Room Issue Reporting System in Buildings using LabVIEW

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***Abstract*— This project presents a Room Issue Reporting System utilizing LabVIEW, myDAQ, and the TCP protocol to enhance building maintenance efficiency. The system integrates sensors for temperature, humidity, motion, and gas to monitor room conditions, automatically detecting and reporting maintenance issues in real-time. Secure communication between client and server VIs ensures prompt issue reporting and prioritization based on severity. Prototype testing confirms high reliability, accurate issue categorization, and quick response times. This project aims to provide user friendly and seamless experience with LabVIEW interface.**

Keywords— LabVIEW, myDAQ, TCP protocol, client and server

I. INTRODUCTION

In the world of modern building management, it's crucial to quickly and effectively address maintenance issues. To tackle this we have developed a Smart Room Issue Reporting System that uses LabVIEW and myDAQ. This system offers a simple way for people in the building to report problems easily, ensuring that issues get fixed fast, and maintenance runs smoothly. The aim is to create a strong issue reporting system that makes it easy for people to report maintenance problems. By allowing real-time reporting, the system reduces latency and puts the safety and comfort of occupants first.

Our system includes some key aspects like sending instant notifications to maintenance staff, keeping all issue reports in one place, and being able to look at the data. By looking at past trends, maintenance teams can find problems early, use resources better, and save money on maintenance in the long run.

This paper provides an in-depth exploration of the system's architecture, integration with myDAQ and various sensors, and the communication flow between client and server VIs. We also depicted the importance of safety measures when connecting sensors to LabVIEW via myDAQ.

II. BACKGROUND

Author [1] introduce a real-time nurse calling system that leverages IoT technology to prioritize patient feedback. Their system's real-time communication approach serves as inspiration for our LabVIEW-based project, which aims to streamline room issue reporting efficiently.

The implementation of IoT technology in a wireless nurse call system [2], has significantly improved communication in healthcare. This study informs our LabVIEW project, where we aim to enhance room issue reporting by drawing insights from their approach.

Author [3] introduces an automatic nurse call system with rapid response times. Their emphasis on swift issue resolution has inspired our approach to efficient issue reporting and resolution within rooms using LabVIEW.

The evaluation of the ESP8266 Wi-Fi module in nurse call systems [4] aligns with our focus on wireless communication in our LabVIEW-based room issue reporting project, ensuring seamless communication in various room settings.

An innovative non-contact control system for disabled patients [5], has inspired the user-friendly LabVIEW interface we are implementing for issue reporting. This inclusive approach ensures efficient room issue reporting for all users.

Author [6] proposed a RoBERTa-based software issue classification method that leverages advanced language models. This approach informs our LabVIEW project, as we aim to enhance issue categorization and tracking within rooms.

The user-driven design principles for healthcare applications [7] highlight the significance of user-friendliness. This informs our LabVIEW project, emphasizing ease of use for room issue reporting in healthcare settings.

Unattended monitoring systems for transmission core rooms [8], guide our approach to efficient, unattended issue reporting in various room settings using LabVIEW, ensuring safety and stability.

The development of ThingSpeak IoT for room condition monitoring [9] inspires LabVIEW-based real-time monitoring of room issues, improving environmental conditions.

The IoT-based room control and monitoring system detailed in [10] aligns with LabVIEW project's goal to automate issue reporting and control in rooms, enhancing user convenience.

ZigBee sensor networks for IDC room monitoring [11] offer insights into remote room monitoring, like LabVIEW-based system for efficient issue reporting.

[12] focuses on unmanned marine engine room monitoring, which informs approach to autonomous room issue reporting using LabVIEW, ensuring safety and stability.

In their proposal, Johnson et al [13] present a method for detecting pre-accident situations in infant rooms. This influences our project's focus on early issue identification in rooms using LabVIEW.
Author [14] introduces a biometric access and control system for rooms, inspiring the secure access features in LabVIEW issue reporting system, enhancing room security.
The LoRaWAN-based smart room monitoring solution described in [15] aligns with LabVIEW project's goal of monitoring room conditions for issue reporting and energy efficiency, improving room environments.

