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Intelligent Safety Monitoring System for Oil and Gas Industry Using Myrio and Labview

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ABSTRACT: The integration of advanced sensor systems in the oil and gas industry represents a significant stride towards mitigating the safety risks. This comprehensive report delineates the methodology, integration processes, and wearable device incorporation in enhancing safety monitoring systems. Sensor integration, including atmospheric pressure, temperature, and vibration sensors, is meticulously detailed, emphasizing optimal connection methods and considerations for accurate data acquisition. Leveraging the My RIO as a central hub for data acquisition, signal processing, and control logic execution ensures robust system performance. The report underscores the importance of sensor selection, hardware and software development, system implementation, and rigorous testing to ensure reliability and accuracy. Additionally, it highlights the critical role of data analysis in identifying safety hazards and trends, facilitating informed decision-making. Through innovative technologies and proactive risk management strategies, the integrated sensor system offers scalable solutions for fostering safer industrial environments. Continued research and development in this domain promise further advancements in industrial safety standards and practices.

KEYWORDS: LabVIEW, My Rio, Safety Monitoring, Integrated Sensor System, Real-Time Data Acquisition, Virtual Safety Instrumentation, Alert System

I. INTRODUCTION

Safety is top priority in the Oil and Gas Industry due to its inherent hazards. Robust safety measures are essential to protect workers and assets. Despite safety advancements, the industry faces ongoing challenges. Slow risk detection and response lead to disruption of worker safety. Our approach integrates sensors like pressure and temperature sensors and Wearables with Haptic Feedback. These, along with MYRIO and LABVIEW, form a comprehensive safety monitoring system. Implementing our Integrated Sensor System promises improved worker safety, operational efficiencies, and sets new safety standards in the industry, promoting a safer and sustainable Oil and Gas sector.

Safety monitoring in the Oil and Gas Industry involves the continuous surveillance of various environmental parameters to identify potential safety hazards. Traditional monitoring systems often rely on manual inspections and periodic checks, which can be labour-intensive, time-consuming, and prone to human error. Moreover, these systems are reactive in nature, responding to incidents after they occur rather than preventing them proactively. In contrast, an integrated sensor system offers a proactive approach to safety monitoring by continuously monitoring key parameters such as gas dispersion, temperature variations, and pressure changes in real-time.

Proactive risk management is essential in the Oil and Gas Industry to prevent accidents, minimize downtime, and ensure regulatory compliance. By identifying potential safety hazards before they escalate into critical incidents, organizations can take timely corrective actions to mitigate risks and protect personnel, assets, and the environment. An integrated sensor system enables proactive risk management by providing early warning alerts, actionable insights, and predictive analytics capabilities. By leveraging advanced data processing algorithms, the system can analyze vast amounts of sensor data in real-time, identifying patterns, trends, and anomalies indicative of potential safety risks.

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II. LITERATURE REVIEW

[1] Tiago et al. (2017) developed MyRIO based mobile robot for rescue competitions. They highlighted the design of a robot for autonomous navigation in unfamiliar environments. They have used the Hokuyo laser sensors and sharp IR sensors, which were used to retrieve the lost data from the memory of the robot.

[2] Jualayba et al. (2018) developed the hazardous gas detection and notification systems that detects methane, propane, and hydrogen gases in a room, sending SMS alerts via a GSM module and displaying gas levels on an LCD monitor. Color-coded lamps indicate gas concentration, a siren alerts of a leak, and an exhaust fan reduces gas levels

[3] Chattal et al. (2019) monitored PLC hardware with LabVIEW software for industrial control. PLCs managed tasks like chemical mixing and manufacturing, with the LabVIEW panel displaying and controlling operations. There setup streamlined maintenance and allowed for quick design changes in LabVIEW. The system efficiently controlled variables like temperature and mixing, replacing traditional devices and reducing costs. Overall, they demonstrated effective process automation and potential for industry - wide improvements

[4] Srikanth et al. (2019) employed LabVIEW, Multisim and MyRIO to model and design a level measurement system. They verified mathematical models and integrated electrical circuit simulations, showcasing the combined use of these tools for measurement modelling. Their approach provided the students with practical experience in modelling, simulation and hardware software interfacing through project-based learning.

