SafeFlow: Intelligent Gas Safety Monitoring and Management System

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INTRODUCTION

- LPG is widely used for cooking and heating but poses severe risks if mishandled, especially when the regulator is not turned off during leaks.

- Current systems detect leaks but lack efficient automated valve shut-off solutions, while alternatives like exhaust fans are not universally effective and fail to address the root cause.

- The proposed device enhances safety by detecting leaks, automating valve shut-off, and simplifying cylinder management through weight monitoring and automated booking notifications.

SCOPE/OBJECTIVES

The aim of our project is to develop a compact and efficient system that integrates gas leakage detection, automatic valve closure, real-time weight monitoring, and automated booking alerts for enhanced safety and convenience.

LITERATURE REVIEW

Arduino Based LPG gas Monitoring & Automatic Cylinder booking with Alert System

R.Naresh Naik, P.Siva Nagendra Reddy ,S.Nanda Kishore , K.Tharun Kumar Reddy

The paper presents an Arduino-based system designed for LPG safety and convenience. It uses MQ-4 gas sensors to detect leaks, sending SMS alerts via a GSM module while activating alarms and displaying warnings on an LCD. The system also automates cylinder booking by continuously monitoring weight with a load cell, notifying the LPG supplier when the weight falls below a threshold, ensuring timely replacements. Additionally, it integrates temperature monitoring to prevent fire hazards and provides a comprehensive solution to enhance safety and streamline cylinder management.

LITERATURE REVIEW

A Wireless Gas Leakage & Level Detection with Auto Renewal System

S.Sivajothi Kavitha, S. Senthil Kumar

The paper presents a wireless gas leakage and level detection system aimed at household and industrial safety. It uses an MQ-5 sensor to detect changes in LPG or natural gas concentrations, triggering audiovisual alarms and sending alerts via GSM/GPRS when thresholds are exceeded. The system also includes a load sensor to monitor LPG cylinder levels, automatically booking replacements when the gas is nearly depleted. An ARM processor manages data from the sensors, calibrates readings, and controls alarms and notifications. This integrated approach enhances safety, reduces manual effort, and ensures timely responses to gas leaks or low cylinder levels.

LITERATURE REVIEW

Gas Leakage Detection & Fail Safe Control for Gas Fueled Combustion Engine

United States Patent and Trademark Office (USPTO),October 22, 2002,US 6,467,466 B1

This patent introduces a system to detect gas leaks in engines that use gas as fuel. It works by measuring the gas pressure when the engine is turned off and the valves are closed. Normally, the pressure should stay the same, but if it drops more than expected, it indicates a leak. For smaller leaks that might not be noticeable immediately, the system monitors the pressure over time and adds up the small changes to identify a leak. If a leak is detected, the system automatically shuts off the gas supply to prevent further leakage and alerts the user with a warning. This ensures the engine is safer to use and helps prevent accidents caused by gas leaks.

