The development of intelligent self-driving monitoring system for 345kV underground transmission line in tunnel.

Jae-yong **Park,** Jong-keon **Yoon**, Du-jin **Kim**, Seung-myun **Lim**, Sung-won **Choi ;** KEPCO(Korea Electric Power Corporation), (South Korea), jypark34@kepco.co.kr

ABSTRACT

There have been a lot of developments of densely populated areas such as metropolises and satellite cities in Korea in recent decades. As the cities are growing bigger, underground power cable systems are of greater important in power grid system. Accordingly, there are demands for higher accuracy in regular inspection and maintenance. But the human-based inspection has its limitation in examining facility's condition. In this paper, we propose the intelligent self-driving monitoring system for the underground power cable system in tunnel that can overcome human-based monitoring method. The system transmits real-time thermal images in moving along the tunnel, goes to the malfunctioning spot and acquires the full HD images, associating with DTS(Distributed Temperature Sensing system) and monitoring system.

INTRODUCTION

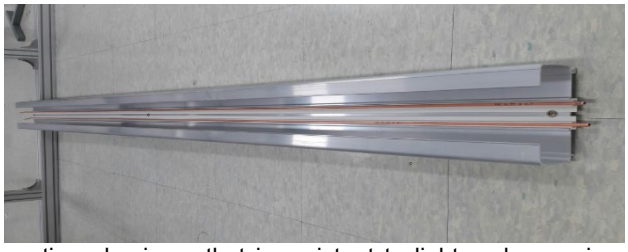
Inspection on power cables and subsidiary facilities in tunnel is basically made in the form of regular patrol and check by human. This visual-oriented patrol not only has the limitation that cannot get the condition of facilities in real time but also has difficulty in looking for the abnormal spot in power cable and accessories. Inspection using a thermal vision equipment for high voltage cables are implemented more than once a year along the cable but it's not sufficient to perfectly monitor power facilities. And it is impossible to monitor the whole section of power facility using fixed CCTVs unless we increase the number of cameras infinitely. Since more than twenty years ago, We also have been operating DTS(Distributed Temperature Sensing system) and DRS(Dynamic Rating System) for monitoring continuous profiles of the temperature of transmission cable and current carrying capabilities. Although these systems have many strengths, they still have weakness for monitoring cable systems. One of those is that we can't watch what happens to the facilities in tunnel in an emergency until we arrive at the field. To solve those problems, we developed and installed the intelligent self-driving monitoring system. The system carries out real-time inspections using full HD image and thermal image and detects the abnormal condition before and in case of emergency such as the fault or the fire.

DEVELOPMENT OF THE SYSTEM

The intelligent self-driving monitoring system for the underground power cable system in tunnel we propose in this paper is not a simple mobile camera but an intelligent system that allows real-time inspection and automatic monitoring operation depending on input data. Hardware of the system is composed mainly of 3 parts: power line communication (PLC) rail, self-driving monitoring robot and image processing and control system.

Power Line Communication Rail

Rail offers the driving route of intelligent self-driving monitoring robot that transmits thermal image and normal camera image simultaneously. It is built with surface die-



casting aluminum that is resistant to light and corrosion. And it is constructed with structure that can protect robot from object fallen from ceiling of the tunnel. The rail performs the transmission of image, the communication for controlling device and the power supply function. So the system does not need the additional communication or power line. It is designed to use DC 24V in order not to cause safety accident such as electric shock.

Fig.1: Power line communication Rail

Self-Driving monitoring robot

Self-driving monitoring robot is in a shape of car with the size of 150mm(w) x 370mm(l) x 200mm(h) and about 3.5kgs in weight. Inner frame is casted with machined high strength aluminum so that it can satisfy both lightness and durability. Main frame is composed of a pan tilt controller, an encoder to recognize location and a bar code sensor. The controller decides the direction of the camera and drives the robot at the maximum speed of 3.1m/s. It can rotate a full 360 degrees to search everywhere. The bar codes are the black and white sensors which show the absolute location attached the rail. So it can make the robot located at the precise spot with a reduction gear's assistance. And it uses four-wheeled drive for forward and backward movement. It has the proximity sensors which can stop at the end of rail or in the front of obstacle. Robot is also equipped with the guide roller that makes robot move along the rail and the power roller that transmits power and image signals. Especially, power roller is coated with gold in order to increase transmission efficiency. Finally, robot has four 3.7V Li-Ion batteries so that it can operate consistently even in case of sudden power cutoff.