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Electrical Cable Identification Using Radio Frequency Identification (RFID) Technology

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Abstract: Widespread demand and consumption in the industry have led to rising copper prices. Because copper is very expensive, accessible, less secure, and relatively easy to steal and sell makes it a target for criminals. When a stolen cable is found, it is difficult for us to identify information on the stolen cable such as the location and organization that owns the stolen cable. Previously, the cable was tagged using the conventional plastic tag or wire marker. However, this type of marker is easy to be removed. Because of this issue, cable identification using RFID technology is proposed where the RFID tag will be attached to the electrical cable. With using this system, it can help to reduce the problem of locating the cable loss. The tags will be listed according to specific names. So, this project will help facilitate and save time and energy to locate the cable loss. Arduino UNO is selected as the microcontroller to program the system. The system is running using a 9v supply. The RFID PN5180 reader was used as a reader in this project, where it is equipped with unique features that improve performance, save energy and optimize power. The data that the RFID reader receives from the RFID tag will be processed by an Arduino microprocessor. When the data is processed, the LED and the buzzer will act simultaneously as indicators. The ID of the RFID tag will be shown on the OLED screen. As a consequence, the result shows that the system is able to run and the overall concept of the system can be implemented for the real application of the tracing system. The device can detect RFID tag up to 10cm through barriers such as iron and rubber. This tracking system can detect RFID tags through an iron barrier at a distance of not more than 6cm.

Keywords: Arduino Uno R3, OLED Display, PN5180 RFID Reader, RFID Tag

1. Introduction

Electrical wire is used to connect two or more devices, which allow electrical signals or power to be transferred from one device to another. Electrical cables are used for a wide variety of purposes, and each has to be customized to that end. It is an assembly of one or more individually insulated electrical

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conductors, usually held together with an overall sheath. If they have a PVC sheath, the PVC is colored to show whether the wire is neutral, ground, or hot wire in your electrical installation. There are several types of electrical cable which are commonly used to transmit electrical power. Electrical cables are normally made of aluminum or copper. They are either bare or insulated and usually protected by a thin layer of PVC. This project is created to identify stolen cables.

Nowadays, copper is commonly used in construction companies and in many sectors around the world. The widespread use of copper in the industry has led to rising market prices. Because copper is very expensive, accessible, less secure, and relatively easy to steal and sell makes it a target for criminals [1]. When a stolen cable is found, it is impossible for the authorities to identify the stolen cable. This paper presents a cable identification using Radio Frequency Identification (RFID) technology in which it can identify the cable tag using an RFID scanner. RFID technology is much more secure compared to other networks [2]. RFID labels play an important role as an inventory tracking technology [3]. RFID is a technology that utilized remotely to evacuate and recover data and to give character codes to the thing being referred to [4]. It incorporates two parts, which are RFID client and RFID tag. The RFID tag is associated with the thing being checked. Character codes as an unprecedented distinctive verification number are entered in the RFID tag, containing all the information on the checked thing [5]. Similarly, the RFID client requests an ID data label when in the questioning zone. The way toward getting, taking care of and transmitting data is being completed continuously. Moreover, the RFID is improved by consolidating the sensor into the tag. One of the application benefits from this technology is an anti-theft solution [6][7]. For this project, the electrical wire is improving by tagging around the electrical cable using an RFID tag. So that the identity of the electrical cable is known. Thus, it enables us to keep track of all the lost cables.

This project uses a passive tag where it is tagged around the electrical cable. A passive tag is used because it does not require external energy to function such as battery power. An active tag is much more expensive than a passive tag, which is too cost-ineffective for large-scale applications [8]. The electrical cable in the system will be tagged according to its specific location if it is stolen and the authorities managed to find it back. The specific location of the stolen cable can be easily identified. So that, the specific location of the electrical cable can be easily identified. Arduino UNO is selected as the microcontroller to program the system. The system is running using a 9 V supply. The RFID PN5180 reader was used as a reader in this project, where it is equipped with unique features that improve performance, save energy and optimize power. The data that the RFID reader receives from the RFID tag will be processed by Arduino microprocessor. When the data is processed, the LED and the buzzer will act simultaneously as indicators. The ID of the RFID tag will be shown on the OLED screen. As a consequence, the result shows that the system is able to run and the overall concept of the system can be implemented for the real application of the tracing system. The device can detect DFID tag up to 10cm through barriers such as iron and rubber. This tracking system can detect RFID tags through an iron barrier at a distance of not more than 6cm. on the rubber barrier, the RFID reader can detect RFID tags at a distance of 10cm. This tracking system can detect RFID tags through an iron barrier at a distance of not more than 6cm.

2. Materials and Methods

Developing of the electrical cable identification using radio frequency identification (RFID) Technology will be included the hardware and method used. The materials and methods used in this study are necessary to obtain the results and analysis of the system.

