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ARTICLE

GDI (IoT-Based Gas Detector) As an Appropriate Technology for Gas Leak Detection in Tarakan City, North Kalimantan

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Abstract: Tarakan City, as the center of oil and gas resource exploitation in North Kalimantan Province, faces significant challenges related to safety and security concerning potential natural gas leaks. With its large population and the presence of 1,400 oil and gas wells, as well as being the largest consumer of natural gas networks in Indonesia with 32,000 consumers, the risk of gas leaks is a major concern. Previous gas leak incidents have demonstrated serious impacts, including fires and explosions resulting in significant losses for the community and the environment. To address these challenges, the 5.0 technology offers a potential solution, particularly implementing the Internet of Things (IoT). Based on this technology, developing an IoT-Based Gas Detector involves surveying potential tools, analyzing economic, social, and environmental factors, assembling the tools, and applying the product. IoT Gas Detectors have an advantage by utilizing connected sensor technology. The IoT-Based Gas Detector can be utilized to detect gas leaks in real-time, providing swift responses and reducing the potential impacts of gas leaks. Consequently, it can increase safety, security, and the efficient use of natural resources. The IoT-based Gas Detector (GDI) program supports several Sustainable Development Goals (SDGs), including: [1] No Poverty, [3] Good Health and Well-being, [7] Affordable and Clean Energy, [9] Industry, Innovation, and Infrastructure, [11] Sustainable Cities and Communities, [17] Partnerships for the Goals.

Keywords: Internet of Things (IoT), Gas Leaks, Technology, Gas Detector, Tarakan, Natural Gas.

1. Preliminary

Tarakan City is the only city in North Kalimantan Province with a population of 275,915 people and a land area of 657.33 square kilometers (BPS Tarakan, 2024). Tarakan is known for its rich potential in energy resources, particularly natural gas and oil. As a strategically important region for natural resource exploitation in the country, Tarakan makes a significant contribution to the national energy supply.

The potential of natural gas and oil in Tarakan City serves as a strategic asset for the energy industry in Indonesia. Data indicates that Tarakan City has approximately 1,400 oil and gas wells managed by PT Pertamina EP Tarakan Field(PT Pertamina EP Tarakan Field, 2024).Furthermore, Tarakan City is the largest consumer of the natural gas network operated by PT Pertamina Gas Negara (PGN) in Indonesia, with a customer base of 32,000 households for cooking and other domestic purposes (PT Pertamina Gas Negara, 2024). The data indicates that the potential of natural gas and oil in

Tarakan City not only serves as a strategic asset for the energy industry in Indonesia but also has a significant impact on strengthening both the local and national economies.

The significant potential of natural resources in Tarakan City can have significant negative impacts if not effectively managed. Risks associated, particularly concerning safety and security, are a primary concern. One of the most prominent threats is the potential for natural gas leaks, which can lead to fires, explosions, and pose serious dangers to both the community and the surrounding environment.

The risk is evidenced by a case that occurred at an oil well in the Kampung Satu District, Tarakan City, North Kalimantan. The well spewed mud approximately 10 meters high and emitted a pungent odor. The smell from the well could be detected within a radius of about 500 meters from the incident site (Susylo Asmalyah, 2021). Another case revealed by the Tarakan City Police, North Kalimantan, stated that a fire broke out in RT 21, Karang Anyar Pantai Village, Tarakan City, on Thursday, June 29, 2023, caused by cooking activities on a gas stove in one of the residential houses. Although there were no casualties, the fire resulted in 90 houses being burned down, and 414 residents evacuated to the emergency shelter at SDN 019 Jembatan Bongkok (Sunny Celine, 2024).

Gas leak cases not only cause material problems but also health problems. Health is a fundamental necessity for every individual, underscoring its critical importance, this aligns with the objectives of development, which aim to enhance community welfare as both the focus and outcome of developmental efforts (Titasari, 2021). Therefore, addressing gas leak incidents is not merely about mitigating economic losses but also safeguarding public health, ultimately advancing the overarching goal of fostering thriving and healthy communities.

As time progresses, technological advancements also develop significantly, especially with the emergence of 5.0 technology promising greater connectivity between humans and machines, as well as between machines themselves (Sukarno, 2020).One of the developing technologies under Industry 5.0 is the Internet of Things (IoT).

