-speed communication with displays, memory cards, or sensors. ○ CAN, Ethernet, and others depending on the module.
5. Wireless Connectivity
   - Wi-Fi (802.11 b/g/n): Built-in wireless communication for internet and local networks.
   - Bluetooth v4.2 (Classic + BLE): Supports both classic Bluetooth and lowenergy devices.
6. Power Supply Options
   The ESP32 can be powered in several ways:
   1. USB connection (5V from computer or adapter).
   2. External power supply (usually 5V via VIN pin).
   3. Li-ion/Li-Po battery, supported natively for portable projects.
      It also includes a voltage regulator that safely provides **3.3V** to sensors and peripherals.

ESP32-CAM:

The ESP32-CAM is a low-cost development board based on the ESP32-S microcontroller, integrated with a camera module (OV2640). It combines Wi-Fi, Bluetooth, and camera capabilities, making it ideal for IoT, surveillance, and AI vision projects. Its compact

design allows embedding in smart devices for image capture, video streaming, and face recognition.

Overview: The ESP32-CAM board is equipped with a dual-core ESP32 chip, an OV2640 camera, a microSD card slot, and GPIO pins. It supports wireless communication, enabling remote monitoring and IoT-based smart applications. Because of its low cost and powerful features, it is widely used in projects like smart doorbells, security cameras, and wireless monitoring systems.

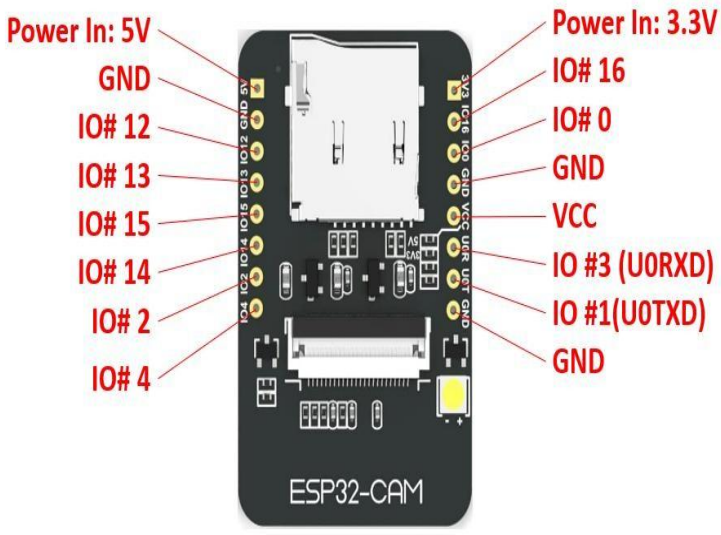
Features

1. Camera Support (OV2640 Sensor)

The ESP32-CAM comes with an OV2640 camera module, capable of capturing images up to 2MP resolution. It supports JPEG compression, making it efficient for streaming and storage. This feature enables face detection, video surveillance, and IoT image applications.

2. Built-in Wi-Fi and Bluetooth

It has 2.4 GHz Wi-Fi and Bluetooth/BLE 4.2 for wireless communication.
This allows remote monitoring, IoT integration, and wireless data transfer without external modules. It makes the ESP32-CAM highly suitable for smart home and IoT projects.



3.MicroSD Card Slot The board includes a microSD card slot for local storage of images and video. It supports cards up to 4–8GB, enabling offline data logging and file saving. This feature is useful for security systems that need backup data. 4. GPIO and Peripheral Support The ESP32-CAM provides **9 GPIO pins** for connecting sensors, actuators, and other modules. It supports UART, SPI, I2C, and PWM communication protocols. This flexibility allows combining the camera with additional hardware for advanced projects.

