

MDM2 – Case Study: Intelligent Systems in Production
One-Page Proposal

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| Team | Group 9 |
| Members | Sameer Kandathinkarayil Subair Karthik Gopi Nihal Sait Nishan Abdul Rashid Kundladi |
| Project Title | Digital Twin of a Rotating shaft for Predictive Maintanance using MATLAB simulink and Simscape |
| GitHub Repository URL | |
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| Industrial Application (target domain/use-case) | Predictive maintenance in rotating machinery systems — focusing on shafts, motors, and drivetrain components in manufacturing and process industries. |
| Keywords (3–6) | Digital Twin, Predictive Maintenance, MATLAB Simulink, Rotating Shaft, Fault Diagnosis, Condition Monitoring |
| Submission Date (YYYY-MM-DD) | |
| Gant Chart | Make a Gantt chart outlining all project phases up to the final |

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| 1) Problem Statement&Measurable Outcomes (3–4 sentences) | Unexpected shaft failures in industrial machines cause unplanned downtime and costly maintenance interruptions. Current preventive methods rely on fixed schedules and often fail to |
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| | <p>detect early faults like imbalance or bearing wear. This project aims to build a digital twin of a rotating shaft using MATLAB Simulink and Simscape to simulate operational conditions and detect fault signatures.</p> <ul style="list-style-type: none"> • Measurable outcomes (KPIs): • Fault detection accuracy $\geq 90\%$ • Prediction error (RUL) $\leq 10\%$ • Reduced maintenance intervention frequency by 20% (simulated comparison) |
| 2) Motivation&Industrial Relevance (2–3 sentences) | <p>This project supports the growing demand for Industry 4.0 predictive maintenance systems by integrating virtual models with AI-based analytics. It benefits production engineers by enabling earlier fault detection, reducing unplanned downtime, and optimizing maintenance schedules — all without the need for physical testing.</p> |
| 3) Related Work Snapshot (2–3 key references) | <p>–Raja Singh, R. et al., “Building a Digital Twin Powered Intelligent Predictive Maintenance System for Industrial AC Machines,” Machines, 2023 (MDPI).</p> <p>–Han, T. et al., “Overview of Predictive Maintenance Based on Digital Twin Technology,” Mechanical Systems and Signal Processing, 2022.</p> <p>These studies highlight digital twin applications in rotating machinery but lack simulation-focused approaches for shaft dynamics using MATLAB/Simulink, which this project aims to address.</p> |
| 4) Method&Feasibility (≤ 6 sentences) | <p>A digital twin model of a rotating shaft will be created in Simulink and Simscape Multibody with adjustable parameters for stiffness, damping, and mass imbalance. Synthetic sensor signals (vibration, torque, temperature) will be</p> |

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| | <p>generated under normal and faulty conditions. Signal processing and feature extraction (FFT, RMS, kurtosis) will be applied using MATLAB toolboxes. Predictive models such as SVM or ANN will be trained using the Predictive Maintenance Toolbox to estimate Remaining Useful Life (RUL). The project is entirely software-based, ensuring feasibility within the semester timeframe.</p> |
| 5) Milestones&Timeline (short table/list) | <p>P1 - Oct 16 - Topic selection, scope, and motivation (proposal + tech stack)</p> <p>P2 - Nov 6 - Core Simulink model setup and baseline simulation</p> <p>P3 - Nov 27 - Feature extraction, data analysis, and model testing</p> <p>P4 -Dec 18 - Predictive maintenance results, demo video, documentation</p> <p>P5 - Jan 15 - Final presentation and report submission</p> |
| 6) Risks&Ethics (1–2 sentences) | <p>As this study uses simulated data, there are no privacy or security risks. Ethical practice will be ensured by proper citation of references, reproducibility of simulation results, and avoidance of biased model training.</p> |

Phase 1 rubric (15%): Team&GitHub (2%), On-time (2%), Topic&Proposal (5%) — Industrial Application, Problem+Outcomes, Feasibility+Timeline; Presentation (6%).