III. BLOCK DIAGRAM

The Room Issue Reporting System combines key components, including IR (Infrared) and Gas sensors, myDAQ, LabVIEW, and TCP protocols as shown in Fig. 1 which can also be extended. IR sensors continuously monitor room conditions, while Gas sensors provide real-time gas concentration data. myDAQ acts as the interface between sensors and LabVIEW, facilitating data acquisition. LabVIEW orchestrates the system, processing sensor data, categorizing issues, and employing TCP protocols for real-time communication between client VIs (sensor-equipped rooms) and server VIs (maintenance personnel). This architecture ensures efficient, secure, and prompt issue reporting and resolution.

IV. FLOWCHART

The operation of the proposed system is described in two different cases.

Case 1: Sensor Automation Flowchart (Fig. 2)

Start: The process begins when the VI is initiated.

Initialize Sensors: Initialize gas and IR sensors.

Read Sensor Data: Continuously read data from the sensors.

Gas Level Check: Check if the gas level exceeds a predefined threshold.

If yes, trigger an alert.

If no, continue.

Log Data: Log sensor data along with timestamps to a CSV file.

TCP Communication: Set up a TCP server to send data to connected clients.

Error Handling: Handle errors gracefully.

End: Terminate the VI when needed.

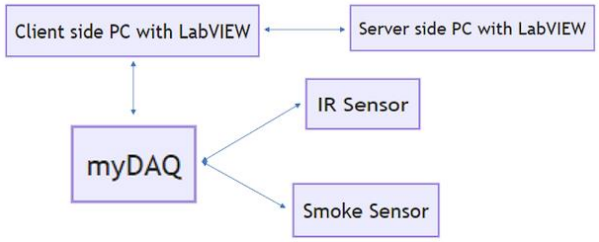

Fig. 1. Basic Block Diagram of Proposed Model

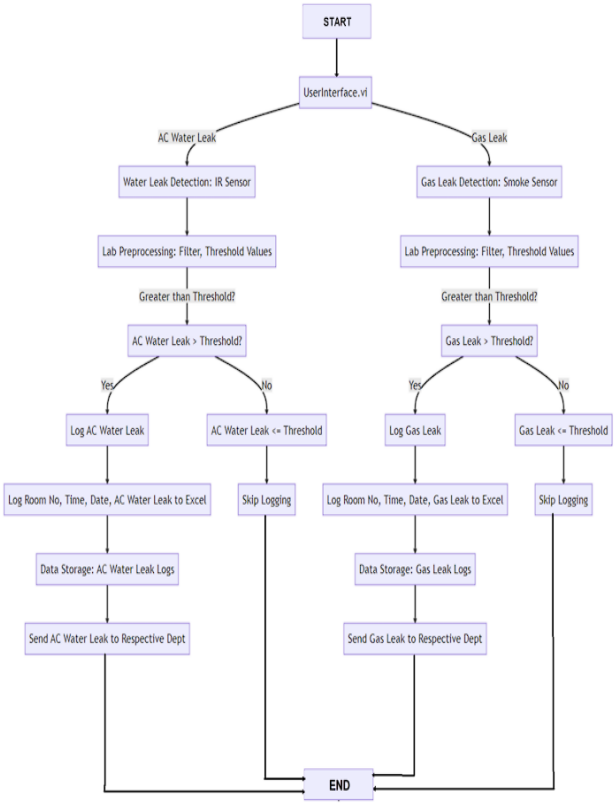

Fig. 2. Execution Flow of Sensor Automation

Case 2: Issue Reporting via User Interface Flowchart (Fig. 3)

Start: The process begins when the VI is initiated.

Issue Detection: Detect potential maintenance issues based on sensor readings.

Check gas sensor reading against threshold.

If threshold exceeded, proceed.

If not, continue monitoring.

Generate Issue Report: Create a structured issue report.

Include issue type, timestamp, and location.

Categorization: Automatically categorize issues based on severity and impact.

High severity issues get prioritized.

Notifications: Send real-time notifications to maintenance staff and responsible personnel.

Include issue details and room location.

Issue Resolution: Allow personnel to view and manage reported issues.

Prioritize and allocate resources for resolution.

Database Management: Store issue reports and details in a centralized database.

Supports tracking and trend analysis.

Data-Driven Decisions: Use LabVIEW's data analysis capabilities to derive insights from issue data.

Optimize maintenance processes.

