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Auto Control and Monitoring of Biogas Plant by using LabVIEW

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Abstract: *This paper titled as, "Auto Control and Monitoring of Biogas Plant using LabVIEW Software" addresses the presenting need for enhanced efficiency, reliability, and sustainability in biogas production. The study explores innovative control algorithms and automation strategies to improve biogas production processes. Also, it demonstrates the feasibility and benefits of automating biogas production processes through Lab VIEW software successfully. The results suggest that this approach could serve as a scalable model. The future developments for global improvement in biogas plants can be taken care of, with LabVIEW automating biogas plants for increased operational efficiency and safety. It can be found from the results that key performance metrics like real-time monitoring, effectiveness of control algorithm, and user interface responsiveness reveal that the system has the potential to optimize the biogas production process.*

Keywords: Biogas Plant Automation, Remote Monitoring LabVIEW Software, Efficiency, Control Algorithms

I. INTRODUCTION

The growing international demand for renewable energy alternatives has been the driving force behind a strong movement towards using renewable energy resources, with biogas proving to be an effective option [1]. Biogas, generated from the anaerobic digestion of organic waste, is not only a renewable source of energy but also helps to manage waste and promote environmental sustainability [4]. Nevertheless, conventional methods of biogas production are commonly associated with drawbacks concerning efficiency, process control, and resource allocation [7]. To mitigate these issues, automation and monitoring systems have been increasingly integrated [5].

II. METHODOLOGY

The research methodology of the "Auto Control and Monitoring of Biogas Plant Using LabVIEW Software" project is organized into various important elements: system planning, integration of LabVIEW, design of the control algorithm, static analysis, and selection and integration of sensors [2]. All these elements are very important and contribute to the successful integration of the automated system

2.1. System Planning

The first step involves understanding the functional requirements of the biogas plant and identifying parameters that need to be monitored and controlled [5]. The system is designed to:

- Monitor temperature, gas level, and digester level.
- Automate gas output control using a solenoid valve.
- Provide real-time visualization via LabVIEW SCADA.
- Send alerts through email notifications in case of anomalies.

2.2. Integration of LabVIEW

LabVIEW software is selected as the central monitoring and control platform due to its graphical programming capability, real-time data acquisition, and SCADA integration. The key steps include:

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- Used for data acquisition and control system integration.
- Provides a user-friendly graphical interface for real-time monitoring and control

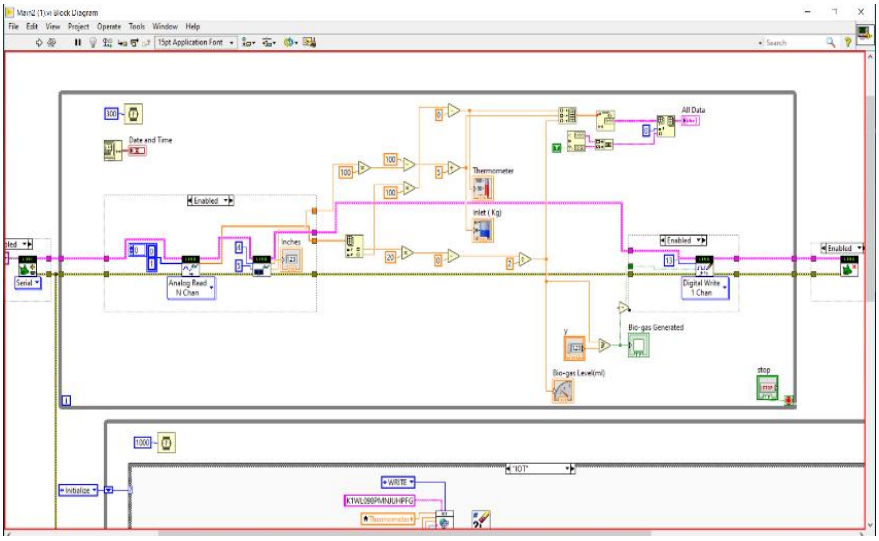

Fig.1. Lab VIEW Software Integration

2.3 Design of the Control Algorithm

The control algorithm is designed to:

- Process real-time sensor data.
- Trigger the solenoid valve to release gas when the pressure exceeds a threshold.
- Send email alerts if temperature or gas levels cross unsafe limits.
- Enable automatic reset of the system after error conditions are resolved.

2.4 Static Analysis

Static analysis involves testing the system in a controlled environment before deployment. This includes:

- Calibrating sensors to ensure accurate readings.
- Simulating different biogas plant conditions to validate the control logic.
- Ensuring smooth integration between LabVIEW, sensors, and actuators.

