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Design and Development of LPG Monitoring and Leakage Detection System

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Abstract: *This study focuses the design and developed of an LPG Monitoring and Leakage Detection System, with the goal of enhancing safety in areas where LPG is utilized by identifying gas leaks and monitoring gas levels in real time. The project employs an Arduino-based sensor system to automate the detection of gas leaks, emphasizing functionality, durability, and safety. The proposed system is assessed for its effectiveness in providing early warnings to avert potential accidents, fires, or health hazards linked to LPG leaks. The system was tested by 30 participants who regularly used LPG for cooking and possessed basic electronics knowledge, enabling them to evaluate the project's materials, functionality, and operation. The results indicated that the system is highly effective in detecting LPG and other combustible gases, which can pose significant safety risks. The device includes a display that indicates the amount of gas detected and the concentration percentage, offering real-time data on gas levels. In the event of a gas leak, the system activates a buzzer to alert users immediately, thereby minimizing the risk of accidents.*

Keywords: Gas leakage, Gas Sensor, Arduino Microcontroller, HX711 Amplifier, Loadcell

I. INTRODUCTION

Liquefied petroleum gas (LPG) is among the frequently utilized conventional fuels for household applications. In many nations, LPG is the primary fuel for cooking due to its affordability, practicality, or preference. Besides, LPG is crucial in life of many Filipinos as it is classified as a basic necessity. In fact, according to the most recent data from the Philippine Statistics Authority, about 40% of Filipino households, or over 8 million, use LPG for cooking. This indicates that 4 out of 10 homes rely on LPG on a daily basis.

However, this rise in the use of LPG has resulted in a higher frequency of incidents involving gas leaks and gas cylinder explosions, which frequently result in fatalities (AI Obi, SO Idoko et al. 2020). That is the main reason why the use of LPG gas is limited due to the drawbacks and hazards that it yields. One of those common hazards that occur with the residential and commercial consumers are the running out of gas tank and the safety that it yields. Most of the factors that causes of this drawback are the improper management and tank leakage. Hence, the solution for this drawback is the proper monitoring system and level indicator device for LPG that will help avoid inconvenience of running out of a gas unexpectedly and provide safety to the consumers.

This device is particularly important for households and businesses that rely on LPG for cooking. In a reason that, it provides users with a convenient and reliable way to monitor the amount of liquefied petroleum gas (LPG) and allows them to plan their usage effectively and avoid running out of gas unexpectedly. With this kind of monitoring and protection system for the LPG, users can easily check the gas level and refill their cylinder or tank in a timely manner, ensuring that they have enough gas to meet their cooking needs. Yet, the device can also yield a safety to the consumers whilecooking.

II. REVIEW OF LITERATURE

LPG (liquefied petroleum gas) is a commonly used fuel source worldwide, especially for cooking and heating purposes. One important aspect of using LPG is knowing the level of gas remaining in the cylinder, as it helps users plan their usage and avoid unexpected gas shortages. To address this need, we come up with this study to design and develop

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LPG gas monitoring and protection system. Where in this section, we researcher gathered some relevant data and research papers that will help us to build this study.

In a study presented by V. Tamizharasan et al. (2019) they implemented an IoT technology for monitoring the propane content in household LPG cylinders, automated cylinder booking. The project aimed to meet the problem of determining the capacity of LPG cylinders by measuring the level of LPG, with a load sensor, SEN-10245, connected to an Arduino R3. In addition, IoT integration lets users be alerted on their mobile phones if the LPG level is critically low, below 20%. This system would make it easier to streamline the booking processes, prevent accidents from gas leaks, and give users real-time information about the usage of LPG.

Another approach, H.A. Bany Salameh et al. (2021) where in they fully integrated wireless sensor network (WSN) system for the early warning gas leakage detection and monitoring application is proposed, using the IoT features. It integrates hardware and software elements for the improvement of the network. A system that can operate in single- and multihop modes, to adapt to different radio frequency environments and network topologies, is designed for the detection/monitoring of LPG in residential areas and factories by collecting, analyzing, and transmitting data wirelessly to a monitoring center for taking appropriate action. An efficient communication protocol is implemented that ensures reliable data exchange among network nodes, enhancing overall system reliability and effectiveness.

