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Exception Based Monitoring of Oil and Gas Pipelines Using VTOL Type-Unmanned Aerial Vehicles (UAV)

Authors

Francis Enejo Idachaba (Covenant University Ota)

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Abstract

The vast and diverse spread of the oil and gas pipeline infrastructure makes real-time monitoring of the entire network a very costly and impossible task. This topology has provided vandals and crude oil thieves with the opportunity of tapping the pipelines and successfully stealing crude oil from these lines unhindered. Nigeria lost over $11 billion to crude oil theft and pipeline vandalisation over a 4 year period (2007 to 2011). The increase in vandalisation has led to the divestment of assets by some of these oil companies as it is no longer economical to continue operating the assets. Strategies employed by the government and Oil companies to tackle these challenges include the deployment of military personnel to these assets and also along their pipeline right of way. In spite of this attempts, the results show that the deployment of these personnel and the attendant cost have not reduced the quantity and frequency of oil theft as the deployment time to some of these locations also contribute to delay in the response of the security personnel. The deployment of dynamic pipeline pressure profiles of enables the determination of the onset of a leak or a loss of crude oil. This paper presents the deployment plan and communication architecture of the Vertical Take Off and Landing (VTOL) type of Unmanned Air Vehicles for pipeline monitoring. The pipeline network of the company is divided into wide area cells and each cell is controlled from a facility. Low power UAVs with directional antennas and long range zoom cameras are deployed to provide real-time visual

monitoring of the pipeline section whenever a pressure drop or any significant third party activity is detected on section of the pipeline. Security personnel can then be deployed to the pipeline section if vandal activity is detected. This solution has the capability of reducing crude oil theft by providing accurate location data in a timely manner to the company with respect to the bunkering activity along its pipeline ROW and also enabling the timely deployment of personnel to contain the situation.