Automatic Pallet Transport Request by Forklifts

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Abstract

This project presents the development of an Internet of Things (IoT) system designed to coordinate product transport requests between four industrial machines and a forklift. Each machine operator can submit a transport request via a dashboard, which the forklift driver monitors through a dedicated interface. The system uses a FIFO queue to organize requests, ensuring that transport tasks are performed in the order received. Data regarding transport times is stored and analyzed using InfluxDB, allowing both machine operators and the forklift driver to view real-time statistics such as average transport time, standard deviation, and extreme values. Security is ensured through encrypted communications. The system uses MQTT messaging, Node-RED dashboards, and InfluxDB, following the concepts covered in the IoT course.

Keywords: IoT, MQTT, Node-RED, InfluxDB, Industrial Transport

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1. Introduction

The increasing demand for automation and efficiency in industrial environments motivates the integration of IoT technologies in logistics and material handling. This project develops an IoT system enabling machine operators to request pallet transport via a forklift using a dashboard interface. The forklift driver manages these requests via a FIFO queue, optimizing transport order and timing. The system monitors performance metrics such as average transport times and deviations, providing transparency and facilitating operational improvements.

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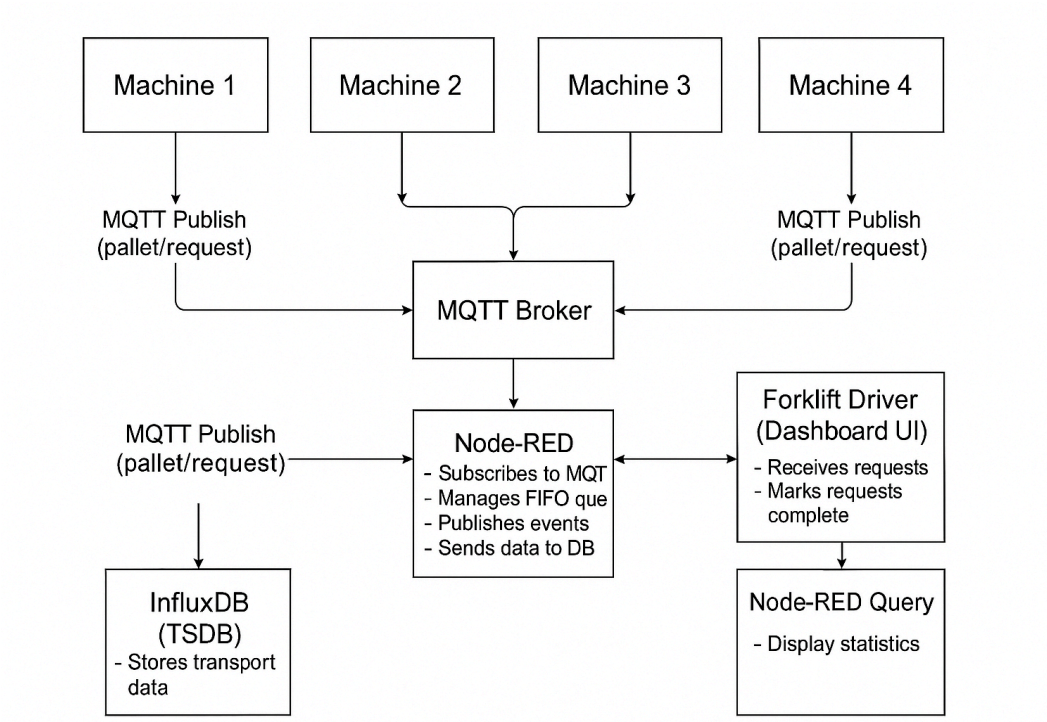
2. System Architecture and Implementation