Furthermore, a research paper by P Anudrahaet al.(2020), who developed real-time updates on gas leakages through IoT communication are provided to a web browser for continuous data monitoring by the users. A LED connected to an Arduino microcontroller is used by the system. Once there is a gaseous substance in the air it activates a LED and an IoT module (ESP8266) that relays information through Wi-Fi and onto web. The IoT module communicates with the website indicating "leak" when gas is detected. This system can be installed in various places such as homes, hotels, and areas where LPG has stored so that leaks can be detected promptly for necessary remedial actions to take place before any catastrophe or damage can occur.

Yet, several research studies have focused on developing and evaluating LPG gas level indicator systems. These technologies, including wireless sensor-based systems, IoT-based indicators, machine learning-based approaches, and RFID-based solutions, have demonstrated their effectiveness in providing accurate and real-time gas level information. By implementing these advancements, users can better manage their LPG consumption, safety and ensure uninterrupted supply of gas for their everyday needs.

So as we gathered this data we evaluate and propose in this study to use an Arduino Uno as a microcontroller in LPG gas level monitoring and protection system. The system utilized load cell to accurately measure the gas level and transmit the data to a central monitoring unit. It provided real-time and accurate gas level information, enabling users to monitor their gas consumption effectively. As well as it uses MQ-6 gas sensor to detect any gas leakage during cooking. Yet, to notify the user for the gas leakage and running out of gas we utilize a buzzer.

III. CONCEPTUAL FRAMEWORK

Material inputs in innovating the device is carefully planned, designed, constructed, tested and evaluated in order to achieve efficiency of the innovation.

Figure 1: Conceptual Model of the Study

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Figure 1 shows the study's conceptual framework. The study's flow is depicted in the figure. First box represents the input of the study. This entails the first step in developing all the concepts to materialize the project. It also implicates on how the proposed project being weighed.

The second box entails the designing and fabrication of the project. This area discusses the whole design of the project, its diagram, and the connection point. Base on the materials gathered fabrication stage will follow by following the procedural design of the project. Hence, the third box complies the output of the device. It is understood that in this stage the device is now on its completion and undergo already series of testing.

To obtain a successful study prototyping is a crucial step in this project development process as it allows for testing and refining ideas before implementation. It helps identify potential issues and challenges early on, reducing the risk of costly mistakes later. Additionally, prototyping promotes innovation and creativity by encouraging experimentation and exploration of different design possibilities. Besides, prototyping can significantly improve project outcomes by enhancing understanding, reducing uncertainties, and increasing the likelihood of project success.

Objectives of the Study

The main goal of this study is to develop and evaluate a gas monitoring system with gas leakage detector to enhance safety, convenience, and efficiency. Specifically, this study aims to achieve the following objectives:

1. To established the design of the innovated LPG level monitoring and gas leakage detection system.

In terms of :

1.1 Technical adjustment

1.2 Costing

2. To develop the device based on the established procedures.

3. To evaluate the perception of the device.

In terms of:

3.1 Functionality

3.2 Applicability

3.3 Durability

3.4 Safety

4. Scientific data on the accurateness of the device.

5. To develop user's manual.

Significance of the Study

This research project shall be valuable to the following individuals:

- **Residential Consumers**. This study will enable consumers to have a cost-effective and efficient solution for monitoring the gas level in their homes, apartments, and condominiums.
- **Commercial Establishment**. The study will help the Commercial Establishments such as restaurants and other food services to ensure continuous and uninterrupted gas supply for cooking and heating purposes.
- **Future Researchers**. The prototype may be the bases of the other researchers for future conduct of project studies in improving grounded on lapses found the present study.

Scope and Limitations

The study focuses on designing and developing an LPG level indicator to enhance safety and convenience for users in Barangay Taft, Surigao City. The indicator aims to prevent accidents by alerting users before gas runs out unexpectedly and helps optimize refills to save money. Researchers, with the support of knowledgeable individuals, will conduct the project.