[5] Suzi et al. (2020) proposed the safety system for detecting and controlling LPG gas leaks from household cylinders. LPG, while clean, posed a risk due to its flammable nature. The system used a sensor to detect leaks and had lights and a buzzer for local alerts. It could also send alerts remotely through a mobile app called Blynk. If the gas level rose too high, a motor shut off the gas supply. All of this was controlled by a special Wi-Fi-enabled device called NodeMCU ESP826.

III. PROPOSED SYSTEM

This paper proposes an integrated sensor system that addresses the limitations of traditional monitoring methods and offers a more comprehensive and proactive approach to safety in the oil and gas industry. The core components of the system are:

Sensor Network: A strategically deployed network of various sensors chosen for their effectiveness in monitoring critical parameters:
MQ Series Gas Sensors: These versatile sensors offer detection capabilities for a wide range of gases commonly encountered in the oil and gas industry, such as methane, hydrogen sulfide, and carbon monoxide.

DS18B20 Temperature Sensors: These sensors provide continuous temperature monitoring of equipment, enabling early detection of overheating and potential equipment failures.

SW-18010P Vibration Sensors: These sensors monitor equipment vibration, allowing for identification of potential mechanical issues and facilitating predictive maintenance practices.

Force Sensing Resistors (FSRs): These sensors can be strategically placed to monitor pressure levels in pipelines and storage tanks, aiding in leak detection and preventing catastrophic ruptures.

Data Acquisition System: The NI MYRIO 1900 serves as the data acquisition system. This compact and versatile device facilitates real-time data collection from the sensor network and ensures reliable transmission to the processing unit.

Data Processing and Analysis Platform: LabVIEW, a graphical development environment, acts as the central platform for receiving, processing, and analysing sensor data. Within LabVIEW, a virtual safety instrumentation system is programmed to:

Visualize Real-Time Data: The system provides a clear and intuitive graphical representation of current safety conditions across the facility, allowing for quick identification of anomalies.

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Perform Data Analysis and Machine Learning: Data analysis techniques and potentially machine learning algorithms can be integrated to identify abnormal patterns and trends, predict potential threats before they escalate, and enable predictive maintenance practices.

Generate Alerts: The system can be programmed to trigger automatic alerts for exceeding pre-defined safety thresholds, prompting immediate response from personnel.

IV. METHODOLOGY

This section outlines the development and implementation of the integrated sensor system for real-time safety monitoring in the oil and gas industry. The methodology can be divided into the following stages:

Sensor Selection and Network Design

Identify critical parameters to be monitored based on safety risks in the oil and gas environment (e.g., presence of flammable and toxic gases, equipment temperature, vibration levels, pressure in pipelines). Select appropriate sensors for each parameter, considering factors like sensor range, sensitivity, accuracy, and environmental compatibility (e.g., mq series gas sensors for various gases, ds18b20 temperature sensors, sw-18010p vibration sensors, and force-sensing resistors (fsrs) for pressure monitoring). Design the sensor network topology considering factors like spatial coverage, data transmission requirements, and potential obstacles. This may involve a combination of wired and wireless sensors depending on the application.

Data Acquisition System Setup

Select a data acquisition system capable of collecting data from various sensors and transmitting it reliably to the processing unit. In this case, the NI MYRIO 1900 is used for its compact design and real-time data acquisition capabilities.
Configure the data acquisition system to communicate with the chosen sensors using appropriate protocols (e.g., serial communication, analog input). Develop a program to manage data collection from the sensors, ensuring proper data formatting, labeling, and time synchronization.

