Revolutionizing Kitchen Safety and Efficiency: Harnessing Cutting-Edge Connectivity and Automation

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Abstract. In modern advancements, technology has revolutionized various aspects of our lives, and the kitchen is no exception. The integration of the Internet of Things (IoT), GSM (Global System for Mobile Communication), and Arduino technologies offers a promising solution to enhance stoves' functionality, safety, and energy efficiency. IoT technology enables remote monitoring and control through a user-friendly smartphone app by establishing a connection between the smart stove and the internet. Additionally, GSM technology ensures prompt notifications to both the user's smartphone and designated emergency contacts in case of emergencies. The system's Arduino board effectively manages temperature, gas levels, and flame intensity, even allowing for automatic stove shutdown during critical situations. Thus, the smart stove system harnesses these cutting-edge technologies, providing users convenience, improved safety measures, and heightened energy efficiency. By transcending the limitations of existing implementations, the proposed smart stove system presents an attainable and cost-effective means to elevate safety and energy efficiency standards within both residential and commercial kitchens.

Keywords: IoT, Arduino, Stove, Sensors, Safety, Microcontroller, Efficiency, GSM

INTRODUCTION

In the quest for culinary perfection, it's time to leave behind the traditional ways of using LPG gas for cooking and embrace a new era of innovation. Introducing the Smart Stove system, a groundbreaking solution poised to redefine the way we utilize LPG gas for cooking. Seamlessly blending IoT technology with unparalleled safety features, this cutting-edge marvel is set to transform our kitchens into the epitome of modernity and convenience.

Safety has always been paramount when it comes to LPG gas usage, and the Smart Stove system takes this concern to heart. No longer will gas leaks, overheating, or overloading haunt our culinary adventures. This visionary system incorporates a host of safety features designed to safeguard both users and their surroundings. The Smart Stove ensures accidents are kept at bay through state-of-the-art gas leak detection mechanisms and intelligent temperature sensors,

allowing the user to cook with absolute peace of mind.

The Smart Stove system incorporates an IoT infrastructure that seamlessly integrates with a smartphone, providing users with unprecedented control and convenience. Through a user-friendly mobile app, individuals can effortlessly manage various stove functions, such as igniting or extinguishing flames, setting cooking temperatures precisely, and remotely monitoring the progress of their culinary creations. This level of convenience allows users to multitask and optimize their cooking experience effectively.

Additionally, the Smart Stove system revolutionizes LPG gas consumption management by eliminating the inconvenience of running out of gas while cooking. Through the innovative load cell monitoring system, users receive timely notifications for gas cylinder refills. This intelligent feature accurately tracks the gas cylinder's weight, alleviating the anxiety associated with empty cylinders and ensuring a seamless cooking experience.

By leveraging IoT technology, gas leak monitoring, temperature sensors, and load cell monitoring, the Smart Stove system empowers users to cook with confidence, transforming their kitchen into a hub of innovation. Embrace the future of cooking today with the Smart Stove system.

RELATED WORKS

To save gas waste and maintain kitchen safety, the researchers created an ATmega328p microcontroller-based gadget which automatically shuts down the kitchen gas valve operation. The appliance has an exhaust fan that turns on when necessary to maintain a safe temperature range, a solenoid valve that cuts off the gas supply when the hob is not in use, and a timer system for cooking. The device also has a gas leak monitoring system with alarm and notification functions and Bluetooth technology for voice-controlled hob operation [1].

The experts suggested a cooker that is equipped with a kid lock system, a gas leak-determining feature, and two-way safety capabilities. To put the system into practice, the researchers used a Raspberry Pi, a Gas Detection Module, and machine learning methods. In order to prevent kids from turning on the cooker, the cooker uses deep learning architecture (CNN) and machine learning object detection (Haar Cascade) to determine the age of users from real-time video streaming. Additionally, it has a notification and alarm system for gas detection to improve safety precautions in the event of a gas leak [2].

The researchers implemented a smart cooking stove that utilizes an energy harvesting system to increase efficiency. The system includes a Thermoelectric Cooler (TEC) module that generates power from the cooking heat, improving energy utilization. The stove also incorporates gas leakage observation and an IoT-based notification system. In case of a gas leak, the system sends real-time alerts to the user's mobile device [3].

