International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 10 Issue: 10 | Oct - 2026 SJIF Rating: 8.659 ISSN: 2582-3930

IOT-Based Digital Factory Dashboard

[1]Arun Raj R, [1], [1]Arunkumar K, [1]Arunmani V, [1]Dharshan R [2] P Mani
[1]Student, [2]Assistant Professor
[1,2]Department of Electronics and Communication Engineering
[1,2]K Ramakrishnan College of Technology, Tiruchirappalli, India

Abstract: The IoT-Based Digital Factory Dashboard is a smart industrial monitoring system designed to improve manufacturing operations through real-time data collection and analysis. Traditional manufacturing systems often face challenges such as manual machine monitoring, unexpected equipment failures, production delays, excessive energy consumption, and limited visibility into machine performance. The proposed system uses Internet of Things (IoT) sensors and an IoT gateway to collect essential parameters such as machine status, production count, temperature, vibration, energy consumption, and machine downtime. The collected data is transmitted through communication technologies such as Wi-Fi and Message Queuing Telemetry Transport (MQTT) to a cloud-based database for storage and processing. A web-based dashboard provides centralized access to machine conditions, production performance, energy usage, and operational efficiency. The system is intended to identify abnormal machine conditions, monitor production activities, reduce unplanned downtime, and support efficient maintenance planning. The performance of the proposed system can be evaluated through experiments involving data transmission, monitoring response time, sensor accuracy, machine status detection, and dashboard reliability. Proper system configuration, database management, and experimental testing are essential to ensure reliable industrial monitoring.

Keywords: IoT-Based Digital Factory Dashboard, Internet of Things (IoT), Smart Manufacturing, Industrial Monitoring, MQTT Communication, Cloud Database, Machine Status Monitoring, Predictive Maintenance, Energy Monitoring, Web-Based Dashboard.

INTRODUCTION

Manufacturing industries require continuous monitoring of machines, production activities, and energy consumption to maintain operational efficiency. Traditional monitoring methods often depend on manual inspection and separate monitoring systems, which may delay the identification of machine faults and production interruptions. These limitations can increase machine downtime, reduce productivity, and make it difficult to analyze overall manufacturing performance.

The Internet of Things (IoT) provides an effective solution by connecting industrial machines, sensors, communication networks, and software applications. Through IoT technology, physical devices can collect operational data and communicate the information to centralized platforms for monitoring and analysis. This approach helps manufacturing industries improve visibility into equipment performance and production activities.

In the proposed IoT-Based Digital Factory Dashboard, IoT sensors are used to monitor machine parameters such as temperature, vibration, production count, energy consumption, and machine status. An IoT gateway collects the sensor readings and transmits the information to a cloud-based system using Wi-Fi and MQTT communication. The collected data is processed and stored in a database for real-time visualization and historical analysis.

One of the important features of the proposed system is the development of a web-based dashboard that displays industrial information through a centralized interface. The dashboard provides machine operating status, production statistics, energy consumption, downtime records, and sensor readings. It also supports the identification of abnormal operating conditions through configurable threshold-based alerts.

The primary objective of this study is to develop a cost-effective and user-friendly digital monitoring system for manufacturing industries. The performance of the system can be evaluated by measuring sensor accuracy, data transmission reliability, dashboard response time, machine status detection, and energy monitoring accuracy. Proper hardware integration, network configuration, database management, and experimental testing are essential to ensure the reliability of the proposed system.

Materials And Methods

The proposed IoT-Based Digital Factory Dashboard consists of IoT sensors, a microcontroller or industrial IoT gateway, a Wi-Fi or Ethernet connection, an MQTT communication system, a cloud-based database, and a web-based monitoring platform. These components work together to collect, transmit, process, and display industrial operating data.

IoT sensors are used to measure machine temperature, vibration, and energy consumption. Machine status sensors or controller signals are used to determine whether equipment is running, idle, or stopped. A production counter records the number of products manufactured during a specified period. The collected data is transmitted to the server through an IoT gateway using an appropriate communication protocol.

The MQTT protocol can be used for lightweight data communication between the IoT gateway and the backend application. The cloud-based database stores sensor readings, machine status, production counts, and downtime information. The web application retrieves the stored information and presents it through a dashboard.

The gateway can be programmed using a suitable embedded development environment, depending on the selected hardware. The web-based monitoring platform can be developed using appropriate frontend and backend technologies. The system processes the incoming data and calculates important performance indicators, including machine availability, production achievement, and energy consumption.

Machine availability can be calculated using the following equation:

Machine Availability (%) = (Operating Time / Planned Production Time) × 100.

Production achievement can be calculated as:

Production Achievement (%) = (Actual Production / Target Production) × 100.

