**VIT Hackathon Problem Statement Topics**

1. **Title: - (Priority 1 challenge)**

**Smart Automated Docking for Medical Device Systems in Dynamic Clinical Environments**

**Context:**  
In busy operating rooms, medical devices often need to be repositioned and docked quickly to patient tables or imaging systems. Manual docking is time-consuming, error-prone, and can disrupt sterile workflows. Since the docking point and parking point are fixed, there is an opportunity to create a system that can automatically move from parking to docking with precision and minimal human intervention.

**Challenge:**

* Simulate or prototype a mobile base that automatically aligns to a docking point once the front wheels are positioned on the docking plate.
* Demonstrate soft tracking from parking to docking without modifications to the floor.
* Use sensors (camera, LiDAR, ultrasonic, etc.) for position detection and obstacle avoidance.
* Ensure smooth movement, precision docking, and quick disengagement.
* Validate functionality in a lab setup

**Goals for Participants:**  
Design an automated docking mechanism that can reliably guide a mobile medical device to align and connect accurately in a dynamic clinical environment, while being safe, efficient, and easy to integrate.

1. **Title: Low-Cost Immobilizer Bed Concept for Surgery**

**Context:**

During surgeries or image-guided procedures, even slight patient movement can affect accuracy and outcomes. Existing immobilization systems are often expensive and not easily adaptable to local needs.

**Goal:**

Design an affordable, indigenized immobilizer bed concept that can securely restrict patient movement while ensuring comfort and safety.

**Challenge:**

Create a simple yet effective immobilization mechanism for surgical use.

Ensure comfort, safety, and ease of adjustment.

Focus on low-cost design using locally available materials.

Demonstrate the concept through a prototype or simulation.

1. **Title: Low-Cost Breath Hold Monitor for Medical Use**

**Context:**

During certain medical procedures (e.g., imaging or radiotherapy), patients are required to hold their breath for short intervals. Current monitoring solutions can be expensive or complex, making them less accessible in resource-limited settings.

**Goal:**

Develop a low-cost, easy-to-use breath hold monitoring solution that ensures accuracy and supports indigenized design.

**Challenge:**

Use readily available sensors (e.g., chest strap, airflow sensor, or wearable devices).

Provide clear visual or audio feedback during breath hold.

Ensure the system is simple, reliable, and patient-friendly.

Demonstrate feasibility with a working prototype or simulation.

1. **Title: Economical IR Optical Tracker for Fiducial Ball Tracking**

**Context:**

In image-guided medical procedures, fiducial balls are used as reference markers for precise navigation. Current IR optical tracking systems are accurate but often expensive, limiting accessibility in cost-sensitive settings.

**Goal:**

Design a low-cost optical camera concept that can accurately detect and track fiducial balls in real-time using infrared technology.

**Challenge:**

Use affordable camera modules and IR illumination sources.

Implement basic image processing to detect and track fiducial balls.

Ensure tracking accuracy within a few millimetres.

Demonstrate performance with a prototype setup or simulation.

1. **Title: Automatic Device Movement Mechanism Using Swerve Drive Wheel for Medical Devices**

**Context:**

In operating rooms, medical devices often need to be repositioned quickly and precisely. Traditional caster wheels’ limit mobility, slowing down setup and risking delays in critical procedures. A swerve drive wheel system can enable smooth, omnidirectional movement, allowing devices to navigate tight spaces and dock accurately.

**Goal:**

Develop a compact, motorised swerve drive–based mechanism to move and align a medical device platform with high precision and safety.

**Challenge:**

Design a basic swerve drive configuration suitable for a medical device.

Implement manual or semi-autonomous control for precise movement.

Include basic obstacle detection and safety stops.

Show a working prototype or simulation that demonstrates smooth movement and accurate docking.

1. **Title: AI-Driven Real-Time Anomaly and Anatomy (Liver, Lung , Spine vertebra, bone, tumor) Detection in Image-Guided procedures**

**Context:**

In image-guided surgeries and interventions, small anomalies—like instrument misalignment, image distortion, or organ shift —can be missed due to human fatigue or limited real-time analysis. This can affect the accuracy and safety of the procedure.

**Challenge:**

Use sample medical imaging datasets (CT, Ultrasound, or simulated images).

Apply computer vision or ML to detect anomalies such as movement, distortion, or misalignment.

Show real-time detection with a simple interface or alert system.

Focus on speed, accuracy, and ease of integration into an existing workflows.

**Goals for Participants:**

Create an AI-based system that processes live 2D/3D medical images to detect anomalies instantly and alert the operator