5. Low-Cost and Compact Size

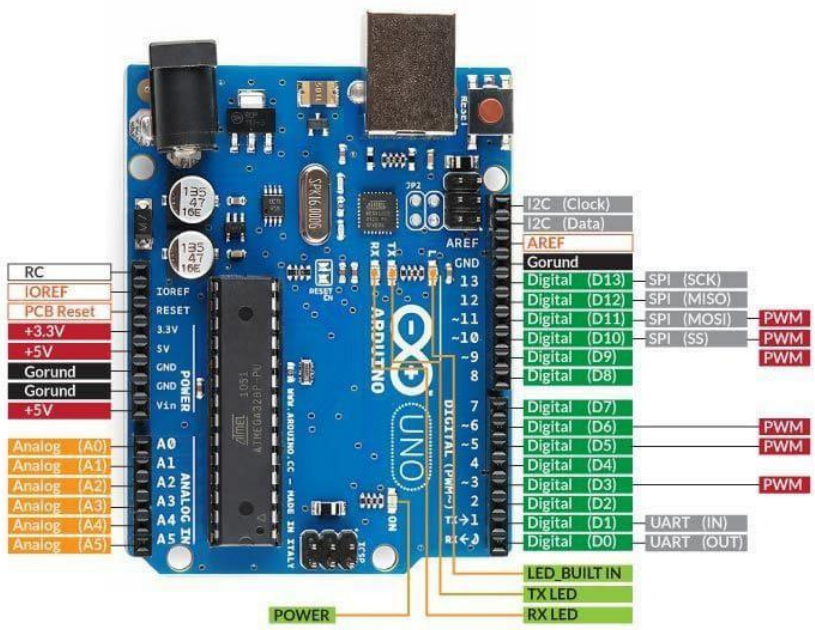
It is very affordable compared to traditional camera modules with Wi-Fi.
The compact design makes it easy to embed into small devices or portable

gadgets. This makes it popular in DIY, hobbyist, and commercial IoT projects.

6. AI and Face Recognition Capabilities

Using the ESP32's powerful processing and libraries like **ESP-WHO**, the board supports face detection and recognition. This feature enables AI-based security systems and smart authentication methods. It is widely applied in smart door access, surveillance, and robotics.

Arduino Uno



The Arduino Uno is one of the most widely used microcontroller boards based on the ATmega328P microcontroller. It serves as an essential component in embedded systems and IoT Arduino Uno is used to handle additional sensor and actuator controls that require separate analog or digital processing, working in coordination with the ESP32 and ESP32-CAM modules.

Overview

The Arduino Uno operates at 5V and runs at a clock speed of 16 MHz. It provides 14 digital input/output pins (of which 6 can be used as PWM outputs) and 6 analog input pins, allowing flexible interfacing with a wide range of electronic components. The board is powered through a USB connection or an external adapter (7–12 V) and can easily communicate with other devices via serial, I²C, or SPI protocols. It is programmable using the Arduino IDE, which supports C/C++ language, making development simple and efficient.

Features

1. Microcontroller
    1. ATmega328P (8-bit AVR RISC-based microcontroller)
    2. Operating frequency: 16 MHz
    3. Flash Memory: 32 KB (0.5 KB used by bootloader)
    4. SRAM: 2 KB
    5. EEPROM: 1 KB
2. Input/Output Pins
    1. 14 Digital I/O Pins (6 PWM outputs for controlling motors or LEDs)
    2. 6 Analog Input Pins (10-bit resolution)
    3. Onboard LED indicator on Pin 13
3. Communication Interfaces
    1. UART (Serial Communication) – for debugging and module communication
    1. 2. I^2C and SPI support for sensor and peripheral interfacing
    2. 3. Compatible with Wi-Fi modules, Bluetooth modules, and other external controllers
4. Power Supply
    1. Operating Voltage: 5 V
    2. Input Voltage (recommended): 7–12 V
    3. 3.3 V output pin for low-voltage sensors
    4. Built-in voltage regulator for stable performance

HX711 Module:

The HX711 is a precision 24-bit analog-to-digital converter (ADC) designed for weigh scales and industrial control applications. It is commonly used with load cells to measure weight by amplifying and converting small analog signals into digital form. The module

provides accurate, stable, and easy-to-read weight data for microcontrollers like Arduino or ESP32.

Overview: The HX711 module integrates an amplifier and ADC in one chip, reducing the need for external components. It has two differential input channels and a programmable gain amplifier (32, 64, 128), ideal for load cell signals. Due to its low cost, high accuracy, and easy interfacing, it is widely used in digital weighing machines and sensor projects.

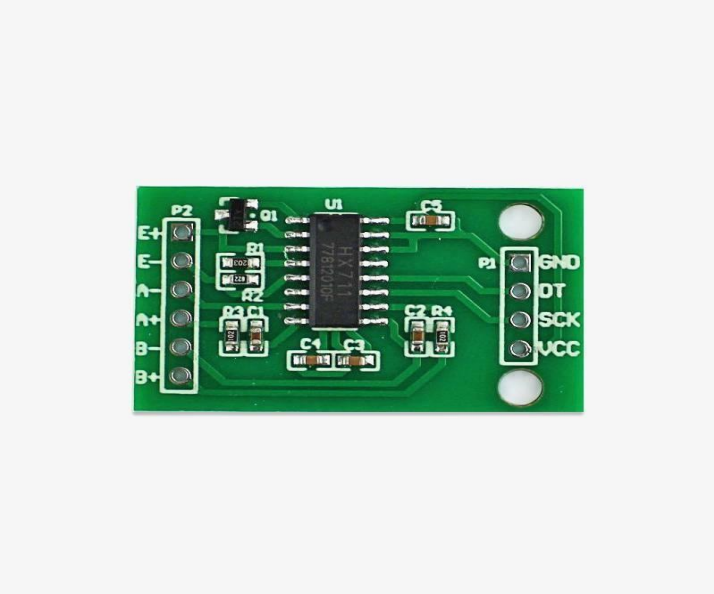
Features:

1. 24-bit ADC (Analog-to-Digital Converter)

The HX711 provides a 24-bit high-resolution ADC, allowing it to measure very small voltage changes from load cells. This makes it highly precise compared to standard 10bit or 12-bit ADCs in microcontrollers. It ensures accurate weight measurement in grams or even smaller units.

2. Programmable Gain Amplifier (PGA)

It includes a built-in low-noise programmable gain amplifier with selectable gains of 32, 64, and 128. This amplifies weak signals from strain gauges in load cells without external amplifiers. As a result, even tiny weight variations can be detected reliably.



3. Dual Channel Input

The module has two differential input channels (Channel A & Channel B).
Channel A offers programmable gain (128 or 64), while Channel B has a fixed gain of 32.
This flexibility allows using multiple load cells or sensors in one system.

Ultrasonic Sensor and Servo Motor with ESP32-CAM:

An ultrasonic sensor is an electronic device that can measure distance using sound waves. It works by sending out a short sound pulse through the Trigger (TRIG) pin. When the sound hits an object, it bounces back, and the Echo (ECHO) pin receives the reflected signal. By measuring the time taken for the echo to return, the distance of the object can be calculated.

- TRIG Pin: Sends the sound pulse.
- ECHO Pin: Receives the reflected pulse and measures the time.

A servo motor is a type of motor that can rotate to a fixed angle, usually between 0° and 180°. It is controlled using PWM (Pulse Width Modulation) signals from the ESP32-CAM. In this project, the servo motors will move according to the data received from the ultrasonic sensors.

In our setup, three ultrasonic sensors are used to detect distances, and six servo motors are connected to control movements. The ESP32-CAM works as the central controller that reads the sensor data and sends commands to the servos.

<u>Key Features of this Project</u>

1. Measures distance in real time using ultrasonic sensors.
2. Moves servo motors based on the distance data.
3. Uses ESP32-CAM as the main controller.

4. A low-cost and practical setup for robotics, obstacle detection, and automation.

<u>Power Connections:</u>

- VCC of all sensors and servos → 5V (or an external power source if required).
- GND of all components → Common Ground with ESP32-CAM.

The combination of ultrasonic sensors and servo motors makes this project simple yet effective. With the ESP32-CAM handling both sensing and control, the system can detect objects and respond instantly by moving the servos. This makes it a useful project for robotics, smart monitoring, and safety applications

Servo Motor, Voice Regosnition Module, Flame Sensor:

A servo motor is a type of motor that allows precise control of angular position, speed, and direction. It consists of a DC motor, a control circuit, and a feedback system (usually a potentiometer). Servo motors are widely used in robotics, automation, and control systems where accuracy is needed, such as moving robotic arms or opening/closing mechanisms.

A voice recognition module is an electronic component that can recognize and process human speech commands. It works by capturing voice input through a microphone, analyzing it, and converting it into digital signals understandable by a microcontroller. Modules like the Elechouse Voice Recognition Module or built-in ESP32 voice features are used in smart home devices, voice-controlled robots, and automation systems.

A flame sensor is a device that detects the presence of fire or flame based on infrared light emitted by fire. It typically uses an IR receiver (like a photodiode or phototransistor) to sense flame wavelength and sends a signal to a microcontroller. Flame sensors are commonly used in fire alarm systems, safety devices, and smart monitoring systems.

Gas Sensor Module Features

<u>Gas Leakage Detection</u>: The gas sensor module is designed to detect the presence of hazardous kitchen gases such as liquefied petroleum gas (LPG), propane (C_3H_8), methane

(CH_4), and hydrogen (H_2). In our project, this feature plays a vital role in ensuring kitchen safety by providing early alerts in case of accidental gas leakage.

Sensor Technology: The module typically uses a semiconductor-based sensing element, which changes its electrical resistance in the presence of target gases. This variation is converted into an electrical signal that the system interprets to detect abnormal gas concentration levels.

Kitchen Safety Integration: In the proposed smart kitchen system, the gas sensor works as part of the Kitchen Safety Monitor. When leakage or unusual gas concentration is detected, the system provides instant voice alerts to the user, making it especially useful for visually impaired individuals. Additionally, the alert can be expanded to include buzzer alarms or wireless notifications.

