Development of IoT Integrated Data Logger System for Smart Factory

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ABSTRACT – Existing data loggers are unsuitable for implementation in a smart factory since they are costly, have limited smart functions, and only support minimal data storage. In this work, we propose a low-cost IoT integrated data logger system, where it can read mass data from multiple sensors, and the data will be stored in a database. Furthermore, the system is also equipped with a dashboard to assist a factory workflow and environment monitoring from anywhere. The system also could notify a user when an anomaly case occurs. The project is developed using Prototyping Model, consist of requirement gathering, designing, and building the prototype.

1. INTRODUCTION

The data logger is widely used in a smart factory environment as it is essential to ensure workplace safety, mass production, and energy-saving using various intelligent applications. However, industries do not have comprehensive data loggers due to the high cost and their limited functions without intelligent functions. Multiple problems have occurred in the previous project, such as limited data storage and a non-reliable connection for the system to be communicated by the user [1-3]. Furthermore, the existing data loggers require a high cost and have minimal functions [4,5], as shown in Table 1.

This paper proposed Data Logger for Internet-of-Things (IoT) System to overcome the weakness and problems of the existing project (refer Figure 1). This project created a data logger by connecting a sensor directly to the Raspberry Pi 4 microprocessor. The sensor will capture the data from the facility environment based on the type of sensor. Data received from the sensors will be uploaded and recorded by the microprocessor into the database automatically.

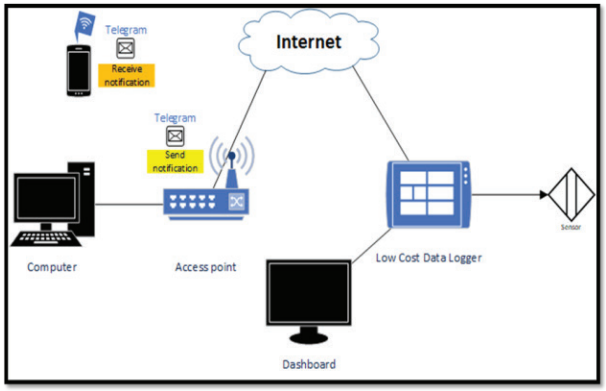


Figure 1 Design of IoT Integrated Data Logger System

The microcontroller can be connected to the wireless internet connection to upload the data directly to the system without causing any delay. Open-source software will create a user interface, namely the Grafana dashboard. The data recorded inside the database will be shown to the user using the Grafana, a user-friendly interface to help the user view and analyze the data for future use. The proposed system is also equipped with a notification system for anomaly cases, where users will receive alert messages from the Telegram application

Table 1 Previous works vs. Proposed Solution

Sources	Media	Storage	Estimated (RM)
[1] (2020	Bluetooth	MicroSD	556.90
[2] (2018)	Wired	MicroSD	2479.96
[3] (2020)	Wi-Fi	MicroSD	1083.68
[4] (2020)	Wired	-	2000.00
[5] (2018)	Wired	-	2667.50
Proposed	Wi-Fi	Database	265.00

2. METHODOLOGY

In this project, a prototyping model has been used, consisting of 3 phases: Requirements Gathering, Design, and Building Prototype.

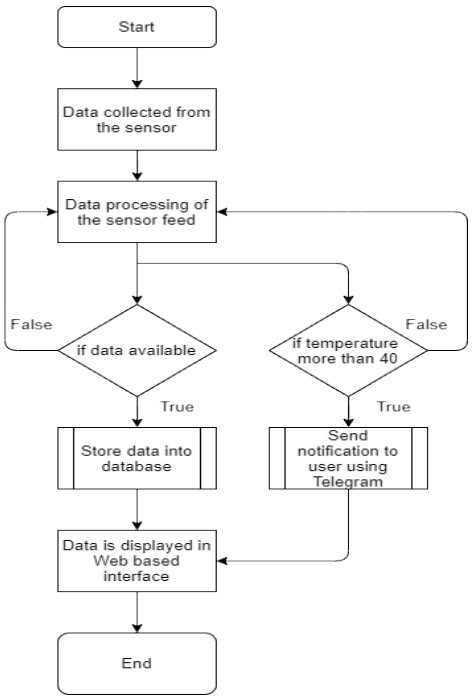


Figure 2 Block Diagram for the developed prototype

Figure 2 shows a flowchart that has been created in the design phase. Data collected from sensors will be processed using a low-cost microprocessor, Raspberry Pi, and the data will be stored in Database InfluxDB. The stored data will be sent to a user interface using Grafana Dashboard and Telegram for anomaly alerts.

