A NOVEL METHOD OF POWER LINE MONITORING SYSTM USING INTERNET OF THINGS

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***Abstract*: The advancement of Internet of Things (IOT) technology and its application with a smart wireless sensors has introduced better capturing of the physical entities from long distance places to the monitoring stations. However, after reviewing existing power monitoring system, we find that majority of the work carried out till date is associated with manually or semi-automatically rectifying power failure in the grid. Therefore, the proposed system introduces a model that is capable of identifying electrical grid problem by using electrical sensors at each pole. Each pole is given its own unique ID and if any problem has occurred in an electric pole it is being intimate automatically to the power monitoring stations and power supply to that electrical pole is stopping in order to avoid further damage to the poles. One's problem is being recognized by the sensors it need to be sent to power monitoring stations which are done through the transmission medium called IOT. The proposed system contributes to developing smart power grid in which all the ID's of electrical poles are being stored in cloud and in case of any problem in any electrical poles its ID is send to cloud which is pre-stored already and if same ID is matched it stop current flows to that electric pole and sends information to power monitoring station that this particular pole is being damaged. The Experimental outcome shows highly improved the balance between the computational time and overall accuracy as the result obtained from this system.**

***Keywords*: Electrical grid, IOT, electrical sensors, cloud, poles.**

I. INTRODUCTION

In recent years, considerable attentions have arisen over the Internet of Things (IOT) technology and its applications. An IOT is a network which consists of a variety of smart devices, such as radio frequency identification (RFID), infrared sensors, Wireless Sensor Networks (WSN), global positioning system (GPS), laser scanners and the Internet to sense and identify physical world. Based on the Internet and telecommunication networks, the IOT utilizes computing facilities and software systems for information processing and knowledge digging. By IOT technology, one can achieve human-to-thing and thing-to-thing information exchange and seamless linkage of information flows, thus accomplishing real-time control, accurate management and intelligent decision-making of the physical world.

We are using this technology to achieve the main objective of our work on the power line monitoring remotely we can sense the changes occurred in the power line due to natural calamities, power fluctuations, short circuit etc.,

Line workers in India are still in the top 10 most dangerous professions based on annual fatalities. Even though they do not get much recognition in the public media, these men and women keep the power flowing to hospitals, factories, stores and homes. Without them, everything from traffic lights to junior's video game would go dark. Power cuts in India are common. The recent massive collapse of India's power grid was the worst in the decade. Three out of the five regional power grids collapsed leaving about 670 million people powerless making July 2012 as the largest blackout month in history. Two persons were electrocuted this morning while carrying out repair work on an electric pole in Uttar Pradesh's Jhansi. One died on the spot; the condition of the other is said to be critical.

Therefore, the proposed system discusses a novel modelling of a power monitoring system that is capable of automatically receiving information regarding failure in electrical grid .

The next Section II presents a discussion on related works followed by brief outlining of associated problems in it. Section III. Proposed methodology .Section IV Hardware requirements to solve the problems associated. Section V followed by an illustration of software implementation in Section VI. Results obtained from hardware sensors and android application. Section VII finally the conclusive remarks.

II. RELATED TECHNIQUES

This section discusses the existing approaches that deal with the investigation of the power failure in electrical grids under various scenarios. Existing techniques have witnessed usage of manual or semi-automatic power failure detection schemes that are quite high in number followed by research towards power failure detection techniques and various actions taken to overcome the problem.

The work carried out by Natalie matta [1] Substation monitoring has become a necessity for the next generation power grid. A wireless sensor network, with its sink able to communicate with the utility's control system, the sink is usually placed at one end of the substation's site. a cooperation strategy based on sensed values' priorities, denoted as Priority-Based Cooperation (PBCoop) If p(x) is equal to 0, then no further action is performed (no messages are sent). If it is equal to 2, the value is sent to the sink, because it is considered as urgent and a notification needs to be directly sent. Alternatively, in case of priority 1, we consider that the value should be reported because it may signal a fault or a problem, but that it is less urgent than pri-2 data.

