NAME:TUMMA SYAM BABU
REG NO:113323106109
NM ID:aut113323ecb53
DPT/SEC/SEM:ECE/B/IV

Phase 2: Innovation & Problem Solving

Title Quality Control Manufacturing

Innovation in Problem Solving

To enhance quality assurance in manufacturing by implementing innovative solutions that reduce defects, increase efficiency, and ensure consistent product standards through the use of AI, IoT, and data analytics.

Core Problems to Solve

Manual Inspection Errors: Inconsistencies and human error in product inspections lead to defects passing through.

Delayed Defect Detection: Quality issues are often identified too late, causing increased rework or scrap.

Process Variability: Lack of real-time insights leads to process deviations going unnoticed.

Data Silos: Fragmented data across machines and systems hinder accurate quality analysis.

Innovative Solutions Proposed

1. AI-Based Defect Detection System

Solution Overview: Use computer vision and machine learning to detect defects in real time across the production line.

Innovation: The system adapts to new defect types using self-learning models, improving over time with continuous feedback.

- **Technical Aspects**:High-resolution cameras and edge AI for visual inspections. Deep learning models trained on defect image datasets. Continuous improvement via feedback loops from quality engineers.

2. Predictive Quality Analytics

Solution Overview: Monitor machine parameters (temperature, vibration, etc.) and predict quality deviations before they occur.

- **Innovation**: Integrate with IoT sensors to proactively manage process stability.
- **Technical Aspects**:
  - Sensor data ingestion in real-time.
  - Anomaly detection using time-series AI models.
  - Preventive alerts for corrective actions.

3. Digital Twin for Process Optimization

Solution Overview: Simulate the manufacturing process virtually to detect potential quality issues before they occur physically.

Innovation: Use AI-driven simulations to test production changes without interrupting realworld operations.

- **Technical Aspects**: Real-time synchronization with production floor.
  - Simulation models trained with historical production data. AI algorithms to suggest process improvements.

4. Secure Quality Data Logging with Blockchain

- **Innovation** Ensure data integrity and transparency across supply chain partners.
- **Technical Aspects**
  - Blockchain-based logging of inspection results.
  - Access control for stakeholders (e.g., suppliers, auditors).
  - Timestamped, tamper-proof data entries.

Implementation Strategy

Solution Overview: Use blockchain to create an immutable quality log for audits and traceability.

1. Model Development and Training data. Use synthetic data to cover rare defect scenarios.

2. Pilot Deployment on Assembly Line

- Deploy vision systems and IoT sensors on a small-scale assembly line.
- Validate defect detection accuracy and process insights.

3. Blockchain Integration

Test blockchain-based logging for selected production batches.

Challenges and Solutions

- **Data Quality**: Addressed through data preprocessing and validation pipelines.
- **Change Resistance**: Resolved via workforce training and visual dashboards for better acceptance.

System Integration: Overcome using middleware that connects legacy machines with modern platforms.

Expected Outcomes

Reduced Defects and Rework: Early detection and correction will minimize production losses.

Improved Process Control: Real-time insights enable proactive quality management.

Enhanced Traceability: Blockchain ensures data trust and simplifies audits.

Scalable Solution: Modular design allows easy scaling to other production lines and plants.

Next Steps

Pilot Testing: Validate the system in a real-world manufacturing environment.

Feedback-Driven Improvements: Use operator feedback to refine AI models and interfaces.

Full-Scale Rollout: Extend implementation to all production areas, with regular performance assessments.