The Internet of Things abbreviated as IoT, is a technology that innovates everyday objects with the Internet to make daily activities easier and more efficient. IoT is a technology that enables objects around us to be connected to the Internet (Susanto et al., 2022).

The utilization of Internet of Things (IoT) technology as a gas leak detection tool can be an innovative, sophisticated, and responsive solution to the security challenges along the natural gas network in Tarakan City. Through the implementation of sensitive and connected sensors on IoT, this device can provide the ability to detect gas leaks in real-time, allowing us to take quick and appropriate actions to address the potential dangers of gas leaks (Brian Hakim Pangestu & ZulyBudiarso, 2023)

The Sustainable Development Goals (SDGs), translated in Indonesian as *Tujuan Pembangunan Berkelanjutan*, is a comprehensive vision issued by the United Nations (UN) to achieve a better world by 2030. The SDGs consist of 4 pillars, 17 goals, and 169 targets. The four pillars of the SDGs are the pillar of Social Development, the pillar of Economic Development, the pillar of Environmental Development, and the pillar of Legal and Governance Development (Dr. Ir. Arifin Rudiyanto, 2020).

Figure 1. Sustainable Development Goals (SDGs) (Bappenas, 2024)

The method of calculating achievements in GDI (Gas Detector Based on the Internet of Things (IoT)), aligns with the SDGs indicators implemented by PT. IoT Energi Tarakan Field is as follows.

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Table 1. GDI Program Supporting SDGs

No	SDGs Goals		Description
1.		No Poverty	Build resilience to environmental, economic and social disasters.
2.		Healthy and Prosperous Lives	Reduce disease and death from harmful chemicals and pollution.
3.		Clean and Affordable Energy	Expanding and improving energy services for communities.
4.		Industry, Innovation and Infrastructure	Expand and improve energy services for communities.
5.		Sustainable Cities and Settlements	Making Cities and Settlements Inclusive, Safe, Resilient and Sustainable.
6.		Partnerships to Achieve Goals	Stakeholder Cooperation encourages collaboration between various parties namely City Governments, Oil and Gas Companies, NGOs, and local communities to help improve efficiency and productivity.

Therefore, GDI (Gas Detector Based on the Internet of Things (IoT)) as an Appropriate Technology for Gas Leak Detection has significant potential to increase safety, security, community comfort, environmental protection, and the efficient use of natural resources in Tarakan City. This device can be a crucial step in supporting the vision of sustainable development and future-oriented resource management, as well as synergizing with the vision and mission of Tarakan City as a smart city.

A. Problem Formulation

1) How can the innovation process of the GDI (IoT-Based Gas Detector) device and the laboratory test results enable it to become an early gas leak detection tool?
2) Mitigating the risk of fires caused by gas leaks in Tarakan City, North Kalimantan.
3) Reducing repair and maintenance costs because damage can be detected early and can be performed by the general public or businesses.

B. Objectives

The objectives of this innovative device are as follows:

1) Increasing safety and security in homes with natural gas pipelines and oil wells installed,
2) Detecting early potential hazards occurring in 1,400 existing wells and 32,000 homes with natural gas pipelines installed
3) Mitigating the risk of fires and minimizing losses caused by household gas leaks and Blowouts, which are incidents involving the uncontrolled flow of oil, gas, or other fluids from oil and gas wells to the surface or underground.
4) Socializing and educating about safety, security, and comfort in the areas surrounding oil wells, household gas networks, and businesses.

C. Benefits

This device can be utilized by 32,000 users of the national gas network, LPG gas cylinders, and 1,400 oil wells existing in Tarakan City as well as other areas throughout Indonesia. Additionally, the presence of this device also initiates the formation of the Tarakan City Disaster Volunteer Group (Korlakar) in collaboration with the Tarakan Fire Department (PMK) and the Tarakan City Regional Disaster Management Agency (BPBD). As an educational tool for Vocational High School (SMK) 2 Tarakan City, this module/practical application of appropriate technology aims to increase awareness and community concern regarding the dangers of gas leaks that can lead to fires

2. Research Methods

A. Conceptual Framework

GDI (IoT-Based Gas Detector) is a tool resulting from the development of innovative appropriate technology that utilizes smart sensor technology capable of detecting gas leaks. This innovation is designed to assist the community through audible warnings generated by this innovative product. Additionally, through this product, the community can determine the gas levels present so that in the event of a gas leak, they can promptly take action to minimize losses. This product operates in real-time by utilizing Internet of Things (IoT) applications.