Data Processing and Analysis Platform Development

Utilize LabVIEW, a graphical development environment, to design the virtual safety instrumentation system and alert system. Program LabVIEW to receive sensor data from the data acquisition system. Develop data visualization tools within LabVIEW to provide a clear graphical representation of real-time sensor data (e.g., gauges, charts, trends).
Integrate data analysis algorithms or machine learning techniques (if applicable) into LabVIEW to analyse sensor data for anomaly detection, pattern recognition, and predictive maintenance purposes. Program an alert system within LabVIEW to trigger notifications for exceeding pre-defined safety thresholds or abnormal sensor readings. These alerts can be visual (on-screen displays), audible (alarms), or automated actions (e.g., equipment shutdown).

System Testing and Deployment

Conduct thorough testing of the entire system in a controlled environment to ensure accurate sensor readings, reliable data transmission, proper functionality of the virtual safety instrumentation system, and effectiveness of the alert system.
Refine and troubleshoot any identified issues in the system before deployment. Deploy the integrated sensor system in the oil and gas facility, strategically placing sensors at designated locations based on the network design. Train personnel on the operation and functionality of the system, including how to interpret the data visualizations and respond to system alerts.

System Maintenance and Improvement

Establish a regular maintenance schedule for the sensor network, including sensor calibration, data acquisition system checks, and software updates for the LabVIEW platform. Continuously monitor the system's performance and effectiveness in identifying safety threats. Based on operational data and feedback from personnel, refine the system by optimizing sensor placement, improving data analysis algorithms, or incorporating new features into the virtual safety

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instrumentation system. Figure 1 shows Methodology of safety instrumentation system which was proposed. Figure 2 shows the block diagram of sensor integration.

