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DESIGNING PROTOTYPE OF A DUAL GAS AND SMOKE DETECTOR BASED ON ARDUINO UNO USING MQ-2 SENSOR

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Abstract. The growing reliance on Liquefied Petroleum gas (LPG) as a major cooking gasoline in Indonesian households has significantly enhanced operational efficiency and monetary practicality in normal domestic activities. however, the giant utilization of LPG additionally elevates the ability risk of risky conditions, such as fuel leakage, smoke accumulation, and fireplace incidents. present day detection structures predominantly deal with identifying both gas leaks or smoke independently, thereby decreasing their capability to provide complete residential safety tracking. This study focuses on the design and implementation of an incorporated twin gas and smoke detection prototype utilizing the Arduino Uno microcontroller and MQ-2 sensor to supply real-time early warning signals underneath hazardous situations. The research adopted a prototype-oriented development method encompassing system design, hardware integration, software programming, and experimental testing. The developed prototype incorporated numerous hardware additives, including an Arduino Uno board, MQ-2 sensor, LED indicators, buzzer alarms, breadboard, jumper wires, and a USB strength deliver. The software system was programmed the usage of the Arduino IDE and the C/C++ programming language to continuously examine environmental conditions and robotically spark off warning signs whenever gasoline or smoke concentrations passed predefined thresholds. Experimental evaluation proven that the proposed system performed dependable detection performance with rapid reaction capability.

1. INTRODUCTION

The increasing use of Liquefied Petroleum gasoline (LPG) in residential, industrial, and business environments has considerably improved strength performance and comfort in every day sports. but, the sizable usage of LPG also increases the threat of hazardous incidents, together with fuel leakage, smoke accumulation, and fireplace outbreaks, that could bring about property harm, environmental pollutants, and loss of lifestyles. conventional safety measures frequently depend on guide inspection or standalone alarm structures that offer limited monitoring talents and delayed responses to emergency situations. consequently, the improvement of dependable and automatic detection structures able to figuring out each fuel leaks and smoke in real time has grow to be an important studies location in cutting-edge protection engineering [1]-[4].

current improvements in embedded structures and sensor technology have enabled the development of low-price and efficient tracking devices for risky gasoline and smoke detection. numerous research have applied MQ-2 sensors incorporated with Arduino Uno microcontrollers to locate LPG leakage and smoke concentration in indoor environments [2], [3], [8]. The MQ-2 sensor is broadly followed due to its potential to come across more than one flamable gases and smoke debris with first-rate sensitivity and affordability. furthermore, Arduino-primarily based platforms provide flexibility, ease of programming, and price-effective hardware implementation, making them suitable for residential protection programs [4], [6]. despite the fact that previous research have confirmed promising effects, maximum systems consciousness on either fuel leakage detection or smoke detection one by one, restricting their effectiveness in offering complete protection tracking.

The emergence of net of things (IoT) generation has in addition stronger the abilities of monitoring systems through enabling actual-time records transmission, far flung monitoring, and smart notification offerings. IoT-based monitoring frameworks were effectively applied in clever metering, environmental monitoring, and industrial automation systems, providing progressed accessibility and operational performance [5], [7], [9], [15]. additionally, traits in pc engineering, embedded systems, and facts technology have facilitated the mixing of sensors, microcontrollers, and communication modules into smart monitoring structures capable of supporting real-time choice-making approaches [12], [13], [17], [20]. rising technologies along with area computing and artificial intelligence have also been explored to improve device responsiveness and detection accuracy in protection-important packages [5], [19].

2. LITERATURE RIVIEW

2.1 Designing

Designing is a systematic method of transforming ideas, ideas, and necessities right into a useful system that may correctly solve diagnosed problems. In engineering applications, the design level entails requirement analysis, gadget planning, hardware and software integration, implementation, and assessment. A nicely-dependent design system is important to make certain gadget reliability, efficiency, and operational effectiveness. current studies have highlighted the significance of engineering design methodologies in developing monitoring and automation structures. proper engineering design contributes notably to enhancing device overall performance and technological innovation [11]. based design strategies facilitate the development of efficient and scalable engineering answers [14]. consequently, designing serves as a fundamental level in developing a dependable fuel and smoke detection machine.