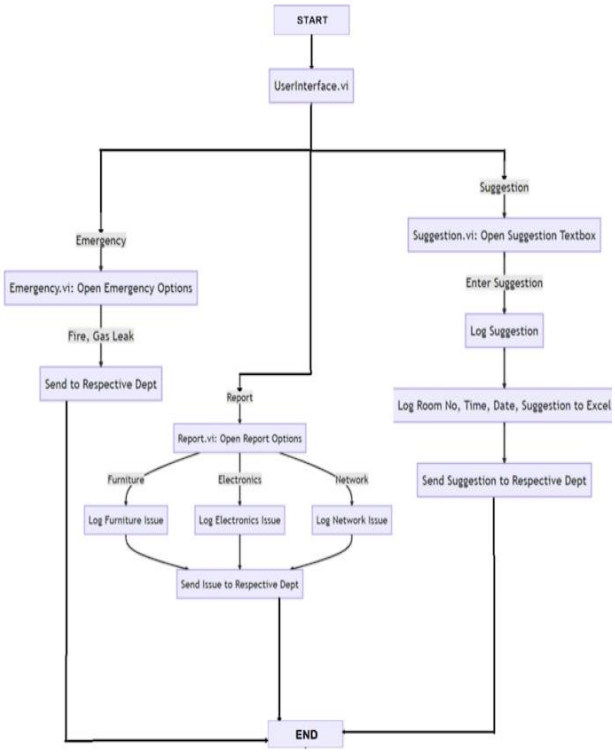

Fig. 3. Execution Flow of Reporting via User Interface

System Reliability: Ensure system reliability through testing and monitoring.

Error Handling: Handle errors gracefully.

End: Terminate the VI when needed.

V. RESULT AND DISCUSSION

Case 1: Reporting by User Interface

The Room Issue Reporting System's user-friendly interface is designed using LabVIEW, presenting a simplified front panel with three intuitive buttons. The front panel serves as the user's gateway to interact with the system and report maintenance issues promptly. As depicted in Figure 4, the front panel consist of the following buttons:

As we can observe in Fig. 5 the default case of buttons is set to True. So, Execution of buttons happens only when it becomes False. So, as shown in Fig. 6 when the True case arises nothing happens.