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Below is the flowchart and algorithm of the product:

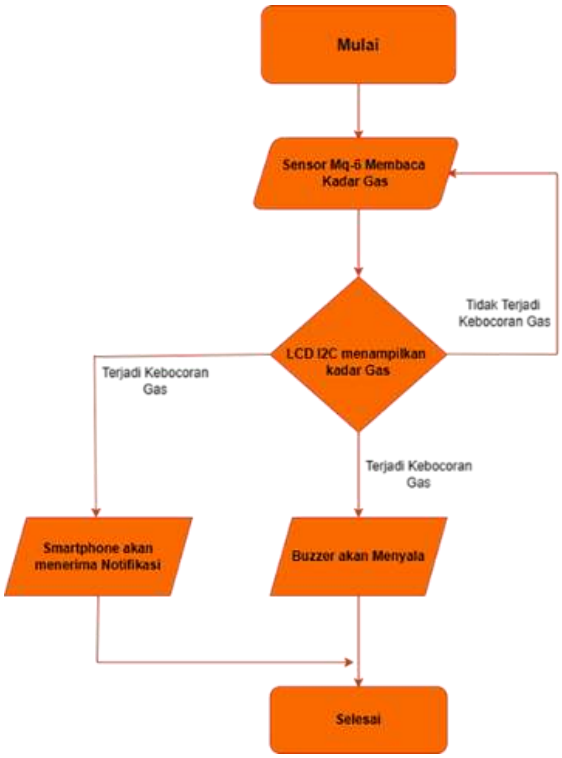

Figure 2. GDI Device Flowchart Design

The literature review is also taken as a reference for the foundation and support of the issues as well as theories. It serves as a comparison with related journal titles. In the SIMETRIS journal, Vol. 7 No. 2 November 2016, UNISNU Jepara Electrical Engineering Program, by Dias Prihatmoko, titled "The Implementation of Internet of Things (IoT) in Learning at UNISNU Jepara." In this journal, IoT is utilized as a means for remote automatic control systems using microcontrollers. The implementation of the Internet of Things (IoT) in the electrical engineering department of UNISNU Jepara involves controlling electronic devices such as LED lights using an Arduino Uno microcontroller via the internet. The implementation includes the task of controlling the lighting system designed using hardware components (LED lights and Arduino pins), as well as utilizing software such as PHP programming language, Batch Programming, and Arduino programming.

B. Activity Details

The first production activity commenced in early January 2024, with the following steps:

1) Problem Identification

Problem identification is conducted to obtain data on gas network consumer users and the risk of past fire incidents as a basis for designing innovation.

2) Problem Analysis

Examining the potential and data from observations of risks or disasters such as fire caused by gas leaks.

3) Making Schematic Circuit Diagram

The schematic circuit diagram is created using platforms like Fritzing and Wokwi (schematic drawing platforms) to check the compatibility of components.

4) Prototype Development

The development process involves connecting the sensor to analog pins and the alarm to digital pins using a breadboard (a special prototype board) and calibrating the sensor.

5) Application Development

The application development process utilizes Firebase and MIT App Inventor to create the application and connect it to the device.

6) Laboratory Testing

Laboratory testing is essential to assess the readiness of the device and the connectivity of the application to the device.

Vol 1 : This device is equipped with sensors and an alarm to provide danger warnings.

Vol 2 : This device will be supplemented with battery backup power and features indicators in the form of LED lights colored green, yellow, and red to indicate the level of danger from detected gas.

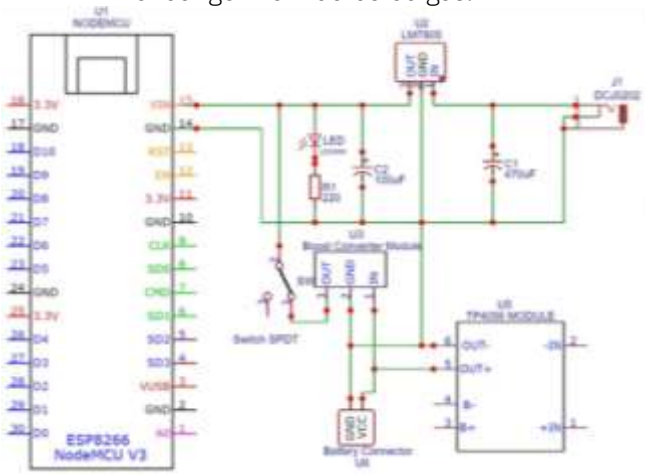

Figure 3. Electrical Design of GDI Device

3. Results and Discussion

GDI is a versatile innovation derived from observations of the risks or disasters caused by gas leaks leading to fires. Through various research circuits and development steps, this innovation transcends

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ordinary technological products. The device reflects the dedication, research, and hard work of innovators in creating meaningful and sustainable solutions for the community of Tarakan City. The success of this device is not only measured by its functionality but also by the positive impact it can have on improving the quality of life and the environment in the area of Tarakan City and its surroundings.

