

**DEVELOPMENT OF NON-INVASIVE URIC ACID  
MONITORING DEVICE BY USING INFRARED**

**NURUL NAQUIAH BINTI NOORAKMAR**

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Politeknik Sultan Salahuddin Abdul Aziz Shah

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## DECLARATION

“I declare that the work of this thesis entitled “Development of Non-Invasive Uric Acid Monitor by Using Infrared (IR) ” is the result of my own research except as cited in the reference.” This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

Signature :  .....

Name : NURUL NAQUIAH BINTI NOORAKMAR

Registration No : 08UEU14F3019

Date : 18/07/2016

## **DEDICATION**

### ***TO OUR BELOVED PARENTS:***

**My beloved father, Noorakmar Binti Abd Jabar**

**My beloved mother, Shamsinar Binti Mohd Ali**

**For their support, love and guidance.**

### ***LECTURER OR SUPERVISOR:***

**Pn.Rusnani Binti Yahya**

**For guidance and support**

### ***LOVELY FRIENDS:***

**For their help and moral support**

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**In the name of Allah, The Most Gracious and The Most Merciful**

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## ABSTRACT

Gout is a kind of disease in which occurs because of defective metabolism uric acid. High concentration of uric acid also known as hyperuricemia. Based on reported cases it shows 90 % gout patient is referred to men and usually it will attack within the age above 40. While for women it can begin after the age of menopause. Maintaining healthy uric acid concentration is advantageous to prevent gout or kidney failure. Thus, a simple and portable of non –invasive for uric acid monitoring has been developed for early warning sign for gout disease .While, it also can give awareness to people about danger of high uric acid. In addition, by using non- invasive device, the patient can cut their cost to buy needle and strips. Furthermore, this project using infrared sensor with the wavelength 1700nm for detection of uric acid concentration through finger. While, photodiode sensor was used to receive and calculate the light absorption and scattering. Then, the signal was amplified and in this project, microcontroller of Arduino Uno is used for programming . Next, the concentration of uric acid will be displayed on LCD and the data can be sent to the phone by using Bluetooth device. The accuracy of non-invasive device of uric acid is tested by using invasive method. The proposed device is compatible and friendly user.

***Keyword-* Uric acid , microcontroller, infrared sensor, non-invasive method.**

## TABLE OF CONTENT

CHAPTER	TITLE	PAGE
	TITLE PAGE	i
	ENDORSEMENT	ii
	DECLARATION	iii
	DEDICATION	iv
	ACKNOWLEDGEMENT	v
	ABSTRACT	vi
	ABSTRAK	vii
	TABLE CONTENT	viii
<b>1</b>	<b>INTRODUCTION</b>	
	1.1 Overview	1-3
	1.2 Problem Statement	4
	1.3 Objective	4
	1.4 Project Scope and Limitation	4-5
	1.5 Significant of project	5
<b>2</b>	<b>LITERATURE REVIEW</b>	
	2.1 Introduction	6-9
	2.2 Important of controlling uric acid level	9-11
	2.3 Uric Acid Measurement	11
	2.3.1 Clinical Test	12-13
	2.3.2 Fluorescence	13-14
	2.3.3 Uricase based methods	14-15
	2.3.4 Point of care Testing	15

	2.3.5 Easy Touch Uric Acid	16
	2.3.6 Electroporation (EP) and reverse iontophoresis (IR)	16
	2.3.7 Near- infrared in medical perspective	17
	2.3.8 Non-invasive determination of uric acid level	18
	2.3.9 Invasive Uric Acid Monitoring Using Near Infrared Spectroscopy	18-19
	2.4 Properties of Near Infrared Sensor (IR)	20-21
	2.5 Photodiode	21-22
	2.6 Microcontroller	23-24
	2.7 Examination of Uric Acid Blood Test	24-25
	2.8 Examination of Uric Acid Urine Test	26
<b>3</b>	<b>METHODOLOGY</b>	
	3.1 Project Specification	27-32
	3.2 Project development	33-34
	3.3 Analysis of project	35
	3.4 Project Management	36
	3.4.1 Project Schedule	36-39
	3.4.2 Cost Estimation	39-40
	3.5 Summary	40
<b>4</b>	<b>RESULT AND ANALYSIS</b>	
	4.1 Introduction	41
	4.2 Analysis by Survey	42-43
	4.3 Testing	43-47
	4.4 Error and Improvement	48
<b>5</b>	<b>CONCLUSION AND RECOMMENDATION</b>	
	5.1 Summary	49-50
	5.2 Conclusion	50
	5.3 Recommendations	51

