IIT Tirupati Navavishkār I-Hub Foundation

भारतीय प्रौद्योगिकी संस्थान तिरुपति
IIT TIRUPATI

विज्ञान एवं प्रौद्योगिकी विभाग
DEPARTMENT OF SCIENCE & TECHNOLOGY

Quantum-based PNT System for Underwater Robot Navigation

Breif Background

Quantum clocks offer ultra-precise timekeeping by exploiting quantum mechanical transitions, enabling far greater stability than traditional atomic clocks. This makes them highly suitable for mission-critical applications in navigation, communication, and scientific research. The Adaptive Quantum Clock System advances this further by incorporating environmental sensing and intelligent control, using real-time data and digital twins to adjust its operation and maintain accuracy even in harsh or dynamic environments.

Application Sectors

- 1. Underwater exploration,
- 2. Defence,
- 3. Deep-sea mining,
- 4. underwater vehicles

TRL 4

Tech/Prod. Summary

This quantum clock is designed to work reliably in changing environments. It adjusts itself using live data and smart controls, even in places like underwater or noisy areas.

Tech/ Product Description

The Adaptive Quantum Clock System is a precision timekeeping platform that uses quantum mechanics to maintain ultra-accurate timing even in harsh environments. It integrates real-time sensor data, digital twin modeling, and adaptive control algorithms to adjust clock behaviour dynamically under changing conditions such as underwater environments, electromagnetic noise, or temperature variations. A noise modeling module further filters interference, ensuring stable and reliable performance at all times

Market Potential

Global Precision Time market: Projected to reach USD 1.5 – 2.0 Billion by 2030

Impact - SDG:

SDG 9 – Industry, Innovation and Infrastructure;
SDG 14 – Life Below Water

Value Proposition

1. Precise, stable timekeeping in underwater environments
2. Adapts to noise, pressure, and power changes using smart controls and real-time data.