2.5 Selection and Integration of Sensors

The selection of sensors is crucial for accurate data acquisition. The chosen components are [8]:

- LM35 Temperature Sensor – Monitors digester temperature for optimal gas production.
- MQ2 Gas Sensor – Detects methane levels to ensure safety and efficiency.
- Ultrasonic Sensor – Measures digester liquid levels to track biogas production.
- Solenoid Valve – Controls gas output based on monitored parameters.

Table -1: Components and Uses

1)Temperature Sensor: Monitors temperature Crucial for microbial activity and biogas yield.	2) Gas Flow Sensor: Measures the flow rate of biogas, essential for process control

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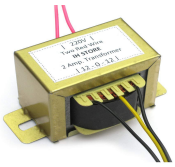
3) Ultrasonic Sensor: Show digester feedstock levels for optimal digestion	4) Solenoid valve: Control Gas output
	
5)Arduino UNO R3: Microcontroller To Control Logical operation	6) Power Supply: Input Power to the Controll Circuit.
	

Fig. 2: Sensors and Microcontroller

2.6 SCADA User Interface

- Designed for ease of use, allowing operators to interact with the system effectively.
- Ensures accessibility for users with varying levels of technical expertise.

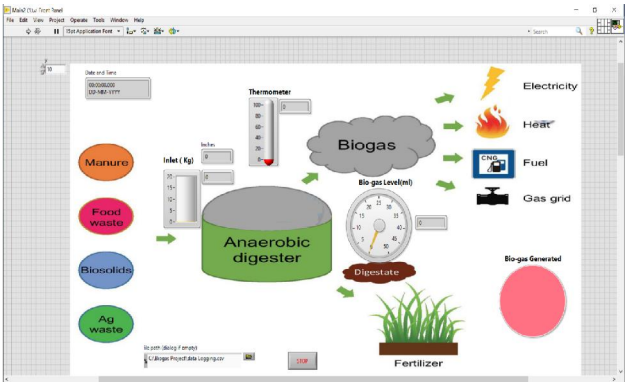


Fig.3: SCADA System User Interface

2.7 Data Logging System:

- Capable of handling large volumes of data with efficient storage and retrieval
- Ensures accurate analysis of logged data for performance monitoring

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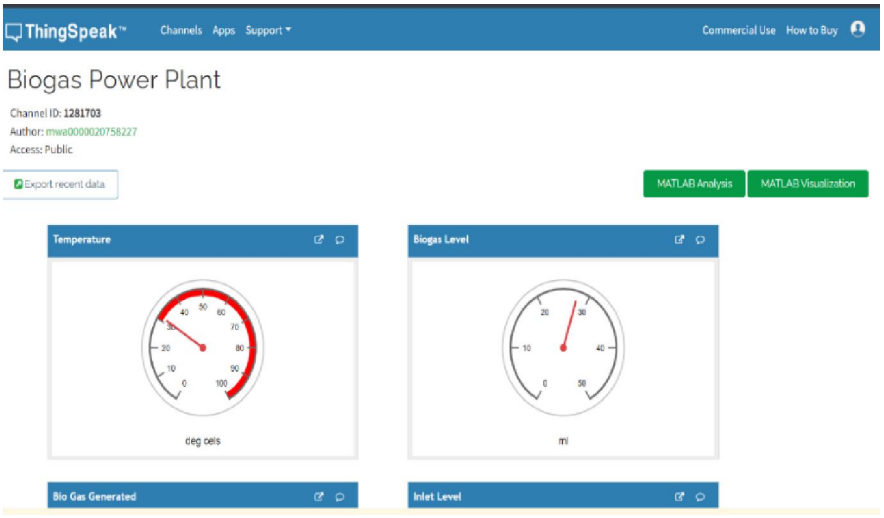

Fig.4: Data Logging.

2.8 Alerts and notification:

- Provides immediate E-mail alerts for abnormal conditions or system failures
- Includes visual indicators and audible alarms for on-site personnel