However, there are limitations to consider. Dependency on batteries and susceptibility to environmental conditions may affect reliability. Additionally, there's a risk of electrical hazards where the indicator relies on electrical components for operation. If these components malfunction or if there's a short circuit, it could lead to electrical hazards such as shocks or even fires. Moreover, chemical exposure could occur if the materials degrade over time, posing risks to users or the environment. Compliance with safety standards is also crucial for regulatory purposes.

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Definition of Terms

The following terms are operationally used in this study.

- **Device.** In the study, it defined as the proposed prototype which is the LPG Gas Level Indicator.
- **Prototype.** It is a preliminary version or model of a product, system, or concept that is created to test and evaluate its design, functionality, and feasibility before full-scale production or implementation.
- **Load Cell.** It is a component used for measuring the weight or pressure of the LPG cylinder or tank. Load cells are sensors that convert mechanical force or weight into an electrical signal, which can then be processed and interpreted by the monitoring system.
- **Operation.** It is defined as an act or instance, process, or manner of functioning or operating.
- **Microcontroller.** Such as Arduino or Raspberry Pi, is used for data processing and controlling the indicator system. It receives data from the ultrasonic sensor and interprets it to display the gas level accurately.
- **Display Unit.** It is an LCD screen or LED display, is used to visually indicate the gas level. It shows the measured level in a user-friendly format, making it easy for users to monitor.
- **LPG.** It stands for liquefied petroleum gas which is a flammable hydrocarbon gas that is commonly used as fuel in heating appliances and cooking equipment.
- **Gas Level Indicator.** It is a device used to measure and display the amount of gas present in a container or system. It provides real time information about the gas level, allowing for monitoring and ensuring sufficient supply or preventing running out of gas.
- **Gas Sensor.** A device designed to detect the presence and measure the concentration of specific gases in the surrounding environment. It operates by converting the chemical reaction caused by the interaction between the target gas and the sensor material into an electrical signal, which can then be analyzed to determine the gas concentration.
- **Arduino Uno.** A microcontroller board widely used in electronics projects and prototyping. It features a simple and versatile design, equipped with various input and output pins, making it ideal for beginners and experienced makers alike.
- **HX711 Amplifier.** It is a precision analog-to-digital converter (ADC) designed specifically for weighing scale applications. It amplifies and digitizes small analog signals from load cells, providing accurate weight measurements with high resolution and low noise.
- **OLED.**It is a type of flat-panel display technology that uses organic compounds to emit light when an electric current is applied.
- **Servo Motor.** A type of rotary actuator that allows for precise control of angular position. It typically consists of a motor coupled with a sensor for feedback and is commonly used in applications requiring accurate and controlled movement, such as robotics, automation, and remote-controlled vehicles**.**
- **MQ-6.** It is a gas sensor module commonly used to detect the presence of LPG (liquefied petroleum gas) and propane in the air. It operates based on the principle of resistance changes in its sensing element when exposed to these gases, providing a simple and cost-effective solution for gas detection applications.
- **Buzzer.** An electronic component that generates sound when it receives a voltage signal from the microcontroller. It is often utilized for alerts, notifications, or feedback in a variety of interactive applications.

Project Design

Below is the pictorial diagram of the research project (Design and Development of LPG Level Indicator), included the labelled parts of the research project.

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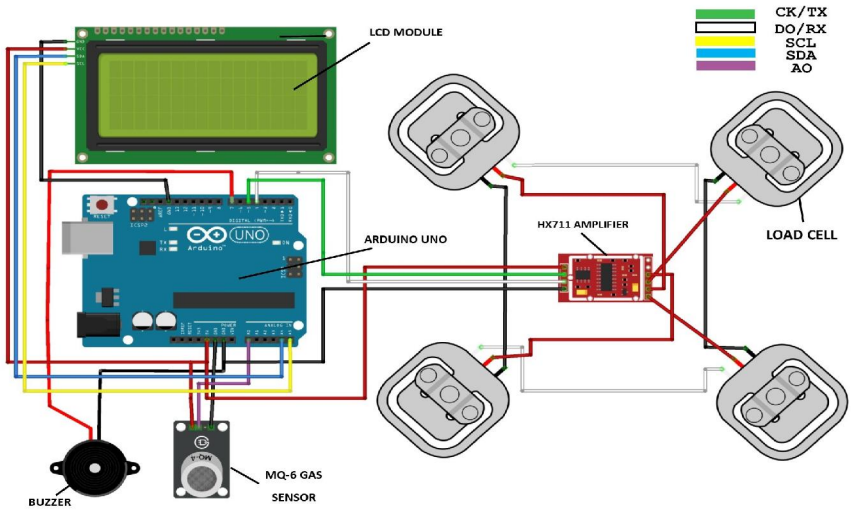

Figure 2: Pictorial Diagram

Project Development

The following are procedural steps in making the project.

