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An IoT Design Effectiveness and Reliability of Electric Power Circuit Breakers

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ABSTRACT

Along with the very rapid development of technology in the current era of globalization. It became3The main instrument in the progress of various social and life aspects. Currently, many people use technology to help solve several problems in life. Almost every activity carried out by humans always uses technology. The use of automated security instruments has become an option nowadays. In modern times like now there are many kinds of technology, and therefore I will develop technology with better security instruments.

Keywords :Home Security, Telegram App, IoT

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1. INTRODUCTION

In an era of rapidly developing technology, the concept of the Internet of Things (IoT) has become the main focus in various industrial applications, including in electric power system management. IoT enables connectivity and communication between devices in real-time, which can improve the efficiency, safety and reliability of electric power systems. One of the critical applications of IoT in electric power systems is in electrical circuit breakers. Circuit breakers are important components in the electricity distribution system whose function is to protect the network from damage due to overcurrent or other disturbances.

Conventional circuit breakers are often operated and monitored manually, which can cause delays in fault handling and system recovery. With the integration of IoT technology, circuit breakers can be monitored and controlled remotely automatically, so that responses to disturbances can be made more quickly and accurately. Additionally, data collected by IoT sensors can be analyzed to predict failures and plan preventive maintenance, ultimately improving the overall reliability of the power system. The effectiveness of IoT design in electrical circuit breakers is very dependent on several factors, including IoT Connection Reliability: Stability and speed of the internet connection used for communication between devices. Sensor Accuracy: The accuracy of data collected by IoT sensors in detecting operational conditions of circuit breakers. Data Security: Protection of data collected and sent over IoT networks from cyber threats.

System Integration: IoT's ability to integrate with SCADA (Supervisory Control and Data Acquisition) systems and other electric power management systems. The aim of this research is Analyzing the Effectiveness of IoT Design: Evaluating the extent to which IoT design can improve the function of electrical circuit breakers in terms of detecting and handling electrical disturbances. and Measuring Circuit Breaker Reliability: Assessing the reliability of circuit breakers that use IoT systems compared to conventional circuit breakers. So that you can Assess the Security and Stability of IoT Connections: Ensure that the IoT system implemented has a stable connection and is safe from cyber threats.

It is hoped that this research will use quantitative and qualitative approaches to analyze the effectiveness and reliability of IoT designs for electrical circuit breakers. Methods used include: Laboratory Experiments: Testing various IoT designs on circuit breakers under controlled conditions to measure performance and response to faults. Field Data Collection: Collect data from circuit breaker systems that have been implemented in the field to analyze real-world performance. Data Analysis:

Using statistical methods and data analysis techniques to examine the relationships between variables that influence system effectiveness and reliability.

Case Studies: Conduct case studies on several IoT based circuit breaker installations to understand the implementation and challenges faced in the field. Significance of Research This research is expected to make a significant contribution to the field of electric power system management by introducing an effective and reliable IoT design for electrical circuit breakers. It is hoped that the findings from this research can help the electricity industry adopt IoT technology more widely, thereby increasing the reliability and efficiency of electricity distribution systems. Apart from that, this research can also be a reference for IoT technology developers in designing better systems that suit industrial needs.

Thus, this research is not only relevant for power grid operators and the electric power industry, but also for technology developers, academics, and policy makers interested in the development and application of IoT technologies in the energy sector

2. RESEARCH METHODS

2.1 Understanding Security

According to the Big Indonesian Dictionary, Safe is:

a). Free from danger. For example: People fled to places that --;

b). Free from disturbances (thieves, pests, and so on). For example: My village recently hasn't been --;

c). Sheltered or hidden; people can't take it. For example: Save things *this valuable in a place that --;*

d). Certain; no doubt; contains no risk. For example: Buying medicine at the pharmacy *more – than buying at the stall;*

e). Serene; don't feel afraid or worried. For example: Arbitrary actions will make people not feel --;

Security has various meanings depending on the perspective of the thing that is the object of security. However, in this research, the object in question is a house or residence. So, home security can be interpreted as an effort to protect the house from things that are considered bad, dangers or disturbances that can disrupt the condition of the house or residence such as theft, fire, electric short circuits, or other things that are considered dangerous. .

Dangers such as theft at home are usually caused by the homeowner's negligence in maintaining home security, such as forgetting to lock the entrance and so on. Meanwhile, dangers such as fire are usually caused by gas leaks and temperatures that are too hot or electrical shorts in the house.