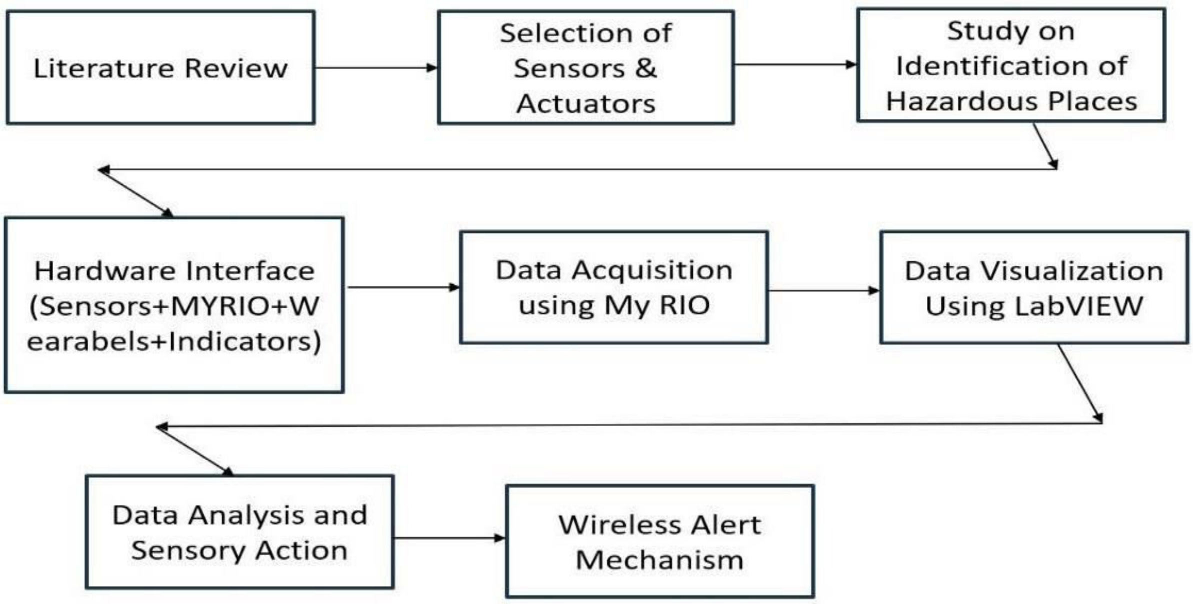

Figure 1: Methodology of safety instrumentation system in oil and gas industry

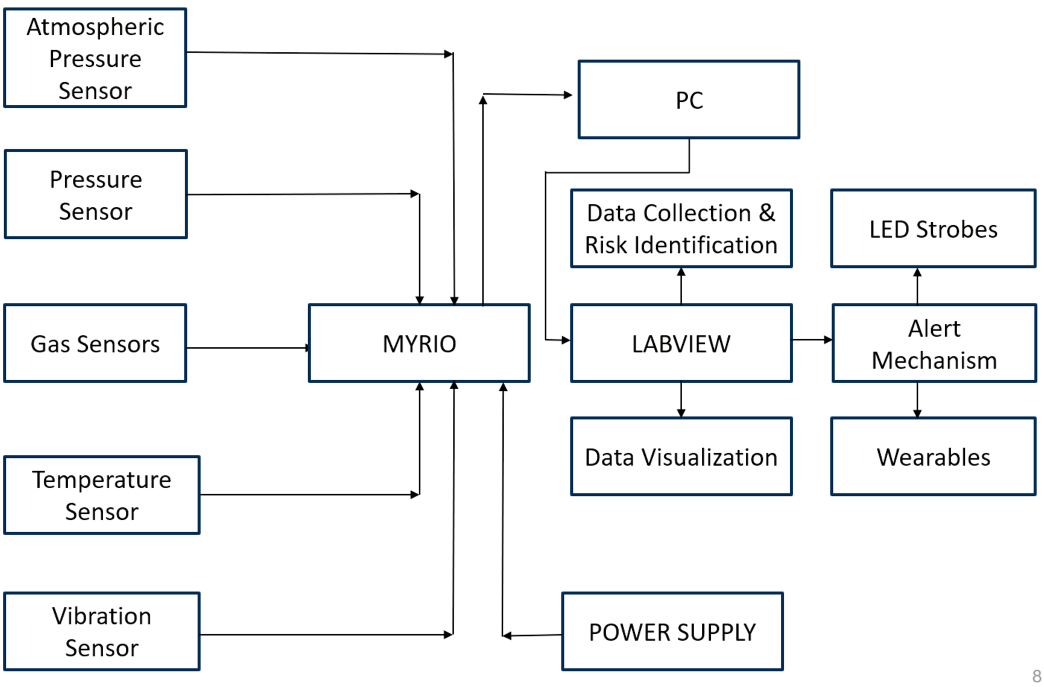

Figure 2: Sensor Integration

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Sensor Integration:

An integrated sensor system combines various components to function as a unified safety monitoring solution. Here's a breakdown of the key integration aspects in the proposed system:

Gas sensors can be serially connected or integrated using an analog bus depending on the chosen communication protocol. Temperature sensors typically utilize a digital or analog output format for integration with the data acquisition system. Similar to temperature sensors, vibration sensors often provide digital or analog output for seamless integration. Pressure sensors (force-sensing resistors) might require signal conditioning circuits to convert their raw signal into a voltage suitable for the data acquisition system.

Data Acquisition and Processing Integration: The NI MYRIO 1900 data acquisition system plays a vital role in integrating sensor data. It should be configured to data from various sensors using compatible communication protocols (e.g., serial communication for some gas sensors, analog input for temperature and vibration sensors). Synchronize data streams from different sensors to ensure accurate correlation of readings with real-time events. Transmit the collected data seamlessly to the LabVIEW platform for processing and analysis.