LITERATURE REVIEW

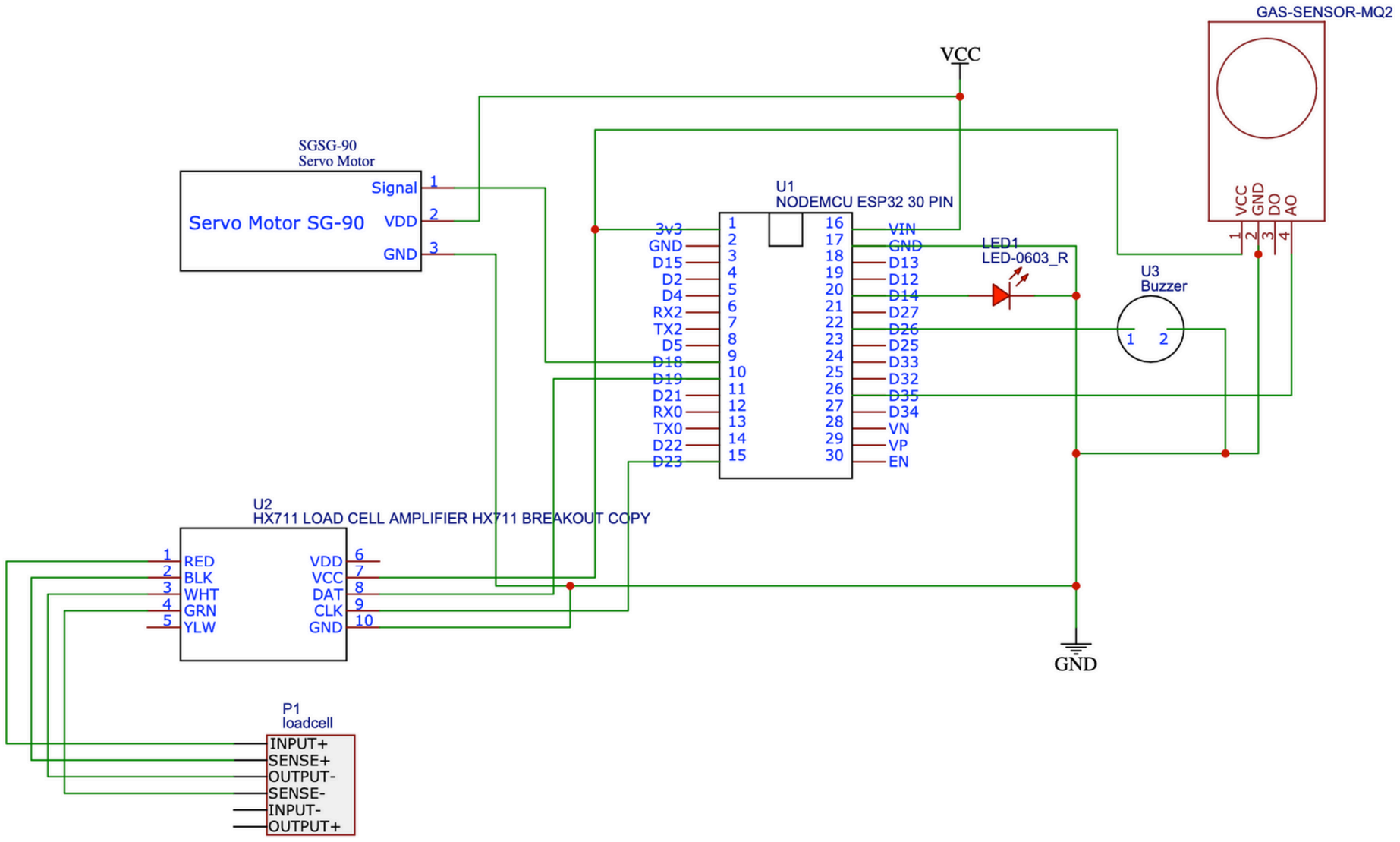
"Smart Gas Level Monitoring, Booking & Gas Leakage Detector over IoT
2017 IEEE 7th International Advance Computing Conference (IACC), Hyderabad, India, pp. 330-332, 2017.

This study focuses on addressing the common issue of gas containers running out unexpectedly. An IoT-based system is proposed to monitor the gas weight continuously and automate gas booking. The system integrates a load cell with a microcontroller to measure weight and compares it with a predefined ideal value. For convenience, RF transmitter and receiver modules are included to relay information. To enhance security, the system employs an MQ-2 gas sensor and an LM35 temperature sensor to detect environmental changes, ensuring both safety and reliability. Any significant variation in sensor readings triggers a 60 dB siren for immediate alert.

LITERATURE REVIEW

Ref	Leakage Detection	Control Gas Flow	Alarm/Buzzer	SMS/Call	Weight Monitor	Gas Booking
[1] IOT-Based Fuel Gas Safety Control System	Yes	Yes	Yes	No	No	No
[2] Intelligent Gas Meter of Internet of Things based on WIFI (Wireless Fidelity) Technology	Yes	No	Yes	No	No	No
[2] Gas Leakage Detection and Fail-Safe Control Method for Gas Fuel Internal Combustion Engine and Apparatus for Implementing the Same	No	No	No	No	Yes	No
[3] Product Available- B24IoT	No	Yes	Yes	No	Yes	No
[4] Smart Gas Level Monitoring, Booking & Gas Leakage Detector over IoT, *2017 IEEE 7th International Advance Computing Conference (IACC)*	Yes	No	Yes	No	No	No
[5] Arduino Based LPG gas Monitoring & Automatic Cylinder Booking with Alert System	Yes	Yes	Yes	No	No	No

SAMPLE CIRCUIT DIAGRAM



METHODOLOGY

Objective Definition

- Objective: Detect gas leakage, measure weight, and control a servo motor.
- Components: ESP32 (NodeMCU), MQ2 gas sensor, HX711 load cell amplifier, SG90 servo motor, LED, and buzzer.
- Power Supply: Ensure a reliable power source compatible with ESP32 and connected modules.
- Specifications: Define measurable thresholds for gas leakage detection and load-cell calibration.

METHODOLOGY

Hardware

- Circuit Verification: Confirm connections in the schematic:
- MQ2 sensor outputs analog/digital signals to ESP32.
- HX711 connects to the load cell and communicates with ESP32 via I2C or other supported protocols.
- Servo motor and LED are controlled through GPIO pins.
- Buzzer activation aligns with the gas detection logic.
- Power Management: Check voltage levels for all modules (e.g., MQ2 needs 5V, HX711 operates with 3.3–5V).
- Prototyping Platform: Use a breadboard for initial assembly before soldering onto a PCB.