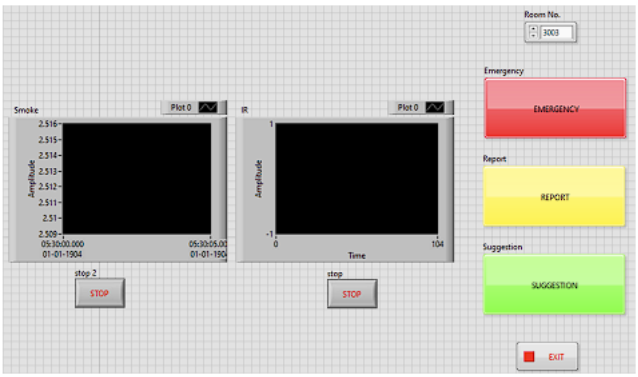

Fig. 4. User Interface Front Panel

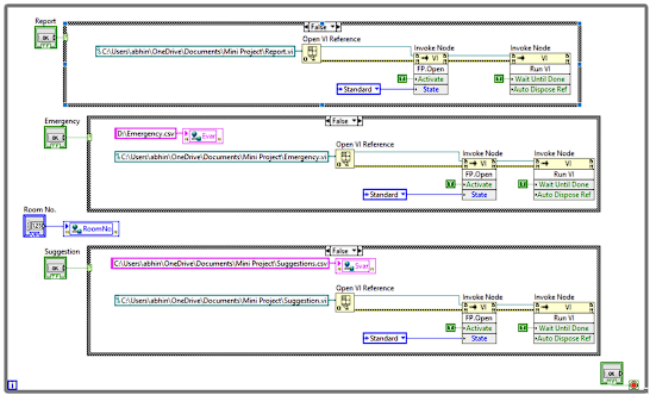

Fig. 5. User Interface Block Diagram for False cases

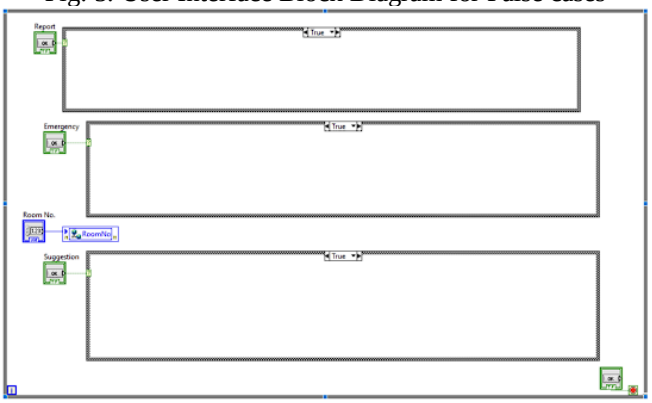

Fig. 6. User Interface Block Diagram for True cases

1. Emergency:

Clicking on the "Emergency" button triggers the opening of the "Emergency.vi" virtual instrument (VI). This VI is specifically tailored to handle critical and urgent maintenance issues that require immediate attention. It allows users to provide rapid responses to the maintenance department.

As shown in Fig. 7 and 8 just an "Emergency" message is sent from client side using TCP/IP Protocols and at server-side Room number, Time stamp and Date of Emergency.

2. Report:

By clicking on the 'Report' button, users can access the 'Report.vi' virtual instrument. This VI is designed to capture detailed maintenance reports related to specific categories, such as Electronics, Network, and Furniture. Users can select the relevant category and provide comprehensive information about the maintenance issue they are encountering. The 'Report.vi' ensures that all essential details are captured accurately for effective issue resolution. Report Front Panel shown in Fig 9 appears when clicked on Report button in UI. It again consists of 3 types of options Electronics, Network and Furniture Issues.

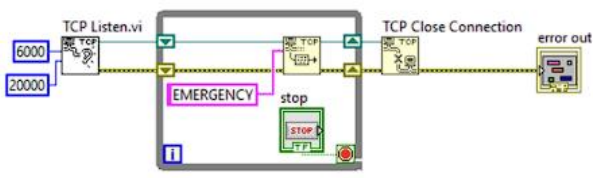

Fig. 7. Emergency Button on Client Side

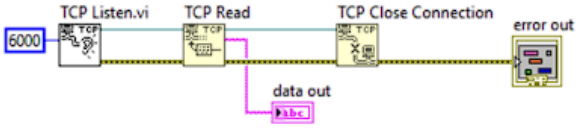

Fig. 8. Server Side of Emergency

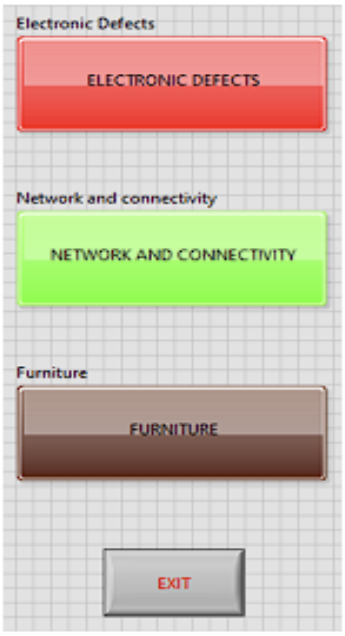

Fig. 9. Report Front Panel

Execution of any button happens only when False. So, during True cases nothing happens as shown in Fig. 10 and Fig. 11

Now when click on Electronics a text box appears, which is a cluster of a single string array which can be visualised as a description box as shown in Fig.12. Electronics also has Default and Blank Cases. When it is Default mode, whatever is typed in text box is sent to spreadsheet, whereas in 'Blank' m ode a '-' is sent instead of blank value as depicted in Fig. 13 and Fig. 14. The output of Electronics issue report will log into Electronics.csv file as shown in Fig. 15.