Below are the advantages of the gas leak detector device that serves as the GDI (IoT-Based Gas Detector) innovation:

3.1. Real-time & Integrated

One of the main advantages of the GDI product is its ability to operate in real-time, meaning accurate gas detection and quick response to leakage threats. It not only provides warnings to the public as users, but the GDI innovation has also been integrated with PT. Pertamina Gas Negara is a gas network management and provider company.

With direct integration with PT. Pertamina Gas Negara as the gas network management and provider company, the GDI device not only provides warnings to users in emergency situations but also directly notifies the company. This means that when a gas leak is detected, information is automatically relayed to a team of technicians prepared to respond immediately.

This results in quick and effective response actions. The technician team will receive comprehensive information including the consumer unit number, consumer contact, and the coordinates of the device identifying the gas leak. This allows the technician team to promptly proceed to the leak location for further evaluation and necessary repair actions. Therefore, our gas detector device not only protects users but also offers an integrated solution that helps increase safety and security for all parties involved.

3.2. Comprehensive Component Features

The gas leak detector device we have developed stands out with various advantages that guarantee maximum safety for users. Firstly, we ensure operational continuity by including backup power, ensuring the device functions even during power outages. Additionally, with integrated microcontrollers and WiFi connectivity, our device operates intelligently and has a long lifespan.

Furthermore, the gas leak detector device we have developed is equipped with an LCD that displays the gas levels in a room. Additionally, the sensor suite, which includes gas, smoke, and fire sensors, ensures early detection of various threats, from gas leaks to fires. We believe in providing comprehensive protection to our users. Furthermore, we will develop a specialized version that is connected to water sprinklers. When a fire detection occurs, our device not only issues a warning but also activates the fire suppression system automatically to extinguish the fire and minimize damage.

3.3. Insurance Support & Regular Checks.

Our gas detector device innovation not only provides protection in terms of early gas leak detection but also reinforces our commitment to consumer safety through two additional important features: Insurance and Regular Checks.

Firstly, by providing insurance for users, we offer additional assurance against the risks that may arise from gas leaks or fires. This insurance provides financial protection for users in case of property damage, or injuries caused by gas-related emergencies. Therefore, users can have additional peace of mind, knowing that they are protected from potential negative financial impacts that may occur. Secondly, regular checks are a proactive step we take to ensure that the gas detection device always remains fully functional. Through routine checks conducted by our technician team, we ensure that the sensors and other components operate correctly and provide accurate results. This also helps identify potential issues or damage; therefore, they can be promptly repaired before becoming serious problems.

By integrating insurance and regular checks into our gas detector device innovation, we not only provide broader protection to users but also ensure that our device remains reliable and delivers optimal performance. This is part of our commitment to providing comprehensive and trustworthy safety solutions to our consumers.

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Table 2. Comparison With Similar Products

Nama Produk			
	GDI-001 | Gas Detector (Real-Time)	Smart WiFi Gas Detector / Gas and Temperature Detector / LPG Leak	Multi Gas Detector Honeywell BW MicroClip XL Ori
Advantages			
Price	Rp 250.000,-	Rp 493.000,-	Rp 7.500.000,-
Features	*Realtime & Integrated and can detect LPG (Methane), Natural Gas, Propane*	Detects LPG (Methane), natural gas, artificial gas, liquefied petroleum gas, liquefied natural gas liquefied natural gas.	Ability to detect 4 gases at once (CO, O2, LEL & H2S)
Service and After Sales	Product Warranty and Insurance Support and Periodic Checks	Product Warranty	Product Warranty

3.4. Legalities and Product Standardization

This innovation has undergone a lengthy and meticulous ideation process before reaching the final concept of this device. The originality of this innovation lies in its integrated system between the device users and the server connected to service providers (PT. Pertamina Gas Negara Tarakan and PT Pertamina EP Tarkan Field), enabling early detection of gas leaks and prompt handling.