1. Gather all necessary material needed in making the LPG level indicator.
2. Check and make sure that all the devices/materials to be use is functional and not defective.
3. Create a schematic diagram and pictorial diagram for the visual presentation of electronic circuitry.
4. Assemble the selected components on a breadboard or prototype PCB.
5. Write and calibrate a program for the microcontroller, arduino code to read the ultrasonic sensor data, process it, and display the gas level on the display unit.
6. Upload the code to the arduino board and connect the arduino board to the computer using a USB cable, click on the "Upload" button to upload the code to the arduino board.
7. Test the LPG level indicator and place the ultrasonic sensor at the bottom of the LPG cylinder, check if the gas level readings are accurate and displayed on the LCD display.
8. Connect all the necessary components that needed in making the LPG level indicator.
9. Check all the wiring components if it is exactly connected to the right connecting point microcontroller, arduino, oled monochrome, ultrasonic sensor and source.
10. Test the components if it is functioning will.
11. After setting all the components, checking the proper wiring connections, now the LPG level indicator is ready to use.

The Research Study includes consideration on the following method of operation:

Installation: The design and development of LPG level indicator is allowing the users to monitor the gas level of their LPG cylinder easily and conveniently. It acts as a monitoring system to the gas level of their LPG cylinder at home. This component installed at the near of LPG cylinder and the ultrasonic sensor installed at the bottom of the LPG cylinder.

Operation Procedure

To determine the device performance of the project, the following operation procedure can be followed:

Calibration

Calibrating the LPG level indicator which ensures that the device is accurately measuring the gas levels.

Check the Whole System

Inspecting whether the components and wirings are correctly installed.

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Testing
Examining the performance of the prototype and evaluate it if gives accurate readings.

Data Collection
Record the readings displayed by the prototype at regular intervals.

Data Analysis
Analyzing the readings and the performance of the prototype. Determining the accuracy, precision, and reliability in measuring gas levels.

Documentation
Document the data collected, analysis methods, and results obtained during the study.

Testing Procedure
In order to assure that every part of the prototype is working properly, the following test procedure should be done:
1. Check every part of the device.
2. Testing all the required components
3. Check each connection points.
4. Set the time for estimated desired timing function.
5. Test the device and conduct an assessment and efficiency on it.

Evaluation Procedures
The evaluation procedure commences with a meticulous assessment of functionality, aiming to ascertain whether the gas level indicator accurately the LPG levels within the cylinder. A selected group of people were asked to rate the project's performance as part of our study approach. Selected electrical professionals from Surigao Del Norte State University comprised this group of responders. The device's operation and the project specifications were explained by the researcher prior to the device's real presentation and evaluation. Before giving the evaluation form to the responders, the researchers went over its contents.
Following the assessment, the information was gathered and processed to ascertain the means for each criterion as well as the overall mean. The primary evaluation criteria are functionality, workability, efficiency, and safety. Consequently, respondents are able to offer their feedback, recommendations, and concepts to further improve and develop the project.

IV. RESULTS AND DISCUSSIONS

This chapter presents the project description, capabilities and limitations, project test results, and the final evaluation.