Quing Wang [2] have chosen various communication solutions like wireless transmission include WIFI and WIMAX for power line monitoring system . WIFI is used to transmit the sensed data in short range and WIMAX to transmit the sensed data to long range. The distance between the 2 sub stations is nearly 200km. Thus each base station should cover the radius of 100 km. Due to path loss and signal attenuation relay stations are used.

The paper Power Quality Monitoring System Using Power Line Communication [3] have emphasized on monitoring the power quality information such as interruptions, change in the voltage and harmonic distortion causes the equipment malfunctions and causes significant cost in the production. So they uses LAN communication at different remote places. If there is any breakage in LAN wires the whole power system will fails.

Mohamad Badra [4] Have adopted bi-directional information flow between the customer's premise and the utility provider using Internet Protocol-based technologies through an Advanced Metering Infrastructure (AMI) for managing and interacting with smart meters. One major security concern in the smart grid environment is how to mutually authenticate the smart grid devices and to securely exchange data between the smart meters and the utility or the service provider.

Bartlomiej Arendarski [5] have presented a technique Renewable Energy Sources (RES) new concept of an interactive planning methodology to be implemented in the design tool for planning and operating energy power infrastructure within rural areas This research is carried out by the project "RIGRID – Rural Intelligent Grid" within the framework of the initiative "ERA-Net Smart Grids Plus."

S Lakshmi narayan [6] a three-layer architecture model of the Internet of things for smart grid (SG-IOT) is proposed to achieve human-to-thing and thing-to-thing information exchange and seamless linkage of information flows, thus accomplishing real-time control, accurate management and intelligent decision-making of the physical world. During natural calamities potential risk to the safety of power line transmission system. An SG-IOT system can be expressed as three layers: the perception layer, the network layer and the application layer. The perception layer consists of various kinds of sensors, multi-dimension code tags and readers, RFID tags and readers, cameras, WSN, GPS terminals, wired sensor networks, machine-to-machine (M2M) terminals, sensor gateways. The network layer is composed of most kinds of telecommunication networks and the
core network. The application layer is usually composed of application infrastructure/middleware and terminal units. Thus this paper has complex task and its expensive too.

The identified problems after reviewing the existing system on object and event detection are as follows:

1. Broadcasting the data through WIFI and WIMAX
between customer and station or substation to store their data. But there is no guarantee that the data would be secured by hackers .

2. Monitoring power lines at different remote places using LAN. But if there is breakage of power line the communication wont takes place.

3. The concept of smart grid which is a two way communications that takes place between the poles and trans-receiver which sends and receives the signal and any sort of information or the problem.

4. The opportunities and challenges of wireless sensor tend to give a fast notification from the power line to the API with high speed, reliable and secured data.

III PROPOSED METHODOLOGY

There are multiple implementation towards Power line and power grid monitoring system. The above problem mentioned can be addressed by using electrical sensors with unique ID at each pole. The problems in the pole intimated automatically to the power monitoring station using transmission medium called IOT and power supply to that electrical pole is stop in order to avoid further damage to the poles. The architecture of the proposed system is highlighted in Figure. 1.