The experimental evaluation should measure data transmission reliability, sensor accuracy, monitoring response time, machine status detection, and database performance.

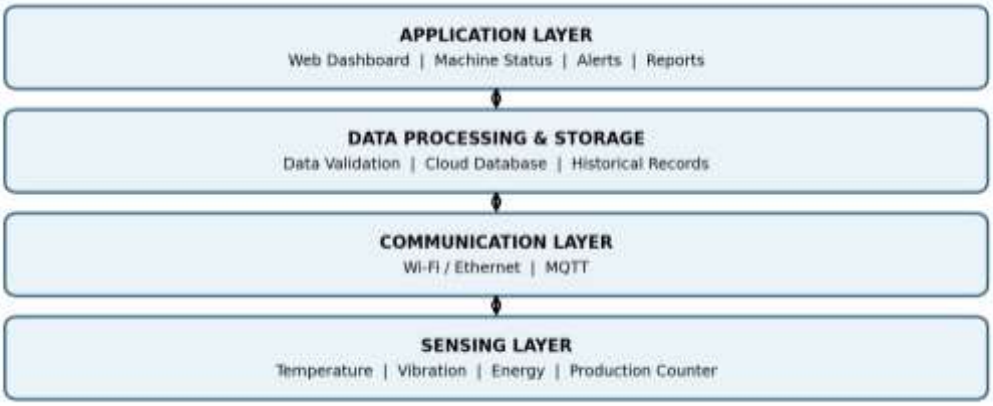


Fig. 1. Four-layer architecture of the proposed digital factory dashboard.

System Design And Implementation

The IoT-Based Digital Factory Dashboard is designed by integrating industrial sensors, an IoT gateway, wireless communication, cloud-based data storage, and a web-based monitoring interface. The sensors are installed on or connected to the selected manufacturing equipment to collect operating parameters.

When the system is powered on, the IoT gateway establishes communication with the connected sensors and the network. The gateway collects the sensor readings at predefined intervals and transmits the data to the server using MQTT or another suitable communication protocol. The received data is validated and stored in the database with timestamps and machine identification details.

The web-based application retrieves the collected information and displays the current condition of each machine. The dashboard provides details about machine status, production count, temperature, vibration, energy consumption, and downtime. When sensor readings exceed predefined thresholds, the system can generate alerts to notify operators of abnormal operating conditions.

The proposed architecture consists of four major layers: the sensing layer, communication layer, data processing and storage layer, and application layer. The modular design allows additional machines and sensors to be integrated according to manufacturing requirements.

System workflow: Industrial machines and sensors → IoT gateway → Wi-Fi/MQTT communication → Cloud database → Web-based dashboard → Monitoring and decision-making.



Fig. 2. System workflow of the proposed IoT-based digital factory dashboard.

Web-Based Monitoring

The IoT gateway is connected to the web-based digital factory platform through a network connection. The dashboard displays machine identification, operating status, production count, temperature, vibration, energy consumption, and downtime information.

The machine status monitoring feature helps operators identify running, idle, and stopped equipment. Production monitoring displays the number of products manufactured and supports comparison with production targets. Temperature and vibration monitoring provide information about machine operating conditions and can highlight readings that exceed configured thresholds.

The energy monitoring feature presents electrical energy consumption and supports the analysis of energy usage over time. Downtime monitoring records equipment stoppages and helps identify interruptions that affect manufacturing operations. Historical records can be used to analyze machine performance and production trends.

The web-based interface allows authorized users to access manufacturing information through a compatible computer or other web-enabled device. The centralized dashboard reduces dependence on separate monitoring systems and provides a common platform for industrial data visualization. Secure communication, user authentication, and suitable access controls should be implemented to protect industrial information.

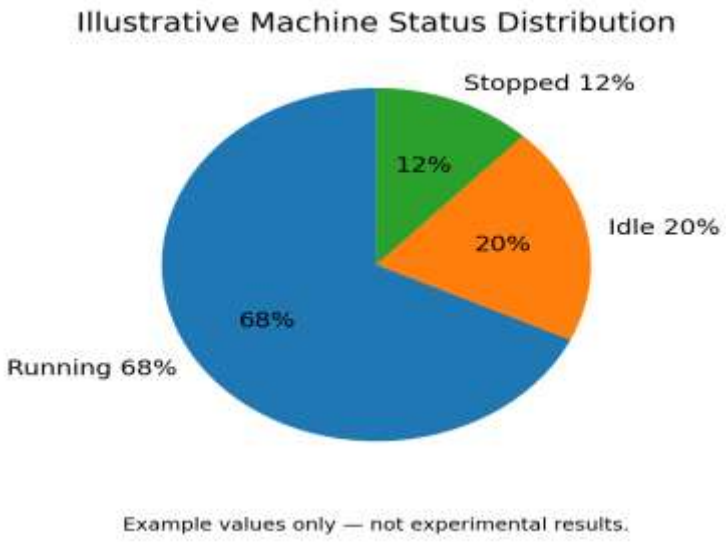


Fig. 3. Example distribution of running, idle and stopped machine states (illustrative data).

