# Empowerment of energy communities in minggir II village yogyakarta with iot-based biodigeser

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## ABSTRACT

In the Minggir Village, there is a Biogas School called Mitra Sarana Energi which is a biogas school UKM located in Minggir Village, Sendangagung Village, Minggir District, Sleman Regency, Special Region of Yogyakarta. The biogas school UKM has been conducting training activities on the manufacture and use of the biogas since 2012. Actually, the UKM has a large enough market opportunity to manage and sell the biogas. However, this opportunity brings consequences and problems, namely the lack of a touch of innovation from the biodigeser remote monitoring system. The implementation team tried to offer solutions to these problems with a touch of science and technology, namely through designing remote monitoring of gas levels and pressures with IoT technology. This monitoring tool system aims to monitor (monitoring) the process of making biogas production from organic waste by detecting gas levels produced from the biodigester, namely methane gas (CH4), carbon dioxide gas (CO2), hydrogen gas (H2), and gas pressure. The system is designed with an ESP32 controller board and MQ4, MQ8, MQ135 gas sensors and MPX10DP gas pressure sensors combined with the Internet of Things (IoT) feature which is then connected to the Blynk app on the cellphone, so that it can be monitored from anywhere and anywhere with the help of a connection. stable internet. The test results obtained that this tool is capable of measuring and monitoring data on monitoring levels of methane gas, CO2 gas, hydrogen gas and gas pressure.

KEYWORDS
Biogas;
Methane gas (CH4);
Carbon dioxide gas (CO2);
Hydrogen gas (H2);
Gas pressure



## 1. Introduction

Minggir is a sub-district in Sleman Regency, Yogyakarta Special Region Province, Indonesia. Minggir District is located in the western part of Sleman Regency. The Minggir Subdistrict Center is located in the Sendangagung Village area, located on Jalan Kebonagung, 50 meters from the Sendangagung Village Office in the south, 50 meters from Kebonagung Market in the west, and 200 meters to the north is a Puskesmas that provides health services for the people of the Subdistrict. Minggir in particular, and people outside the Minggir sub-district. In the village of Minggir, there is a Biogas School that makes a biodigester called Mitra Sarana Energi located in Sleman Regency, precisely in Minggir Village, Sendangagung Village, Minggir District, Sleman Regency, Special Region of Yogyakarta. Biodigester is a tool used to convert organic waste into biogas.

Several studies on biodigesters that support community empowerment, namely the key criteria for considering decentralization in municipal wastewater management, were investigated by Bernal [1]. A multi-criteria analysis of municipal solid waste treatment technology to support decision making in Kisumu, Kenya was investigated by Capuano [2]. Increasing the rate of food waste biodegradation in food waste biodigesters with the synergistic action of co-inoculation of Bacillus paralicheniformis GRA2 and Bacillus velezensis TAP5 producing hydrolase was investigated by Roslan [3]. A scenario analysis based on the dynamics of the residential solid waste management system in Kisumu, Kenya was studied by Dianati [4]. The perspective on the efficacy of green gas production through technology integration in a new bio-circular cascade system was investigated by Lin [5]. Biomass in biogas production: Pretreatment and codigestion investigated by Kasinath [6]. The application of biomagnetic nanoparticles for bio stimulation of biogas production from wastewater treatment was investigated by Kweinor Tetteh [7]. The problem of the location of the biodigester, its economic-environmental-social aspects and techniques: Areas that have not been explored are studied by Jesus [8]. Biogas production from bagasse with South African industrial wastewater and a new kinetic study using the response surface methodology was investigated by Armah [9]. The relevance of biogas technology to the Vhembe district of Limpopo province in South Africa was investigated by Rasimphi [10].

Methane production through anaerobic digestion of tropical fruit biomass and municipal solid waste was investigated by Romero [11]. Combined modeling of design and investment parameters for optimal operation of methane bioreactors: An achievable area concept approach was investigated by Abunde Neba [12]. Lessons from Bali for small-scale biogas development in Indonesia were studied by Silaen [13]. The choice of a biogas-based polygeneration plant utilizing dairy cattle waste: The case of Bolivia studied by Villarroel-Schneider [14]. Comparison of the potential of methane obtained with anaerobic codigestion of municipal solid waste and lignocellulosic biomass was studied by Romero [15]. Barriers and opportunities of the bioenergy transition: An integrated multi-level perspective analysis of biogas uptake in Bali was investigated by Bößner [16]. Effect of sono-assisted modified precipitation on crystallinity, size, morphology, and catalytic application of hematite (α-Fe2O3) nanoparticles: A comparative study was investigated by Fouad [17]. The contextual structure and dynamics of interactions in the Brazilian Biogas Innovation System were investigated by De Oliveira [18]. Life Cycle Engineering in the Industrial Engineering undergraduate program, from the classroom to the real life of students is researched by Ortegon [19]. Analysis of Zimbabwe's biodigester status was investigated by Kajau [20].