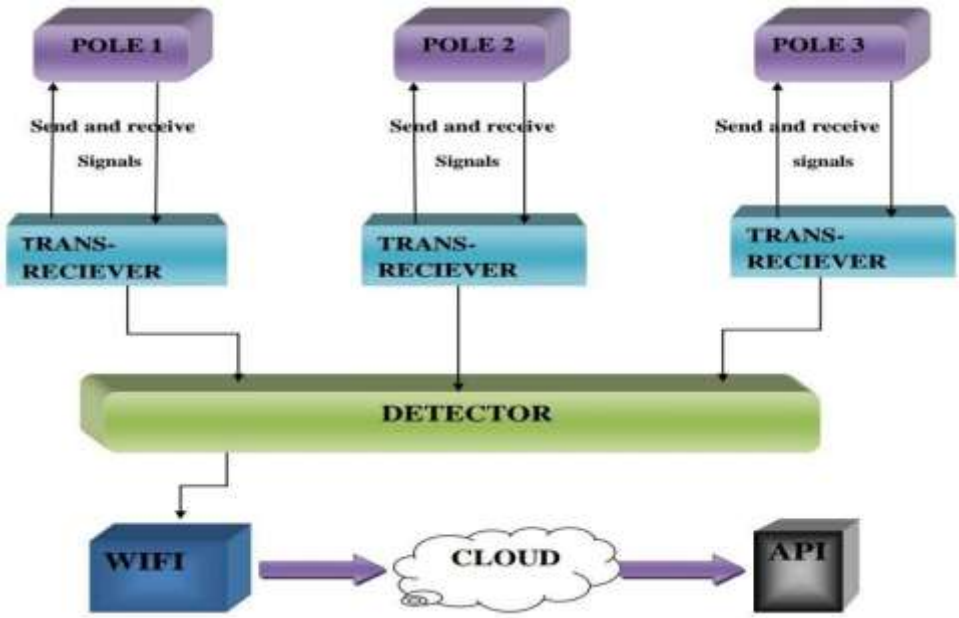

Figure 1

In cloud all the ID's of electrical poles are been stored and in case of any problem in any electrical poles its ID is send to cloud which is pre-stored already and if same ID is matched it stops current flow to that electric pole and sends information to power monitoring station that this particular pole is been damaged.

IV HARDWARE REQUIREMENTS

The hardware implementation consists of the following :
1.Microcontroller that is Arduino UNO
2. IOT device ESP32
3.The Set of SENSOR used.

Arduino is an open source computer hardwareand software, which are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or Breadboards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers.

Figure 2

2ESP32

ESP32 is a Iot device a series of low cost, low power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth process. It is a successor to the ESP8266 microcontroller.

Features of the ESP32 include the following:

➢ Processors:

- CPU: Xtensa dual-core (or single-core) 32-bit LX6 microprocessor, operating at 160 or 240 MHz and performing at up to 600 DMIPS
- Ultra-low power (ULP) co-processor

➢ Memory: 520 KiB SRAM
➢ Wireless connectivity:

- Wi-Fi: 802.11 b/g/n
- Bluetooth: v4.2 BR/EDR and BLE

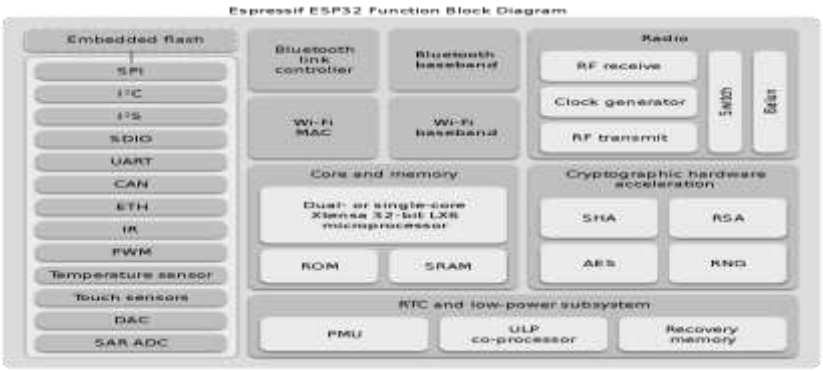

Figure 3

The list of sensors use

➢ A sensor is a device, module, or subsystem whose purpose is to detect events or changes in its environment and send the information to other electronics, frequently a computer processor.