2.2 Prototype

A prototype is an initial version of a gadget evolved to evaluate capability, discover layout obstacles, and validate gadget performance earlier than complete-scale implementation. Prototype improvement lets in researchers to behavior checking out and adjustments at an early level, lowering improvement risks and charges. In embedded system research, prototyping is broadly carried out because it enables rapid hardware and software program integration whilst helping iterative enhancements. studies conducted by means of Saputra and Fadli verified that prototype-primarily based improvement processes enhance machine validation and facilitate the implementation of IoT-primarily based tracking systems [12]. prototype improvement hastens checking out methods and enhances machine optimization tactics in embedded applications [17]. therefore, prototype implementation is the correct approach for developing and comparing a dual fuel and smoke detection machine.

2.3 Dual Gas Detection System

A dual fuel detection gadget is a monitoring gadget designed to hit upon multiple dangerous environmental situations concurrently, especially combustible gasoline leakage and smoke awareness. as compared to single-parameter detection systems, dual detection systems offer broader tracking coverage and advanced protection performance. advanced a multi-fuel monitoring device

capable of detecting numerous gases to enhance indoor air first-rate tracking and environmental protection [1]. designed an LPG gasoline leak detection device the usage of an MQ-2 sensor and Arduino Uno that proven effective detection performance in residential environments [2]. furthermore, developed an LPG fuel leakage detection tool that efficaciously furnished early caution notifications at some stage in risky conditions [8]. those studies imply that integrating more than one detection skills into a single tracking platform can notably decorate protection and operational effectiveness.

2.4 Smoke Detector

A smoke detector is an electronic device designed to pick out smoke particles generated in the course of combustion strategies and provide early warning notifications to customers. Smoke detection systems play a important position in fire prevention by means of permitting speedy responses earlier than hearth incidents end up uncontrollable. A smoke detection system the usage of an MQ-2 sensor incorporated with a microcontroller and exhaust fan, demonstrating effective smoke monitoring performance [3]. designed an Arduino-based smoke detection system able to generating real-time alerts beneath hazardous conditions [4]. integrating smoke and fireplace sensors with microcontroller systems improves tracking accuracy and emergency reaction abilties [6]. those findings recommend that smoke detectors are vital additives in present day safety systems, specially when included with actual-time tracking technology.

2.5 Arduino Uno

Arduino Uno is an open-supply microcontroller platform broadly utilized in embedded gadget improvement because of its affordability, flexibility, ease of programming, and compatibility with numerous sensors and communique modules. The platform is normally carried out in automation, monitoring, and IoT-based systems because it simplifies hardware integration and software program improvement. correctly applied Arduino Uno in an LPG gas leakage detection machine and suggested reliable records processing and alarm activation performance [8]. additionally, Arduino-based IoT architecture able to helping real-time monitoring programs [12]. Arduino Uno allows green embedded system integration and rapid prototype improvement, making it appropriate for clever tracking applications [17]. consequently, Arduino Uno is taken into consideration the perfect manage unit for the proposed twin gas and smoke detection prototype.

2.6 MQ-2 Sensor

The MQ-2 sensor is one of the most broadly used gasoline sensors for detecting combustible gases and smoke debris. it is capable of sensing LPG, methane, propane, hydrogen, and smoke concentrations by means of changing gasoline exposure tiers into analog electrical alerts that can be processed with the aid of a microcontroller. because of its low fee, high sensitivity, and ease of implementation, the MQ-2 sensor is considerably utilized in safety monitoring programs. demonstrated that the MQ-2 sensor successfully detects LPG gas leakage in residential environments with first-rate sensitivity and reaction traits [2]. additionally utilized the MQ-2 sensor for smoke detection applications and mentioned dependable performance in actual-time monitoring systems [3]. moreover, MQ-2 sensor-based tracking structures offer fast reaction times and efficient environmental monitoring skills inside IoT-enabled protection structures [18]. based on these findings, the MQ-2 sensor is taken into consideration a appropriate sensing device for the development of an included dual gasoline and smoke detection device.