Because655For these reasons, as technology continues to develop, home automation devices are also being updated to ensure and create a conducive and safe home atmosphere. In this research, the author wants to research and create a prototype of a smart home as an alternative for home security that can monitor entry to the house, monitor temperature, monitor gas pressure to avoid gas leaks, and monitor the condition of the lights on so that no lights are on when needed so that there is no waste of energy or electrical shorts.

2.2 Microcontroller

A microcontroller is a microprocessor specifically for instrumentation and control. A microprocessor is a digital electronic device that has input and output as well as control with programs that can be written and deleted specifically. A microcontroller is655nstrume in a chip used to control electronic equipment, which emphasizes efficiency and cost effectiveness (Sumardi, 2013). The microcontroller input signal comes from the sensor which is information from the environment, while the output signal is directed to the actuator which can have an effect on the environment. So in simple terms, a microcontroller can be thought of as the brain of a device/product that is able to interact with the surrounding environment. Figure 2.1 below is a picture of a microcontroller.

Figure 1. Source Microcontroller

Microcontrollers are basically656nstrume on one chip, which contains a microprocessor, memory, Input/Output lines and several other complementary devices. The data processing speed on a microcontroller is lower when compared to a PC. On PCs, the speed of the microprocessors used today has reached the order of GHz, while the speed of 12 microcontroller operations generally ranges from 1 –16 MHz. Likewise, the capacity of RAM and ROM on a PC can reach the order of Gbytes, compared to microcontrollers which are only around the order of bytes/Kbytes.

2.3 Internet of Things (IoT)

Internet of Things (IoT) is a concept where objects have the ability to transfer data over a network without requiring human interaction to humans or humans to656nstrume. The way the Internet of Things (IoT) works is by utilizing connectivity between sensors or devices that will communicate with each other in the cloud. Data from sensors sent to the cloud will be processed by software which will determine the next action.

NodeMCU is an open source firmware that provides open source prototyping board designs. The name NodeMCU combines Node and MCU (micro controller unit). The term NodeMCU strictly refers to the firmware rather than the associated development kit. The firmware and prototyping board design are open source (Yuan, 2017).

*Firmware*use656nstru Lua script. The firmware is based on the Lua project, and is built on the Espressif Non-OS SDK for the ESP8266 which uses many open source projects, such as lua-cjson and SPIFFS. Due to resource constraints, users need to select relevant modules for their projects and build firmware tailored to their needs. Support for 32-bit ESP32 has also been implemented (circuito.io, 2018).

The prototype hardware typically used is a circuit board that functions as a dual in-line package (DIP) that integrates a USB controller with a smaller surface-mounted board containing the MCU and656nstrum. The choice of DIP format allows easy prototyping on a circuit board (breadboard). The initial design is based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with the Tensilica Xtensa LX106 core, which is widely used in IoT applications. Figure 2.2 below is an image

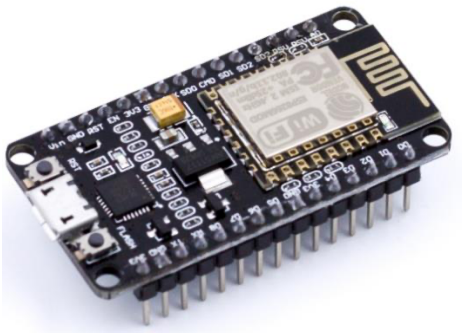

Figure 2. NodeMCU

Quoted from the NodeMCU documentation page, this firmware provides access to GPIO (General Purpose Input/Output) and657nstr pin mapping is part of the API documentation.

NodeMCU is available in several variants. However, the microcontroller commonly used is the ESP8266 type. The pinout design based on the manufacturer's architecture has a standard 30-pin layout. Some designs use pin spacing as wide as 0.9 inches where this design is commonly used. Meanwhile pin spacing of 1 inch is also used, but with several important considerations that must be taken into account.

The most common NodeMCU models are the Amica (based on standard narrow pin spacing) and the LoLin which has wider pin spacing and a larger board. The open-source design of the ESP8266 base allows the market to continuously design new NodeMCU variants. In this research, the NodeMCU version used is the LoLin version of NodeMCU.