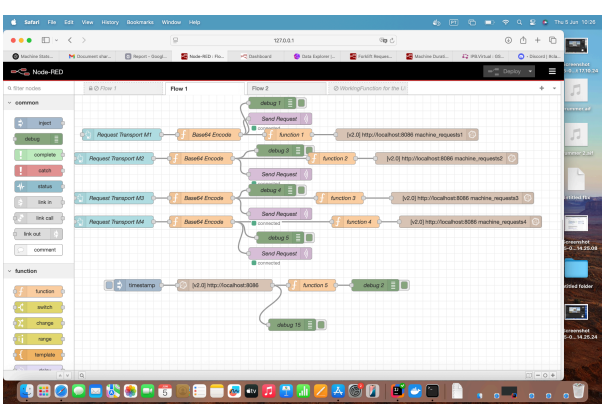
2.1 System Description

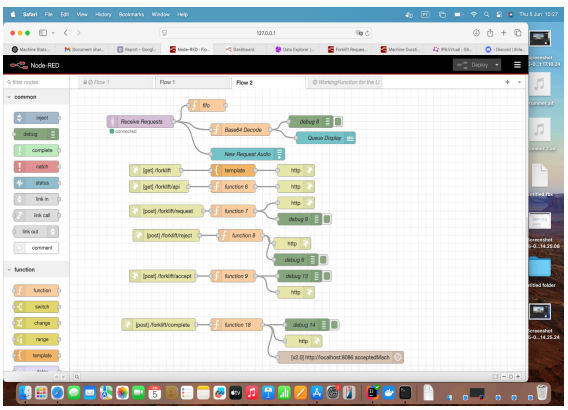
The system consists of four clients, each representing an industrial machine (Machine 1 through Machine 4), and a forklift client. Each machine operator interacts with a dashboard interface to send transport requests for pallets to be moved to a warehouse.

2.2 Communication and Data Flow

Requests are published via the MQTT protocol [1] to a public broker, enabling asynchronous and efficient communication between machines and the forklift. Node-RED handles message routing, dashboard visualization, of requests and responses.







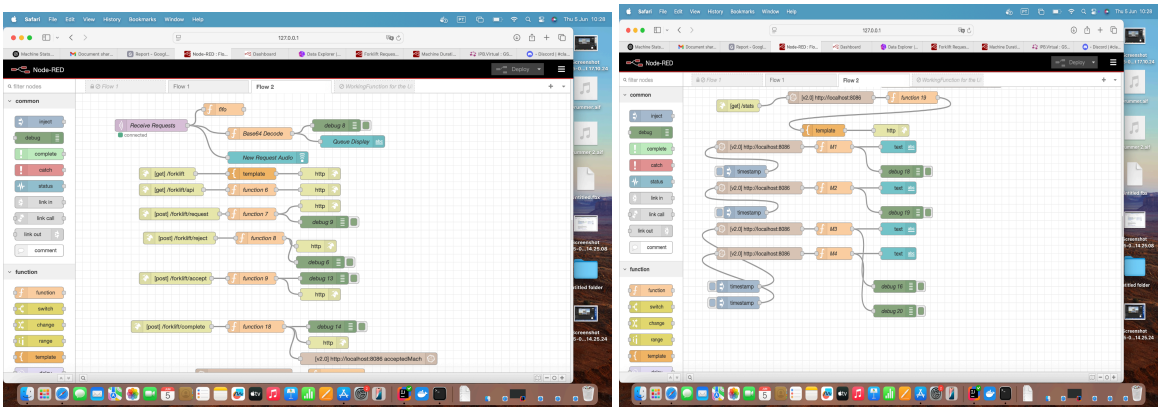
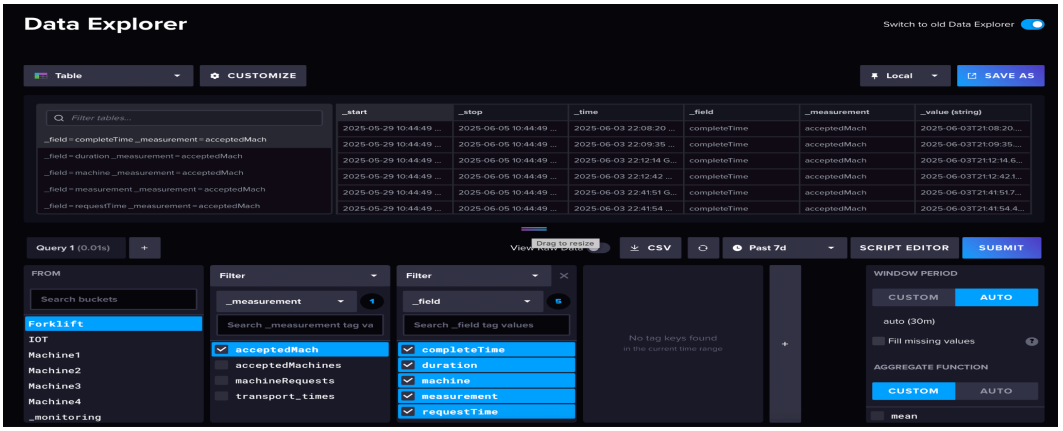
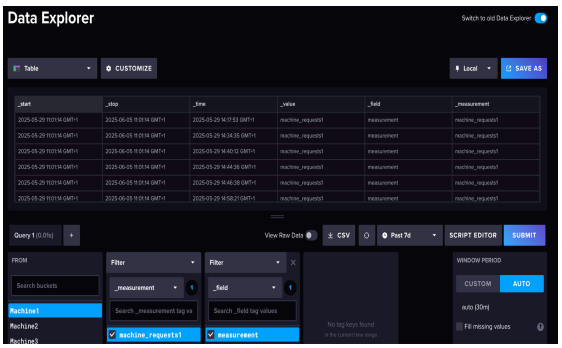