The new innovation of this device is equipped with a Mobile App (GDI Mobile App) and a website: https://bit.ly/GDIGasDetectorTarakan to view and monitor the detected gas levels from the GDI Device. Additionally, the GDI device also comes with an Emergency Phone Number Poster.

Figure 4. Dashboard Display of GDI Mobile App and Website

Figure 5. Emergency Phone Number Poster

In order to support and strengthen the development and marketing process of this gas leak detection device, the IoT Energy Tarakan team transformed into a corporation, namely PT. IoT Energi Tarakan with Registration Number: 820240428723546 and has obtained a Business Registration Number: 1108230098676 with a Micro Business Scale.

Not only that, the business legality of PT. IoT Energi Tarakan is also guaranteed with complete documentation, including the Taxpayer Identification Number (NPWP) with the number 200353274723000. These steps reaffirm the company's commitment to comply with all applicable regulations and tax obligations.

The next step after ideation is to protect its intellectual property. By registering Intellectual Property Rights (IPR), innovators ensure that the concept and design of the device are legally protected, preventing others from claiming or copying the innovation without permission. PT. IoT Energi Tarakan has successfully obtained Intellectual Property Rights through the grant of Copyright for the design flow model of the device we designed and developed, as evidenced by Copyright Number 202435603 in the year 2024. This success serves as official recognition of the innovation by the IoT Energy Tarakan team in

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developing an efficient and effective gas leak detection device.

However, PT. IoT Energi Tarakan's commitment to ensuring product quality and safety does not stop there. The team has taken further steps to ensure that the gas leak detection device has undergone laboratory testing at the Electrical Engineering Laboratory of the Faculty of Engineering, Muhammadiyah University of Jember. The device testing is conducted to ensure that it functions as expected before widespread use. PT. IoT Energi Tarakan has also created and delivered Standard Operating Procedures (SOP) for this Gas Detector product, which serves as a guide in handling and installing the device.

3.5. Technology Readiness Level

Technology Readiness Level (TRL) is a framework used to assess the maturity of a technology. This framework is commonly used across various industries, including information technology, aerospace, and defense. TRL consists of nine levels, from initial concept to full implementation in operations. Here is an explanation of each level:

Figure 6. Technology Readiness Level

In this regard, the IoT Energy Tarakan team has reached TRL Level 7: Prototype Tested in Real Environment. This is the final stage of development before production, involving full-scale testing.

Each TRL level provides a framework that helps development teams, project managers, and stakeholders assess risks, costs, and technology development schedules. It also aids in communicating the status and progress of technology development to all involved parties.

3.6. Market Validation Stage

In marketing the GDI product, we apply the business model canvas (BMC). The business model canvas is a framework used to design, evaluate, and communicate the essential elements of marketing the gas leak detection device. This is done to ensure the business sustainability of the innovation. Here is the business model canvas that we use:

Figure 7. IoT *Gas Detector Business Model Canvas*

3.7. Marketable

A. Household (MSME Photo)

Natural gas is a primary necessity in Indonesia, given its crucial role in providing energy for various sectors, including households. Tarakan City is an example where 32,000 users have already adopted natural gas networks. With the continuously increasing population in Tarakan, as well as ongoing national marketing efforts, this user base is expected to continue growing. To ensure the safety of natural gas usage in households, the use of gas leak detection devices is highly necessary.

B. Food & Beverage (F&B) Industry / MSME (Photo with MSME)

The food and beverage (F&B) industry, including culinary MSMEs, has a very high demand for gas usage, with usage intensity lasting for long periods. Gas usage at such a scale involves significant risks, including the risk of leaks that can lead to fires. Therefore, gas leak detection devices are highly needed to maintain their operational safety and prevent accidents that could disrupt the productivity of this industry.

C. Oil and Gas Companies

Oil and gas companies have a significant responsibility in maintaining operational safety and the surrounding environment. In this high-risk industry, gas leaks pose a serious threat that can have adverse impacts on both human safety and the environment. Gas leak detection devices are crucial in assisting oil and gas companies in enhancing the monitoring of gas hazards, reducing accident risks, and ensuring better workplace safety for employees and the surrounding community.