As previously explained, the NodeMCU used in this research is the LoLin version which uses a 32-bit ESP-8266 microcontroller. This model has PCB dimensions of 58mm x 32mm with pin spacing of 1.1" (27.94mm). This NodeMCU works in a temperature range from -40C to 125C. For input voltage, this NodeMCU can be powered with a voltage of 4.5V-10V and has a working voltage of 3.3 Volts. Users can use a voltage converter or regulator to get the working voltage according to their needs. The voltage input can be connected via the Vin pin (V input) or micro USB connector. Apart from being a voltage input, the USB connector also functions as an initiator between the NodeMCU and the computer, but to connect to the computer a CH340G driver is needed as an intermediary. For clock speed, the NodeMCU is equipped with an 80MHz oscillator. The flash memory and RAM provided on the NodeMCU are 4MB and 64KB. The connector between the NodeMCU and the internet network uses WiFi Built in 802.11 b/g/n.

NodeMCU has 30 pins with 11 pins functioning as digital I/O pins. Meanwhile, the other 19 pins function as voltage, ADC and GND pins. The following is a picture of the NodeMCU pinout.

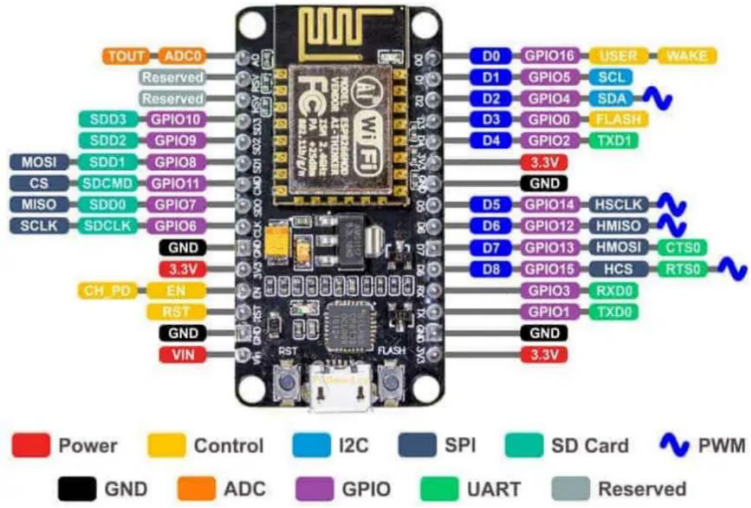

Figure 3. NOdeMCU pinout

The following is an explanation of the function of each pin on the NodeMCU.

1. Power pins have four pins. VIN pin and three 3.3V pins.
2. The VIN can be used to directly supply the NodeMCU/ESP8266 and its peripherals. The power sent to the VIN is regulated via an onboard regulator on the NodeMCU module. Users can also supply regulated 5V to the VIN pin.
3. The 3.3V pin is the output of the onboard voltage regulator and can be used tosupplies power to external components.
4. GND is the ground pin of the NodeMCU/ESP8266
5. I2C pins are used to connect sensors and657I2C instruments. Both I2C Master and I2C Slave. The functionality of the I2C interface can be realized programmatically, and the maximum clock frequency is 100 kHz. It should be noted that the I2C clock frequency must be higher than the slowest clock frequency of the slave device.
6. GPIO pins NodeMCU/ESP8266 has 17 GPIO pins that can be used for functions such as I2C, I2S, UART, PWM, IR Remote Control, LED Lights, and Buttons programmatically. Each digitally enabled GPIO can be configured to internal pull-up or pull-down, or set to high impedance.

When configured as an input, it can also be set to edge-trigger or level-trigger to generate a CPU interrupt.

7. Embedded NodeMCU Channel ADC with 10-bit precision SAR ADC. Both functions can be implemented using ADC. Testing supply voltage VDD3P3 pin power and TOUT pin input voltage testing. However, their implementation cannot be done simultaneously.
8. The NodeMCU/ESP8266 UART pin has 2 UART interfaces (UART0 and UART1) that provide asynchronous communication (RS232 and RS485), and can communicate at up to 4.5 Mbps. UART0 (TXD0, RXD0, RST0 & CTS0) can be used for communication. However, UART1 (TXD1 pin) only displays data transmission signals so it is usually used to print logs.
9. The SPI pins of the NodeMCU/ESP8266 have two SPIs (SPI and HPI) in slave and master mode. This SPI also supports the following general purpose SPI features:
    - 4 SPI format transfer time modes
    - Up to 80 MHz and 80 MHz split clock
    - FIFO up to 64-Byte
10. SDIO Pin NodeMCU/ESP8266 has a Secure Digital Input/Output Interface feature (SDIO) which is used to directly connect the SD card. 4-bit 25 MHz SDIO v1.1 and 4-bit 50 MHz SDIO v2.0 are also supported.
11. PWM Pins This board has 4 Pulse Width Modulation (PWM) channels. PWM output can be implemented programmatically and used to drive digital motors and LEDs. The PWM frequency range is adjustable from 1000 s to 10000 s (100 Hz and 1 kHz). Control pins are used to control the NodeMCU/ESP8266. These pins include the Chip Enable (EN) pin, Reset (RST) pin and WAKE pin.