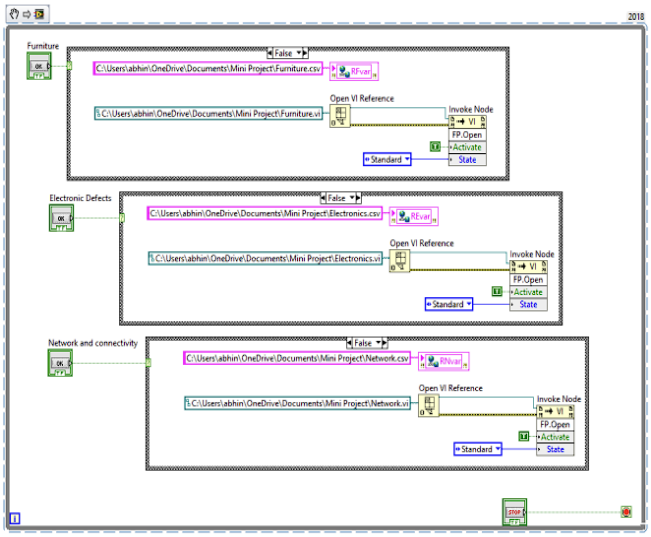

Fig. 10. Report Block Diagram for False Cases

Fig. 11. Report Block Diagram for True Cases

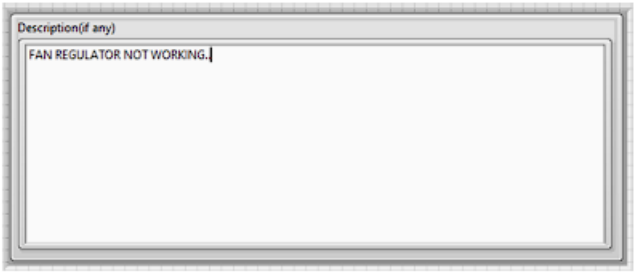

Fig. 12. Electronics Front Panel

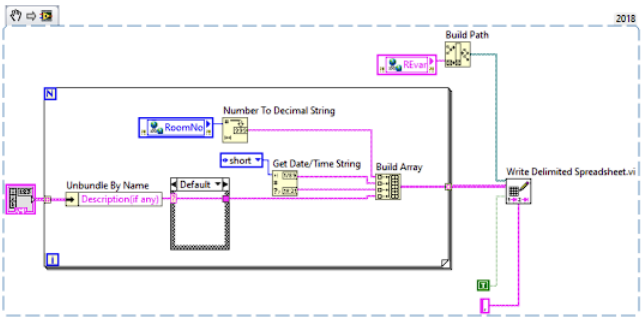

Fig. 13. Electronics Block Diagram for Default Case

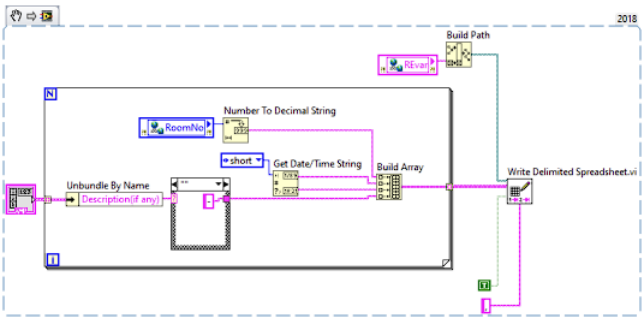

Fig. 14. Electronics Block Diagram for Blank Case

Similar to Electronics, Network and Furniture also have Default and blank to address issues more specifically to specific departments as shown in Fig. 16-23.

	A	B	C	D
1	Room no.	Date	Time	Description
2	3003	18-06-2023	5:46 PM	-
3	3003	18-06-2023	5:46 PM	Light Not Working FROM 2 DAYS
4	3003	18-06-2023	5:47 PM	AC not working
5				