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3.8. Promotion and Marketing Strategy

GDI (IoT-Based Gas Detector) has a tagline/motto: "Zero Accident, GDI Gas Detector, We Are the Protector". The promotion strategy is based on the identification of competing products, many of which are gas detectors available in the market with specifications limited to displaying gas levels and requiring manual checks, alongside being relatively expensive. These products lack maintenance services and additional features such as the IoT-based Gas Detector. GDI's promotion strategy includes:

a. Initial distribution through corporate social responsibility (CSR) programs of companies (PT. Pertamina Gas Negara and PT. Pertamina EP Tarakan Field).
b. Emphasis on initial sales prices in the form of discounts.
c. Maximizing social media as a marketing platform for the product (marketing content and occupational health and safety (K3) content).
d. Marketing through official outlets of PT. IoT Energi Tarakan.
e. Participation in product exhibitions and technology expos.
f. Sales through E-Commerce platforms.
g. Socialization and education to the public regarding the importance of fire disaster prevention mitigation.

Figure 8. SMKN 2 Tarakan

Figure 9. Department of Youth and Sports

It is a socialization and education activity regarding the importance of fire disaster prevention mitigation at SMKN 2 Tarakan and the Department of Youth and Sports Tarakan. GDI has collaborated with various parties through the GDI - IoT-Based Gas Leak Detector Cooperation Forum as a Suitable Technology for Gas Leak Detection in Tarakan City, North Kalimantan.

Here is a list of collaborations between PT. IoT Energi Tarakan and other stakeholders:

a. Tarakan City Government
b. Head of the Tarakan Regional Disaster Management Agency
c. Head of the Tarakan Fire Department
d. PT Pertamina EP Tarakan Field
e. PT Pertamina Gas Negara (Tarakan)
f. PT Asuransi Kredit Indonesia (Askrindo)
g. Borneo University Tarakan
h. Director of STMIK PPKIA Tarakanita Rahmawati
i. Tarakan City Posyantek (Technology Service Post)
j. SMK Negeri 2 Tarakan City (Vocational High School 2)
k. Community Groups (Korlakar or Disaster Volunteers of Tarakan City)

3.9. Cost of Production and Selling Price of Products

Based on the analysis of component purchase prices for the production of an IoT-Based Gas Leak Detector without backup power, which amounted to IDR 139,000, the team has estimated the selling price by adding a profit margin of 44%. Thus, the selling price per unit reaches IDR 200,000. This process involves thorough calculations of the cost of production and profit strategies that align with the added value provided by this product. With the set selling price, it is expected to cover production costs and provide a sufficient profit margin to support the sustainability of the business and product development in the future. Thus, this pricing strategy not only reflects the product's value financially but also considers the economic factors that play a role in the product's success in the market.

In an effort to increase security and protection for users of the IoT-Based Gas Leak Detector device, this product has been integrated with insurance, with an annual cost of Rp. 50,000. Thus, the final selling price is IDR 250,000.00, which is the result of adding together the cost of production, a 44% profit margin, and the annual insurance cost.

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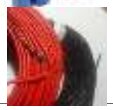
3.10. Specifications of Innovative Technology / Energy Device

Table 3. Components of GDI PT. IoT Energi Tarakan

No.	Item Name	Volume	Tools	Function
1.	Nodemcu ESP8266 V3	1		As the main component of the input tool / device
2.	Buzzer	1		As a sound output generator
3.	Sensor Gas Mq-6	1		As an input receiver / gas leak detector
4.	PCB	1		As a place to organize component parts
5.	Box Packaging	1		As a protector of the component parts
6.	Buck Converter	1		Regulates the voltage of the BLDC motor during braking to match the working voltage of the battery
7.	Tp 4056 Charger	1		The electrical input provides power to the server from the device and charges the battery
8.	18650 Batttery	1		As spare power of gas detector
9.	Cable	1		As a connector for each component of the tool
10.	Battery Case	1		Sebagai tempat dari baterai untuk mengalirkan daya ke otak dari alat
11.	GSM GPRS	1		As a modem module to provide internet connection to the device
12.	Telkomsel IoT Card	1		As a GSM network that can be used to store data and transfer information