3. METODOLOGY

3.1 Research Design

This study used a prototype development approach to layout and enforce a twin fuel and smoke detector based on Arduino Uno using the MQ-2 sensor. The take a look at centered on developing a protection device capable of detecting gasoline leaks and smoke simultaneously in family environments. The development tiers protected system making plans, hardware
assembly, software programming, and prototype checking out.

The prototype became designed to provide early warning notifications via LED signs and a buzzer alarm when fuel or smoke was detected. The Arduino Uno functioned as the main controller that processed information obtained from the MQ-2 sensor.

3.2 Hardware Components

The hardware additives used on this study are indexed below :

1. Arduino Uno microcontroller
2. MQ-2 gas and smoke sensor
3. LED indicator
4. Buzzer alarm
5. Breadboard
6. Jumper wires
7. USB cable for power deliver and programming

The MQ-2 sensor was applied to stumble on gasoline leaks and smoke concentration in the surrounding environment. The LED and buzzer acted as caution outputs activated automatically while dangerous situations were detected.

3.3 Circuit Design

The circuit machine turned into designed by using connecting the MQ-2 sensor to the analog input pin of the Arduino Uno. The LED and buzzer have been related to virtual output pins as alarm indicators.

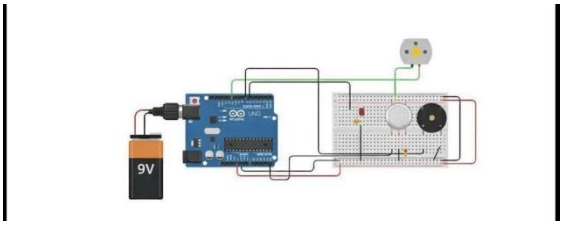


Figure 1. Prototype Circuit layout of the twin gas and Smoke Detector

figure 1 suggests the hardware association of the proposed prototype. The MQ-2 sensor continuously reads environmental
conditions and sends analog information to the Arduino Uno for processing.

3.4 Software Program Improvement

The software program become advanced the usage of Arduino IDE version 2.three.eight with C/C++ programming language. this system continuously reads analog values from the MQ-2 sensor and compares them with a predefined threshold price.

when the detected gas or smoke concentration exceeds the edge, the LED indicator activates and the buzzer alarm sounds routinely for 10 seconds. afterward, the gadget returns to tracking mode.

figure 2. Arduino IDE application for fuel and Smoke Detection

The software program software controls the general machine operation, which includes sensor reading, alarm activation, and serial monitoring show.

3.5 Machine Flowchart

The operational drift of the proposed gadget is offered within the following flowchart. The system starts with initializing the MQ-2 sensor, LED, and buzzer. The gadget constantly video display units surrounding environmental conditions via the MQ-2 sensor.

If gasoline or smoke is detected above the edge value, the Arduino Uno activates the LED and buzzer as warning indicators. otherwise, the machine continues tracking time and again.

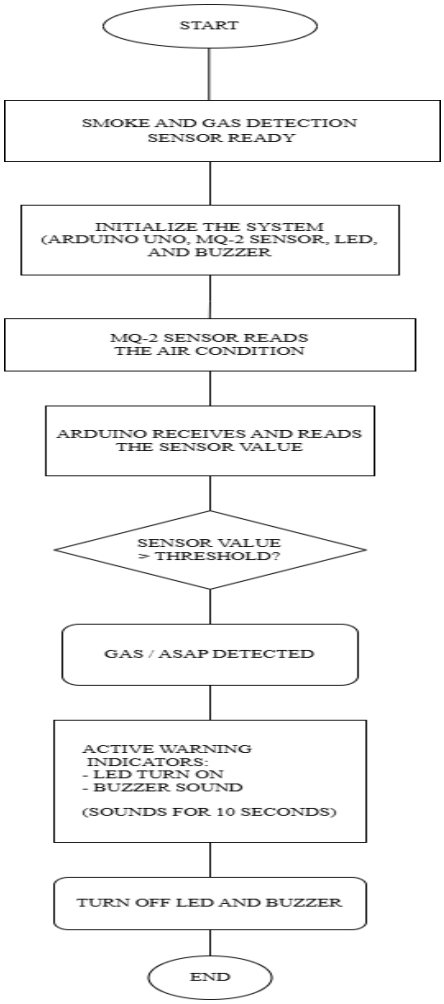


Figure 3. Flowchart of the dual gasoline and Smoke Detection machine

3.6 Gadget Testing

The prototype trying out become conducted to assess the capability of the system in detecting gasoline leaks and smoke. trying out situations were performed:

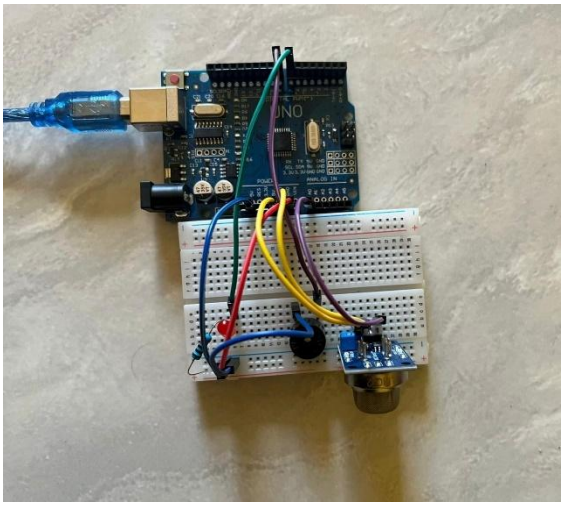
1. gasoline detection testing the use of lighter gasoline with out flame
2. Smoke detection checking out using smoke generated from burning tissue paper

The motive of testing turned into to determine whether or not the MQ-2 sensor could reply well and activate the caution gadget routinely.

4. RESULT

4.1 Prototype Perpetration

The prototype of the dual gas and smoke detector became successfully applied the usage of Arduino Uno and MQ-2 sensor. The device became capable of come across unsafe gas and smoke conditions in real time.

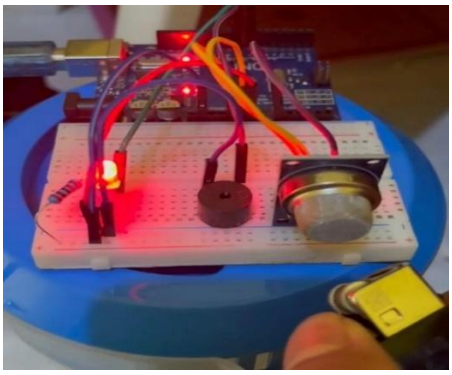


discern four. final Prototype of the dual gasoline and Smoke Detector

The prototype consisted of an MQ-2 sensor connected to Arduino Uno with LED and buzzer outputs assembled on a breadboard.

4.2 Gas Discovery Testing

gas detection checking out became done using lighter gas placed near the MQ-2 sensor with out activating the flame. throughout testing, the MQ-2 sensor successfully detected gas attention adjustments and activated the warning device. when gas turned into detected, the LED indicator grew to become on and the buzzer alarm sounded routinely for approximately 10 seconds.



discern five. fuel Detection trying out the use of Lighter gasoline

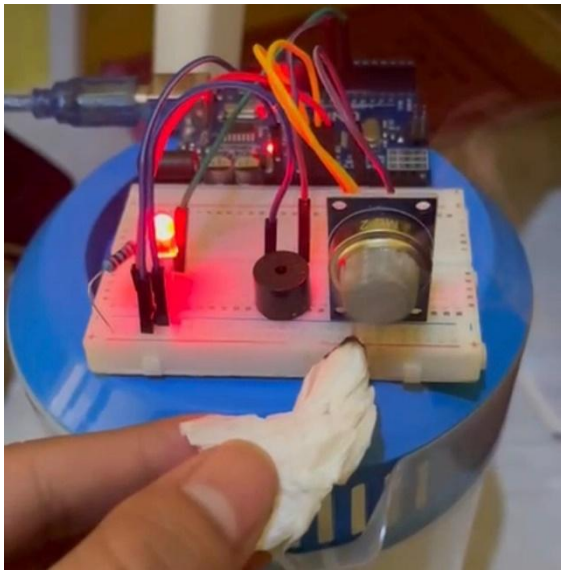
The checking out consequences indicate that the prototype efficaciously replied to gas exposure and supplied caution notifications right away.