2.1 Materials

All tools have their special measuring function. Figure 1 illustrates the overall block diagram of the system configuration for the development of an electrical cable identification using Radio Frequency Identification (RFID) technology using Arduino IDE software. The overall block diagram can be

divided into three (3) main parts which are input, process and output. Specifically, the material used in this study as stated below:

i. **Input**

The RFID reader will receive data from the RFID tag and the data will be sent to Arduino for processing.

ii. **Process**

A 5V power supply is connected to the Arduino UNO board via USB cable to power up the board. The load input is being processed in Arduino UNO with several codes. The RFID reader is required to perform tasks according to the command from the Arduino program code.

iii. **Output**

OLED Display is used as an output indicator to display the UID tag number and the name of the cable. The RFID reader will receive data from the RFID tag and the data will be shown on the OLED.

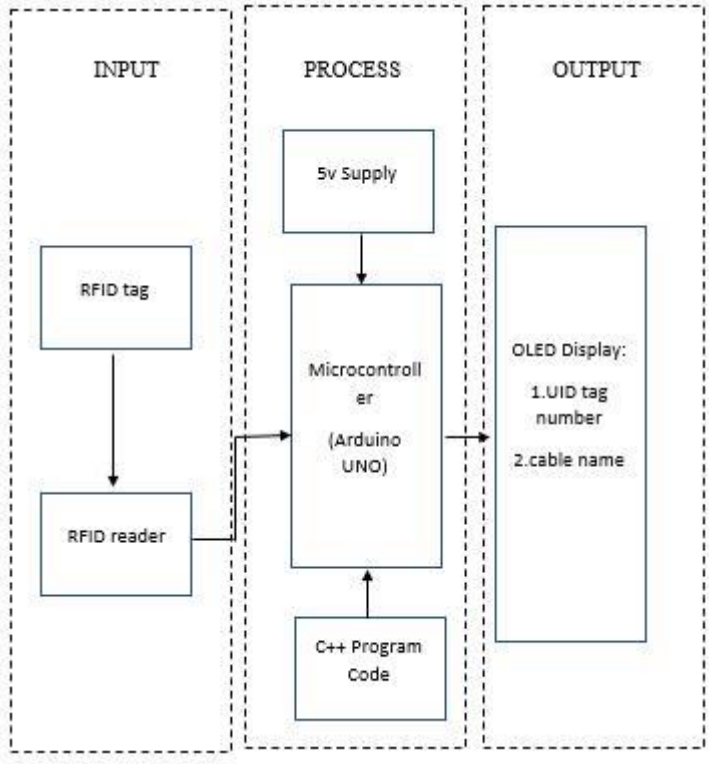

Figure 1: Overall block diagram of an electrical cable identification using RFID technology

2.2 Methodology

This research was carried out using Proteus and Arduino software to obtain the required simulation results. The work flow shall be structured, as shown in Figure 2, according to the goals that need to be accomplished. Methods for this study are divided into three phases which is phase 1, phase 2 and phase 3. Generally, these 3 phases addressed the problem detection, the working progress of the program, the solution to the error that occurs, the workflow to achieve the best circuit design and also the steps that need to be taken to achieve the high-performance generation. The following steps will be carried out in order to complete the project within the timeline:

i. Phase I: Literature review based on RFID reader and RFID tag;

ii. Phase II: Development and simulation of electrical cable identification using RFID technology by using Arduino IDE software; and
iii. Phase III: Designation and experimentation of the prototype

The flow chart below will show the flow of Electrical cable identification using radio frequency identification (RFID) technology.