6 REFERENCES

7 APPENDICES

### LIST OF FIGURES

FIGURES NO.	TITLE	PAGE
1.1	Electromagnetic Spectrum	3
2.1	Gout at foot joint	8
2.2	Kidney stone	9
2.3	Uric acid crystal deposition in joint	10
2.4	Block diagram of process to detect uric acid	11
2.5	Relation System of uric acid	12
2.6	Point of care testing uric acid	13
2.7	Phenomena of fluorescence detection	14
2.8	The uricase catalysed reaction	15
2.9	The wavelength or spectrum for infrared	17
2.10	Non-Invasive Uric Acid Monitoring Using Near Infrared Spectroscopy	19
2.11	IR spectrum of uric acid	20
2.12	Change in voltage vs uric acid concentration	21
2.13	Photodiode basic structure	22
2.14	Arduino Uno board as microcontroller	24
2.15	Uric Acid tested through blood	25



2.16	Uric acid tested through urine sample	26
3.1	Testing the (IR)	28
3.2	Penetration of IR through human skin	28
3.3	Testing of photodiode	29
3.4	Photodiode as receiver	29
3.5	Arduino Uno board as microcontroller	30
3.6	LCD display for uric acid concentration	31
3.7	Part of bluetooth device	31
3.8	Part of testing bluetooth device	32
3.9	Flowchart for project implementation	32
3.10	Circuit of non-invasive uric acid monitor	33
3.11	Coding of uric acid by using Arduino Uno	34
3.12	Flowchart of project	35
4.1	Graph for survey of non-uric acid monitor	43
4.2	Accuracy of infrared with wavelength 950nm	44
4.3	Accuracy of infrared with wavelength 1550nm	46
4.4	Accuracy of infrared with wavelength 1700nm	47

### LIST OF TABLE

TABLE NO.	TITLE	PAGE
2.1	Normal reading for concentration of uric acid	25
3.1	Schedule of project for semester	37
3.2	Schedule for Final Project In Semester	38
3.3	Cost for Final Project	39-40
4.1	Survey of non-invasive uric acid monitor	42
4.2	Testing of accuracy uric acid devices ( Infrared 950nm) for women	43
4.3	Testing of accuracy uric acid devices ( Infrared 950nm) for men	44

4.4	Testing of accuracy uric acid device (Infrared 1550nm) for women	45
4.5	Testing of accuracy uric acid device (Infrared 1550nm) for men	45
4.6	Testing of accuracy uric acid devices (Infrared 1720nm) for women	46
4.7	Testing of accuracy uric acid devices (Infrared 1720nm) for men	47

## **Chapter 1**

### **Introduction**

#### **1.1 Overview:**

Uric acid is the primary end-product of purine metabolism and excreted in the urine. Furthermore, it is a chemical compound which is including of carbon, oxygen, hydrogen and nitrogen. The level of uric acid in body fluids such as serum and urine is a clinically valuable diagnostic indicator. Normally, uric acid is present in the blood in concentration range 0.15- 0.45 mmol/L and excreted in urine in 1.19-2.98 mmol/day.[1]

The presence high level of uric acid is a sign of gout and it also called as hyperuricemia. Otherwise, increase in 16% of hyperuricemia increase all causes of mortality and 39% of total cardiovascular disease.

Uric acid is formed by the liver and mainly excreted by the kidneys (65-75%) and intestines (25-35%) .

Similarly, the high level of uric acid are related to other conditions including increased alcohol consumption, obesity, diabetes, high cholesterol, kidney disease, and heart diseases.

Many researcher have suggested that serum uric acid is also a risk factor for cardiovascular disease .[2] Although, hyperuricemia also can cause gout where it is a kind of arthritis where it happen at part of joint and gout also can be happen because of genetics. Many people with gout have a family history of the disease where estimates range from 20 to 80 percent and gout is more common in men than women until around age 60.[3]

