DESIGN OF A DEVICE FOR CHECKING THE CONTINUITY IN ELECTRICAL CIRCUIT

FA’IZAH BINTI YA’ACOB
POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

MASLIZAH BINTI MUNAH DAR
POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

NUR SYAFIQAH BINTI ABDULLAH
POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

ABSTRACT

The purpose of this project is to design and develop a device for checking the continuity in any electrical circuit named as Portable Continuity Tester. Most of the technicians are currently facing the delay process in testing circuit. The technician and also individual involved in electrical wiring work need to ensure an electrical path between two points are establish for wiring purpose. However, the existing of continuity tester is unable to measure the continuity from any place within 20 meter range. In this paper one device has been designed so we can measure the continuity of any type of electrical circuit. A Portable Continuity Tester is an idea that is potential to make a better technology in the future. It uses This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 315MHz. The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter. In this study, Portable Continuity Tester facilitates the measurement of resistance between two points in the wiring. The tester is also having been divided into two circuits which is transmitter and receiver circuits. It transmits data through radio frequency between the paths. The status condition in Portable Continuity Tester will appear on the LCD display and the buzzer as the indicator to shows the result. The data transmission distance ranges are between 10 to 20 meters. Furthermore, the existence of this tester is to identify short circuit problem in short time. This continuity tester gives a lot of benefits to the wiring testing.

KEY WORDS: continuity, radio frequency, electrical path, RF module

1. INTRODUCTION

Electrical and electronic equipment used in various applications are prone to faults and defects. Most of the time these defects are minor and superficial and are in the form of breaks in the wires, for example a break in the supply line. Since much of this equipment involves a bunch of wires, the fault finding may become pretty tough and difficult to diagnose. However, as usual, electronics technology has a remedy for all problems. The small, inexpensive circuit of a continuity tester may be used to detect such defects and can save you from the unnecessary trouble of uninstalling the entire machinery.

A continuity tester is used to determine the presence of electrical path that can be established in between two points of an electrical circuit. The circuit under test is completely
de-energized before connecting the apparatus (Pralay Roy, 2016). It is an indispensable tool to check broken wires and undesired shorting of wires. If we want to check if the wire is connected from one end to another, then use the probes of the continuity tester and put to the ends of the wires to be tested. If the wires are connected, then the circuit makes a sound indicating that the wires is continuous without any break in the middle. We can also make use of this tool to make a tester to check discontinuity of wires (Electronics Hub, 2015). In addition, many a times when we are connecting the components on the printed circuit board or the breadboard, there is always a possibility of the components to get attached due to defects in the printed circuit board or bread board or due to the mistakes which we may commit while assembling the circuit. What so ever the case is, the continuity tester helps us to debug our circuit with ease.

The tester consists of an indicator in series with a source of electrical power - normally a battery, terminating in two test-leads. If a complete circuit is established between the test-leads, the indicator is activated. The indicator may be an electric light or a buzzer. This led to the term "buzzing out a circuit" (which means to test for continuity). Audible continuity buzzers or beepers are built into some models of multi meter, and the continuity setting is normally shared with the ohmmeter setting (Wikipedia, 2016). Continuity testers have been divided into two circuits which is transmitter and receiver circuit. It has two terminal probes on the transmitter circuit for the continuity purpose while the receiver circuits have LCD to display the result and buzzer as the indicator.

2. LITERATURE REVIEW

2.1 Introduction

A continuity tester is an item of electrical test equipment used to determine if an electrical path can be established between two points; that is if an electrical circuit can be made. The circuit under test is completely de-energized prior to connecting the apparatus. For instance, if the two probes of a continuity tester are touched to the two ends of a wire bundle, its indicator may get activated to confirm that there is no interruption in the continuity of the wire and everything’s fine, or, if the indicator shows no action it would mean that there’s a break in the continuity of the wire and needs attention.

2.2 Radio Frequency Module

RF modules are widely used in electronic design owing to the difficulty of designing radio circuitry. RF modules are widely used in consumer applications such as garage door openers, wireless alarm systems, industrial remote controls, smart sensor applications, weather monitoring system, RFID, wireless mouse technology and wireless home automation systems. An RF module (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through radio frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter or receiver. RF module consists of two units. One Transmitter unit and another is Receiver unit. Basically RF modules are used to build wireless connection between two points. We can easily communicate over 300-500m distance through RF module. A wireless radio frequency (RF) transmitter and receiver can be easily made using HT12D Decoder, HT12E Encoder and
ASK RF Module (George, 2013). The HT12D Decoder and the HT12E Encoder ICs are series of CMOS LSIs for remote application. These ICs are paired with each other. They are capable of encoding 12 bit of information which consists of N address bits and 12-N data bits. For proper operation a pair of encoder/decoder with the same number of address and data format should be selected. The decoder receive the serial address and data from its corresponding decoder, transmitted by a carrier using RF transmission medium and gives output to the output pins after processing data. Wireless transmission can be done by using 433 MHz or 315MHz ASK RF Transmitter and Receiver modules. In these modules digital data is represented by different amplitudes of the carrier wave, hence this modulation is known as Amplitude Shift Keying (ASK).

