

APPLICATION OF THE INTERNET OF THINGS IN OIL-GAS INDUSTRY

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ABSTRACT. Article proposes an architecture based on the Internet of Things (IoT) for easy, safe, reliable and rapid data collection from in oil and gas industry. New opportunities are created by processing of data collected via sensors for improvement of safety of oil platforms (deposits), optimization of operations, prevention of problems, troubleshooting and reduction of exploitation costs in oil and gas industry.

Keywords: internet of Things, monitoring, sensors, smart objects, network gateways, control center.

AMS Subject Classification: 65E05, 65E99.

1. INTRODUCTION

Oil-gas industry covers expedition, production, processing, transportation and sale processes of oil products. Fuel, oil and gasoline form the majority of products of this industry. Oil is also the raw material for many chemical products, including drug preparations, solutions, fertilizers, pesticides and plastic production. As demand for natural fuel is increasing daily, oil and gas companies must create new technologies and improve operations for increased productivity. Application of IoT, which is based on sensors, can be taken as a topical issue as the way of implementing the right strategy in gathering information in the oil and gas sector. Application of this technology will enable to control efficiency, make efficient decisions, improve production and increase competitiveness [1]. Directions such as increasing the speed of exploration and detection of oil, increasing oil production and reducing the risks to health, security of humans and the environment identified as a result of equipment malfunctions or operator errors are constantly developed with application of Internet of Things.

Internet of Things is characterized as the next revolutionary development layer of information technologies fields after computer, Internet and mobile telephone communication. IoT is already encountered in each activity field of our daily lives. It is mainly used in medicine, agriculture, oil-gas industry and other fields in order to remotely control occurring changes, prevent fires and provision of other useful functionality. Kevin Ashton, one of the developers of Radio Frequency Identification (RFID) technology notes that, Internet of Things has a potential to change the world as much as Internet, may be even more [2].

Solution of several important social problems is expected with realization of Internet of Things. Also, improvement issues of control development processes in oil and gas industry will be solved.

Oil and gas industry monitoring system based on internet of things

Main results of IoT technologies for oil and gas industry are following [3]:

- (1) IoT has several significantly important potential applications in facility exploration, excavation and production operations, maintenance and overall facility control.
- (2) Works on application of IoT technologies in oil and gas field are on experimental level for now and performed works are focused on intensive processing of data and effective control of entrance/exit loadings.

Main objectives of IoT technologies' application are as following:

- (1) detection of more hydrocarbon deposits;
- (2) safe, efficient production and transportation with minimal ecological impact ;
- (3) more efficient and cost saving processing and product distribution;
- (4) planning of optimization;
- (5) customer relations management;
- (6) identification of new opportunities and markets.
- (7) Controlling used equipment (engine, pumps, drilling rigs, etc.);
- (8) Optimization of drilling axis replacement;
- (9) Automatic production platform control;
- (10) Early detection of leaks;
- (11) Pipeline monitoring (for the safety of mechanical-physical condition);
- (12) Greater interaction between automation and security devices;
- (13) tracking staff through geolocation and monitoring of certain security factors (for example, based on immobility for a certain period of time to notify if the staff member has been injured or fallen by determining the user's pulse through smart helmets or anklets);
- (14) Reducing the need for man-made inspections, detecting leaks in real time, as well as measuring various parameters at the entrance of the oil well to optimize parameters through analytics and machine learning.

Article presents the IoT (Internet of Things) based architecture for monitoring various operations of the oil and gas industry. The proposed architecture consists of three modules - sensors (smart object modules), network module (gateways) and application (control center) modules [4, 5]. Each module carries out monitoring of various oil field environments related to each other.

Sensor layer (smart object). Sensor layers consist of sensors installed on different equipment of oil wells and wireless network technologies (3G, 4G, Wi-Fi, ZigBee, etc.) that connect them. Each smart object (sensors) is a physical device, and most of them are placed in different oil equipment. Smart objects allow you to measure and collect data. Each smart object is equipped with different types of sensors such as acoustics, temperature, pressure, etc., in order to detect any leaks on it. Installation of a group of Smart objects on different equipment in oil-field environment is called Smart Oilfield. Signals received from sensors installed for monitoring of oil field pumps (pressure and temperature of pumps, pump outlet, etc.) mainly assists the control process [6]. Information collected from oil fields should be transmitted to the server for processing and analysis.

Network layer (gateways). The network layer is also known as a transmitter layer and is used as an intermediate layer in the Internet architecture of items [7]. The gateway layer basically assures that the data collected on the oil platform is conveyed to the IoT control center or vice versa provides safe transmission of received signals from control center to the sensor layer. Created network controls the installed oil wells devices in several areas, based on the WLAN (Wireless Local Area Network) protocol. In this layer, data is received from the sensor node and if necessary, is encrypted and transmitted to the control center. Because the wells in the oil industry are located far from the center, there is usually no 4G network in these areas and therefore it is important to set up a dedicated wireless network to support the system's service [6].

Application layer (control center). The application layer is implemented as the top layer of the Internet of Things [8]. The Control Center (server) module responds to application control and analysis of data collected from smart object modules. At this layer, automated control of oil

pump monitoring is carried out on the basis of the data control and analysis on each well. It collects data and makes important decisions for anomaly events and supports the decision-making process of the control panel. The application layer is largely responsible for managing processes and consists of object interfaces, central IoT control servers, IoT applications, databases, visualization tools etc. The IoT control center receives data from sensors installed on pumps in real time. The collected data (oil well temperature, pressure, flow, etc.) is analyzed through a smart application and management is performed without human intervention after grouping according to types [6]. The Control Center has two primary goals: to analyze information transmitted to the control center from smart objects through different sensors on the state of equipment, detect malfunctions or predict the possibility of their occurrence. Thus, the control center will assist in the implementation of preventive measures to increase productivity and minimize malfunctions, thereby facilitating better control and maintenance of equipment with lower health and safety risks. The second is to analyze data on production performance based on the daily use and production of oil and gas in the control center [4].

2. CONCLUSION

The article recommends a monitoring system based Internet of Things technology to improve the safety of oil platforms (deposits), optimization of operations, preventing emerging problems, eliminating errors and reducing operational costs based on data collected through sensors in the oil and gas industry. The issues of ensuring the solution of a number of technological problems in the oil and gas industry through the application of the Internet technologies of items have been analyzed.

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