From previous research, it can be seen that the biodigester has not been monitored by remote technology using IoT. Several studies on IoT that support this community empowerment program include integrated urban water management with micro-storage which was developed as an IoT-based solution researched by Oberascher [21]. Passenger BIBO detection with IoT support and machine learning techniques for intelligent transportation systems was investigated by Mastalerz [22]. Application of Haze Computing During Hajj Season: A Proposed Framework researched by Alraddady [23]. Avoiding the internet from unsafe industrial matters is researched by Urquhart [24]. The analysis of internet reliability of things using the Space Fault Network was researched by Li [25]. The application of the Internet of Things in academic buildings for efficient use of space using occupancy and booking data was researched by Azizi [26]. Smart Logistics in Smart City development was researched by Korczak [27]. The algorithm for better estimation of ETA and its potential impact on supply chain decision making was investigated by Urciuoli [28]. Optimizing the use of actor-based system resources is researched by Nguyen [29]. New Edge architecture for AI-IoT service deployments in dresearched by Debauche [30].

A hierarchical and scalable architecture for a real-time monitoring system for electrocardiography, using contextual computing was researched by Malekian [31]. Apply forget about wireless sensor networks for mobile applications researched by Todolí-Ferrandis [32]. A lightweight cryptography framework (LWC) for securing heap memory in the Internet of Things was researched by Khalifa [33]. An IoT-

enabled communication system in a test environment was investigated by Hellbach [34]. Towards Prediction of System Disruptions in Industry 4.0: A Machine Learning-Based Approach researched by Brik [35]. Welcome to the forensic almond smart home hub researched by Awasthi [36]. A reconfigurable frequency domain antenna for COVID-19 tracking was investigated by Akinola [37]. A scalable edge cloud platform for IoT services was researched by Sonkoly [38]. Smart Contracts and the Internet of Things: Qualitative Content Analysis using the Technology-Organization-Environment Framework to Identify Key Determinants researched by Schmitt [39]. Video big data in smart cities: Background construction and optimization for surveillance video processing researched by Tian [40]

The UKM Mitra Sarana Energi has conducted training activities on the manufacture and use of biogas. This biogas school has been led by Mr. Suyono since 2012. Actually, Mr. Suyono has a large enough market opportunity to manage and sell the biogas. However, this opportunity brings consequences and problems, namely the lack of a touch of innovation from the biodigester remote monitoring system.

## 2. Method

There are two methods of planning activities in order to implement the solutions offered for community empowerment programs, namely tool design and tool installation.

### 2.1. Tool Design Method

The design of the biodigester remote monitoring tool is shown in Fig. 1. The Fig. 1 shows that the esp32 microcontroller is used to read the sensor. The MPX10DP sensor is used to read gas pressure. The MQ4 sensor is used to measure levels of CH4 methane gas. The MQ12 sensor is used to read gas levels of NH3, NOx, alcohol, benzene, and CO2. The MQ8 sensor is used to read hydrogen gas levels.

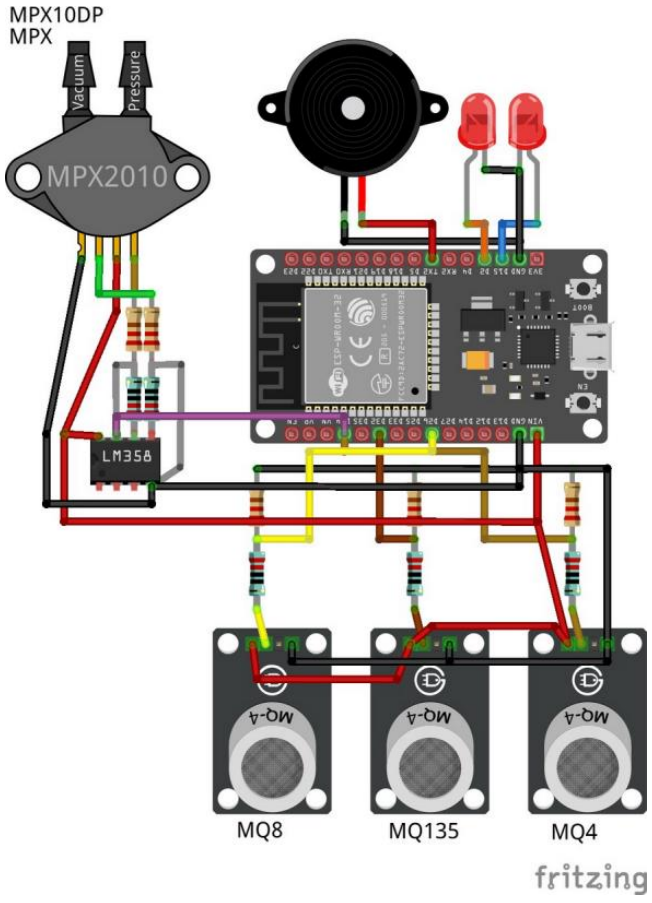


**Fig. 1.** Biodigester remote monitoring design

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### 2.2. Tool Installation Method