PROPOSED SYSTEM

The idea and use of the smart cooking burner with safety features have been investigated in this study. In his research, a technique for harvesting energy from cooking heat has also been proposed to increase the conventional cooking stove's efficiency. To do this, a Thermoelectric Cooler (TEC) module and a heat-absorbing core are used. Heat gets absorbed through the TEC module and the Seebeck effect is used to generate power. Once stored in a battery, the electricity that is produced can be transmitted to the load. An IoT server has been used to develop a sensor-based safety feature that may detect gas leaks and alert the user via mobile SMS. Using the TEC module from this original prototype, 14V have been produced from the heat of cooking.

The Smart Stove system is designed to reduce the manual control of LPG and improve the safety features of traditional LPG stoves. The system utilizes a range of sensors, including a load cell, gas leakage detector, and temperature sensors, to monitor the cooking process and ensure the user's safety. The system also integrates IoT technology, enabling the user to control the stove through a mobile phone. The smart stove system is implemented

using Arduino, a microcontroller board that enables the integration of sensors, actuators, and other electronic components. The project's load cell, which has a 20-kilogram capacity, is utilized to track the LPG cylinder's weight. By linking the load cell to the Arduino board, the load cell's analog signals are transformed into digital signals that the microcontroller can read. The Arduino board is also connected to the gas leakage detector that is being utilized in the project. The detector's purpose is to find any gas leaks, and if one is found, it will inform the microcontroller. The temperature sensors are used to monitor the temperature of the stove and send an alert signal to the microcontroller in case of overheating.

The microcontroller board has a GSM module attached to it that sends notifications via text message to the user's mobile phone. In the event of a gas leak, overload, or overheating, the GSM module notifies the user through SMS so that they are informed of the issue and can take the appropriate action. The IoT technology used in the project allows the user to control the stove through a smartphone app. Through the app, the user may remotely monitor the cooking process, adjust the temperature and cooking duration, and turn the stove on and off. The app communicates with the microcontroller board via Wi-Fi, enabling real-time communication between the stove and the user's smartphone. In conclusion, the Smart Stove project utilizes a range of sensors, IoT technology, and a GSM module to improve the safety features of traditional LPG stoves. By integrating load cell monitoring, gas leakage detection, temperature sensors, and SMS notification, the project ensures that the user can cook with peace of mind. The use of Arduino and GSM modules provides a reliable and cost-effective solution for implementing the Smart Stove project.

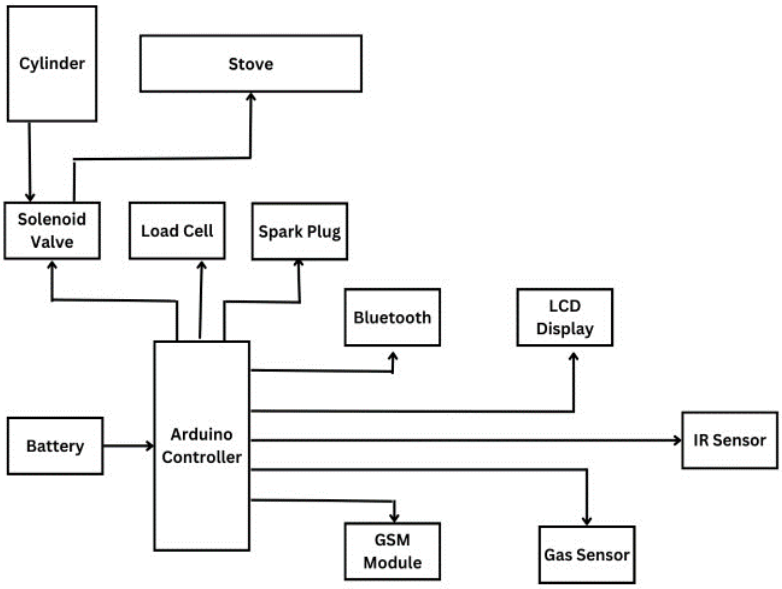

FIGURE 1. Architecture Diagram

Mobile Phone

The mobile phone can be used to control and monitor the stove remotely. The user can use the mobile phone to turn on/off the stove, adjust the temperature, and receive alerts when the stove is not working correctly.

LPG stove

The LPG stove is the main component that provides heat for cooking. The stove needs to be equipped with sensors and controllers to make it smart.

Temperature Sensor

A key element in assuring the user's safety is the temperature sensor employed in the smart cooker concept. It is used to gauge the surface temperature of the stove and alarm the microcontroller if it gets too hot. The temperature sensor is attached to the microcontroller board, which transforms the analog signals from the sensor into digital signals that the microcontroller can read and analyze. The microcontroller board adjusts the stove's heat output to maintain the correct temperature range, avoiding overheating and lowering the possibility of a fire or other accident. The smart stove project's temperature sensor is extremely accurate, dependable, and built to withstand high temperatures, ensuring the stove's security and effective operation.