Software Integration: LabVIEW serves as the central integration platform for data visualization, analysis, and safety monitoring functionalities. Key integrations within LabVIEW include:

Real-time data visualization: LabVIEW should be programmed to acquire sensor data from the NI MYRIO 1900 and translate it into user-friendly graphical representations like gauges, charts, and trends. These visualizations provide a holistic view of current safety conditions across the facility.
Data analysis and anomaly detection: Data analysis algorithms or machine learning models can be integrated into LabVIEW to analyse sensor data for patterns, deviations from normal operating conditions, and potential anomalies indicative of safety threats. Alert system integration: An alert system should be programmed within LabVIEW to trigger notifications when sensor readings exceed pre-defined safety thresholds or anomaly detection algorithms flag potential issues. These alerts can be visual (on-screen displays), audible (alarms), or automated actions (e.g., equipment shutdown procedures).

V. EXPERIMENTAL RESULTS

Our sensor system, employing MQ series gas sensors, DS18B20 temperature sensors, SW-18010P vibration sensors, and force-sensing resistors for pressure measurement, was successfully integrated with the NI MYRIO 1900 for data acquisition. LabVIEW served as the platform for developing a virtual safety instrumented system and alert mechanism.

LabVIEW's real-time visualization enabled instant monitoring of environmental parameters, including gas concentrations, temperature, vibration levels, and pressure. Thresholds set for each parameter facilitated automatic alerts within the LabVIEW GUI when values exceeded or fell below safe limits. This integrated approach improved situational awareness and enabled swift responses to safety hazards, enhancing safety protocols in the oil and gas industry.

Figure 3 Shows Sensor Integration with My Rio. Figure 4 Shows when Pressure sensor range is higher & LabVIEW HMI Shows danger mode. Figure 5 When Pressure sensor range is higher & LabVIEW HMI Shows safe mode. Figure 6 shows Real-time outcome with software and hardware interface.

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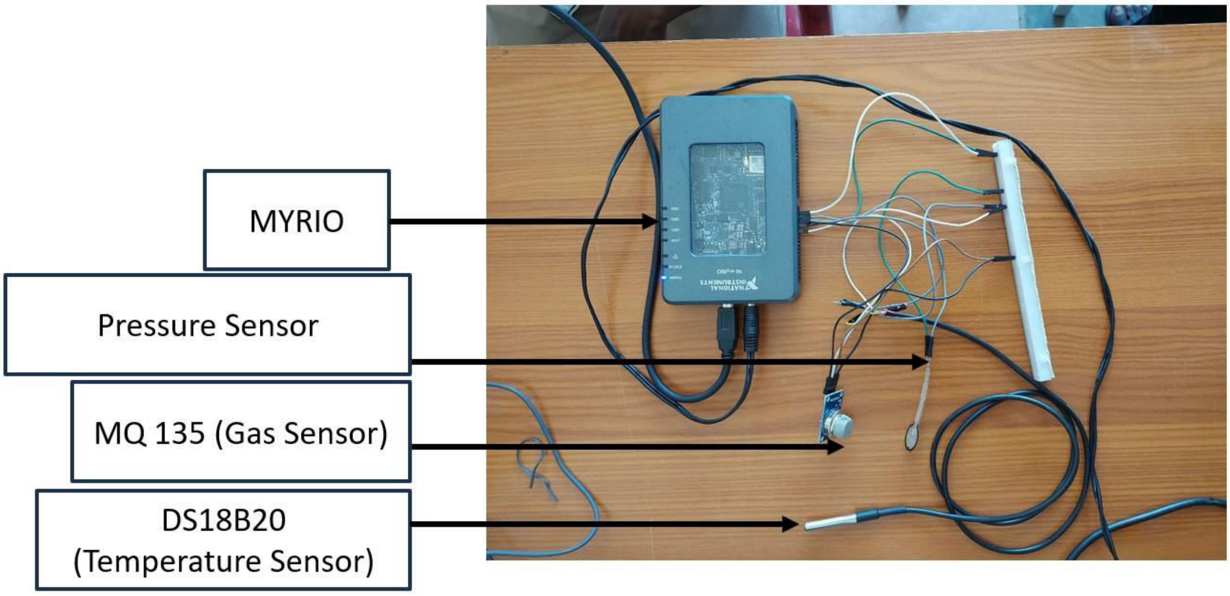