Dht11:

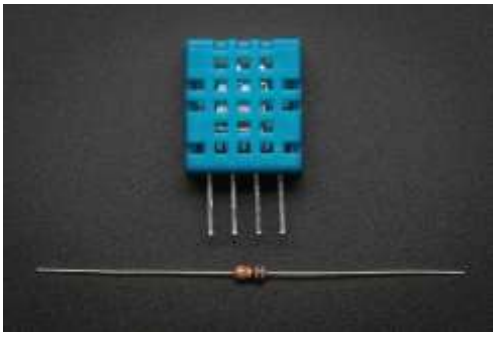

Figure 4 Dht11 sensor

This DHT11 Temperature and Humidity Sensor includes a resistive element and a sense of wet NTC temperature measuring devices.

Fire sensors: A flame detector is a sensor designed to detect and respond to the presence of a flame or fire, allowing flame detection.

Figure 5 Fire sensor

➢ **Hall effect sensor:**

A Hall effect sensor is a transducer that varies its output voltage in response to a magnetic field. Hall effect sensors are used for proximity switching, positioning, speed detection, and current sensing applications.

Figure 6 Hall effect sensor

Rain sensor:

The rain sensor module is an easy tool for rain detection

Figure 7 Rain sensor

The rain sensor has a built-in potentiometer for sensitivity adjustment of the digital output (D0). It also has a power LED that lights up when the sensor is turned on and a digital output LED.
When the board is:

- **Wet:** the resistance increases, and the output voltage decreases
- **Dry:** the resistance is lower, and the output voltage is higher

V SOFTWARE IMPLEMENTATION

This section outlines the algorithm implemented for the purpose of identifying the power failure in the power grid. The proposed system considers a open source software which interfaces with the arduino applications under which the complete evaluation is carried in a stipulated period. The first algorithm is mainly responsible for the sensing values need to be detected like fire on transformer or short circuit on different poles through respective sensors. Then those values are extracted to display on the LCD screen locally and some buzzers are also used for local indication.

Algorithm interfacing arduino

Step 1: Output from the sensors are fetched

Step 2: Fetched data are assigned to local variables **Step 3:** If rain = = true then rain fall detected buzzer on else do nothing
Step 4: If fire = = true then fire on transformer buzzer on else does nothing
Step 5: If pole1 = = true then pole 1 short circuited else do nothing
Step 6: If pole2 = = true then pole2 short circuited else do nothing
Step 7: If pole3 = = true then pole3 short circuited else do nothing

The second algorithm is mainly responsible for module for IOT interface IOT device actually used for the remote monitoring of system. All the sensed values are sent on to the IOT device where a set of code which interface with a open source application "blynk" tries to push on the values remotely.

Algorithm to interface IOT
Step 1: Assign the authentication code from registered mail id
Step 2: Set the name of the hotspot
Step 3: Set password of hotspot
Step 4: if fire = = true then led on display fire on transformer else do nothing
Step 5: if rain = = true then display rain fall detected else do nothing
Step 6: if pole1 = = true then display pole 1 is short circuited else do nothing
Step 7: if pole2 = = true then display pole 2 is short circuited else do nothing
Step 8: if pole3 = = true then display pole 3 is short circuited else do nothing

VI. RESULTS

The entire system is set up as shown in the Figure. The system consists of three nodes. Each node consists of an embed interfaced to sensors and controlling circuits.
The measured data from the sensors can be view locally on a LCD and remotely using android app. For each channel to be measured gives a feed id and API key. Feed id and API key are provided to embed and then code is executed to update the values in android app. The outputs in android app can be seen in fig
The client-server communication is done by using RPC (Remote Procedure Calls). MQTT is the communication protocol used. The commands and arguments are passed in between client and server. The output of sending and receiving data can be figured out in Figure
.

Figure 8: Hardware model

Figure 9: Fire on Transformer Detection

Figure 10: Short circuit Detected

Figure 11: Setup

Figure 12: Fire detected

VII. CONCLUSION

The existing prototypes of IoT-aided SG systems were surveyed which can serve as a baseline for future research in this area. Since IoT-aided SG systems can generate huge amount of data, therefore, we also surveyed and provided solutions for big data processing in IoT-aided SG systems. We concluded the survey by presenting open issues, challenges, and future research directions for IoT-aided SG systems.

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