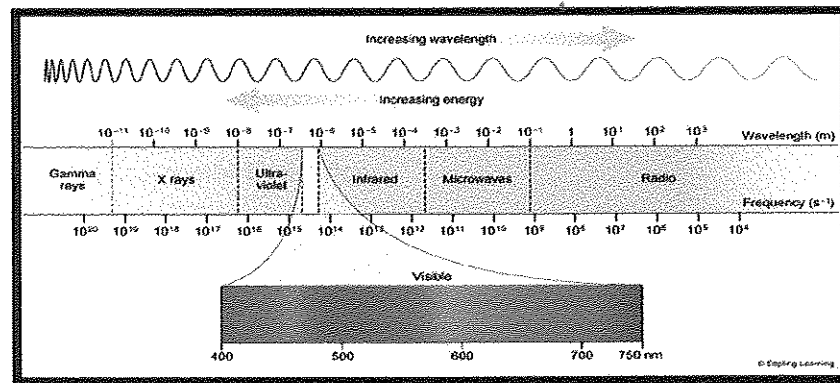
In addition, gout sign can be detected when the patient feels tenderness, redness, swelling, heat at part of joint. The concentration of uric acid can be check through serum, or urine. The concentration of uric acid in urine can be check by using spectrophotometric method. Where, it is the quantitative measurement of the reflection or transmission properties of a material as a function of wavelength.

It is more specific than the general terms of electromagnetic spectroscopy in that spectrophotometry deals with visible light, near-ultraviolet, and near-infrared, but does not cover time-resolved spectroscopic techniques. While through serum ,usually the patient check by using invasive method . Being invasive means that a needle has to penetrate the skin in order to collect the sample.

Invasive procedures are usually painful, but when using invasive device the patient need to spends a lot of their money to buy strips and needle .Therefore, it is necessarily to develop a non-invasive uric acid monitor without using strips and needle which is more friendly user. Development of non-invasive uric acid need to use infrared sensor with the range of wavelength 1500nm to 1700nm.

Then, the value of uric acid can be achieve based on measurements of the absorption of light through the finger where the analysis of absorption ratios is performed for various sets of these wavelengths. In this project, the near infrared is use as emitter while photodiode use as receiver. The concentration unit of uric acid can measured in mg/dL, mmol/dL, and  $\mu\text{mol/dL}$ . While, non-invasive device it will be measured in mg/dL. Normal value for uric acid is 3.4-7.0 mg/dL for men and 2.4-6.0 mg/dL for women.

Successful implementation and verification of the prototype carries major significance in the portable, non-invasive, and cost-effective nature of this project will potentially be a major benefit to patients who are either at risk for, or suffer from, and complications associated with hyperuricemia.



**Figure 1.1: Electromagnetic Spectrum**

## **1.2 Problems Statement:**

The high level of uric acid can cause gout or kidney failure. Normally the patients are tested by drawing the blood and test it on the strip. The method is inconvenient for some patient. Based on statistics obtained from survey analysis, most of the measurement for uric acid in blood test is done manually by using the invasive method like blood drop and test. Moreover, to test the blood drop must be using the strip and it limited, costly and has expired date. Although, it also can make patient feel pain and also fear to check. Therefore, to overcome this problem non-invasive device are invented.

## **1.3 Objective:**

- i. To design non- invasive uric acid monitoring by using detector of infrared sensor (IR).
- ii. To develop a device without causing pain or traumatic the patient.
- iii. To build a device with friendly user.

## **1.4 Project scope and limitation:**

There are two part of the project. The first part is software in which is consists of microcontroller and computer. The processing is done by using Arduino Uno where it function as microcontroller and it also used to develop a coding for concentration of uric acid. Although, in this project using

bluetooth device, where the patient can directly transfer their reading of uric acid to the mobile phone.

Second part is about hardware development where the main component use is infrared sensor and photodiode. The infrared sensor act as transmitter and it wavelength to penetrate the human finger is about 1500nm and above. While photodiode is component which as receiver where it used to calculate the absorption of light. The signal from the sensor are being amplify to produce high signal to noise ratio (SNR ). Then, in this project will use few sample to test the accuracy of uric acid value between invasive device and non-invasive device.

#### **1.5 Significant of Project:**

Development of the non-invasive uric acid monitor is use to focusing on awareness of the people about dangerous of high level uric acid which is called as hyperuricemia. Mostly the people , did not know the effect of hyperuricemia as instant, it can cause kidney failure, gout, and diabetes mellitus. Although, by using invasive method people feels pain when to check the reading, so to overcome this problem the detector of Infrared will be used at the same time, it also can helps to cut cost for strips and needles.

This project can be used by anyone especially for gout patient, because by using this non-invasive method , the people can control their reading of uric acid frequently and easily at home. Besides that, the accuracy by using invasive method (needle, strips) and non-invasive method will be test after this project completed.

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