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Robotic Cable Bridge Inspection using Non Destructive Testing Method

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***Abstract* - This paper presents the model of a semiautonomous robot for the inspection of overlay bridge electric cables. This robot can be employed in the cable path to know accurate, real time information about the cable status even in harmful environments. The Bluetooth module installed in the robot sends us the exact place of the fault. With this knowledge we can evaluate the danger level and rectify accordingly. Hence this robot travelled the inspection of human in the cable path. The design platform consists of a microcontroller, 2.4 GHz wireless communication module, sensors and motor drivers. Though there were several approaches made for the monitoring of underground cable, this paper indicates that a low-cost robotic system embedded with Bluetooth module can improve the efficiency of the cable inspection system.**

Keywords: Inspection Robot, Bluetooth, Wireless Communication, Data, Matlab, Overhead Lines, Fault Detection, ICING, Sensor.

I. INTRODUCTION

Long transmission lines run across the world to provide electricity in various states, cities, blocks and houses. They are the most universally distributed assets amongst the utility industry. Now the major question here is to maintain the constant and the effectiveness of these transmission lines that is achieved by regular inspection, done either manually or by using helicopters (used only in foreign countries), which are included to be costly as well as risky modes of scrutiny. As per Forbes, inspection and restoring of Transmission Lines is the 7th most dangerous job in the world.

The professional utility of a Robot for this inspection would remove the risk by 100 percent and increase the data accuracy. The job would be done speedy and required to better inspection; the health of the power systems would improve.

II. LITERATURE SURVEY

1. Wavelet Based Transmission Line Fault Identification and Classification: Fault identification and classification is Required to ensure steady and valid operation of the power system. During the fault condition, tripping action mostly depends on current and voltage wave forms which are acquire at relay location. Identify and classify the power transmission line faults, fast and exact analysis is required. Most of the signal processing algorithms used to study the voltage and current wave forms of fault signals. This paper focuses on disconnected wavelet based signal analysis to identify and classify the type of transmission line faults. Disconnected wavelet transform uses the current waveform of fault signals to locate and classify the fault. The coefficients of disconnect approximation of the db8 wavelet used as an index for fault identification and classification. MATLAB/SIMULINK is used to test the model system and to create the various types of fault signals. The proposed system performance is demonstrated from the simulation results acquired by applying the algorithm and it is easy to implement for computer relaying applications.

2. A New Approach for Identification Of The Fault Type on Transmission Lines: The fault phase recovery voltage included a frequency component and then a free oscillation component when a single-phase ground fault occurs, only a fundamental frequency component when a permanent ground fault occurs. In order to distinguish between the transient error and the permanent error, a new criterion was proposed in this article, which is based on the estimation of the signal parameters using invariance of revolution techniques (ESPRIT). ESPRIT algorithm based on subspace revolution invariance techniques to estimate the signal parameters can exactly estimate the frequency and amplitude of the signal. When transient fault occurs, there are two spectral lines of free oscillation component and basic frequency component, while when permanent fault occurs, only a spectral line of the basic frequency component. The simulation results show that ESPRIT algorithm can exactly estimate the frequency and amplitude of the signals, and the proposed criterion can more effectively discriminate between the transient fault and the permanent fault.

3. Transmission Line Parameter Identification Considering Non – Synchronized Time of Fault Recording

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Information: The difference of transmission line parameters in different external environments need that the parameter identification steps has a higher timely update rate and identification exact. The on-line parameter identification based on the fault recording information definitely satisfies the actual line parameter identification requirements. The method proposed unsynchronized time to double-ended fault recording information and solves the out-of-sync time by the electrical quantity constraint equation. Based on the altered two-terminal synchronous voltage and current phasors, the constant parameters of transmission line are identified. The IEEE 9-node model investigated to shows that the alignment time is about 10-5 seconds, which improves the validity of using fault information to analyze the transmission line parameters.