Experimental Evaluation

The proposed IoT-Based Digital Factory Dashboard can be evaluated through experimental testing to investigate its functionality, performance, and reliability. The evaluation should include sensor data collection, machine status monitoring, production counting, energy measurement, communication reliability, and dashboard response time.

During testing, sensor readings should be compared with appropriate reference instruments to determine measurement accuracy. Data transmission tests should be performed to evaluate whether the information generated by the IoT gateway is successfully received and stored in the database. Dashboard response time should be measured from the generation of sensor data to its display on the monitoring interface.

Machine status detection can be tested under running, idle, and stopped conditions. Temperature and vibration tests can be performed using normal operating conditions and controlled test conditions that exceed configured thresholds. Production count accuracy can be evaluated by comparing the recorded count with the actual number of manufactured products.

The data transmission success rate can be calculated as:

Data Delivery Rate (%) = (Messages Received Successfully / Total Messages Sent) × 100.

The monitoring latency can be calculated as:

Monitoring Latency = Dashboard Display Time − Sensor Data Generation Time.

The experimental results should be recorded for repeated trials to evaluate the consistency of the system. These tests will help determine the suitability of the proposed dashboard for real-time industrial monitoring.

Results

The proposed IoT-Based Digital Factory Dashboard integrates industrial sensor monitoring, IoT communication, cloud-based data storage, and web-based visualization into a centralized platform. The system is designed to collect and display important manufacturing parameters, including machine status, production count, temperature, vibration, energy consumption, and downtime.

The web-based dashboard is intended to provide real-time access to machine conditions and production information. Sensor readings can be used to identify abnormal operating conditions, while production and downtime records can support the analysis of manufacturing performance. Energy consumption information can help operators identify equipment and operating periods that require further investigation.

The system is also designed to store historical data for performance analysis and maintenance planning. However, the actual accuracy, response time, communication reliability, and operational benefits must be established through experimental testing.

The experimental results should be presented using measured values for sensor accuracy, data delivery rate, dashboard latency, production count accuracy, and machine status detection. Graphs can be used to compare temperature, vibration, energy consumption, production output, and downtime over time.

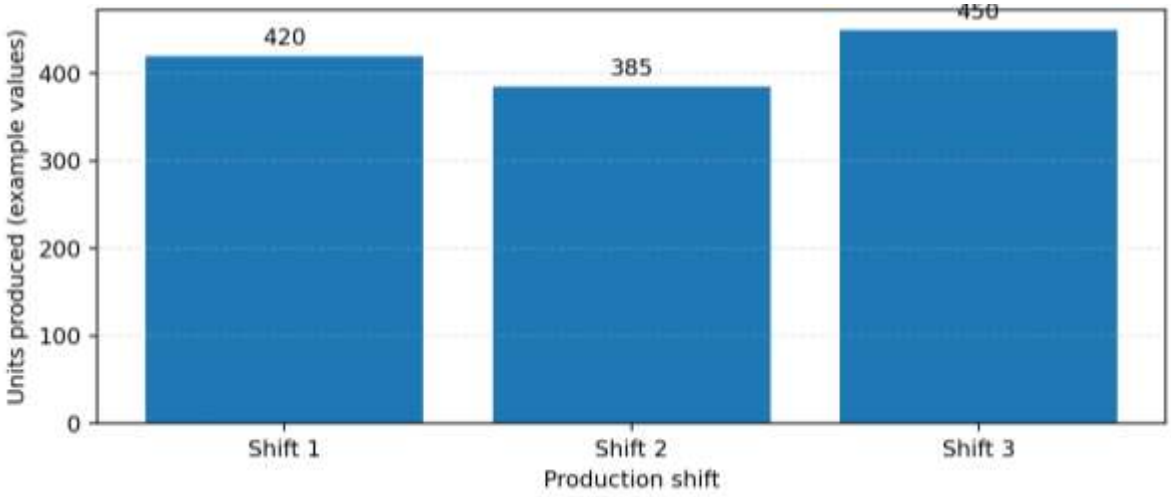


Fig. 4. Example bar graph format for production monitoring (illustrative values, not measured results).

Discussion

The proposed IoT-Based Digital Factory Dashboard combines industrial sensing, embedded processing, wireless communication, cloud storage, and web-based visualization to improve manufacturing monitoring. The centralized dashboard provides a common interface for observing machine conditions and production activities, helping operators access relevant information without relying entirely on manual inspections.