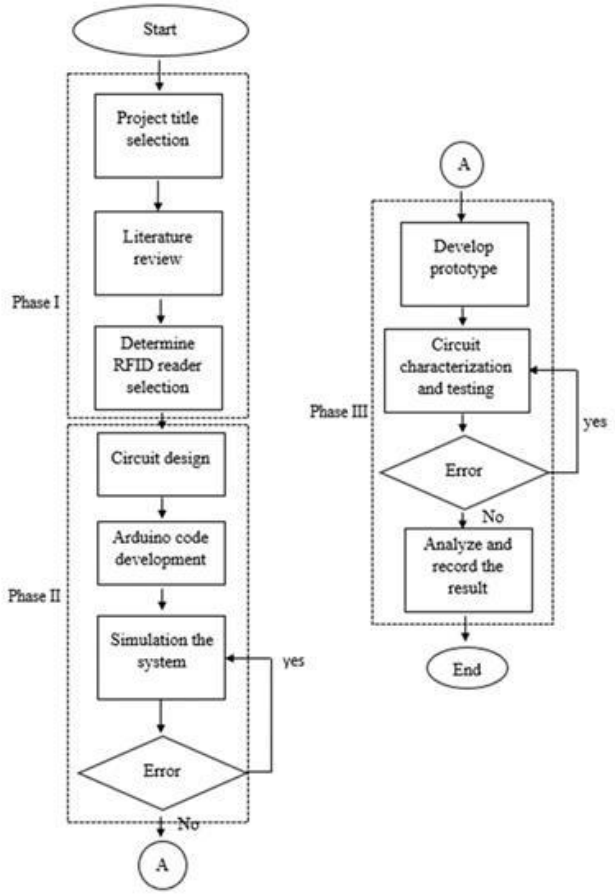

Figure 2: Electrical cable identification using radio frequency identification (RFID) technology

3. Results and Discussion

In this section, the researcher will explain the results of the study about an electrical cable identification using radio frequency identification (RFID) technology. The result and discussion section present data and analysis of the system.

3.1 Radio Frequency Identification (RFID) reader range of detection.

This part mainly concentrates on determining the ability of the RFID scanner to detect the RFID tag with different insulation and angle. Thick rubber and metal act as the insulation for this project. It also conducts with two-position which is in a vertical and horizontal position. RFID readers are tested and the results obtained are compared with the distance of RFID tags. The input data when the RFID reader detects the RFID tag on the serial monitor display is recorded. The analysis is done and the results are highlighted.

3.2 Vertical voltage drop test

Figure 3 shows the graft voltage drop vs RFID range. Based on the theory, a voltage drop is a reduction in the electrical potential along the direction of the current flowing through the electrical

circuit. Voltage drops in the internal resistance of the source, through conductors, through contacts, and through connectors are undesirable since some of the energy supplied is dissipated. The change of voltage drop is taken at a different range of RFID readers which from 1cm to 10cm range. From this graph, the voltage drop that occurs in the air and tick rubber test is almost the same. The voltage drop will decrease according to the distance. The farther the distance the higher the voltage drop. At 2cm, the voltage drops decline dramatically from 0.30V to 0.19V. After that, the voltage slowly decreases by distance until the reading of the voltage drop is 0.16 at 10cm distance. Different from the metal test, the reader is only able to detect the tag at a position of 6cm only. This is because there is a large decrease in voltage at the start of 1cm which is from 0.30V to 0.26V.