4. Design and Implementation of High-Voltage Transmission Line Inspection and Foreign Bodies Removing Robot: This paper direct at the problems of low speed for the existing high-voltage line inspection robot moving over obstacles, and plan an inspection and foreign bodies removing robot walking on twin bundle conductors, which can move over the spacers and counterweights rightly and fast. In this paper, the motion simulation shows that a robot using four regular driving wheels cannot move over the spacer, thus the unbalanced driving wheel is designed. And through the prototype test, it proved that the robot with four unbalanced driving wheels can directly and fast move over spacers and counterweights. This not only give a feasible and efficient solution for transmission line inspection robot moving over barrier, but also has certain engineering value for the evolution of transmission line inspection robot

5. Mechanism Design and Strength Analysis of Key Components of Flight-climbing-slide Robot for High-voltage Transmission Line Inspection: There are very large and complex power grids in China, but the high-voltage transmission lines inspection relies mainly on physical inspection. The non-manual high-voltage transmission line inspection steps mainly involve flight inspection and robot online inspection. However, these two kinds of high-voltage inspection steps have some restriction and shortcomings leading that they can't be widely used in harsh environments, such as the wind and cold in Xin Jiang territory. This paper presents a new inspection step that combines the advantages of flight inspection and robot online inspection, aiming at making the inspection robot have the functions of flight, glide and crawl to can carry out flight inspection and robot online inspection. The work ability of the inspection step and the rationality of the mechanism were demonstrate through the design of the flight-climbing-slide robot, the kinematics and dynamics analysis of the bionic mechanism, the simulation analysis and the strength analysis and modal analysis of the key parts of the mechanism.

6. Fiber Bragg Grating Sensor for Differential Fault Detection in Overhead Power Transmission lines: In this paper, a fiber optic based sensor capable of various fault detection in power systems is investigated. Bragg wavelength shift, is manipulate to evaluate fault current in power systems. Magnetic fields initiated by currents in overhead transmission lines source a strain in a magnet obstructive material which is then recognized by a Fiber Bragg Grating (FBG). Optical Spectrum Analyzers (OSA) monitor the reflected FBG signals and the Bragg wavelength shift is measured. It is shown that the faults in the overhead transmission line source a detectable wavelength shift from the Fiber Bragg Grating.

7. Faults Detection and Classification of HVDC Transmission lines of using Discrete Wavelet Transform: Now a days, HVDC Transmission System are being used required to its advantage over HVAC Transmission systems based on various features like minor Transmission losses, effective control of Electric power flow, stability and economical for long Transmission lines. Transmission Line having limit of various kilometers and placed in open surroundings for this fault occurring chances are very high as compared other part of power system. These faults have various effects, its need to detect and categorized these faults within very short time for safe operation of power system. This paper presents the conclusion of fault detection and categorization of overhead HVDC Transmission lines by applying Discrete Wavelet Transform (DWT). Faults in HVDC Transmission line of various methods have been created using MATLAB/Simulink. The current signals of HVDC Transmission Lines are complete from Current Transformer and Scope block in work space, and then decompose by means of DWT to attain the details coefficients up to three ranges. Furthermore, Norm of detail coefficient at 3rd level is determined. To detect and Classification the faults on HVDC Transmission lines Value of Norm are differentiated with threshold values of the system. The proposed approach has been successfully tested for several types of faults at different line location.

8. Research on Self-Power Supply System of Inspection Robot for High-Voltage Power Transmission Lines: Inspection robot is a promising procedure in automatic fault detecting for high-voltage power transmission lines. However, the low energy capacity and poor life of the battery hold back the application of inspection robots. To solve this issue, a self-power supply system is designed to notice the online battery charging by utilizing the voltage induced from the present on the transmission line in this paper. The key issues in the

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optimal design and practical execution are discussed in details, including the induction module, the power conversion module. Experiments have been carried on to demonstrate the rationality and effectiveness of the designed self-power supply system for inspection robots.

III. EXISTING SYSTEM

There is no existing system available for monitoring the ICING effect and fault of the transmission. Thus, the way we go for the proposed system in usually monitor through wireless.