In the developed prototype, the DHT11 sensor is used to collect temperature and humidity data. In contrast, the MQ-2 Gas sensor collects gas data such as LPG, Smoke, Alcohol, Propane, Hydrogen, Methane, and Carbon Monoxide. Both sensors are connected to the Raspberry Pi microprocessor by using jumper wires. Figure 3 shows the developed prototype, and Table 2 shows the Hardware vs. GPIO Pin connection.

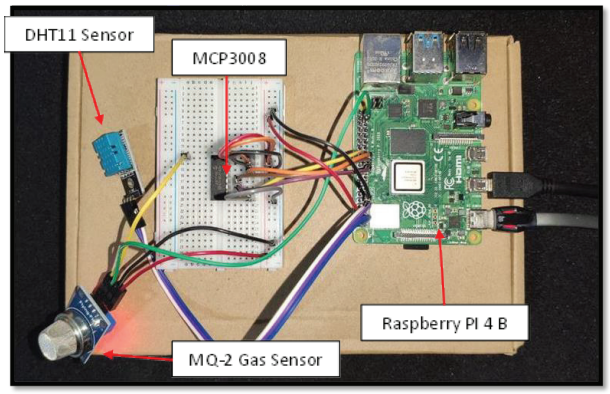


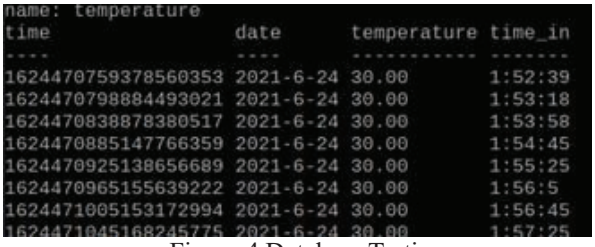
Figure 3 Prototype of IoT Integrated Data Logger System

Table 2 Hardware vs. GPIO Pin

Hardware	Wire	Pins
DHT11Sensor	OUT	GPIO 4
MQ-2 Gas Sensor	AO	CH0
	DO	GPIO 26
MCP8002 AC to DC Converter	CH0	AO
	ABOUT	GPIO 9 MISO (SPI0)
	DIN	GPIO 10 MOSI (SPI0)
	CS/SHDN	GPIO 25

3. RESULT AND DISCUSSION

A functionality test has been done to ensure the developed prototype is fully integrated among three modules: Database, Notification, and Dashboard. Figure 4 shows that detected data has been inserted into the database. The detected temperature and time have been successfully inserted into the database table.



```
name: temperature
time                date       temperature time_in
----                ----       ----------- -------
1624470759378560353 2021-6-24  30.00       1:52:39
1624470798884493021 2021-6-24  30.00       1:53:18
1624470838878380517 2021-6-24  30.00       1:53:58
1624470885147766359 2021-6-24  30.00       1:54:45
1624470925138656689 2021-6-24  30.00       1:55:25
1624470965155639222 2021-6-24  30.00       1:56:5
1624471005153172994 2021-6-24  30.00       1:56:45
1624471045168245775 2021-6-24  30.00       1:57:25
```

Figure 4 Database Testing

Figure 5 shows the developed dashboard using Grafana. The dashboard successfully views the detected data. From the dashboard, data from the whole factory can be monitored from the monitoring room. A worker needs to attend to or fix the problem only if an anomaly alert is received by Telegram. The dashboard can view the current temperature, time, date, and graph showing temperature changes.

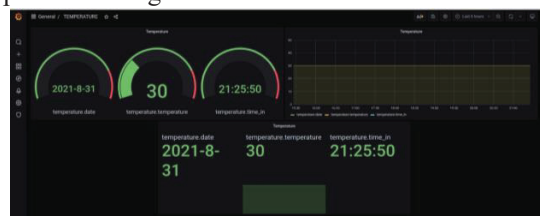


Figure 5 Grafana Dashboard

Figure 6 shows an alert message that on-duty staff will receive when an anomaly situation is detected. Once the system detects any high-temperature or gas reading, a notification message will be sent to the user through Telegram along with the reading.

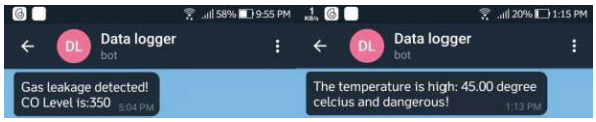


Figure 6 Telegram Notification for Anomaly Detection.

4. CONCLUSIONS

This research paper covers the IoT integrated Data Logger System development for Smart Factory. The project will contribute to smart factory management, where mass data collection from multiple sensors can be collected using IoT technology. On-duty staff can only monitor the factory condition and mass production conditions from their smartphone through the dashboard. The anomaly alert sent to the Telegram will help the staff efficiently manage the factory monitoring.

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