Fig. 15. Electronics.csv

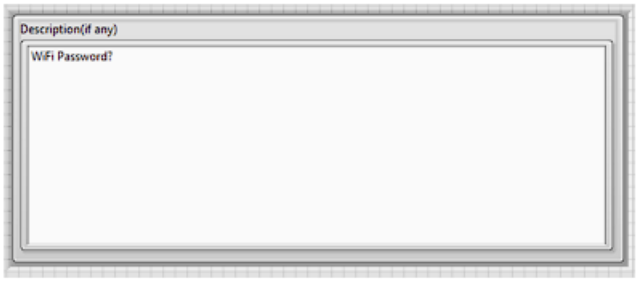

Fig. 16. Network Front Panel

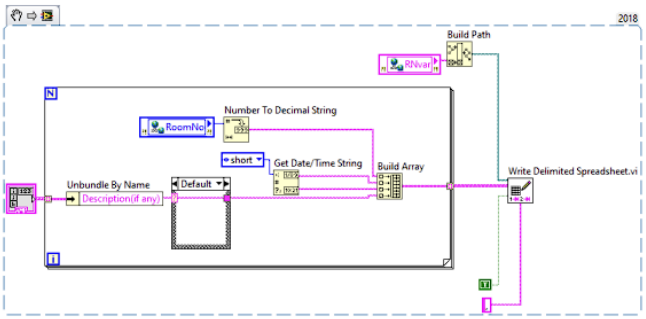

Fig. 17. Network Block Diagram for Default Case

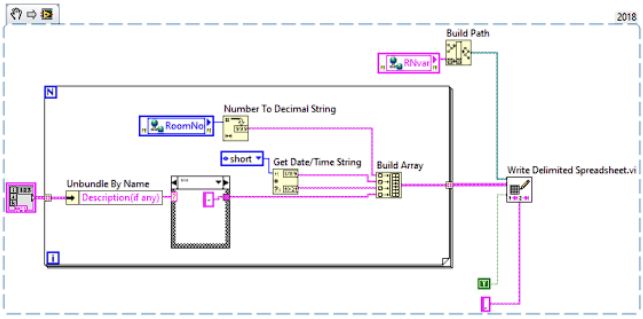

Fig. 18. Network Block Diagram for Blank Case

The output of Network issues report will log into Network.csv file as shown in Fig. 19.

3. Suggestions:

The "Suggestions" button opens the "Suggestions.vi" virtual instrument, allowing users to provide valuable suggestions and feedback related to the building's maintenance or any other relevant aspects.

This VI encourages occupants to contribute their insights, fostering a collaborative approach to maintaining a safe and comfortable environment. Here we can provide suggestions to improve the quality and infrastructure of rooms as shown in Fig. 24 which are sent to respective departments. Like reporting issues in suggestions also we can use text via TCP/IP protocol and shared variables concepts.

	A	B	C	D
1	Room No.	Date	Time	Description
2	3003	18-06-2023	5:54 PM	WiFi Password ERROR still persists
3	3003	18-06-2023	5:54 PM	WiFi Password ERROR still persists
4	3003	18-06-2023	5:54 PM	Projector not connecting to laptop
5	3003	18-06-2023	5:54 PM	Enable IP Routing for Proxy exchange in this room
6	3003	18-06-2023	5:55 PM	-
7	3003	18-06-2023	5:55 PM	Need of LAN cable and an HDMI Cable
8				

Fig. 19. Network.csv

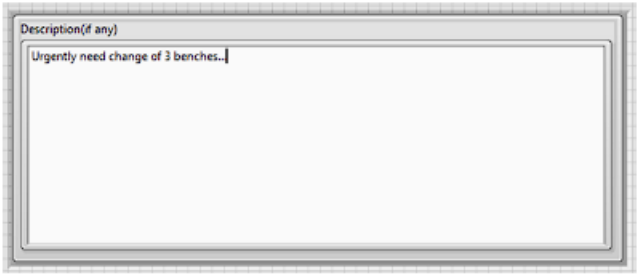

Fig. 20. Furniture Front Panel

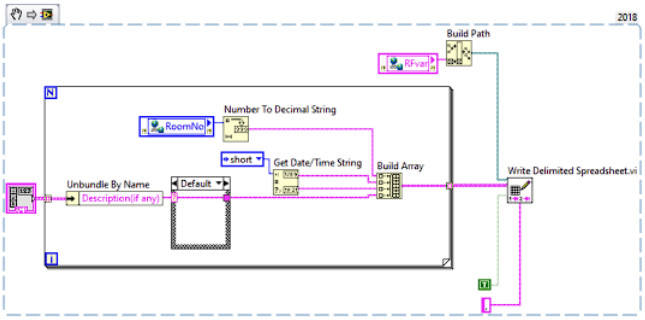

Fig. 21. Furniture Block Diagram for Default Case

The output of Furniture issues report will log into Furniture.csv file as shown in Fig. 22.

From Fig. 25 and Fig. 26 are the Block diagrams of Suggestions panel. Here also we can use Default and Blank cases to send information accurately and easy analytics.