Acceptability of Advanced LPG Monitoring and Leaking Detection System on its Functionality

Criteria and Statement	Mean	Qualitative Description
A. Functionality		
Function of the device is meet as it expected.	4.83	**Excellent**
The device performs the task effectively.	4.76	**Excellent**
The device has a minimal error.	4.7	**Excellent**
The device can be enhanced or updated.	4.63	**Excellent**
The quality and consistency of the device's outputs,	4.68	**Excellent**

Legend: 4.21 – 5.00 Excellent 3.41 – 4.20 Very Good
2.61 – 3.40 Good 1.81 – 2.60 Fair
1.00 – 1.80 Poor

The table uses five distinct statements about the functionality and performance of the device to evaluate the "Functionality" criterion. Each claim outlines a unique feature of the device's operation. The average ratings or scores

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assigned to each statement are shown in the "Mean" column. As an illustration, Statement 1 scored on average 4.83, Statement 2 scored on average 4.76, and so on. The overall evaluation of each statement's functionality is reflected in the mean score. Based on each statement's mean score, the "Qualitative Description" column offers a qualitative evaluation or description of it. Statements 1 to 5 in this instance were given the rating of "Excellent," signifying that they were highly regarded and delivered great work. This table suggests that the functionality of the device was positively assessed. The device was given an "Excellent" grade for statements 1 to 5, which refer to the equipment meeting expectations and carrying out duties efficiently.

Acceptability of Advanced LPG Monitoring and Leaking Detection System on its Applicability

B. Applicability	Mean	Qualitative Description
The device's effectiveness in specific real-world applications or environment.	4.73	**Excellent**
The device meets the needs of intended user group.	4.83	**Excellent**
The device withstands the specific environmental and usage conditions of its intended application.	4.76	**Excellent**
Measure how quickly and easily users can adopt the device, considering factors like training requirements and the user interface's intuitiveness.	4.36	**Excellent**
Level of maintenance required for the device and the availability of user support and resources.	4.66	**Excellent**

The table displays the respondents' perceptions, which assess the "Applicability" criterion based on five distinct assertions about how well-suited and adaptable the device is to various applications and user requirements. The average ratings or scores assigned to each statement are shown in the "Mean" column. As an illustration, Statement 1 obtained an average score of 4.73, Statement 2 an average score of 4.83, Statement 3 an average score of 4.76, Statement 4 an average score of 4.36, and Statement 5 an average score of 4.66. The total evaluation of the applicability of each statement is represented by the mean score.

Based on each statement's mean score, the "Qualitative Description" column offers a qualitative evaluation or description of it. Statements 1 to 5 in this situation were both given the rating "Excellent," meaning that is indicated it was extraordinary and met or surpassed safety requirements. This table suggests that the device's applicability was given a favourable evaluation. According to Statement 1, the device's effectiveness in specific real-world applications or environment. was given an "Excellent" rating, indicating that it is suitable for a specific function or purpose. Statement 2 emphasizes the device meets the needs of intended user group received an "Excellent" grade, signifying that it is able to satisfy the wants and preferences of its users. The device's other criterions received excellent meaning it encompasses to the expected applicability of which excellent in all forms.

Acceptability of Advanced LPG Monitoring and Leaking Detection System on its Durability

C. Durability	Mean	Qualitative Description
1. The device withstands physical forces, including compression, tension, and torsion.	4.73	**Excellent**
2. The device's performance under various environmental stresses, such as temperature extremes, humidity, dust exposure, and water resistance.	4.67	**Excellent**
3. The materials used in the prototype behave under repeated use over time, which may include abrasion resistance and wear testing.	4.73	**Excellent**
4. Device performance under high and low temperature conditions.	4.53	**Excellent**
5. Device longevity and performance of the battery under typical usage conditions, including charge/discharge cycles.	4.50	**Excellent**

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The table evaluates the "durability" criterion based on five distinct statements about the unit's ability to withstand high temperatures, resist deformation, and be well-designed. The average ratings or scores assigned to each statement are shown in the "Mean" column. As an illustration, Statement 1 to 5 both obtained an excellent result. These shows the device durability of each assertion is evaluated overall and represented by the mean score. Each statement is given a qualitative evaluation or description in the "Qualitative Description" column based on its mean score. In this instance. Statement 1 to 5 was given the rating of "Excellent," signifying that its design was of the highest calibre and that it was extraordinarily well regarded. The device's durability was determined to be favourable based on the information in this table. Statement 1 to 5, which focuses on withstands physical forces, including compression, tension, and torsion, the device's performance under various environmental stresses, the prototype behaves under repeated use over time, which may include abrasion resistance and wear testing, and Device longevity and performance of the battery under typical usage conditions, including charge/discharge cycles, was given an "Excellent" rating, indicating that the device demonstrated best resilience and kept its form under a variety of circumstances.