Figure 3: Sensor Integration with My Rio

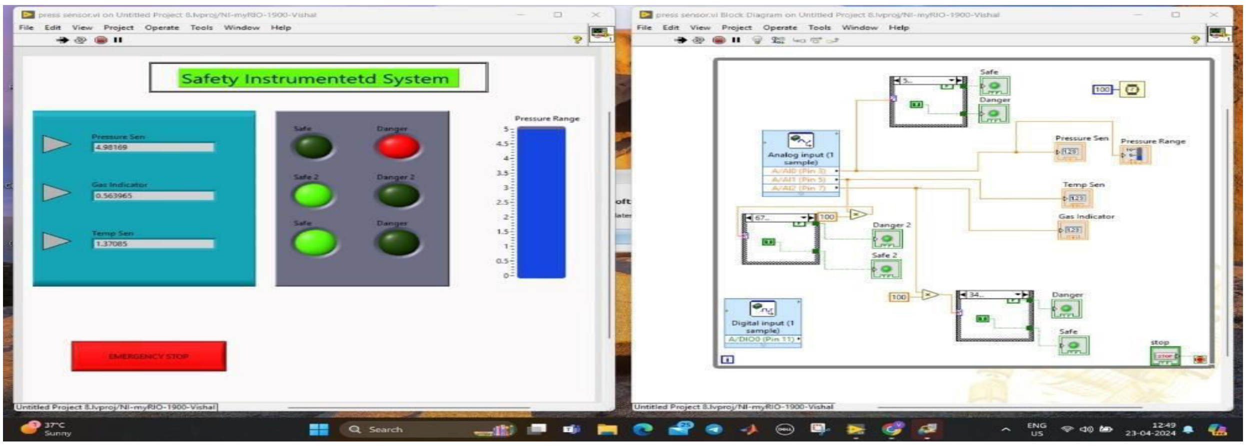

Figure 4: Pressure sensor range is higher & LabVIEW HMI Shows danger mode

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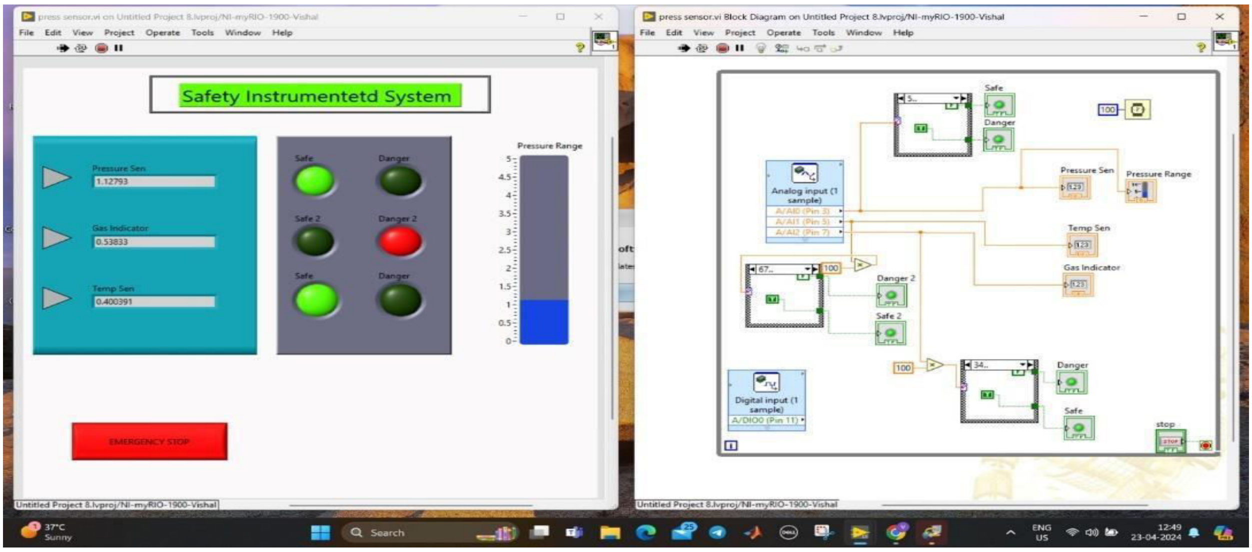