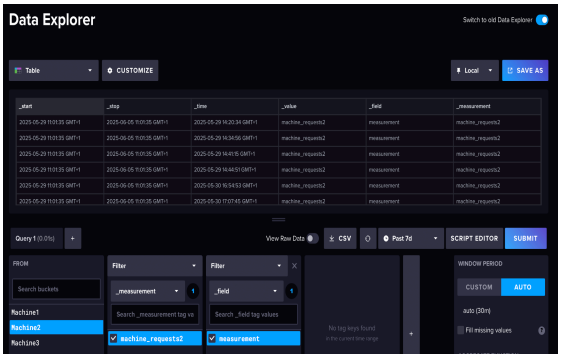
Figure 1 : Diagram of system architecture showing machines, MQTT broker, Node-RED flows, and forklift dashboard.

2.3 Database and Data Analytics

Transport data is stored in InfluxDB [2], a time-series database, with each machine having its own bucket to isolate and organize its data. This structure supports computation of statistics such as average transport time and standard deviation for each machine, as well as overall metrics for the forklift interface.







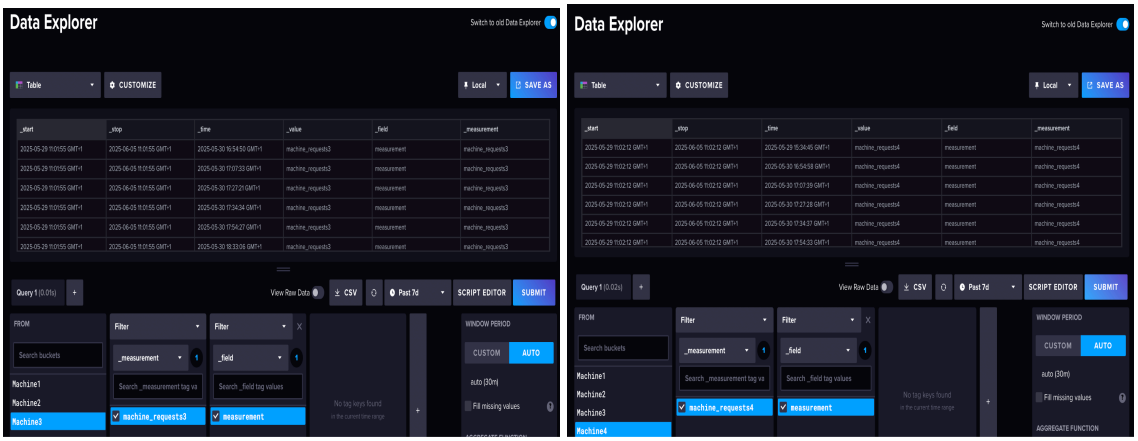


Figure 2 : Screenshot of InfluxDB buckets and sample data visualization.

