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Faculty of Electrical and Electronic Engineering Technology

DESIGN OF LOW-COST RESPIRATION ANALYSIS SYSTEM USING ARDUINO

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APPROVAL

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ABSTRACT

The respiratory rate is one of the most crucial measures of a person's health. It is the rate at which a person breathes while at rest, measured in breaths per minute. The rate of respiration changes from child to adult, as well as when a person is unwell. The suggested respiratory rate control is built using an electrical circuit and a push switch. An elevated respiratory rate can signal a number of pathological problems, including respiratory, cardiovascular, and metabolic issues. We've created a breathing sensor that's non-invasive, compact, simple to use, and affordable. This gadget measures the temperature differential between the inhalation and exhalation stages of the respiratory cycle. Individually, digital stethoscopes on the market are often not inexpensive, particularly in poor nations and impoverished areas; they are a fantastic tool for doctors, but with telemedicine, we need the instrument to diagnose patients remotely. The idea is to develop a device that combines a traditional stethoscope with a broadband microphone and uses a Sound sensor MAX4466 detect airway sounds. The gadget and LCD detect and display whether it is normal breathing, which is shown by a green light led blinking, or abnormal respiration, which is shown by a red light led blinking.

ABSTRAK

Salah satu petunjuk kesihatan seseorang yang paling penting adalah kadar pernafasan mereka. Ini adalah kadar pernafasan seseorang yang diukur dalam nafas seminit semasa mereka dalam keadaan rehat. Kadar pernafasan berbeza dari bayi hingga dewasa, dan juga berbeza ketika seseorang sakit. Litar elektronik dengan sakelar tekan digunakan untuk membuat kawalan kadar pernafasan yang dicadangkan. Kadar pernafasan yang meningkat dapat memberi isyarat kepada sejumlah masalah patologi, termasuk masalah pernafasan, kardiovaskular, dan metabolik. Kami telah mencipta sensor pernafasan yang tidak invasif, padat, mudah digunakan, dan berpatutan. Perbezaan suhu antara fasa penyedutan dan pernafasan kitaran pernafasan diukur dengan peranti ini. Stetoskop digital di pasaran umumnya tidak berpatutan secara individu, terutamanya di negara- negara membangun dan masyarakat yang berjuang; mereka adalah alat yang sangat baik untuk doktor, tetapi dalam telemedicine, kita memerlukan alat untuk mendiagnosis pesakit dari jauh. Ideanya adalah untuk membuat peranti yang menggabungkan stetoskop standard dengan mikrofon lebar jalur lebar dan merakam suara sistem pernafasan menggunakan telefon pintar . Aplikasi yang mengesan peranti, mengesannya, dan menganalisisnya untuk tanda-tanda gejala tertentu.

TABLE OF CONTENTS

		PAGE
DECLARATION		
APPROVAL		
DEDICATIONS		
ABSTRACT		**2**
ABSTRAK		**3**
ACKNOWLEDGEMENTS		**4**
TABLE OF CONTENTS		**1**
LIST OF TABLES		**4**
LIST OF FIGURES		**5**
LIST OF SYMBOLS		**6**
LIST OF ABBREVIATIONS		**7**
LIST OF APPENDICES		**8**
CHAPTER 1	**INTRODUCTION**	**8**
1.1	Background	9-10
1.2	Problem Statement	11
1.3	Research Objective	12
1.4	Scope of Project	12-13

CHAPTER 2 LITERATURE REVIEW 14

2.1 Introduction 14

2.2 Review of Current Situation 14-18

2.3. Literature Review: Previous Study on Respiration Analysis System 18

2.3.1 A Novel Design of a Respiratory Rate Monitoring System usinga Push Switch Circuit and Arduino Micocontrolle 18-19

2.3.1.1 Design and Simulation of Respiration Rate Monitoring System using a Push Switch Circuit and Arduino Micocontrolle 19-20