Figure 5: Pressure sensor range is higher & LabVIEW HMI Shows safe mode

Figure 6: Real-time outcome with software and hardware interface

VI. CONCLUSION

The integration of advanced sensor systems, NI MYRIO, and LabVIEW presents a significant advancement in safety monitoring for the oil and gas industry. Through real-time data acquisition and processing, our system enables proactive risk management, enhancing worker safety and operational efficiency. Its seamless integration fosters swift responses to safety hazards, setting new standards for safety protocols in the industry. Continued innovation promises further enhancements, ensuring a safer and more sustainable future for the oil and gas sector.

VII. ACKNOWLEDGEMENT

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REFERENCES

[1] Fadhil, T. Z. (2017). Wireless Control and Monitoring of Industrial Processes by AVR and LabVIEW. Journal of University of Human Development, 3(2),855861.https://doi.org/10.21928/juhd.v3n2y2017.pp85 5-861

[2] Tomoloju V , Usikalu1M R , Ayara W A and Obafem N L (2020), Design and implementation of a smart watch, doi:10.1088/1757- 899X/1036/1/012061

[3] Ng.K.M, Haziq Mohd Suhaimi M.A, Ahmad A and Razak N.A, "Remote Air Quality Monitoring System by Using MyRIO-LabVIEW," 2018 9th IEEE Control and System Graduate Research Colloquium (ICSGRC), Shah Alam, Malaysia, 2018, pp. 105-109, doi: 10.1109/ICSGRC.2018.8657501

[4] Sarnin, Suzi & Ametefe, Divine & Naim, Fadzlina & Mohamad, Wan & Ishak, Norlela & Wahab, N. & Ya'acob, Norsuzila. (2020). Liquefied petroleum gas monitoring and leakage detection system using nodemcu ESP8266 and wi-fi technology. Indonesian Journal of Electrical Engineering and Computer Science. 17. 166. 10.11591/ijeecs.v17.i1.pp166-174.

[5] JUALAYBA.M, REGIO.K, QUIOZON.H and DESTREZA.A, "Hazardous Gas Detection and Notification System," 2018 IEEE 10th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment and Management (HNICEM), Baguio City, Philippines, 2018, pp. 1-4, doi: 10.1109/HNICEM.2018.8666358.