3.11. Product Utilization Design

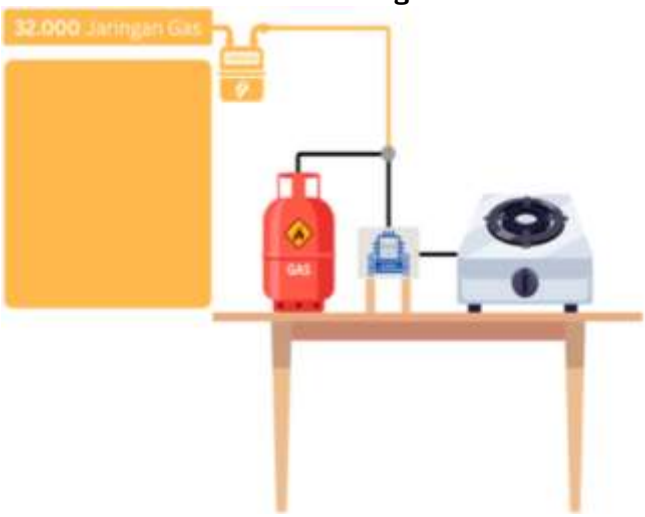


Figure 10. Gas Detector Device Utilization Position Design

Performance of Gas Leak Detector Device on Household Gas Network:

a. The device is placed 50 cm away from the gas pipeline/hose or gas cylinder hose on the gas stove.
b. The sensor detects the gas concentration in the vicinity of the stove.
c. The sensor sends the gas concentration data to the microcontroller.
d. The microcontroller receives data from the sensor.
e. The microcontroller sends the gas data to the database.
f. The application will display the gas concentration data in the database.
g. This information will be sent to the user and service provider.

Figure 11. Gas Detector Device Utilization Position Design

Performance of Gas Leak Detector Device in Oil Well:

a. The device is placed 50 cm away from the oil well.
b. The sensor detects the gas concentration in the vicinity of the oil well.

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c. The sensor sends the gas concentration data to the microcontroller.
d. The microcontroller receives data from the sensor.
e. The microcontroller sends the gas data to the database.
f. The application will display the gas concentration data in the database.

This information will be sent to the user and service provider.

4. Conclusion

The innovation process of GDI involves a series of comprehensive research, development, and testing phases. Laboratory testing at the Faculty of Engineering, Muhammadiyah University of Jember, has shown that GDI functions as expected, providing real-time gas leak detection with high accuracy. The integration of IoT technology allows this device to transmit data directly to users and service providers, ensuring quick and precise responses in emergency situations.

The innovation process of GDI involves a series of comprehensive research, development, and testing phases. Laboratory testing at the Faculty of Engineering, Muhammadiyah University of Jember, has shown that GDI functions as expected, providing real-time gas leak detection with high `1`accuracy. The integration of IoT technology enables this device to transmit data directly to users and service providers, ensuring quick and accurate responses in emergency situations.

GDI significantly reduces the risk of gas leak-related fires by providing early warnings to users and relevant parties, including PT. Pertamina Gas Negara. The presence of this device enables preventive actions and swift responses, thereby reducing the potential for greater damage and danger. Additional features such as gas, smoke, and fire sensors, along with an automatic water sprinkler system, provide an extra layer of protection.

With early gas leak detection, GDI helps reduce repair and maintenance costs. This device enables the identification of issues at an early stage, allowing repairs to be carried out before damages escalate. This not only saves costs but also empowers businesses and the general public to take corrective actions independently with guidance from the device. Periodic checking features and additional insurance provide users with assurance and peace of mind.

In conclusion, GDI is an innovative solution that increases the safety and security of natural gas usage. This product not only provides direct protection against the dangers of gas leaks but also contributes to improving the quality of life and the environment in Tarakan City and its surroundings. This success reflects the outcome of research, development, and a strong commitment to technological innovation that has a tangible impact on society.

For the future GDI can be improved with integrating water sprinklers and fans into home vents. These tools not only offer early warnings but also provide immediate preventive actions during emergencies. The fan can expel leaking gas from the home, while the water sprinkler can help extinguish fires and cool down affected areas. This improved version is highly recommended for businesses or communities with a high risk of fire.

5. Acknowledgments

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3) Head of the Tarakan Fire Department (PMK), for his cooperation 12 / 12 security and fire prevention aspects.
4) PT Pertamina EP Tarakan Field, for the technical support and resources that are provided. \
5) PT Pertamina Gas Negara (Tarakan), for cooperation in providing data and coordinating with customers.
6) PT Asuransi Kredit Indonesia (Askrindo), for insurance support in this project.
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We hope that the results of this research can provide great benefits to the people of Tarakan City and be the first step in developing IoT-based technology for community security and safety.

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