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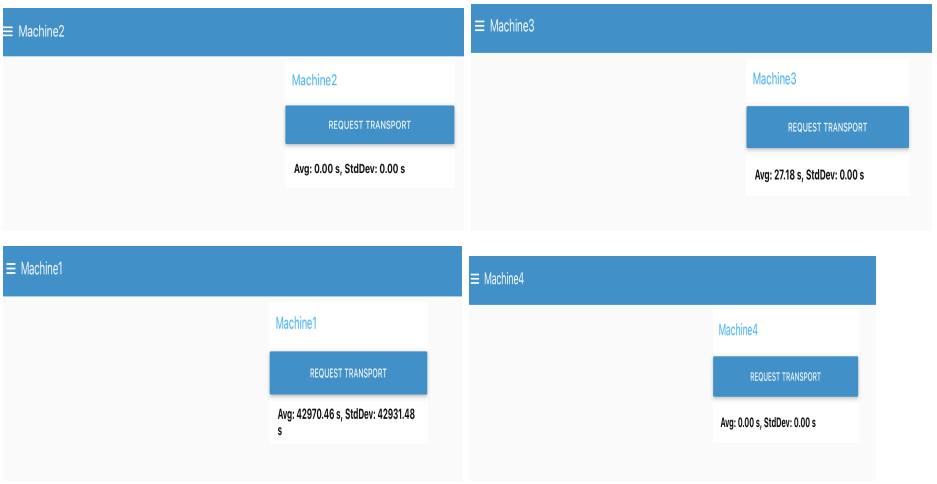
3. User Interfaces and Features

3.1 Machine Operator Interface

- Dashboard to submit pallet transport requests to the forklift.
- Visualization of average transport time and standard deviation from request submission to transport completion, specific to each machine.



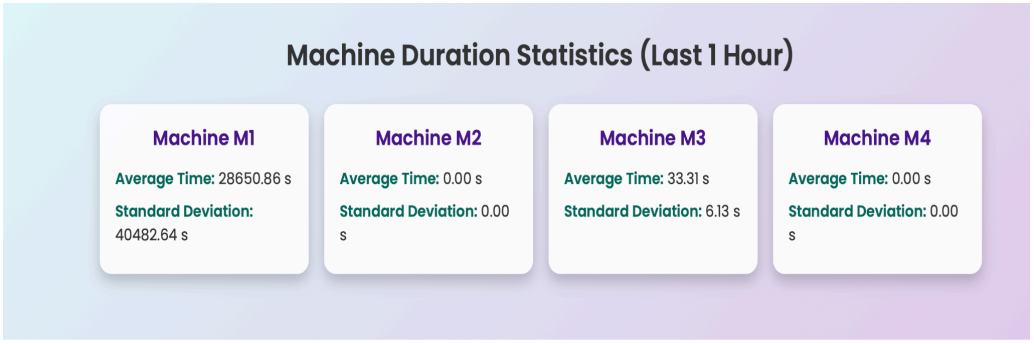


Figure 3 here: Screenshot of Machine Operator dashboard.

3.2 Forklift Driver Interface

- Displays a FIFO queue of incoming transport requests with real-time updates.
- Provides a button to mark requests as completed, removing them from the queue.
- Shows average transport time for all operations.
- Displays the shortest and longest transport times and identifies the corresponding machines.
- Plays an audio alert when a new transport request is received.