Methods of equipment installation activities include site surveys, coordination with biogas owners, installation of biodigester monitoring equipment, and remote testing. The first activity is a site survey that aims to find out the problems faced by partners, namely the biogas monitoring process. MSME partners cannot know the ammonia (CH4) level, they can only know the gas pressure. Methane gas is used to start gas stoves. Even though the pressure is large but the biogas content is small, the stove does not turn on. The second activity is coordination with the owner. This activity aims to install a remote biodigester monitoring device. The third activity is the installation of biogas monitoring equipment. The last activity is remote monitoring of biogas levels.

## 3. Results and Discussion

This community service activity program involves partners in the Minggir Village. In the village there is a Biogas School that makes a biodigester called Mitra Sarana Energi located in Sleman Regency, precisely in Minggir Village, Sendangagung Village, Minggir District, Sleman Regency, Yogyakarta Special Region. The method of implementing community service and empowerment has four steps, namely the first step in this program is a survey of the initial location whose purpose is to find out the problems and potentials that exist in MSME partners in energy facilities. The initial location survey was carried out on February 20, 2021 and was attended by the entire service team as shown in Fig. 2. The Fig. 2 shows that the UMKM partners in energy facilities have cowsheds.

**Fig. 2.** Survey of the location of MSME partners for energy facilities

The second step is to coordinate with MSME partners, Mitra Sarana Energi on March 16, 2021, which is shown in Fig. 3. From Fig. 3, we are met by the wife of the owner of the energy facility partner. We coordinate to install gas monitoring and gas pressure.

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**Fig. 3.** Coordination with MSME partners of energy facilities

The third step is to install pressure monitoring and gas levels in the biodigester on March 20, 2021, as shown in Fig. 4. The Fig. 4 shows that monitoring gas pressure and gas levels with IoT is installed near the manual gas pressure monitoring tool near the gas stove.


**Fig. 4.** Installation of a biodigester monitoring device

The fourth step is a trial of monitoring gas levels and gas pressure using IoT as shown in Fig. 5. The Fig. 5 shows that the pressure level and gas content decrease. This is because the biodigester reactor tube

lacks food waste and cow dung. With this remote monitoring, the owner of the biodigester can refill the biodigester reactor.

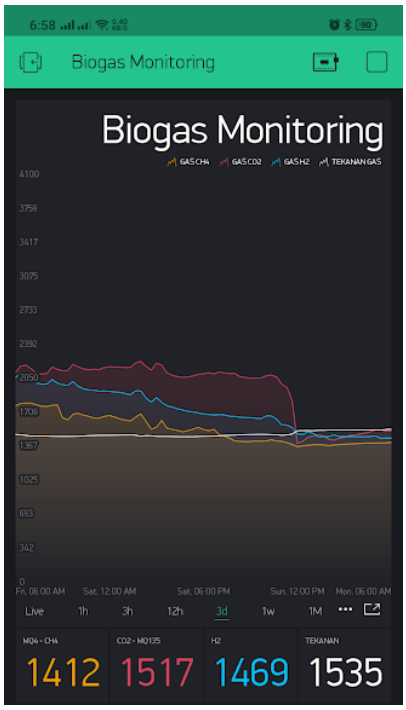


**Fig. 5**. Biodigester remote monitoring

## 4. Conclusion

The conclusions that can be drawn from PKM activities for community empowerment in the installation of gas monitoring equipment at Mitra Sarana Energi located in Minggir Village, Sendangagung Village, Minggir District, Sleman Regency, Yogyakarta Special Region are as follows, the first activity of the initial location survey was carried out on 20 February 2021 and participated by the entire service team. The second step is to coordinate with MSME partners Mitra Sarana Energi on March 16, 2021. The third step is to install pressure monitoring and gas levels in the biodigester on March 20, 2021. The fourth step is a trial of monitoring gas levels and gas pressure using IoT. From this community empowerment activity program, it can be seen that this program is successful because it can monitor gas pressure and ammonia gas levels used to turn on gas stoves.

## Author Contribution

All authors contributed equally to the main contributor to this paper. All authors have read and agreed to the published version of the manuscript.

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## Conflict of Interest

The authors declare no conflict of interest.

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