This research is an implementation of a mesh network topology in a sensor network. The sensor network is used to carry out centralized monitoring of the room. In this research, a monitoring system was built consisting of sensor nodes as sources of information and sink nodes as observation centers where all information is collected. The system model is built to be able to meet the design criteria for sensor nodes and sink nodes which are carried out to fulfill the research that will be carried out. On**Error! Reference source not found.**The model of the proposed room surveillance system is shown. The research model designed a system consisting of sensor nodes and server nodes as a monitoring center.

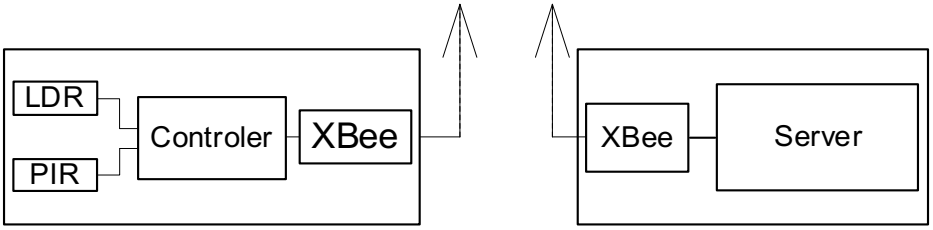

Figure 4. Sensor Node (a) and Server Node (b) Design

3. METHOD

This research uses a scientific research approach, namely an approach based on science and technology. The data source in this research uses Library Research, which is a way of collecting data from several sources, namely books, journals, theses, theses and other literature which can be used as a reference for discussion on this issue.

The data collection methods used are observation and interview methods as primary data sources, as well as literature study as secondary sources.

a) Observation

Field study (Observation) is an activity regarding a process or object with the aim of understanding knowledge of a phenomenon based on previously known knowledge and ideas, to obtain the information needed to continue a research.

b) Interview

Interviews are data collection techniques face to face with conversations between two or more people that take place between the source and the interviewer. The aim of the interview is to obtain accurate information from trusted sources.

The research instruments used in the research are:

The hardware used for testing is divided into several parts, including:

1) Intel Core i3 processor type
2) *Hard disk*
3) 2 GB memory
4) Processor speed 2.3 GHz.

Designing an energy prototype as an alternative for home safety includes several stages including initial concept design, circuit schematic design and hardware, and tool program algorithm design. This tool is an example of using Internet of Things-based bots that use Telegram software servers as cloud data that is received by sensors on the tool. However, before the working principle of this tool is explained further, below we will discuss the tool design planning flow.

Before starting research on designing the module, the author initially conducted literature studies and observations. The literature study in question is collect a basic theoretical basis that can be used as an initial concept and/or working principle of this design. The theoretical basis can be obtained from books, journals,
scientific articles, as well as internet articles and also other reading materials. Apart from literature studies, at this stage the author also makes observations which will make it easier for the author to continue research. The observation in question is like studying659Working instruments are similar tools that use RFID modules, DHT22 temperature sensors, MQ-5 gas sensors, telegram bots, as well as other instruments that have similar working principles.

5. CONCLUSION

From the results of trials implementing mesh topology in a centralized spatial surveillance network, it can be concluded that:

1. Network formation occurs when an intermediary node is available that can forward the data sent. When a node malfunctions and becomes inactive on the network, the node on the network will look for a replacement node to forward the information to be sent. So the placement of nodes in the room being monitored needs to be considered so that at least one node can be connected to be able to transmit information. For this, it is necessary to research a protocol that allows increasing the transmit power of the node to find the nearest node that can be used as an intermediary node.
2. From the test results, it was found that sending one frame with 17 bytes was 0.09 s, 0.11 s, and 0.12 s for 1 hop, 2 hops and 3 hops respectively.
3. Utilizing a mesh topology with Digi mesh provides convenience because new nodes can be added without the need to make changes to the existing network configuration.
4. The more hops the data goes through, the data delay will increase. There needs to be a study carried out to determine the optimal number of hopes for multi-hop communication.

Developments that might be carried out in future research include the need for a gateway to combine with different networks such as the internet. The use of other RF transmission media can also be considered for further development. Using mobile applications for monitoring can make monitoring easier at any time.

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