Drawbacks

- Manpower is needed to monitoring
- Manual error may occur
- Difficult to monitor in the snow areas

IV. PROPOSED SYSTEM

In proposed system, we can plan a new system to monitor the transmission line. Observed information is transmitted using wireless communication.

Advantages

- Low cost
- Easy method to monitor the transmission line
- High flexibility

In the proposed system we were using the Arduino microcontroller in terminal sections. In the section we are going to monitoring and find the fault in the transmission lines with help of Sensors. In the Sensors section we are analyzing the wire defect and details of transmission lines continuously with periodic time interval. Whenever fault find by sensors corresponding command transmitted to monitoring app to phone.

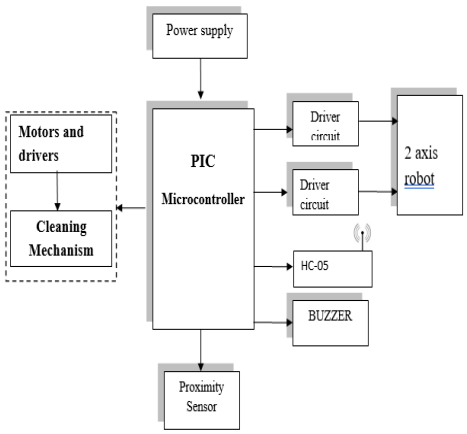

Figure 1: Block diagram of proposed system

If the fault finds the robot will be stopped and buzzer will be making sound for fault intimation. And corresponding information transmitted to monitoring section. The statuses will be displayed with help of LCD.

V. RESULT AND DISCUSSIONS

The simulation of the robot circuit is done in proteus software using the Arduino microcontroller, Bluetooth and Motor library. The screenshot of the simulation output is shown in figure 2. A prototype of the cable inspection robot is built and tested which is shown in the figure 3.

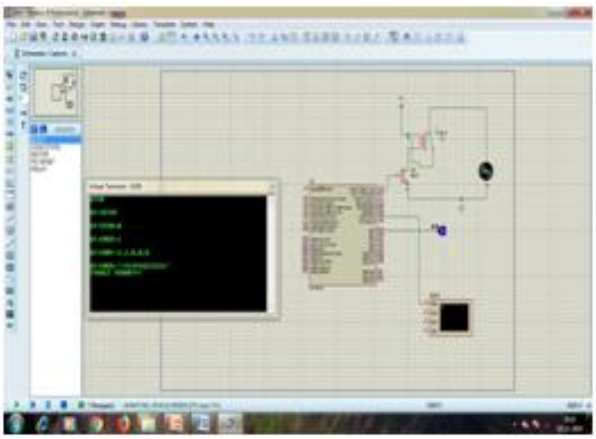

Figure 2: Proteus Simulation Output

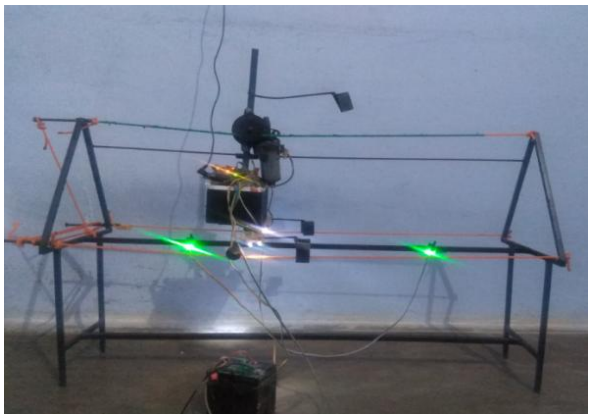

Figure 3: Hardware Prototype of Cable Inspection robot

The robot is tested by hovering over a bridge like model and the robots detected fault location and sends alert to the monitoring unit.

VI. CONCLUSIONS

Based on the survey, from the different papers, the proposal design has been come to the conclusion with the faulty line and cleaning mechanism will be automatically controlled by the inspection robot and data's will be send to the monitoring node using Bluetooth communication medium.

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