Threshold-Based Alerts: The module allows setting specific gas concentration thresholds. If the gas level crosses the predefined safe limit, the sensor immediately triggers an alarm. This threshold-based functionality ensures reliable and prompt responses in critical situations.

Calibration and Accuracy: For long-term reliability, the gas sensor requires initial calibration and periodic re calibration. Calibration helps maintain accuracy in real-world kitchen conditions, reducing false alarms caused by normal cooking fumes.

Real-Time Monitoring: The sensor continuously monitors the environment, ensuring 24/7 protection. This feature is highly significant for blind users, as the system announces the hazard through audio feedback without requiring any visual monitoring.

System Reliability: As part of the multi-sensor network in the project, the gas sensor enhances both safety and automation. It complements other sensors (temperature, pressure, weight, camera) and ensures a complete smart kitchen solution.

Features:

1. Automatic Weight Measurement
2. Touchless Item Detection
3. Voice Recognition and Control System
4. Low-Quantity Alerts and Reminders
5. Kitchen Safety Monitor

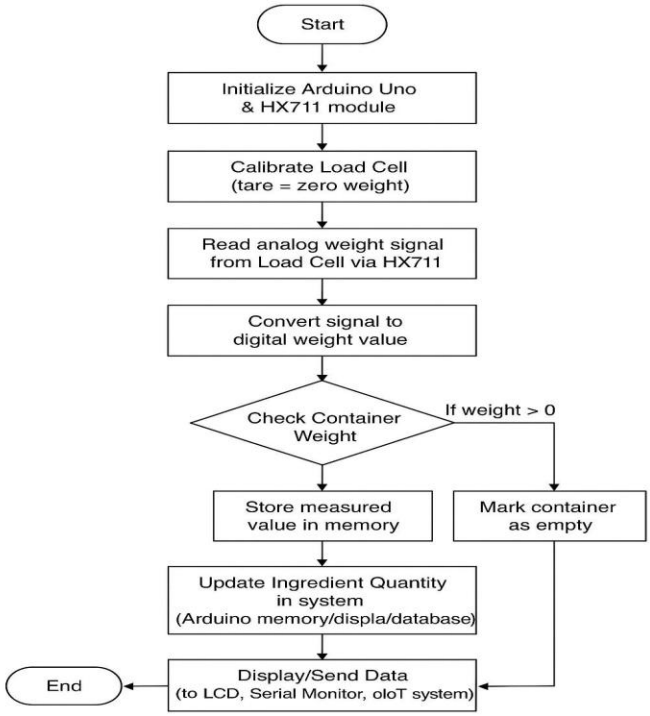
6 .AI-Based Item Detection and Recognition

7. Wi-Fi Connectivity for Online Orders

1. Automatic Weight Measurement

Each container is integrated with a weight sensor that continuously measures the stored quantity of ingredients such as rice, lentils, oil, salt, sugar, and spices. The system updates the remaining stock automatically, reducing the need to open containers frequently.

1.



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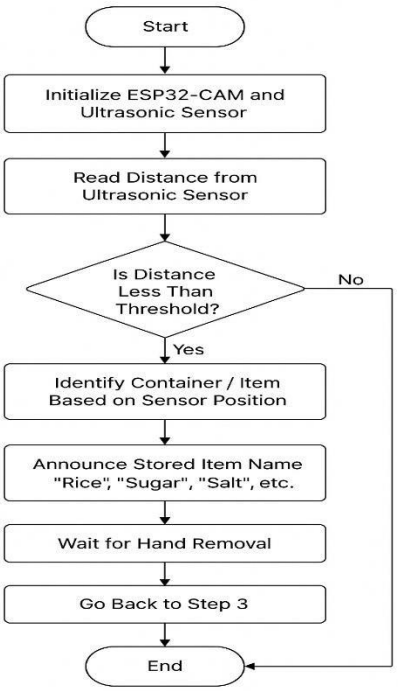
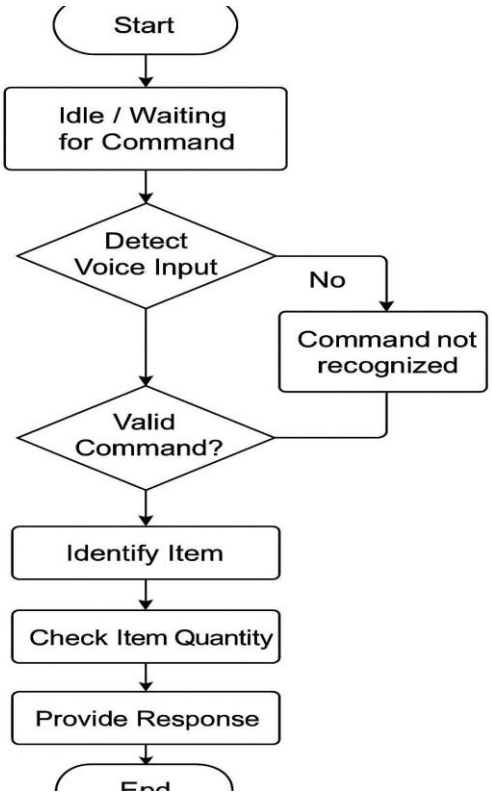
Automatic Weight Measurement Flowchart



