TEAM M051

Real-Time Construction Logistics Platform with Dynamic Scheduling (SitePulse)

Anass Alqahtani , Hamoud Aljadidi, Faisal Almutairi , Hassan Misbah , Abdullah Almeshhen , Suliman Lami
Coach: Dr. Omar Hamma

CIE 4 CEE
ICS ISE

PROBLEM STATEMENT

Traditional construction management relies on static schedules and manual coordination, causing delays and congestion in over 70% of projects. This project develops a real-time logistics platform leveraging IoT monitoring and dynamic scheduling to minimize waiting times and enable adaptive, data-driven decision-making.

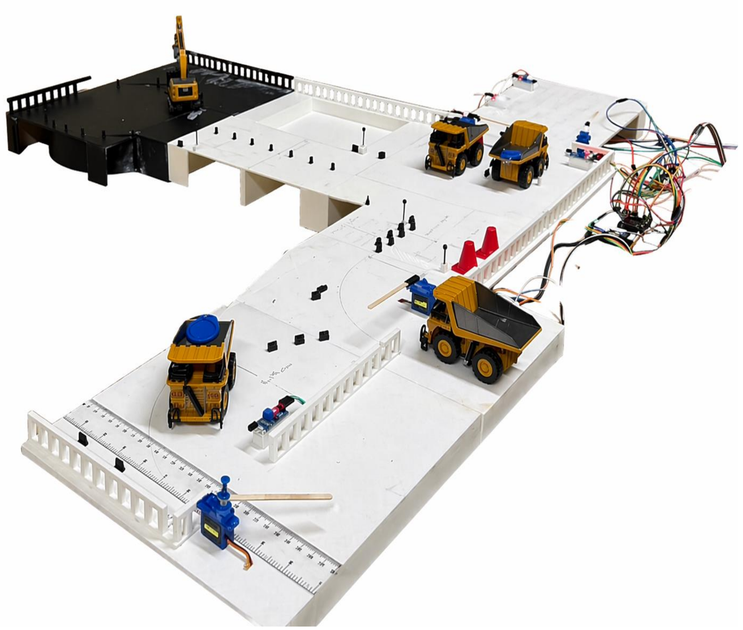
CONSTRAINTS

Web-browser accessible	Energy ≤ 0.8 kWh/day per gate kit
PDPL (SADIA) compliant	On-site traffic speed limit ≤ 14 km/hr
Gate vehicle inflow ≤ 36 Veh/hr	Min. turning radius ≥ 12 m per gate
Safety zone width ≥ 1.0 m	Sensor/control box area ≤ 3 m^2 per gate

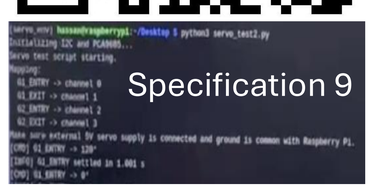
CONCLUSION & NEXT STEPS

IoT platform with dynamic scheduling & simulation reduces wait times and improves gate flow. Industrially validated. Future works include ML prediction, digital twin, and site tailoring.

PROTOTYPE DESIGN – TESTING & VALIDATION



SitePulse




```
=== Specification 1 Check ===
Spec: Suggest alternatives within 150 s of bottleneck detection
Elapsed time = 149.31 s
Alternatives generated = 2 (min required = 2)
Time check -> PASS ✅
Count check -> PASS ✅
Specification 1 Overall -> PASS ✅
Objectives: [258.0, 254.0]
```

```
=== Specification 3 Check ===
Spec: Auto-update ≤ 10.0 s (± 0.10s tolerance)
Measured latency = 10.032 s
Result: PASS ✅
```

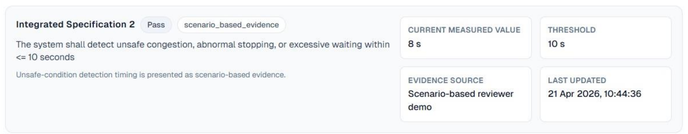
Part	Consumption
Raspberry Pi	480 Wh/day
PWM driver	0.1365 Wh/day
Load cell	0.01215 Wh/day
RFID	0.0891 Wh/day
6 IR sensors	10.8 Wh/day
4 Servo motors	10 Wh/day
Total	0.50103 KWh

```
=== Constraint 6 Check (Optimized) ===
Rule: For each gate, max starts in any 60 min window ≤ 36 veh/hr
Gate 0: max inflow = 8 veh/hr -> PASS ✅
Gate 1: max inflow = 8 veh/hr -> PASS ✅
Constraint 6 Overall -> PASS ✅
```

```
=== Specification 5 Check (Optimized) ===
Spec: Queue length at each gate ≤ 2 at all times
Gate 0: max queue length = 2 -> PASS ✅
Gate 1: max queue length = 1 -> PASS ✅
Specification 5 Overall -> PASS ✅
```

```
=== Bottleneck Prevention Spec ===
As-Is bottlenecks: 1
Optimized bottlenecks: 0
Prevention Rate: 100.00%
PASS ✅
```

```
=== Specification 4 Check (Optimized) ===
Spec: ≥ 90% trucks wait ≤ 15 min
Measured service level = 100.00% (16/16)
P90 waiting time = 6.00 min
Result: PASS ✅
```



SPECIFICATIONS

1. Alternatives suggested within 150 s of detection
2. Data acquired & time-stamped every ≤ 10 s
3. Schedule updates within 10 s of site change
4. 90% of trucks wait ≤ 15 min at the gate
5. Gate queue length ≤ 2 vehicles at all times
6. Vehicle headway distance ≥1.1× avg vehicle length
7. Entry-to-Exit ratio between 0.8 -1.2 per half-hour
8. Affected events update within 10s of any change
9. Gate settling time ≤ 5 s
10. ≥ 99% event logging reliability (per 100 entries)
11. Arrival/departure time accuracy ± 2 min
i.1. Prevent ≥ 80% of bottlenecks before occurrence
i.2. Detect congestion or excess waiting within ≤ 10 s
i.3. Event updates with ≤ 30 min delay and ≤ 15% progress err

Ready to optimize your site?

Contact us: SitePulse@outlook.com