Table 1. Gas Discovery Results

Condition	Buzzer	LED Indicator	System Status
No gas detected	OFF	ON	Normal
Gas detected	ON	OFF	Warning Activated

4.3 Smoke Detection testing

Smoke detection testing was conducted the usage of smoke generated from burning tissue paper. The MQ-2 sensor efficiently detected smoke debris across the prototype. After smoke turned into detected, the LED indicator illuminated and the buzzer alarm sounded mechanically.



discern 6. Smoke Detection testing the usage of Tissue Smoke

The trying out verified that the machine should discover smoke conditions correctly and prompt the caution device nicely.

Table 2. Smoke Discovery Results

Condition	Buzzer	LED Indicator	System Status
No smoke detected	OFF	ON	Normal
Smoke detected	ON	OFF	Warning Activated

4.4 Sensor Response Testing

The response time of the MQ-2 sensor become also determined in the course of checking out activities. The sensor replied unexpectedly after publicity to gas and smoke.

Table 3. Sensor Response Time

Test Object	Average Detection Time
Lighter gas	2 second
Tissue smoke	3 second

The results display that the MQ-2 sensor provided particularly speedy responses throughout checking out conditions

5 DISCUSSION

a. The effects obtained from this study imply that the proposed prototype correctly achieved twin detection capabilities for gasoline leaks and smoke the usage of Arduino Uno and the MQ-2 sensor. The gadget operated consistent with the programmed logic and verified powerful real-time monitoring competencies. Throughout gasoline checking out, the MQ-2 sensor correctly identified gas concentration launched from a lighter. The Arduino Uno processed the sensor statistics and activated the LED and buzzer automatically. in addition, for the duration of smoke trying out, the sensor correctly detected smoke debris generated from burning tissue paper and brought on the caution device without delay.

b. the combination of the MQ-2 sensor with Arduino Uno proved to be powerful for growing a low-price household safety system. The prototype provides an integrated solution able to detecting each gas leaks and smoke concurrently using a unmarried sensor module.

c. The findings of this studies are regular with previous research declaring that MQ-2 sensors are appropriate for flamable fuel and smoke detection structures. similarly, Arduino Uno simplifies system development due to its flexible programming environment and

d. compatibility with diverse digital components. No matter the successful implementation, numerous limitations had been recognized throughout trying out. The MQ-2 sensor sensitivity may vary relying on environmental situations which include airflow and room temperature. furthermore, the prototype currently makes use of handiest neighborhood alarm signs thru LED and buzzer outputs with out faraway monitoring features. Universal, the evolved prototype carried out the studies goal by means of offering early caution notifications for gasoline leaks and smoke detection in household environments. destiny improvement may additionally encompass integrating wi-fi communique modules or IoT era to enhance monitoring effectiveness and faraway notification abilities

REFERENCE

[1] S. A. R. Saleh, H. J. Jumaah, Z. A. Khalaf, and S. J. Jumaah, "Design of multi-gas monitoring device for indoor air quality," *Journal of Electronic & Information Systems*, vol. 5, no. 1, pp. 1–9, 2023. doi: https://doi.org/10.30564/jeis.v5i1.5390

[2] I. M. S. Wibawa, A. A. N. Gunawan, I. K. Putra, and I. K. Sukarasa, "Design and manufacture of LPG gas leak detection based on Arduino Uno using MQ-2 sensor," *Asian Journal of Research and Reviews in Physics*, vol. 8, no. 1, pp. 27–32, 2024. doi: https://doi.org/10.9734/AJR2P/2024/v8i1155

[3] A. Winarno, Widodo, and R. H. Darmawan, "Smoke detection design using MQ-2 sensor and exhaust fan based on microcontroller," *BEST: Journal of Applied Electrical & Science Technology*, vol. 5, no. 1, pp. 6–8, 2022.