2.2.1 Radio Frequency Transmitter and Receiver 315 MHz

These wireless transmitters work with our 315MHz receivers. They can easily fit into a breadboard and work well with microcontrollers to create a very simple wireless data link. Since these are only transmitters, they will only work communicating data one-way, you would need two pairs (of different frequencies) to act as a transmitter/receiver pair (Cytron, 2008). This low cost RF transmitter can be used to transmit signal up to 100 meters (the antenna design, working environment and supply voltage will seriously impact the effective distance). It is good for short distance, battery power device development. These wireless receivers work with our 315MHz transmitters. They can easily fit into a breadboard and work well with microcontrollers to create a very simple wireless data link. Since these are only receivers, they will only work communicating data one-way, you would need two pairs (of different frequencies) to act as a transmitter/receiver pair (Cytron, 2008).

![RF Transmitter 315MHz module](Figure1.png) (Cytron, 2008)

2.3 Microcontroller

Microcontrollers are essentially a computer on a chip. They consist of an integrated circuit with processor core, memory, and with programmable input/output peripherals. Many also have a Light Emitting Diode (LED) or Liquid Crystal Display (LCD) display for output. Microcontrollers typically do a limited number of tasks, but they do them well. They are best suited for embedded applications designed for a specific purpose (Huthaifa Ahmad Al_Issa, 2016). For this research a PIC16F877A microcontroller, manufactured by Microchip, was selected. PIC and PIC micro are registered trademarks of Microchip technology (Microchip, 2003). It is generally thought that PIC stands for Peripheral Interface Controller, although General Instruments’ original acronym for the initial PIC1640 and PIC1650 devices was "Programmable Interface Controller". The acronym was quickly replaced with "Programmable Intelligent Computer".

PIC 16F877 is one of the most advanced microcontroller from Microchip. This controller is widely used for experimental and modern applications because of its low price, wide range of applications, high quality, and ease of availability. It is ideal for applications such as machine control applications, measurement devices, study purpose, and so on. PIC
microcontroller PIC16F877A is one of the most renowned microcontrollers in the industry. This controller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it uses FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output. PIC16F877A is used in many microcontroller projects. PIC16F877A also have many applications in digital electronics circuits. PIC16F877A finds its applications in a huge number of devices. It is used in remote sensors, security and safety devices, home automation and in many industrial instruments. An EEPROM is also featured in it which makes it possible to store some of the information permanently like transmitter codes and receiver frequencies and some other related data. The cost of this controller is low and its handling is also easy. It’s flexible and can be used in areas where microcontrollers have never been used before as in coprocessor applications and timer functions etc. (Malik, 2015).

As it has been mentioned before, there are 40 pins of this microcontroller IC. It consists of two 8 bit and one 16 bit timer. Capture and compare modules, serial ports, parallel ports and five input/output ports are also present in it.

![Figure 2: Pin diagram of PIC microcontroller](Microchip, 2003)

### 2.4 Buzzer

A buzzer is an audio signaling device that may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input.

### 2.5 LCD display

For displaying the sensed data, a 2 row by 16 column LCD screen was used as shown in figure 3. This LCD screen was attached to the PIC16F877A microprocessor.

![Figure 3: LCD screen 2 row×16 Column](Cytron, 2008)
3. METHODOLOGY

3.1 Introduction

This research development was divided into two major parts. There are hardware design and software design. The main objective of this research was to build a device containing a set of RF module RF transmitter and RF receiver to transmit and receive a predetermined frequency of 315MHz, used to build a wireless connection between two points, display the sensed data on the LCD, and buzzer as indicator to show the result when the continuity will be detected. All the continuity data between two points using wireless is processed by PIC 16F877A microcontroller. The microcontroller was programmed to do command specific tasks depending on the distance of connection two points probe using wireless. These tasks are to transmit data for both circuits. Transmitter circuit has two probe which aims to test the continuity that we use during wiring work. Receiver circuit has LCD and buzzer as indicator if the connection between two points detect within a minimum distance from the device. These features will give the user assistance and awareness of the surrounding environment. The block diagram in Figure 4 shows the construction of the research plan and how the hardware was connected.