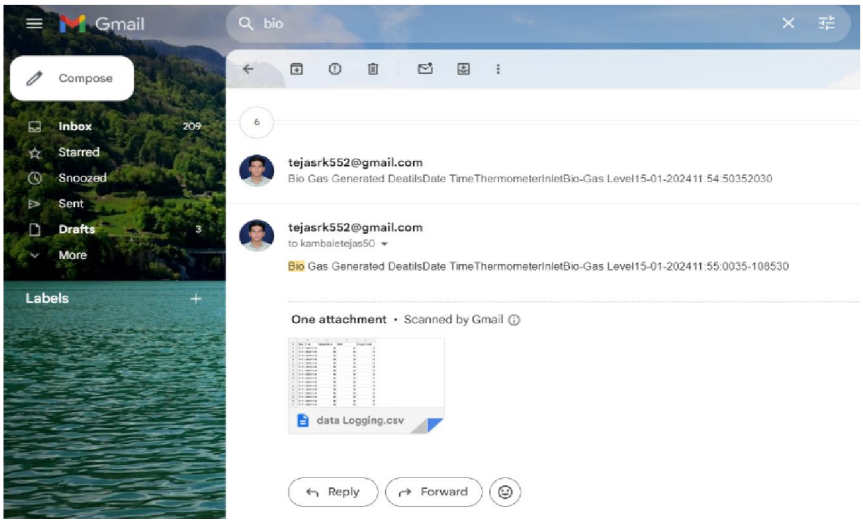

Fig.5: Alert and notification through E-mail.

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III. SYSTEM FLOWCHART

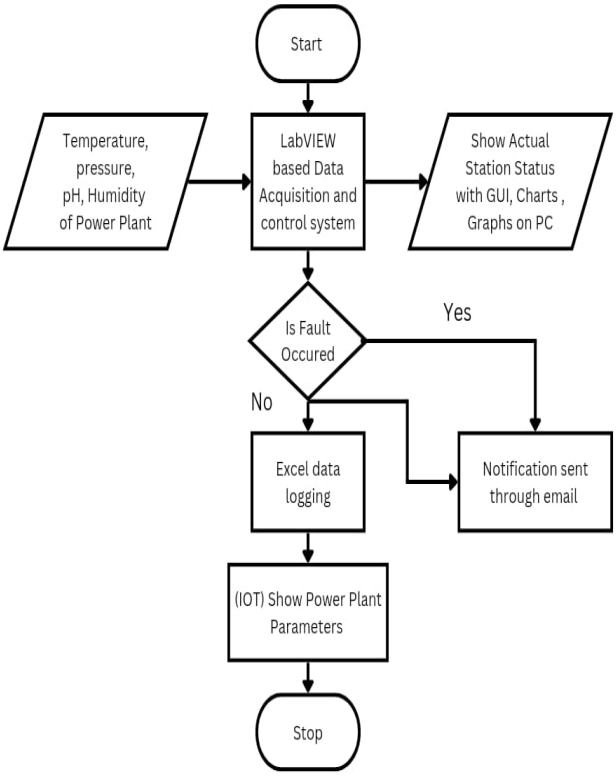

Fig.6: System Flow chart

IV. RESULT

The implementation of the "Auto Control and Monitoring of Biogas Plant Using LabVIEW Software" has yielded significant results and benefits, enhancing the overall efficiency and sustainability of biogas production processes. The following key outcomes have been observed:

Increased Biogas Production Efficiency

The automated system has led to a measurable increase in biogas production efficiency. By optimizing operational parameters through real-time monitoring and control, the system has improved the conversion rates of organic waste into biogas, thereby maximizing energy output.

Enhanced Resource Utilization

The project has effectively utilized available resources, such as organic waste, leading to a more sustainable approach to biogas production. The integration of advanced control algorithms has allowed for better management of feedstock input, ensuring that resources are used efficiently and waste is minimized.

Real-Time Monitoring and Control

The system provides continuous real-time monitoring of critical parameters, including temperature, pH, pressure, and gas flow rates. This capability allows operators to make informed decisions quickly, ensuring optimal conditions for anaerobic digestion and reducing the risk of operational failures.

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V. CONCLUSION

The "Auto Control and Monitoring of Biogas Plant using LabVIEW Software" article is a milestone achievement in the field of sustainable energy management and automation. With the precise use of LabVIEW and advanced control algorithms, this project set out to make biogas production processes more efficient, reliable, and environmentally friendly. From the initial stage of conceptualization to the implementation stage, numerous milestones and learning points have marked the process, leading to a revolutionary solution for the biogas sector. The successful operation of an automated control system has not only maximized biogas production but has also been a factor in environmental preservation.

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BIOGRAPHIES

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	Aishwarya Kulkarni is from Sangamner and is currently pursuing a B.E. in Electrical Engineering at Amrutvahini College of Engineering. She is passionate about learning new technologies and enjoys working on innovative projects. She is dedicated to applying her knowledge to real-world challenges and contributing to the field of engineering through research and practical solutions.
	Chetan W. Jadhao received his degree in Electrical (Electronics & Power) Engineering (B.E.) from S.S.G.M.C.E, Shegaon, India in 2013. He has 10 years of teaching experience and currently working as Assistant Professor in Electrical Department at A.V.C.O.E. Sangamner. He has guided project at U.G, P.G Level. He has more than 20 technical publications in Journal, Conference of International level.