Acceptability of Advanced LPG Monitoring and Leaking Detection System on its Safety

D. Safety	Mean	Qualitative Description
The device has a buzzer, warning indicators, and user manuals for safety usage.	4.15	**Very Good**
Device absence from harmful substances, such as toxic materials.	4.10	**Very Good**
The physical design of the device to identify sharp edges, pinch points, or moving parts that could pose risks during use.	4.10	**Very Good**
The device potential electrical hazards, including short circuits, overloads, and proper grounding.	4.25	**Excellent**
The device's ability to manage heat during operation.	4.15	**Very Good**

The device has a buzzer, the absence of poisonous compounds, and the provision for protection are three specific assertions that the table uses to evaluate the "Safety" criterion. Mean: Each statement's average score or rating is shown in the "Mean" column. As an illustration, Statement 1 obtained an average score of 4.15, Statement 2 an average score of 4.10, and Statement 3 an average score of 4.10. Statement 4 with an average score of 4.25 and Statement 5, got the score of 4.15. The overall evaluation of each statement's safety is represented by the mean score. Qualitative Description: Each statement is given a qualitative evaluation or description based on its mean score in the "Qualitative Description" column. All five of the statements in this instance were given the rating "Very Good," indicating that they were highly regarded and thought to have good safety precautions. The data in this table led to the conclusion that the device's safety was adequate. Statement 1: The item has a buzzer and received a "Very Good" grade. This means that the equipment was designed with an alarm system that would inform right away if it encountered any gas leakage. Statement 2, which also received a "Very Good" rating, supports this. The absence of hazardous ingredients in the device shows that the degree of safety during production was carefully taken into account to ensure that the user would not be harmed. According to statement 3, the device's physical design identifies any moving elements, pinch points, or sharp edges that could be dangerous to use. This also shows the device's level of safety, allowing for effortless operation. Statement 4 shows how the fabrication process considers the device's possible electrical risks, such as overloads, short circuits, and adequate grounding. One of the primary goals is to make the gadget safer while in use. Last but not least, the process of manufacturing the device includes consideration of its capacity to control heat while in use (statement 5). This will involve the device's capacity to tolerate any room temperature and to operate without concern in the event that it malfunctions or breaks.

Overall Acceptability

Criteria	**Mean**	**Rank**	**Qualitative Description**
A. Functionality	4.68	**1**	Very Good
B. Applicability	4.67	**2**	**Excellent**

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C. Durability	4.63	**3**	Very Good
D. Safety	4.15	**4**	Very Good
Grand Mean	4.53		Very Good

The table assesses the acceptability of an advanced LPG monitoring and leak detection system based on its performance in four key areas: Functionality, Applicability, Durability, and Safety. Each area is evaluated with specific features, and the average scores indicate the device's overall performance. For instance, the system achieved an average score of 4.68 for functionality, suggesting it met or surpassed expectations in its operation. Applicability also received a high rating, with an average score of 4.67, demonstrating the device's effectiveness in real-world scenarios and its adaptability to various user requirements. Regarding durability, the device excelled, with average scores 4.63, showcasing its capacity to endure physical and environmental challenges. Safety was rated "Very Good," with average scores from 4.15, reflecting the system's robust safety features, including alarms, material safety, and electrical protections. Overall, the device garnered consistently high ratings, particularly in functionality and applicability. The comprehensive evaluation of the system indicates it is highly acceptable across all criteria, showcasing strong performance and reliability.

Summary

The purpose of the research is to analyse the efficiency of the proposed design of LPG monitoring and gas leakage detection system. It looks into various parameters alongside the functionality such as applicability, durability, safety and the innovativeness of the systems solutions to the users.

The system was examined using 30 respondents who use LPG cylinders for cooking in their households. The respondents were selected since they have an understanding of how the system components work and its purpose thus able to critique its performance and usability.