![Block Diagram of Research](image)

Figure 4: The block diagram of research
Figure 5: Flow chart of the research

Figure 5 shows the flow chart in this research. From flowcharts circuit will operate when the switch is pressed. The signal will be sent to microcontroller to receive input and shows that the circuit functions and LCD displays 'Continuity Tester'. To test the continuity, the two probes are placed between two points or wires in the circuit. When touched both probes in two point two conditions will show whether continuity in the circuit occurs or not.

1. LCD will display 'YES' and a buzzer will sound indicating there is continuity between two points
2. LCD will display 'NO' and the buzzer does not beep to indicate that there is no continuity in the circuit

4. ANALYSIS AND RESULT
There are several methods that we used to determine the circuit effectiveness for this project.

### 4.1 Measuring distance using RF module

In this test, the device measures the distance between two points using the RF module to transmit data via wireless. The transmitter and receiver circuit data signal can be transmitted via wireless at a frequency of 315 MHz. LCD will indicate the results of this test. The results are shown "YES" or "NO" indicating the presence of continuity between two points or cable in the circuit. The maximum distance based on the test is 20 meters with obstacles. The radio frequency is capable of transmitting data up to 100 meters in open space. For this test, the distance was measured using tape rope and recorded in meters. The results are shown in Table 1.

#### Table 1: Continuity Test Range Result

<table>
<thead>
<tr>
<th>Range (meter)</th>
<th>LCD display</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>YES</td>
</tr>
<tr>
<td>4</td>
<td>YES</td>
</tr>
<tr>
<td>6</td>
<td>YES</td>
</tr>
<tr>
<td>8</td>
<td>YES</td>
</tr>
<tr>
<td>10</td>
<td>YES</td>
</tr>
<tr>
<td>12</td>
<td>YES</td>
</tr>
<tr>
<td>14</td>
<td>YES</td>
</tr>
<tr>
<td>16</td>
<td>YES</td>
</tr>
<tr>
<td>18</td>
<td>YES</td>
</tr>
<tr>
<td>20</td>
<td>YES</td>
</tr>
<tr>
<td>21</td>
<td>NO</td>
</tr>
</tbody>
</table>

### 4.2 Sound

The buzzer will indicate the result if the Portable Continuity Tester manages to verify the electrical path between two points for a certain cable. The buzzer was used to notify the technician about the result immediately. The sound of the buzzer can be heard up to 3 floors above the ground level, which is suitable for this research.

### 4.3 Voltage
9 Volt battery DC was used for the transmitter and receiver circuit. An advantage is that several 9V batteries can be connected to each other in series to provide higher voltages. The radio frequency range can be extending by increasing the voltage power supply. In this test, we can determine the maximum range for the radio frequency to transmit data by measuring the distance. Table 2 shows the result.

Table 2: Continuity Test with voltage

<table>
<thead>
<tr>
<th>Range (meter)</th>
<th>Voltage (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1.5</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>4.2</td>
</tr>
<tr>
<td>8</td>
<td>5.8</td>
</tr>
<tr>
<td>10</td>
<td>6.3</td>
</tr>
<tr>
<td>12</td>
<td>7.4</td>
</tr>
<tr>
<td>14</td>
<td>8.1</td>
</tr>
<tr>
<td>16</td>
<td>9.6</td>
</tr>
<tr>
<td>18</td>
<td>10.3</td>
</tr>
<tr>
<td>20</td>
<td>12</td>
</tr>
</tbody>
</table>

5. CONCLUSION

From this research, it can be easily conclude that it is a good device which can be used for checking the continuity between two points or connection of any electrical circuit. With the help of this device, we can avoid any unexpected accident. Portable Continuity Tester gives an audible indication of continuity between the probes, so you can keep your eyes on the probe tip. It can also measure the circuit continuity up to 20 meter with obstacles using RF module. The continuity test is a quick check to see if a circuit is open or closed. If the circuit closed or open, LCD and buzzer will display and indicate the condition of the testing.

References

Journal

Electronic source


BIBLIOGRAPHY AUTHORS

Fa’izah Binti Ya’acob Lecturer of Electrical Engineering Department, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam Selangor, she was born in Malacca, she was graduated Bachelor Degree of Science of Electrical Engineering (Control & Instrumentation), expertise area of PLC & Automation System, Embedded System, Instrumentation and Equipment repair. Experience as Finale Project Supervisor, control and PLC

Maslizah Binti Munahdar Lecturer of Electrical Engineering Department, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam Selangor, she was born in Ipoh, Perak, she was graduated Bachelor Degree of Electrical Engineering, expertise area of Power Electronics, Circuit Analysis, and Control. Experience as Finale Project Supervisor and Power Electronics.

Nur Syafiqah Binti Abdullah Lecturer of Electrical Engineering Department, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam Selangor, she was born in Sabah, she was graduated Bachelor Degree of Electrical Engineering(Education), expertise area of Semiconductor, Equipment Repair, and Project. Experience as Finale Project Supervisor.