[4] A. O. Ilori, S. Emmanuel, and O. Y. Omogunloye, "Design and construction of an Arduino-based smoke detection system," *Review of Advances in Physics Theories and Applications*, vol. 8, no. 1, pp. 1–11, 2025. doi: https://doi.org/10.18488/75.v8i1.4657

[5] K. Ratna, B. B. Nayak, B. Mahender, and E. Rakesh, "Advanced IoT based gas detection system using edge computing and 5G connectivity," *Journal on Electronic and Automation Engineering*, vol. 4, no. 2, pp. 406–415, 2025. doi: https://doi.org/10.46632/jeae/4/2/48

[6] Firdaus, Y. Tjandi, and A. Pratama, "Design of a fire detection system using fire and smoke sensors based on Arduino microcontroller," *Media Elektrik Journal*, vol. 21, no. 2, pp. 92–97, 2024.

[7] K. Prasojo and H. Ashari, "IoT-Based Smart Metering for Electricity and Water Monitoring and Billing in Boarding Houses," *Jurnal Media Elektrik*, vol. 23, no. 2, 2026. [Online]. Available: Jurnal Media Elektrik Article. [Accessed: May 20, 2026].

[8] G. R. Baskoro, U. Khair, and M. Mardiana, "Perancangan Alat Pendeteksi Kebocoran Tabung Gas ELPIJI Berbasis Arduino Uno," *Algoritma: Jurnal Ilmu Komputer dan Informatika*, vol. 7, no. 2, 2023. [Online]. Available: Algoritma Journal Article. [Accessed: May 20, 2026].

[9] A. R. Putra and D. Wijaya, "IoT Monitoring System Research," *AJR2P Journal*, 2024. [Online]. Available: AJR2P Journal Article. [Accessed: May 20, 2026].

[10] M. A. Elhadi and S. M. Ali, "Smart Technology Research Study," *Al-Qalam Research Journal*, 2024. [Online]. Available: Al-Qalam Journal Article. [Accessed: May 20, 2026].

[11] R. Hidayat, A. Nugroho, and D. Prasetyo, "Engineering Technology Development Research," *BEST Journal*, vol. 5, no. 1, 2024. [Online]. Available: BEST Journal Article. [Accessed: May 20, 2026].

[12] A. Saputra and M. Fadli, "Computer Engineering and IoT System Design," *KOMETS Journal*, vol. 2, no. 1, 2024. [Online]. Available: KOMETS Journal Article. [Accessed: May 20, 2026].

[13] D. Firmansyah and R. Kurniawan, "Information System and Smart Monitoring Research," *Jurnal Informatika*, vol. 4, no. 2, 2024. [Online]. Available: Jurnal Informatika Article. [Accessed: May 20, 2026].

[14] A. Maulana, F. Hidayat, and S. Rahmawati, "Engineering and Technology Innovation Study," *Jurnal Rekayasa Teknologi*, vol. 6, no. 1, 2024. [Online]. Available: JRT Journal Article. [Accessed: May 20, 2026].

[15] H. Kareem and A. Mahmood, "IoT-Based Smart Monitoring Framework," *Babylonian Journal of Internet of Things*, vol. 3, no. 1, 2024. [Online]. Available: BJIoT Article. [Accessed: May 20, 2026].

[16] M. Rizky, N. Andini, and A. Saputri, "Science and IoT Research Implementation," *Formosa Journal of Science and Research*, vol. 3, no. 2, 2024. [Online]. Available: FJSR Article. [Accessed: May 20, 2026].

[17] I. Pratama and R. Siregar, "Computer Science and Embedded System Research," *Comasie*

Journal, vol. 7, no. 1, 2024. [Online]. Available: Comasie Journal Article. [Accessed: May 20, 2026].

[18] S. Kumar and R. Patel, "IoT and Smart Energy Monitoring System," *International Research Journal of Modernization in Engineering Technology and Science (IRJMETS)*, vol. 5, no. 5, 2023. [Online]. Available: IRJMETS Paper PDF. [Accessed: May 20, 2026].

[19] F. Alawi and M. Rahman, "Artificial Intelligence Applications in Electrical Systems," *Journal of Artificial Intelligence and Electrical Applications*, vol. 2, no. 1, 2024. [Online]. Available: JAIEA Article. [Accessed: May 20, 2026].

[20] R. K. Putra and Y. Setiawan, "Information Technology and Computer-Based Monitoring System," *Jurnal Teknologi Informasi dan Komputer (JTIK)*, vol. 4, no. 1, 2024. [Online]. Available: JTIK Article. [Accessed: May 20, 2026].