## 

Proposal

**Manifetch**

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### **1. Project Title**

### **A Unified Web-Based Platform for Real-Time NICU Signal Monitoring and AI-Assisted Diagnosis**

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### **2. Problem Definition & Objectives**

### **Problem Definition:**

### Neonatal Intensive Care Units (NICUs) rely on multiple monitoring devices to track newborns’ vital physiological parameters such as heart rate, respiration rate, oxygen saturation, and temperature. However, these systems often operate independently, lacking a unified interface to integrate real-time signals with AI-driven diagnostic insights which causes delays in clinical decision-making, increases the risk of human error, and leads to inconsistencies in diagnosis and reporting across hospitals. Moreover, clinicians often struggle to access data remotely or visualize patient health trends over time in an integrated way.

### To address these challenges, there is a need for a secure, web-based, and interoperable platform that can collect real-time data from IoMT-enabled NICU devices, process them through AI diagnostic models, and provide clinicians with an integrated dashboard for monitoring and reporting

### **Objectives:**

### Developing a secure, responsive web application that integrates IoMT and AI-based diagnostic modules.

### Providing real-time visualization of neonatal respiratory and cardiac health indicators.

### Enabling standardized clinical reporting accessible from any hospital unit.

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### **3. Scope**

### Integration of real-time physiological signal data from IoMT-enabled sensors and devices.

### Development of AI modules for early diagnosis of respiratory distress and cardiac irregularities.

### Implementation of a secure middleware to manage data flow between NICU devices, HIS, and AI modules.

### Visualization of patient health metrics and AI predictions through an interactive web-based dashboard.

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### **4. User Profile**

### **Target Users:**

### **NICU clinicians and nurses** for real-time patient monitoring and alerts.

### **Hospital administrators and IT staff** for system management and report generation.

### **Biomedical engineers** for device integration and system maintenance.

### **Healthcare researchers and data scientists** for analyzing neonatal health trends and improving AI models.

**Institutional Partner:**

* ERTUNÇ ÖZCAN Import & Representation

### **5. Anticipated Challenges & Constraints**

### **Technical Challenges:**

### Integrating heterogeneous IoMT devices with different data formats and communication protocols (e.g., MQTT, HL7, FHIR).

### Ensuring real-time data synchronization and low-latency streaming between NICU devices and the cloud backend.

### Developing robust AI models capable of accurate diagnosis despite noisy or incomplete physiological signal data.

### Maintaining interoperability with existing Hospital Information Systems (HIS) without disrupting their workflows.

### **Time and Resource Constraints:**

### Limited project timeline may restrict large-scale data collection and model training.

### High computational requirements for real-time signal processing and AI inference may demand GPU-enabled servers.

### Dependency on hospital collaboration for data access and testing could delay certain development phases.

### **Ethical and Regulatory Considerations:**

### Compliance with healthcare data protection regulations (e.g., HIPAA, GDPR).

### Obtaining patient data anonymization and informed consent prior to data usage.

### **Risk Mitigation Approach:**

### Adopt modular system design enabling independent testing of IoMT, AI, and dashboard components.

### Use synthetic or publicly available neonatal datasets for model prototyping before deploying with real hospital data.

### Conduct pilot testing with a small-scale deployment to identify and resolve integration or latency issues early.

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### **6. Data Sources**

### **Public Neonatal Signal Datasets:**

### Preterm Infant Cardio-Respiratory Database (PICS-DB), PhysioNet — contains ECG, respiration, and SpO₂ recordings from preterm infants in NICUs. This dataset will be used for AI model training and validation to detect respiratory distress and cardiac irregularities. (Access link:<https://physionet.org/content/picsdb/>)

### MIMIC-IV Waveform Database, PhysioNet — includes multi-parameter physiological waveforms (ECG, SpO₂, heart rate, etc.) from neonatal and pediatric ICU patients. It will be used to complement the PICS-DB data by providing healthy and diverse patient samples for comparative model analysis. (Access link: <https://physionet.org/content/mimic4wdb/>)

### **Simulated and Synthetic Data:**

### Synthetic NICU data generated via signal simulation tools (e.g., BioSPPy, NeuroKit2) for early-stage model testing.

### **Collaborative Hospital Data:**

### Real-world anonymized patient signal data collected in partnership with healthcare institutions, ensuring ethical data usage and compliance.