2. Touchless Item Detection

Using an ultrasonic sensor, the system detects when a user's hand approaches a container. Based on the detected position, the system announces the name of the stored item without requiring any physical contact, ensuring convenience and hygiene.

Touchless Item Detection Flowchart



2. Voice Recognition and Control System

The system is equipped with a microphone module and voice recognition capability, allowing users to directly ask about the availability or remaining

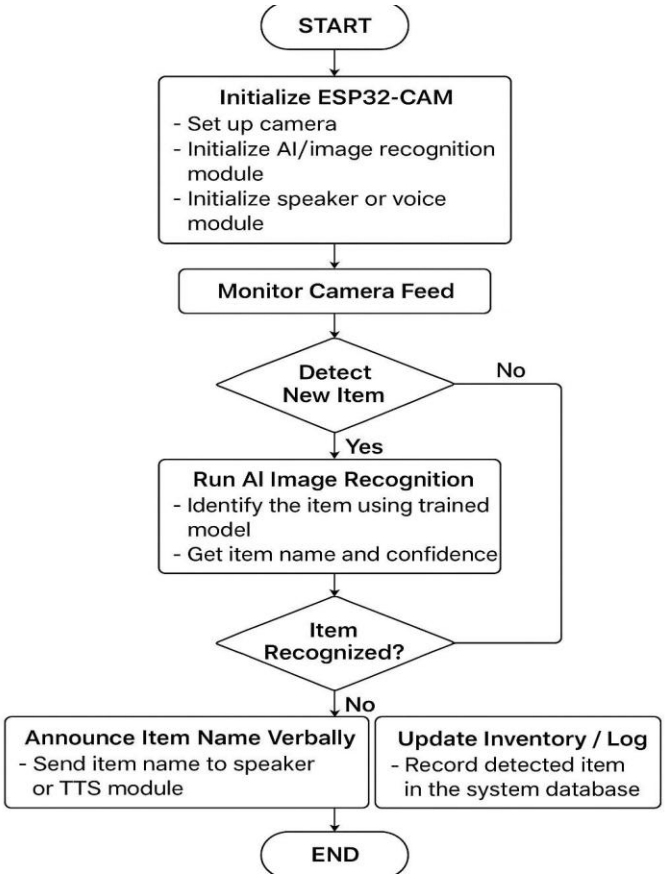
quantity of any item. Commands such as “How much rice is left?” will be recognized and answered in real time.

4. Low-Quantity Alerts and Reminders

When the stock of any item falls below a pre-set threshold, the system generates early alerts. This reminder prevents sudden shortages and helps users plan kitchen management efficiently.

5 Kitchen Safety Monitor

The device integrates a gas leakage sensor, pressure sensor, and temperature monitoring unit to ensure household safety. It detects unusual rises in stove temperature, checks remaining LPG levels, and alerts the user immediately in case of gas leakage or fire hazards.



6. AI-Based Item Detection and Recognition

A camera module powered by basic AI image recognition is used to identify incoming grocery items. This is especially beneficial for visually impaired users, as the system verbally announces the name of newly placed items in the kitchen.

7. Wi-Fi Connectivity for Online Orders

The system uses Wi-Fi connectivity to link with e-commerce platforms or nearby shops. This feature enables direct communication for placing orders, updating inventory data, and ensuring seamless kitchen automation.

Esp 32 code (automatic weight measure +low quantity alerts +gas and flame sensor) :

https://github.com/anannya975/sample_code/blob/main/Sample%20code%20for%20ESP32.pdf

Arduino Uno code (Voice recognition + touchless item detection+WiFi connectivity for online order):

https://github.com/anannya975/sample_code/blob/main/Sample%20code%20for%20Arduino%20Uno.pdf

Esp-32 cam code (AI based item detection and recognition) :

https://github.com/anannya975/sample_code/blob/main/Sample%20code%20for%20ESP32-CAM.pdf