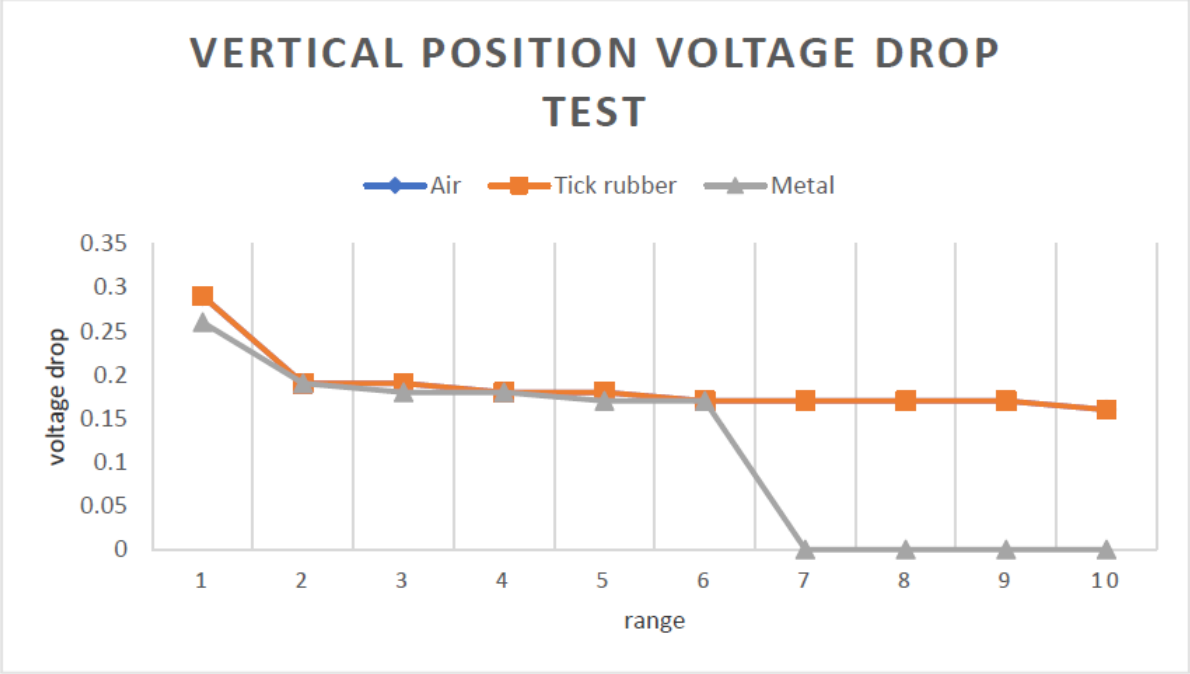

Figure 3: Voltage drop vs range analysis in vertical position

3.3 Horizontal voltage drop test

Figure 4 shows the graft voltage drop vs RFID range. The change of voltage drop is taken at a different range of RFID readers which from 1cm to 10 cm range. The result from Figure 4.13 and Figure 2 almost the same. That means the position reading for the RFID reader does make any big change for voltage drop in both positions. But this horizontal position is more batter than the vertical position. The voltage drop is more stable and the range of the RFID reader can be extended to 15cm. From this graph, the voltage drop that occurs in the air and tick rubber test is almost the same. The voltage drop will decrease according to the distance. The farther the distance the higher the voltage drop. At 2cm, the voltage drops decline dramatically from 0.30V to 0.18V. After that, the voltage stable until the reading of the voltage drop is 0.17 at a 10cm distance. Different from the metal test, the reader is only able to detect the tag at a position of 6cm only. This is because there is a large decrease in voltage at the start of 1cm which is from 0.30V to 0.26V.

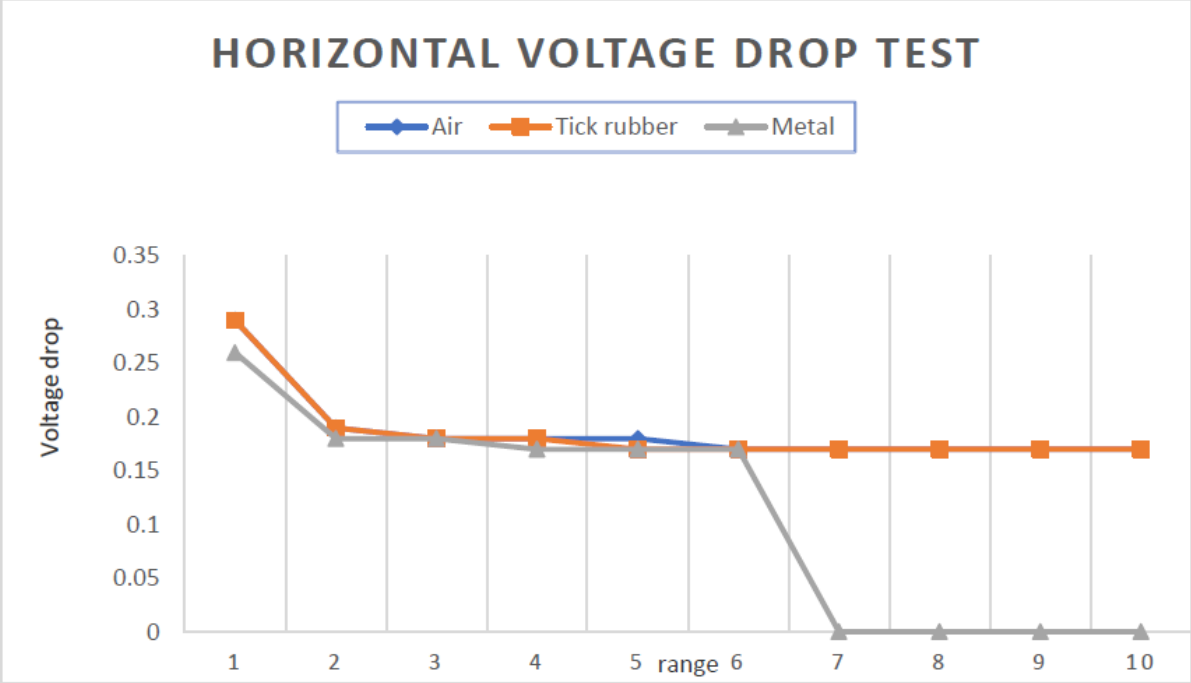

Figure 4: Voltage drop vs range analysis in horizontal position

4. Conclusion

The implementation of electrical cable identification using RFID technology is believed to have a positive impact as it can provide the right solution to help users to detect the correct cable. The prototype is been built by using an Arduino UNO microcontroller in correlation with the Arduino program code. In conclusion, all objectives of this project have been successfully achieved. The main objective is to design and develop an electrical cable identification system using RFID technology. The RFID PN5180 reader was used as a reader in this project, where it is equipped with unique features that improve performance, save energy and optimize power. The last objective is also able to characterize the length of detection of the developed electrical cable identification system. The distance that can be obtained by the RFID reader after the test is 15cm and the reader can also identify the cable behind the barrier. To keep it short, the proposed prototype could have improved user management by reducing the user's time to locate the cable.

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