METHODOLOGY

Software

- Development Environment: Using Arduino IDE or ESP-IDF for coding.
- Libraries: Install and configure:
- MQ2 sensor library for gas detection.
- HX711 library for weight measurement.
- Servo.h for motor control.
- buzzer and LED libraries .

METHODOLOGY

Hardware Implementation

- Assemble all components on a PCB or breadboard as per the schematic.
- Test connections for stability and performance.

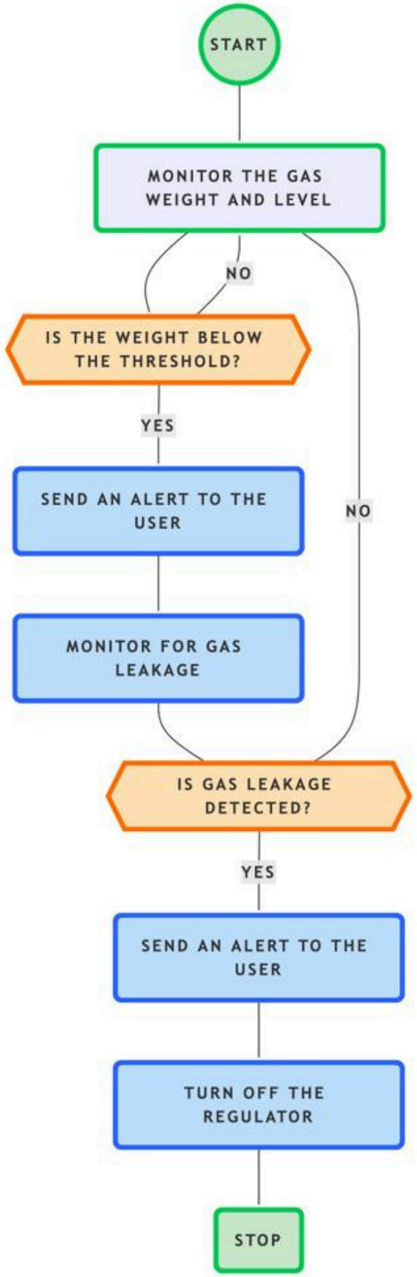
System Testing

- Test with various gas concentrations to verify the MQ2 sensor's accuracy.
- Ensure all alerts (LEDs, buzzer) activate properly upon gas detection.

WORKING

This circuit involves multiple components connected to an ESP32 microcontroller to create a system with gas sensing, load measurement, and actuation. The MQ2 gas sensor detects the presence of combustible gases and sends an analog signal to the ESP32 for monitoring. The HX711 load cell amplifier, interfaced with a load cell, measures weight or force, transmitting data to the ESP32 via digital communication. A servo motor (SG90) can be controlled through PWM signals from the ESP32 to perform physical movements, such as opening or closing a mechanism. Additionally, an LED and a buzzer provide visual and auditory alerts based on the system's logic, such as threshold breaches for gas concentration or load. The ESP32 acts as the central controller, processing data and executing actions based on preprogrammed conditions. The system could be used in applications like gas-leak detection combined with automated responses.

BLOCK DIAGRAM



TIME PLAN

- Start hardware assembly: Next month.
- Complete Testing and validationn: January.
- Finish hardware and paper by February

WORK DONE BY EACH MEMBERS

- Ambadi - Circuit Diagram and ppt
- Sreehari – Paper reference and literature study
- Akash – Paper reference and literature study

REFERNCES

[1] “IOT-Based Fuel Gas Safety Control System,” Patents No- CN203287793U, China, pp. 1-6, 2013. [Publisher Link]

[2] “Intelligent Gas Meter of Internet of Things based on WIFI (Wireless Fidelity) Technology,” Patent No- CN202615503U, China, pp. 1-6, 2012. [Publisher Link]

[3] “Gas Leakage Detection and Fail-Safe Control Method for Gas Fueled Internal Combustion Engine and Apparatus for Implementing the Same,” Patent No- US6467466B1, United States, pp. 1-15, 2000. [Publisher Link]

[4] Product Available- B24IoT. [Online]. Available: https://www.b24iot.com/

[5] Kumar Keshamoni, and Sabbani Hemanth, “Smart Gas Level Monitoring, Booking & Gas Leakage Detector over IoT,” 2017 IEEE 7th International Advance Computing Conference (IACC), Hyderabad, India, pp. 330-332, 2017. [CrossRef] [Google Scholar] [Publisher Link]

[6] R. Naresh Naik et al., “Arduino Based LPG gas Monitoring & Automatic Cylinder Booking with Alert System,” IOSR Journal of
Electronics and Communication Engineering, vol. 11, no. 4, pp. 6-12, 2016. [CrossRef] [Google Scholar] [Publisher Link]

THANK YOU