	A	B	C	D
1	Room No.	Date	Time	Description
2	3003	18-06-2023	5:50 PM	2 chairs Broken
3	3003	18-06-2023	5:50 PM	-
4	3003	18-06-2023	5:50 PM	Urgent need of 5 Benches
5				
6				

Fig. 22. Furniture.csv

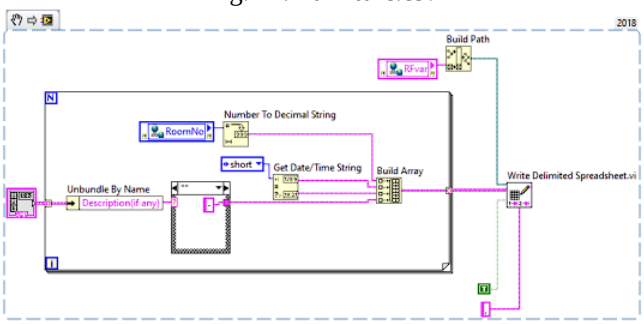

Fig. 23. Furniture Block Diagram for Blank Case

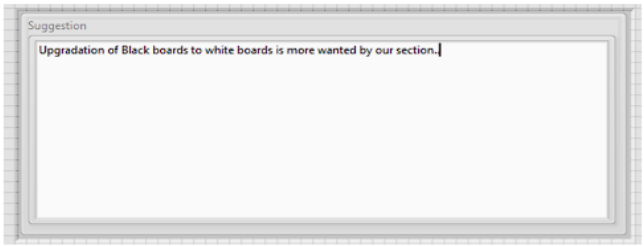

Fig. 24: Suggestions Front Panel

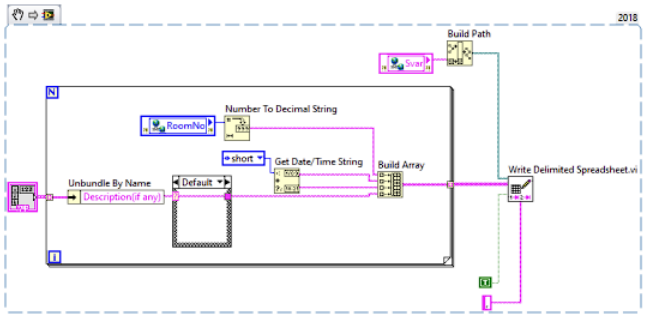

Fig. 25. Suggestions Block Diagram for Default Case

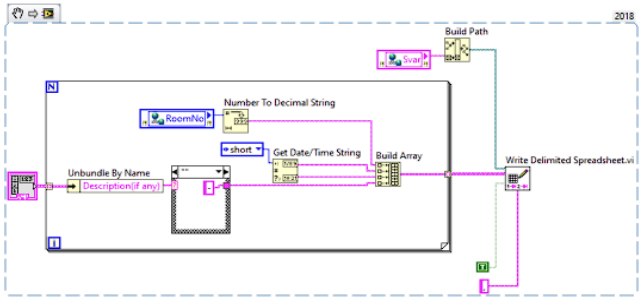

Fig. 26. Suggestions Block Diagram for Blank Case

The Suggestions will be logged into Suggestion.csv file as shown in Fig. 27:

Case 2: Sensor Automation:

While the above process is functioning, all sensors interfaced gets activated and run in background making it automatically waiting for detecting malfunctions in electronics or connectivity issues etc. In our prototype we just used IR sensor to detect AC leakage by sensing leaking water drops. This can be achieved by data acquisition from myDAQ interfaced with IR sensor and LabVIEW software as shown Fig. 29 and Fig. 30.

A threshold value is set for number of drops after that signal is sent to respective departments automatically. Similarly, we can also interface smoke/gas sensor as shown in Fig. 30 and Fig. 31. Proposed system is shown in Fig. 32.

	A	B	C	D
1	**Room No.**	**Date**	**Time**	**Suggestion**
2	3003	11-May-23	13:22	Make the Door retractable
3	3003	11-May-23	13:24	Our section prefers white board over blackboard
4	3003	11-May-23	13:29	Please make the WiFi available in rooms for interviews
5	3003	11-May-23	13:32	-
6				
7				

