Smart Monitoring and Control System for Crude Oil Pipeline Vandalism

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Abstract*: Crude oil pipeline vandalism, theft, and unauthorized interference present a significant challenge to the oil industry's security, profitability, and sustainability. Despite initial measures such as security patrols, traditional methods have proven inadequate, particularly in difficult terrains and aquatic regions. These methods often fail to promptly detect and prevent vandalism and theft, which results in significant economic, environmental, and safety risks. This study developed and implemented a smart monitoring and control system to address these challenges by improving the detection of oil pipeline vandalism, including incidents in aquatic environments. The Prototyping methodology was adopted, allowing for continuous testing and improvements throughout the development process. The system was built using C#.NET under the .NET Framework, with Microsoft SQL Server as the database, incorporating an encryption layer for database security. To enhance its effectiveness, an oil theft detection algorithm was integrated with a web-based interface to facilitate real-time monitoring, visualization, and reporting. Testing scenarios demonstrated that the system successfully detected threats and ensured seamless data flow from sensors to the central system. This solution marks a significant advancement in the security and sustainability of oil infrastructure, contributing to environmental protection and the safety of stakeholders*

Keywords: Crude Oil Pipeline Vandalism, Oil Theft Detection, Internet of Things (IoT), and Smart Monitoring System