Arduino Microcontroller

Anyone can easily create interactive electronic devices with the Arduino microcontroller board, which is available as an open-source product. The Arduino board is in charge of integrating the different sensors and actuators required to track and manage the operations of the stove in the context of the smart stove project. The load cell, gas leakage detector, and temperature sensors provide input data to the Arduino board, which then processes the information to produce the desired output. For example, the phone used by the user can receive a signal from the Arduino board to buy a new LPG cylinder if the load cell shows that the cylinder is running low. Similarly, the Arduino board may stop the stove's output if thegas leakage detector detects a gas leak to avoid it.

Gas Detection Sensor

The gas detection sensor used in the smart stove is a crucial safety component. It is intended to identify any gas leaks and notify the user if any are found. The gas detection sensor works on the principle of detecting the presence of LPG gas in the air. It consists of a sensing element and an electronic circuit that detects changes in the concentration of LPG gas. When LPG gas is detected, the resistance of the sensing element changes, and the electronic circuit triggers an alert signal to the Arduino microcontroller. The gas detection sensor is an essential safety feature of the smart stove, ensuring that the user is immediately notified in case of any gas leakage.

Infrared Sensor

The user's presence in close proximity to the stove is detected by the infrared sensor. It can turn off the stove if the user is not near the stove for a specified period.

Air Flow Solenoid Valve

The airflow solenoid valve is used to control the airflow to the stove. It helps to control the stove's heat output and prevent overheating.

Gas Cylinder

The gas cylinder provides fuel for the stove.

Load Cell

The gas cylinder's weight is determined by means of the load cell. When the gas cylinder is running low, it alerts the user.

GSM Module

To transmit warnings and notifications to the user's mobile phone, use the GSM Module

WORKING MECHANISM

- The stove's temperature is measured by the temperature sensor, which then transmits the information to the Arduino microcontroller.
- To modify the heat output, the data is processed by the Arduino Microcontroller, which also operates the airflow solenoid valve.
- The gas detection sensor continuously keeps an eye on the stove's gas leak. Through the GSM module, it notifies the user's mobile phone if there is a gas leak.
- The IR Sensor picks up on the user's presence close to the stove. To avoid any accidents, the cooker can be set to switch off if the user is not close to it for a predetermined amount of time.
- When the gas cylinder is running low, the load cell weighs it and notifies the user through text message on their mobile device.
- The cooking device can be managed by the user using their smartphone. They have the ability to turn the cooking device on and off, control the temperature, and get notifications when something is wrong with the cooking device.

RESULT AND DISCUSSIONS

Safety

The safety features of the smart stove system were tested by simulating emergency situations such as a gas leak or fire. The GSM module successfully sent alerts to the user's smartphone and emergency contacts, ensuring prompt action to prevent any accidents. The Arduino board's automatic turn-off features also worked efficiently, preventing further damage and ensuring safety. These results demonstrate the effectiveness of the smart stove system in enhancing safety in residential and commercial kitchens.

Energy Efficiency

The energy efficiency of the smart stove system was tested by monitoring the stove's energy consumption before as well as after the system was put into place. The outcomes revealed a notable decrease in energy usage due to the stove's optimized temperature control and automatic turn-off feature. These results indicate that the smart stove system can be an effective solution for reducing energy consumption and promoting energy efficiency in households and commercial kitchens.

Convenience

The convenience features of the smart stove system were tested by using the smartphone app to monitor and control the stove remotely. This allowed the user to set the stove's temperature and turn it off from anywhere, making cooking more convenient and hassle-free. These results demonstrate the potential for the smart stove system to improve the convenience of cooking, making it more accessible for individuals with mobility or accessibility issues.

Real-time notification

The Smart Stove project sends an SMS notification to the user's phone in case of gas leakage, overloading, or overheating. This feature ensures that the user is aware of the problem and can take necessary action.

Cost Effective

The use of Arduino and GSM modules provides a cost-effective solution for implementing the Smart Stove project. The cost of the project is relatively low, making it accessible to a wider audience.