Continuous monitoring of temperature and vibration can help identify abnormal operating conditions that require further investigation. Production count and downtime information can support the identification of production interruptions, while energy consumption records can help evaluate equipment usage and energy efficiency. Historical data may also support predictive maintenance when sufficient data and suitable analytical methods are available.

The performance of the system depends on sensor accuracy, reliable network connectivity, database availability, and correct configuration of the monitoring software. Network interruptions can delay dashboard updates, while inaccurate sensor readings may produce misleading information. Threshold-based alerts can identify predefined abnormal conditions but do not independently guarantee accurate prediction of future machine failures.

The system can be improved through integration with programmable logic controllers (PLCs), automated alert notifications, machine-learning-based anomaly detection, and advanced production analytics. Additional security measures, including authentication, encrypted communication, and controlled access, are important for industrial deployment. Further experimentation is necessary to determine the effectiveness of the system under different manufacturing conditions.

CONCLUSION

The IoT-Based Digital Factory Dashboard is a proposed industrial monitoring solution that integrates IoT sensors, an IoT gateway, wireless communication, cloud-based data management, and a web-based dashboard. The system is designed to monitor machine status, production count, temperature, vibration, energy consumption, and machine downtime through a centralized platform.

The web-based interface provides an accessible method for viewing manufacturing information and analyzing operational performance. Continuous collection of industrial data can support early identification of abnormal machine conditions, improved production visibility, energy monitoring, and maintenance planning. The modular architecture also allows additional machines and sensors to be integrated as manufacturing requirements change.

The proposed system offers a foundation for digital manufacturing and Industry 4.0 applications, particularly in facilities that require centralized and scalable industrial monitoring. However, improvements in productivity, energy efficiency, and downtime reduction must be verified through experimental measurements and comparison with baseline manufacturing data.

Future enhancements may include predictive maintenance using machine learning, integration with industrial automation systems, mobile notifications, advanced energy analytics, and improved cloud security. Further testing will be required to evaluate sensor accuracy, data transmission reliability, response time, and overall system performance.

REFERENCES

[1] Agistya Anugrah, R., Adhidarma, F. B., Hutama, R. S., Maulana, V. K. R., & Winarno, Y. F. (2025). Arduino and IoT-based LPG gas leak detection systems: A focused review of sensors, architectures, and reliability issues. Journal of Automotive and Mechanical Applied Technology.

[2] K. Ashton, “That ‘Internet of Things’ Thing,” *RFID Journal*, vol. 22, no. 7, pp. 97–114, 2009.

[3] Design and development of a gas leak and fire detection system using the Internet of Things (IoT) with Telegram notification. (2025). In Proceedings of the 5th International Conference of Science and Information Technology in Smart Administration (ICSINTESA). IEEE.

[4] S. Hoque, I. Ahmmed, A. Jobair, M. S. Hossain, M. R. Uddin, and M. Hasan, “Development of a Scalable Industrial Process Monitoring Sensor System for Large-Scale IoT Networks Using MQTT and Time Series Database,” in *Proceedings of the IEEE 3rd International Conference on Electrical Power and Energy Systems (ICEPES)*, 2024.

[5] International Organization for Standardization, *ISO 50001:2018—Energy Management Systems—Requirements with Guidance for Use*, 2018.

[6] H. Lasi, P. Fettke, H. G. Kemper, T. Feld, and M. Hoffmann, “Industry 4.0,” *Business & Information Systems Engineering*, vol. 6, pp. 239–242, 2014.

[7] J. Lee, B. Bagheri, and H.-A. Kao, “A Cyber-Physical Systems Architecture for Industry 4.0-Based Manufacturing Systems,” *Manufacturing Letters*, vol. 3, pp. 18–23, 2015.

[8] Mozilla Developer Network, JavaScript Documentation, MDN Web Docs.

[9] National Institute of Standards and Technology (NIST), *Guide to Operational Technology (OT) Security*, NIST Special Publication 800-82, Revision 3, 2023. Available:

[10] NXP Semiconductors, MFRC522: Standard Performance MIFARE and NTAG Frontend, Datasheet, Revision 3.9, 2016. [10] OWASP Foundation, Authentication Cheat Sheet, OWASP Cheat Sheet Series.

[11] OASIS, *MQTT Version 5.0*, OASIS Standard, 2019. Available:

[12] L. D. Xu, W. He, and S. Li, "Internet of Things in Industries: A Survey," *IEEE Transactions on Industrial Informatics*, vol. 10, no. 4, pp. 2233–2243, 2014.

[13] C. S. Yeh, S. L. Chen, and I. C. Li, "Implementation of MQTT Protocol Based Network Architecture for Smart Factory," *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture*, vol. 235, no. 13, pp. 2132–2142, 2021.