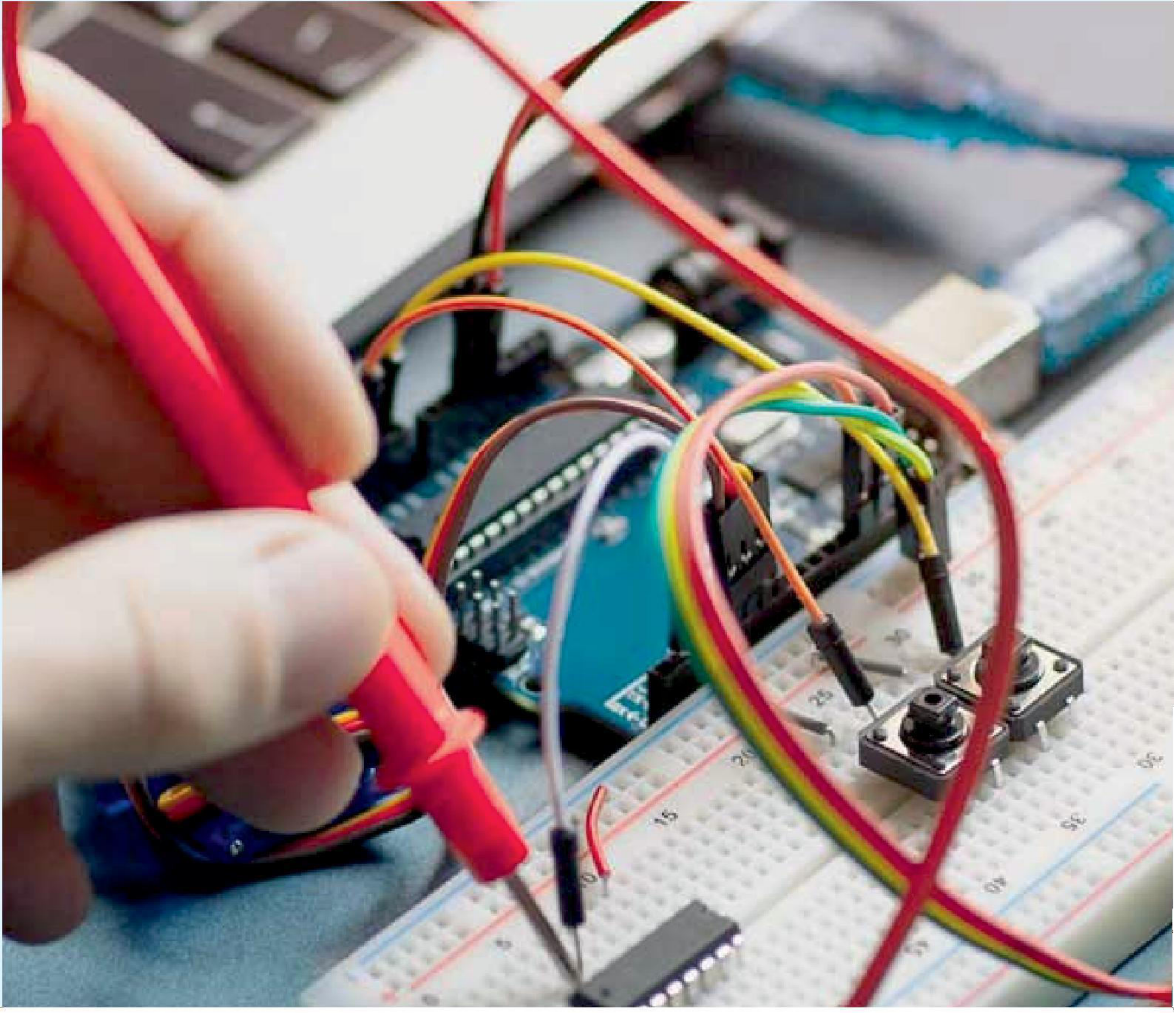
[6] https://jpt.spe.org/iogp-releases-2021-safety-data

[7] Caldeira, Tiago & Al Remeithi, Hamad & Raeesi, Ibrahim. (2017). MyRIO based mobile robot for rescue competitions. 172-177. 10.1109/ICARSC.2017.7964071.

[8] Jualayba, Maribelle & REGIO, Kristian & QUIOZON, Harold & DESTREZA, Adrian. (2018). Hazardous Gas Detection and Notification System. 1-4. 10.1109/HNICEM.2018.8666358.

[9] Chhattal, Muhammad & Madiha, Hina & Bhan, Veer & Ahmed, Shoaib. (2019). INDUSTRIAL AUTOMATION & CONTROL TROUGH PLC AND LABVIEW. 10.1109/ICOMET.2019.8673448.

[10] Srikanth, Manam & Kumar, Santhosh & Namineni, Gireesh & Manideep, T.V.N. & HariChandana, B. & Sangeetha, K.. (2019). A Different way of Level measurement for PBL in Education of Students using NI-LabVIEW, Multisim and MyRIO. 1-6. 10.1109/i-PACT44901.2019.8960023.



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