LITERATURE SURVEY

Topic : Hazardous Area Monitoring for Industrial Plant Powered by Iot

The worker safety in industrial hazardous environments is nowadays a critical issues especially in Oil&Gas, gas storage and distributions or chemical plants, where an explosive atmosphere may be present (Riad et al., 2020), and in which the consequence of a possible accident can be catastrophic (Kelava et al., 2008) (Powell et al., 2008) (Seveso, 2015). The focus of this paper is the development of a wearable monitoring system able to increase the operator safety in gas distribution and storage companies (Fan et al., 2019) (Haitao et al., 2014) (Fraiwan et al., 2011). The flammable and potentially explosive compounds considered are propane or mixture of propane and smaller fraction of butane, due to their widespread use in heating systems not connected to natural gas pipeline. Companies that supply these mixtures, which at environmental temperature can be stored in liquid form and are generally called liquid petroleum gas (LPG), carry out refilling operations of the gas cylinders either inside plants or directly in customer deposits. During preliminary studies in collaborations with a company in the sector namely, Petrolgas in Florence, and Italian national institute for insurance against accidents at work (INAIL), the most common criticalities in the context of industrial hazardous environments have been analyzed with the goal of designing a monitoring system based on wearable smart sensing nodesaiming at reducing the risk of fires and explosions (ISPRA, 2013). The sensing part of the node hosts electrochemical sensors for oxygen and toxic gas detection and a catalytic sensor for LPG detection. Whilelectrochemical sensors have a reduced power consumption, catalytic sensors require a relative high amount of power to operate. This issue has been solved by implementing an adequate powering strategy and exploiting a tradeoff between measurement accuracy, sampling time and energy requirements. The sensor node can generate alarms in case of low oxygen concentration and of potentially explosive concentrations of LPG. When the worker is inside the plant, the sensor node can transmit measurements data with a LoRa transmitter, which transmits periodic data to a gateway responsible for the reception of LoRa packets and for the final transmission of data to the network server (Abrardo et al., 2019). The gateway has a backhaul Internet connection needed to forward the data to a remote application server using a message forwarding protocol. This choice allows for low power consumption and a transmission range able to cover a standard plant area.

References:

Abrardo A., Fort A., Landi E., Mugnaini M., Panzardi E., Pozzebon A., “Black Powder Flow Monitoring in Pipelines by Means of Multi-Hop LoRa Networks”, 2019 IEEE International Workshop on Metrology for Industry 4.0 and IoT, MetroInd 4.0 and IoT 2019 - Proceedings, art. no. 8792890, pp. 312-316.
Addabbo T., Fort A., Landi E., Moretti R., Mugaini M., Parri L., Vignoli V. "A wearable Low-cost Measurement System for Estimation of Human Exposure to Vibrations", 2019 IEEE 5th International forum on Research and Technology for Society and Industry (RTSI), 2019, pp. 442-446, doi: 10.1109/RTSI.2019.8895535.
Fan W., Taiyang W., Mehmet R. Y., “Design and implementation of a wearable sensor network system for IoT-connected safety and health applications”, In 2019 IEEE 5th World Forum on Internet of Things (WF-IoT) (pp. 87-90). IEEE.
Fraiwan L., Lweesy K., Bani-Salma A., Mani N., "A wireless home safety gas leakage detection system", 2011 1st Middle East Conference on Biomedical Engineering, 2011, pp. 11-14, doi: 10.1109/MECBME.2011.5752053.
Kelava M., Gavranic I., Deskin J., "Practical experience with inspection in plants at risk of explosive atmospheres", 2008 5th Petroleum and Chemical Industry Conference Europe - Electrical and Instrumentation Applications, 2008, pp. 1-9.
Haitao L., Xiaoyi M., Yang Y., Andrew J. Mason, "Low Power Multimode Electrochemical Gas Sensor Array System for Wearable Health and Safety Monitoring", IEEE Sensors Journal, vol. 14, no. 10, pp. 3391-3399, Oct. 2014.
ISPRA Rapporti 181/2013 ISBN: 978-88-448-0613-2, Mappatura dei pericoli di incidente rilevante in Italia - Edizione 2013. Mekki K., Bajic E., Chaxel F., Meyer F., “A comparative study of LPWAN technologies for large-scale IoT deployment”, ICT Express, Elsevier, 2019, 5 (1), pp.1-7. ⟨10.1016/j.icte.2017.12.005⟩.Powell D. J., "Explosion Protection: Risk Assessment & Hazard Management inManufacturing", 2008 3rd IET International Conference on System Safety, 2008, pp. 1-6.
Riad B., Elarkam M., Ilhem B., Hayett A., "Risk Asseessment For LPG Storage Tanks Area In Skikda Refinery- ALGERIA Using D-Higraph And Hazop Methods & Simulation Of Dangerous Scenarios Using ALOHA Software", 2020 International Conference on Electrical Engineering (ICEE), 2020, pp. 1-5, doi:10.1109/ICEE49691.2020.9249952.