UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MICROCONTROLLER-BASED TERMINAL IDENTIFIER FOR SINGLE PHASE AC MOTOR

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Automation and Robotics) with Honours.

by

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APPROVAL

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ABSTRAK

Motor arus ulang-alik (AT) digunakan secara meluas dalam industri. Disebabkan Motor AT sentiasa digunakan dalam keadaan lasak dan panas, kerosakan gegelung dalaman adalah perkara biasa. Gegelung Motor AT mempunyai tiga terminal iaitu terminal Pemula, Pelari dan Sepunya. Sehingga hari ini, tiada piawaian warna wayar atau tanda telah ditetepkan untuk mengecam terminal tersebut menyebabkan juruteknik pembaikan sentiasa menghadapi masalah untuk mengenalpasti terminal Motor AT ketika melakukan kerja pembaikan atau mengenalpasti masalah. Untuk menangani masalah tersebut, Pengecam Terminal untuk Motor AT Fasa Tunggal berasaskan pengawalmikro dibangunkan untuk mengenalpasti terminal yang berada dalam Motor AT. Litar ini dibangunkan dengan menggunakan pengawalmikro Arduino, paparan tujuh ruas dan geganti. Peranti yang dibangunkan ini diuji pada dua Motor AT dan didapati bahawa peranti ini mampu mengecam terminal dengan ketepatan 100%.

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ABSTRACT

AC motors are widely used in industry. Since AC motor always utilized in heavy duty and harsh environment, the fault internal winding is a common occurrence. Single phase AC motor consist of three terminals which is Starting, Running and Common terminal. To date, there are no standard wire color or marking has been developed to recognize those terminals. Thus, repair technician always facing hard time to identify the terminal of the AC motor when performing repair or troubleshooting work. Inspire from the limitation, Microcontroller-Based Terminal Identifier for Single Phase AC Motor is developed to identify the three terminals instantly. The circuit is developed by using Arduino microcontroller, seven segment and relays. The device is tested to two AC motor and it is found that the device is capable to recognize the terminal with 100% accuracy.

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DEDICATION

To my beloved parents, who have been our source of inspiration and gave us strength when we thought of giving up, who unconditional give their moral, emotional and spiritual support.

To my brothers, sisters, relatives, mentor and classmate who encourage and advice to complete this project.

Last but not least, I dedicated this work to the best person I ever had, Dr Mohd Badril Bin Nor Shah for being there for me through the entire program to earn the Bachelor of Education. Thank you for your endless support, continual care, and attention.

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LIST OF SYMBOLS

Ω	-	Ohm
V	-	V
A	-	Ampere
I	-	Current
W	-	Watt
P	-	Power

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LIST OF ABBREVIATIONS

AC	Alternating current
PIC	Programmable Interface controller
DC	Direct Current
CPU	Central Processing Unit
USB	Universal Serial Bus
RAM	Random Access Memory
ROM	Read Only Memory
LCD	Liquid Crystal Display
SSD	Seven Segment Display

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CHAPTER 1

INTRODUCTION

1.1 Background

AC motor is an electrical motor operate by alternating current. AC motor converts electrical energy to mechanical energy. AC motors are widely used in many industrial, residential and other useful applications. Many house appliances such as water pump, air conditioner, washing machine, and refrigerator is operating by using AC motor. AC motor can be combined with mechanical equipment such as conveyor and winder. AC motors consist of three basic parts such as rotor, stator, and enclosure as shown in Figure 1.1.

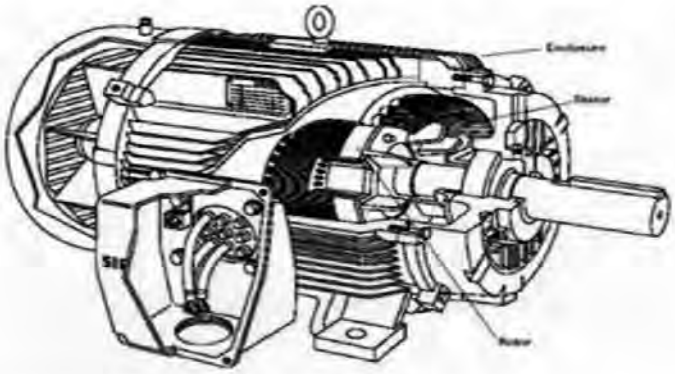

Figure 1.1: Basic construction of an AC motor

AC motor can be classified into two different types which are single phase and three phases. For single phase AC motor, the stator consists of two main winding which are starting winding and running winding. It will create three terminals at motor input which is start, run, and common terminal as shown in Figure 1.2.

