

**UNIVERSITI TEKNOLOGI MARA**

**DEVELOPMENT OF A PORTABLE FIBER OPTIC  
SENSOR PROTOTYPE FOR PESTICIDES RESIDUE  
MEASUREMENT**

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for the degree of

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## Author's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of University Technology MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

In the event that my thesis be found violated the conditions mentioned above, I voluntarily waive the right of conferment of my degree and agree to be subjected to the disciplinary rules and regulations of University Technology MARA.

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## Abstract

In recent years, Malaysian farmers lost million of ringgit due to suspension of their product from being exported to our neighboring countries. This is due to lack of monitoring action being taken to control the pesticides residue used in crops especially in vegetables and fruits. There are a few measuring instruments that can be used to measure the pesticide residue, but due to the incompetent in technical skills of the farmers and also financial constraint, the in-house implementation of the system is restricted.

In this research, a portable fiber optic sensor measuring instrument has been developed. The prototype consists of three sections that are opto-electronic system, electronic system, and fiber optic probe. The probe consists of 32-core fiber optic that has been bifurcated into three parts. The fiber optic probe will be used as a light signal transmission to the samples. In previous research, the complexity of the timer and control circuitry is one of the problem arises in designing the instrument. By then, the timer and control circuitry that use a combination of crystal oscillator and logic gate components was replaced with Peripheral Interface Controller (PIC) microcontroller (MCU). The PIC MCU can reduce the number of components and pin count, thus producing small and portable prototype with competitive performance when compared to other commercially available instrument. The instrument is also introduced with calibration circuit. The circuit can be used to calibrate the prototype with standard samples, thus reduce the zero-and-span problem. For the application of fiber optic sensor, the prototype will measure the color changes of the parameters. The parameters that will be determined are a standard color solution that will represent the pesticides residue concentration. The solution consists of known amount of pesticide residue which inhibit with enzyme in free solution. By adding a color reagent, a yellow color will produce based on the concentration of the pesticides residue. The darker the yellow color produce, the less amount of pesticide concentration in the solution. In this research, the characterization of bioassay for pesticide concentration has been successfully achieved by using fiber optic sensor prototype. The result from the fiber optic sensor measuring instrument is comparable with a spectrophotometer.

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# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

Environment safety is one of the important aspects in our life. Today, among the major problems faced by the nation is the rivers contamination due to the uncontrolled waste caused by the industrial sectors. Water pollution can also occur due to the excessive use of chemical compound, including pesticides that are commonly used in agricultural sector. There are various type of pesticides that have ability to absorb into the underground strata and the situation can be worsen due to excessive use of such pesticides [1]. Since they have a long shelf life, it is actually contributing to contaminate the water sources [1].

The use of pesticide without control on the food, especially vegetables can also cause a long-term effect to human being [2]. For an example, chlorphyrifos and carbofuran are among the types of pesticides that are commonly used in agricultural sector. The main function of these pesticides is to protect vegetables from being attacked by pests and from any type of crop diseases. However, the uncontrolled amount of such pesticides on the crop may have side effects [3]. In fact, this may also risk human life. The pesticide residues that consumed by human are toxic and it is being accumulated from time to time [1]. Human bodies cannot extract the chemical compounds and after some period, it may cause cancer [4 - 7]. The chlorphyrifos for an example can cause nerve damage and mental damage to young children [5] while endosulfan can cause breast cancer and infertility problems [5].