V. FINDINGS

Based on a thorough evaluation of the "LPG Monitoring and Leakage Detection System," the following key findings have emerged:

1. Functionality Performance:

The system performs exceptionally well in terms of functionality, receiving an "Excellent" rating. It efficiently monitors LPG levels and identifies leaks, guaranteeing high safety and performance standards.

2. Applicability in Various Environment:

The device shows impressive versatility, receiving high ratings for its effectiveness in a range of environments. It successfully caters to the needs of diverse user groups and can be easily adapted for both home and business use.

3. Prototype Durability:

The device showcases outstanding durability, earning "Excellent" ratings in every category. It effectively endures physical stresses, operates reliably in various environmental conditions, and retains its shape over time, guaranteeing long-lasting performance and resilience.

4. User Safety and Design Considerations:

The device emphasizes user safety by incorporating features like a buzzer for leak detection, using non-toxic materials, and providing protection against electrical hazards. These aspects guarantee dependable performance while protecting users from possible dangers.

The findings indicate that the LPG Monitoring and Leakage Detection System holds considerable promise for improving safety and efficiency in LPG applications. Its remarkable functionality, applicability to different environments, impressive durability, and focus on user safety position it as a trustworthy and forward-thinking solution. With effective gas monitoring, leak detection, and integrated safety features, this system represents advanced technology ready to elevate safety standards in both home and commercial environments.

VI. CONCLUSION

The "LPG Monitoring and Leakage Detection System" shows great promise in improving safety and efficiency in the use of LPG. It stands out in several important areas, including functionality, applicability, durability, and user safety.

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The system effectively monitors LPG levels, detects gas leaks, and includes safety features such as a buzzer, non-toxic materials, and protection against electrical hazards, making it a dependable choice for both residential and commercial settings.

Its adaptability to various environments, along with its remarkable durability and emphasis on user safety, positions it as a cutting-edge technology that can elevate safety standards. The consistently high ratings across all aspects highlight its practicality and effectiveness.

In summary, the "LPG Monitoring and Leakage Detection System" is a noteworthy solution for improving LPG safety. Its blend of advanced monitoring features, versatility, and safety measures makes it an invaluable tool for preventing accidents and ensuring reliable operation. With ongoing advancements, this system could become a crucial resource in protecting users from gas-related risks.

Recommendations

- **Residential Consumers.** This prototype can enable consumers to have a cost-effective and efficient solution for monitoring the gas level in their homes, apartments, and condominiums.
- **Commercial Establishment.** The prototype can help the Commercial Establishments such as restaurants and other food services to ensure continuous and uninterrupted gas supply for cooking and heating purposes.
- **Future Researchers.** The prototype may be the bases of the other researchers for future conduct of project studies in improving grounded on lapses found the present study.

REFERENCES

[1] Bany Salameh H. A., Dhainat M. F. and Benkhelifa E. (2020). An End-to-End Early Warning System Based on Wireless Sensor Network for Gas Leakage Detection in Industrial Facilities. IEEE Systems Journal https://rb.gy/qlk587

[2] Obi A.L., Okonkwo P.A., Idoko S.O. (2021). Design and Construction of Cooking Gas (LPG) Leakage Detector. ResearchGate. https://rb.gy/202q8s

[3] Press Release. (2021). An Act Providing for the National Energy Policy and Regulatory Framework for the Philippine Liquefied Petroleum Gas Industry. Senate of the Philippines https://rb.gy/o8ylpd

[4] Ravichander J., Anuradha P., Arabelli R.R., Rajkumar K. (2020). Microcontroller Based Monitoring and Controlling of LPG Leaks Using Internet of Things. IOP Science. https://rb.gy/lihjti

[5] Tamizharasan V., Ravichandran T., Sowndariya M., Sandeep R., K. Saravanavel. (2019). Gas Level Detection and Automatic Booking Using IoT. 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS). https://rb.gy/4h2cy9

[6] Zongyu Chen, Bo Dong, Senpeng Zhang, Liu Yang, Qi Shao, Wobi n Huang. (2023). Ultrahigh-sensitivity fiber-tip microcavity ultrasonic sensor based on optomechanical effect. Science Direct. https://doi.org/10.1016/j.sna.2023.114932