Fig. 27. Suggestions.csv

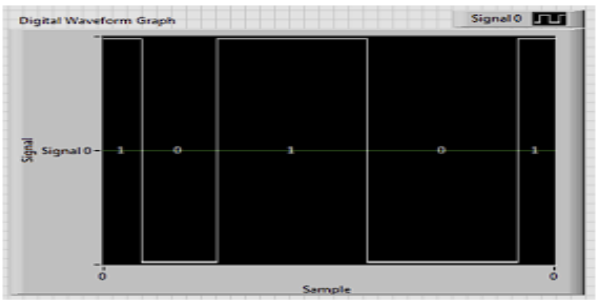

Fig. 28. Visualizing Waveform of IR Sensor

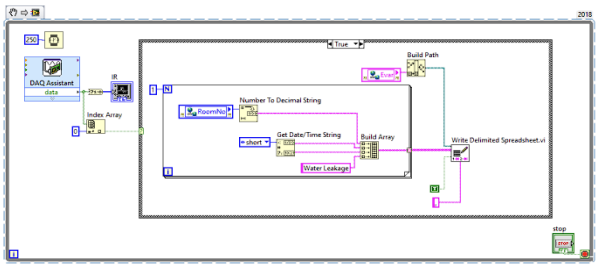

Fig. 29. Interfacing of IR Sensor

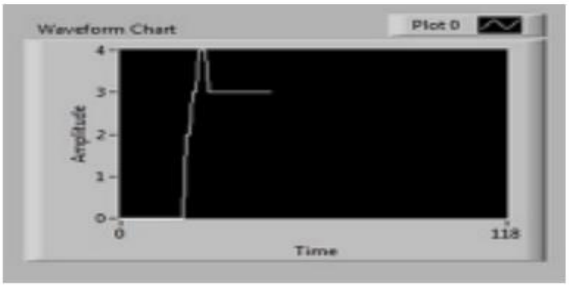

Fig. 30. Visualizing Waveform of Gas/Smoke Sensor

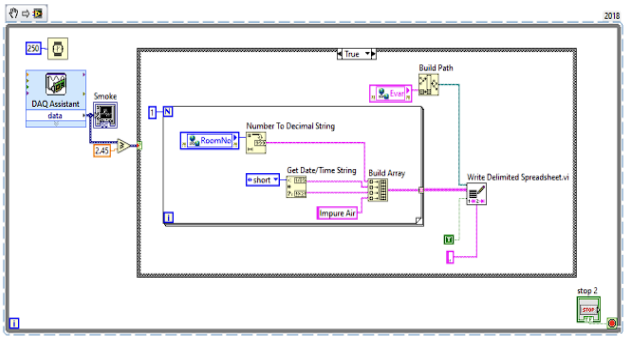

Fig. 31. Interfacing of Gas/Smoke Sensor

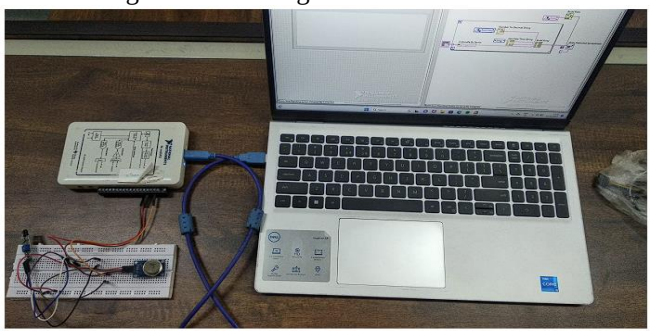

Fig. 32. Prototype of the Project

VI. CONCLUSIONS

The Room Issue Reporting System, built with LabVIEW and myDAQ using TCP, efficiently monitors and reports building maintenance problems. It integrates myDAQ with various sensors for automatic issue detection and real-time reporting. The TCP protocol ensures seamless communication among client VIs in different rooms and server VIs in different departments. It offers reliable performance, accurate issue categorization, and streamlined maintenance workflows. Users appreciate its user-friendly interface, intuitive design, and real-time notifications, leading to faster issue reporting and quicker responses.

VII. FUTURE SCOPE

In the future scope of our project, we can integrate additional sensors to achieve more comprehensive issue detection. We can implement AI-driven responses that automate acknowledgment and resolution processes. A user-centric mobile app can be developed to provide a seamless experience for issue reporting and updates. Predictive maintenance can leverage historical data for forecasting, enabling proactive action. Additionally, we can create an analytics dashboard to offer insights into room conditions and enhance security features while allowing customization to meet specific needs. These potential enhancements aim to make our system more efficient, user-friendly, and proactive in addressing issues.

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