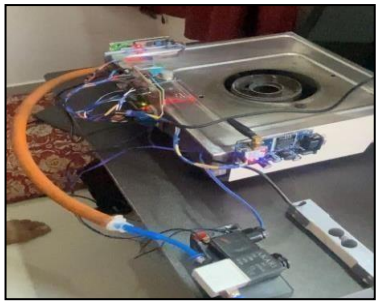

FIGURE 2. Smart Stove

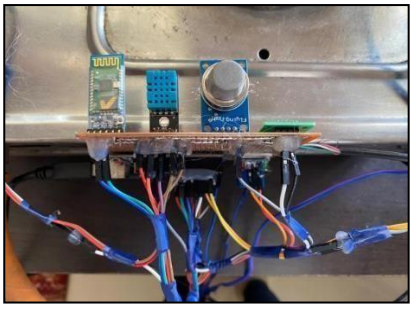

FIGURE 3. Temperature and Gas Sensor and Bluetooth module

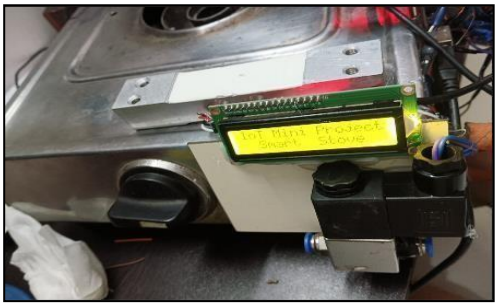

FIGURE 4. LCD, Solenoid Value, and Load Cell

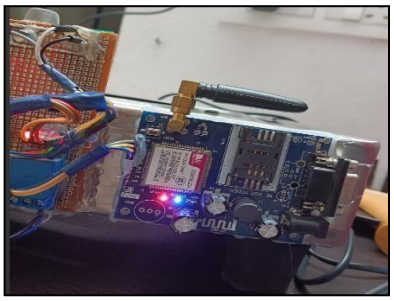

FIGURE 5. GSM Module

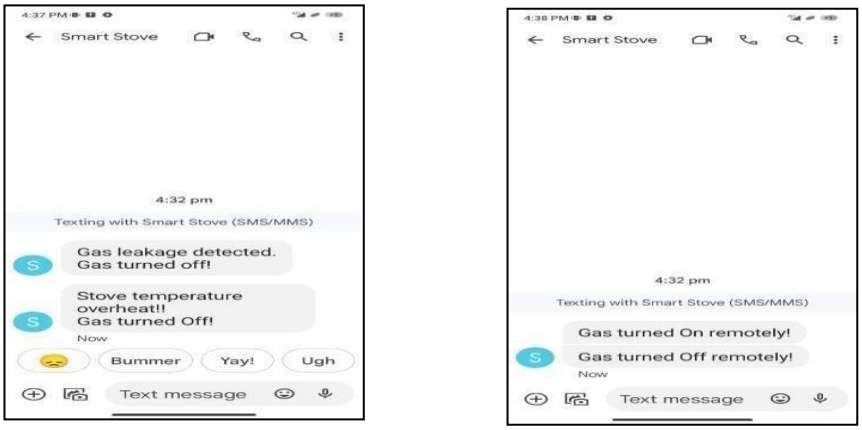

FIGURE 6. Real-Time Notification.

FUTURE ENHANCEMENT

Integration with voice assistant

The integration of voice assistants, such as Alexa or Google Home, would provide an additional level of convenience for the user. The user could control the stove through voice commands, making the cooking process even more effortless.

Machine learning-based gas leak detection

The use of machine learning algorithms could improve the accuracy of gas leak detection. The algorithms could analyze data from multiple sensors and detect patterns that may indicate a gas leak.

Integration with smart home systems

The Smart Stove project could be integrated with other smart home systems, such as smart lighting and HVAC systems. This integration would provide the user with a more comprehensive and seamless smart home experience.

Advanced Temperature Control

The project could incorporate advanced temperature control features, such as precise temperature control for different cooking methods or automatic temperature adjustment based on the type of cookware used.

Integration with a recipe database

The integration of recipe databases could provide users with suggested cooking times and temperatures for various dishes, making cooking even more convenient and hassle-free.

CONCLUSION

This paper proposes a smart stove system that uses IoT, GSM, and Arduino technologies to enhance safety, energy efficiency, and convenience in residential and commercial kitchens. The system was designed to be connected to the internet, allowing remote monitoring and control through a smartphone app. The GSM module sends alerts to the user's smartphone and emergency contacts in case of an emergency, and the Arduino board controls the stove's temperature and monitors gas levels and flame intensity, ensuring safe operation. Additionally, the system can be programmed to automatically turn off the stove in case of an emergency.

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