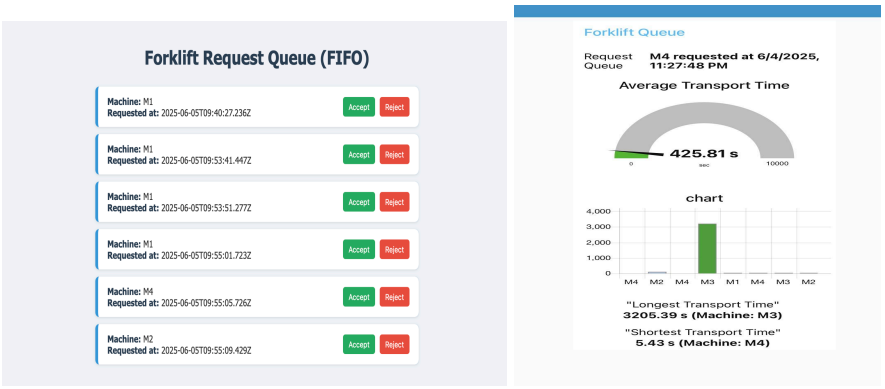


Figure 4 here: Screenshot of Forklift Driver dashboard with queue and stats.

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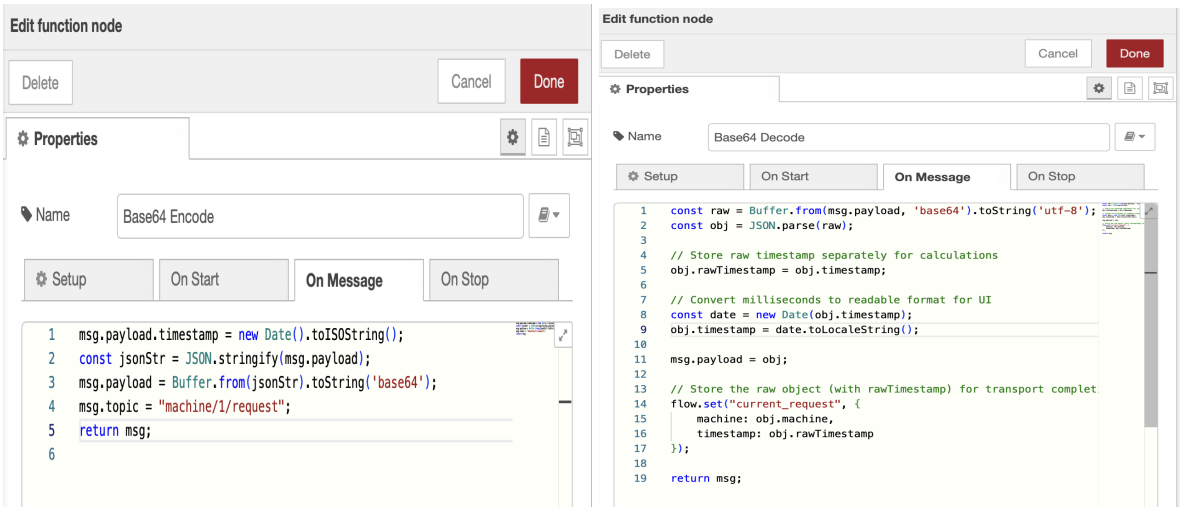
4. Security Considerations

All data communication between the forklift and the machines is encrypted to maintain confidentiality and integrity. This prevents unauthorized access or tampering with transport requests and operational data, following recommended IoT security practices [3].



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5. Conclusions

The developed IoT system efficiently manages pallet transport requests in an industrial environment by leveraging MQTT messaging, Node-RED dashboards, and InfluxDB analytics. The FIFO queuing ensures fair and orderly processing of requests. Real-time statistics improve operational transparency and enable performance monitoring. The implementation of encryption guarantees secure communication. This project demonstrates the practical application of IoT concepts for enhancing industrial logistics.

References

[1] MQTT Version 3.1.1, OASIS Standard, 2014. Available: https://docs.oasis-open.org/mqtt/mqtt/v3.1.1/os/mqtt-v3.1.1-os.html

[2] InfluxData. “InfluxDB Documentation.” Available:

InfluxDB OSS v2 Documentation

[3] S. Sicari, A. Rizzardi, L. Grieco, and A. Coen-Porisini, “Security, privacy and trust in Internet of Things: The road ahead,” Computer Networks, vol. 76, pp. 146–164, 2015. https://doi.org/10.1016/j.comnet.2014.11.008

[3]Gitlab
https://gitlab.estig.ipb.pt/dev-web/iot-mini-project.git