**Requirements Document**

**1. Introduction**

This document outlines the requirements for the development of a real-time monitoring dashboard for industrial sensor data. The dashboard will provide both real-time and historical data visualization, authentication mechanisms, and machine learning-based anomaly detection.

**2. Team Expertise and Rationale**

The project team consists of students from the University of Bradford studying a computer science course. The rationale for this project is to enhance production monitoring efficiency, enabling operators and managers to make data-driven decisions in real time.

**3. Functional Requirements**

**User Authentication:**

* Login and registration system.
* Role-based access control (Operators, Managers - Admins).
* Password reset functionality.

**Dashboard Features:**

* Responsive design (optimised for desktop and tablet, mobile support as a bonus).
* Real-time data visualisation.
* Historical data visualisation (separate from real-time visualisation, including time-based date range filtering and selection for production line, possibly a separate subpage for better UI considerations).
* Sensor charts (grouped or enumerated view).
* Statistical insights (min/average/median/max in the last X hours).
* Traffic light system for anomaly detection (including green, amber, and red thresholds).
* Alert notification system for critical anomalies.

**Data Handling:**

* Real-time data simulation using synthetic and historical data.
* API to handle real-time (synthetic) and historical data.
* Strategies for real-time data simulation:
  + Replaying historical data to simulate sensor readings.
  + Using probabilistic ranges for each sensor based on past data.
* Integration with machine learning models for anomaly detection.

**Additional Features:**

* Interactive filtering of sensor data.
* Export functionality for reports in CSV/PDF formats.

**4. Non-Functional Requirements**

**Performance:**

* Real-time updates every 30 seconds.

**Security:**

* Encrypted authentication data.
* Role-based access control.
* Data anonymization for compliance.

**Usability:**

* Intuitive user interface.
* Support for light/dark mode.
* Accessible for users with disabilities (WCAG compliance).

**Reliability:**

* Automated error handling for missing data.

**Scalability:**

* Support for increased sensor inputs without performance degradation.
* Modular architecture for easy expansion.

**5. Data Description**

**Historical Data Storage:**

* SQL database for past data retrieval.
* Indexed storage for fast querying.

**Real-Time Data Generation:**

* Simulated data using Python.
* Support for multiple sensor types.

**Machine Learning Model:**

* Uses Python-based forecasting models.
* Adaptive thresholding for anomaly detection.
* Focus is on **integration**, not accuracy or validation of ML models.

**6. Interface Design**

**Main Dashboard:**

* Displays sensor data in charts.
* Traffic light anomaly detection with green, amber, and red thresholds.
* Dynamic filtering for different time periods.

**Admin Panel:**

* User management.
* Approval of new user registrations.
* System settings for data thresholds.

**Login Page:**

* Secure authentication mechanism.
* Two-factor authentication support.

**7. Legal, Social, Ethical, and Professional Issues (LSEPI)**

**Legal:**

* GDPR compliance for user data.
* Data retention policies in place.

**Social & Ethical:**

* Transparent AI decision-making for anomaly detection.
* Bias mitigation in ML models.

**Professional:**

* Secure software development best practices.
* Compliance with industry standards.

**8. Risk and Economic Aspects**

**Risks:**

* Data loss due to server failures (mitigated by backups).
* Sensor data anomalies leading to false alerts (addressed via threshold tuning).
* Unauthorized access risks (mitigated via role-based controls).

**Economic Impact:**

* Reduces downtime by providing early alerts.
* Improves efficiency by visualizing key production data.
* Cost-effective anomaly detection compared to manual monitoring.

**Work Plan**

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| **Task** | **Assigned to** |  |
| LSEP | Kamran Khan |  |
| UML | Wassi Abbas |  |
| Registration form | Ibrahim Modak, Moman |  |
| Login form ,peer review ,team meetings | Armaan /Moman |  |
| Dashboard | Kamran Khan |  |
| Admin Panel | Eisa |  |
| Data simulator (LiveDataSim) - grant chart | Ihtisham |  |
| Db config file | Kamran Khan |  |
| Traffic light system | Wassi Abbas, Eisa |  |
| Admin user page – update approve, deny, delete | Kamran Khan |  |
| csvFile.php to add to database | Moman |  |
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