Manhole monitoring via IoT and GIS

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ABSTRACT

Metropolitan Electricity Authority (MEA) is the organization, which provides electricity for 3 responsibility areas such as Bangkok, Nonthaburi, and Samut Prakan in Thailand. Working with underground conductors, manholes are required. But the concerned problem is water effusion in manholes. According to Thailand's weather, there is 5 – 6 raining month a year.

Therefore, MEA has a plan to implement Internet of Thing (IoT) and Geographic Information System (GIS) to solve the problem via 2 kind of sensors; Thermo and Range for water level, providing data to MEA Server for integrating with MEA GIS to display information on the Dashboard Application.

KEYWORDS

Electricity Manhole, Internet of Thing (IoT), Geographic Information System (GIS)

INTRODUCTION

MEA Underground Cable Project

MEA has been converting the power lines from overhead to underground since 1984 collaborating with the relevant agencies to lay the wires underground and remove the power poles in the heart of Bangkok starting from Silom road, one of the most famous commercial centers in Thailand. Following by Phaholyothin Road, Phayathai Road, Sukhumvit Road, and another 10 routes are constructed and under constructing in a total length of more than 214.6 kilometers expecting to be fully finished by 2021 [1]. All of these routes contains more than 9,900 MEA Manholes dividing into 200 under footpath manholes and 9,700 under road manholes approximately.

MEA underground cable project creates more stability for the power system and reduce the risk of damage to the electrical equipment or power interruption caused by wind storms or road accidents. It also helps solve the problem of tangled telecommunications lines and makes the surrounding areas more beautiful enhancing the tourism business. Although, It is practically difficult to detect a fault in an underground electric transmission line, address the problem, and also difficult to upgrade an underground cable, underground electric cables hardly need to be repaired on a regular basis as is the case with the overhead ones.

For underground cable maintenance, MEA operate "Thermo Scanning" once a year at every risers and every gas insulated substations. If a measured temperature is over standard level, MEA field crews have to go check at the related manholes for preventive electric fault in the system. Steps of working with manholes are started from communication with related agents such as customers in the area, SCADA team for switching electricity source, policemen for temporarily road closing, then preparing necessary equipment especially a water pump. Water pumping takes the longest time in operation with manholes. It takes about 1 - 2 hours per a manhole. The problem occurred because water pump preparation cost depends on size of the water pump and its generator which depends on size of the manhole but many times the water volume in the manhole is not that much which waste the cost of water pump preparation. If MEA acknowledges the water level from range sensor via IoT, the water pump preparation cost will be suitable.

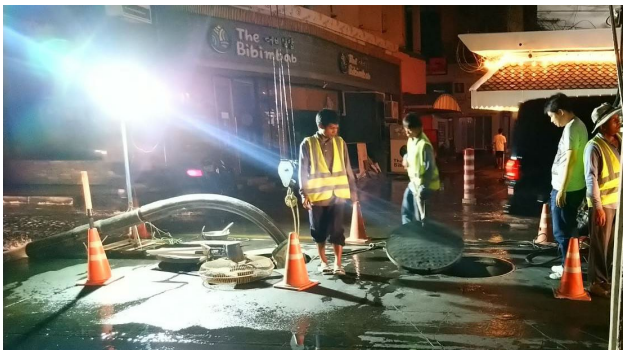

Fig. 1: Water Pumping Manhole

Moreover, the temperature in a manhole can assume an electric fault situation. With IoT technology and Thermo sensor installed in manholes, MEA can be aware of electric fault during the year as well. And, it is much easier representing data from both sensors integrating with GIS.

Hence, this paper will present the case study of Manhole monitoring via IoT and GIS combining with other technologies which is open-source software development; For example, Arduino board which is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board and a piece of software, or IDE (Integrated Development Environment) that runs on a computer, used to write and upload computer code to the physical board. This project use MongoDB which is a cross-platform document-oriented database program, classified as a NoSQL database program, using JSON-like documents with schemata.

The IoT Technology

The IoT technology was described as the intelligent connectivity of smart devices by which objects can sense one another and communicate, thus changing how, where and by whom decisions about our physical world are made. The IoT concept was implemented on some commercial products: refrigerators, washing machines, control devices for smart homes, allowing them to directly connect to the internet using mobile as private networks. As the concept evolved, other types of products where equipped with the necessary technology and today many companies are trying to implement the IoT concept into modern manufacturing systems. Collecting usage data from different production equipment using IoT platform is the main step in building a general, predictive maintenance system, thus simplifying the factory upkeep [2].
IoT is a sensor network of smart devices that connect