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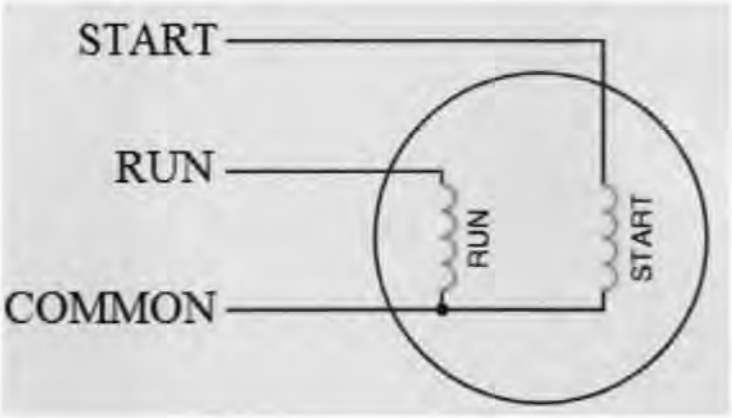

Figure 1.2: Single phase AC motor run, start and common terminal

AC motor does not have a proper or fixed colour wire at each terminal and quite often there is no terminal label provided on motor itself. Therefore, repair technician has to perform inconvenient procedure by using multimeter to identify the terminal.

1.2 Problem Statement

Since AC motor usually used in heavy duty and unpleasant condition, may cause overheat and damage to the AC motor is a common occurrence. When performing troubleshooting or repair work, repair technician always requires identifying the terminal of the motor. However, the repair engineer always facing a hard time in identifying the run, start and common terminal of single-phase AC motor due to the manufacturers do not provide the marking standard and the colour standard of each wire. Therefore, these problems have obscured the motor terminal identification especially during maintenance and troubleshooting process of the single-phase AC motor. Figure 1.3 and Figure 1.4 show the terminal of an AC motor for compressor in a refrigerator and air-conditioner

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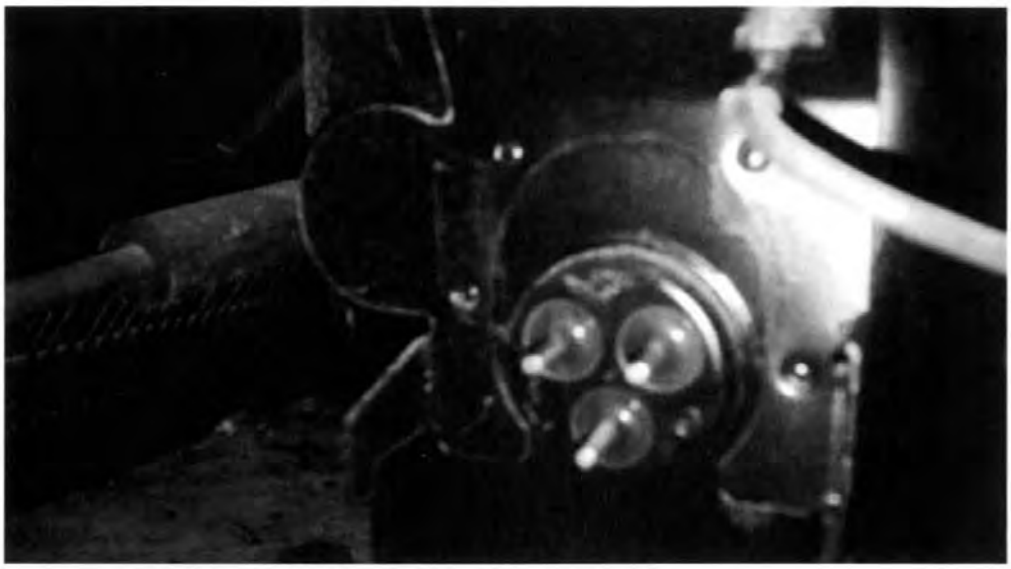

Figure 1.3: Compressor for refrigerator that does not have terminal markings (Brand: Embraco, Model: EGY90HLP)

Figure 1.4: Compressor for air-conditioner that does not have terminal markings (Brand: Nordyne, Model: FS3BA-018KA)

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1.3 Objective

The aims of this project are:

a) To design a microcontroller-based circuit for terminal identifier of single-phase AC motor.

b) To develop hardware prototype that can identify AC motor terminal instantly.

1.4 Work Scope

Scope of the project is as follows:

a) **AC motor**

The device is designed to identify the terminals of single-phase AC motor. The AC motors are widely used in refrigerator, ceiling fan, washing machine, water pump and air conditioner

b) **Hardware prototype development**

A hardware prototype is developed to verify the efficiency of the designed circuit.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Literature review is an important procedure before starting any project. Literature review can provide a helpful information and direction to complete the project. By collecting, analysis and study of the developed projects, this chapter provide detail information of the components used for single phase AC induction motor terminal identifier using microcontroller-based voltmeter and the interpretation of technology used. The ideas from other inventors such as their research on control technique, measurement, circuit design is useful in developing this project. Thus, this chapter will provide the literature review on AC motor construction, terminal identification problem, Arduino Uno, Raspberry Pi, PIC16F877 and previous related work. Thus, literature review is the beginning step to understand the ideas to develop this terminal identifier.

2.2 AC Motor Construction

AC motor is operated based on the principle of having polarity with the rotating magnetic field. An AC motor contains stationary electromagnetic coil or stator, position around a moveable magnet called rotor. For stator construction, the stator core is made up of hundred thin laminations which wrapped together to form a hollow cylinder shape. The insulated wire will fit into the space of the stator core. Each of the coils with the insulated wire will form an electromagnet and the stator will connected to the power source directly.

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