2.3.1.2 Operation of the prototype Respiration Rate devices 21

2.3.1.3 Evaluate the Performance of Respiration Rate devices 21-22

2.3.2 Temperature Sensor Based Ultra Low Cost RespirationMonitori System 22

2.3.2.1 Operation of the Block Diagram for Temperature Sensor Based Ultra low cost Respiration Rate System 23-24

2.3.2.2 Schematic Diagram for temperature SensorBased Ultra low cost Respiration Rate System 24-25

2.3.3 Real time Respiration Rate MeasurementUsingTemperaturSensor 26

2.3.3.1 Block Diagram Operation of Real time Respiration Rate Measurement Using TemperaturSensor 26-27

2.3.3.2 Schematic Diagram of Operation of Real time Respiration Rate Measurement Using TemperaturSensor 27-28

2.3.4 Respiration Monitoring System Using Thermistor 29-30

2.3.5 Comparison of the method used by previous researches 31

2.4 Summary 32

CHAPTER 3 METHODOLO 33

3.1 Introduction 33

3.2 Methodology 33

3.2.1 Process explanation 34

3.2.2 Problem staement 35

3.2.3 Literature Study 36

3.2.4 Review on selected Components 37-42

3.3 Software Development 42

3.4 Schematic Circuit 43-44

3.5 Block Diagram of entire Process 44

3.6 Wiring Diagram of entire Process 44

3.7 Process of Flow Chart 45

3.8 Summary 46

CHAPTER 4 RESULTS AND DISCUSSIONS 47

4.1 Introduction 47

4.2 Project Development 47

4.3 Hardware Development 48

4.3.1 Hardware testing result for Normal Respiration System 49-50

4.3.2 Hardware testing result for Abnormal Respiration System 50-51

4.4 Software & Coding Development 51-52

4.4.1 Coding Development for Respiration System Analysis 52-53

4.5 Analysis 54

4.5.1 Analyze the Respiration Rate of a Teenager 54-55

4.5.2 Analyze the Respiration Rate of a Young Adult 55-56

4.5.3 Analyze the Respiration Rate of a Old Age 56-57

4.6 Final Development Overview 58

4.7 Summary 58

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS 50

5.1 Conclusion 50

5.2 Future Works 50

REFERENCES 51

APPENDICES 52-53

LIST OF TABLES

TABLE	TITLE	PAGE
2.1	Comparison of previous research	31
3.1 :	Pinout for the MAX 4466	41

LIST OF FIGURES

FIGURE	TITLE	PAGE
2.1	Comparison on healthy and affected Chronic Obstructive Pulmonary (COPD)	14
2.2	Comparison on healthy and affected airway	15
2.3	Comparison on normal breathing and breathing with BPD	15
2.4	Comparison on healthy lungs and covid-scarred lungs	16
2.5	Total death and Percent of Dead due to Pneumonia or influenza	17
2.6	The circuit schematic of the proposed RR device consisting 4-pin push switchArduino Uno and Bluetooth module.	19
2.7	Block Diagram of the proposed system	20
2.8	Block Diagram of Respiratory Monitoring System.	23
2.9	Schematic of Respiratory Monitoring System.	24
2.10	Block diagram of the system incorporated	26
2.11	Circuit Diagram of Breath Rate Sensor	27
2.12	Block diagram of respiratory monitoring system	29
3.1	Project Flowchart	34
3.2	Flowchart of Literature Review	36
3.3	ARDUINO(ESP32)	37
3.4	Lcd 16x2	38
3.5	I2C((Inter-Integrated Circuit)	39
3.6	LED	39
3.9	Stethoscope	40

3.10	Sound Sensor Maxx 4466	41
3.11	DC 5V 2A Power Adapter	42
3.12 :	Circuit constructed using Fritzing software.	43
3.13:	Block Diagram of Low Cost Respiration Analysis System Using Arduino	44
3.14:	Wiring Diagram of Circuit	44
3.15:	Flow Chart of Low Cost Respiration Analysis System Using Arduino	45
4.1	Respiration Analysis System Circuit	48
4.2	LCD display at Initial State	49
4.3	LCD result for Normal Respiration	49
4.4	Green LED light up for Normal Resiration	50
4.5	Graph of Normal Respiration in Blynk Application	50
4.6	LCD result for Abnormal respiration	51
4.7	Red LED light up for Abnormal Respiration	51
4.8	Graph of Abnormal Respiration in Blynk Application	52
4.9	Initial declaration of Respiration Analysis System	53
4.10	Connection of Wifi to ESP 8266	53
4.11	Output Coding for Normal Repiration Rate	54
4.12	Output Coding for Abnormal Repiration Rate	54
4.13	Respiration graph of Teenager before Activity	55
4.14	Respiration graph of Teenager after Activity	55
4.15	Respiration graph of Young Adult before Activity	56

4.16	Respiration graph of Young Adult after Activity	57
4.17	Respiration graph of Old Age before Activity	58
4.18	Respiration graph of Old Age after Activity	58
4.19	Final Development	59

LIST OF SYMBOLS

kV	-	Kilo voltage
V	-	Voltage
Hz	-	Hertz

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
Appendix A	Example of Appendix A	51
Appendix B	Example of Appendix B	52

CHAPTER 1

INTRODUCTION

1.1 Background

The mechanism of inhalation and exhalation is referred to as "respiration." The movement of air into the lungs to deliver oxygen to the body is known as inhalation, and the movement of air out of the lungs to remove carbon dioxide is known as exhalation; this process is known as breathing. The number of breaths a person takes per minute is known as the respiration rate. Respiratory rate is a significant health measure since a shift in normal breathing rhythm is the first indication of a person's oxygen level depletion.Whenever a person is at rest, the rate is generally calculated by calculating the number of breaths taken in one minute and the amount of times the chest rises. Increased respiration rates can be caused by fever, disease, or other medical disorders. When testing respiration, make a note of whether the person is having any trouble breathing. In a study of abnormal vital signs, Cretikos et colleagues (2008) revealed that more than 50% of patients who experienced a serious adverse event may have been labeled as high-risk up to 24 hours before. At rest, an adult's respiration rate should be between 15 and 20 breaths per minute. Respiratory rates of more than 25 or fewer than 12 breaths per minute is considered as abnormal respiration rate. Thus according Jonsson et al (2011), early identification and recording of variations in vital signs, particularly respiratory rate, might assist in the diagnosis of respiratory failure, and this is the most common main cause of intensive care admission. Each minute might be deemed out of the ordinary. Bradypnea is described as a respiratory rate of less than 12

and tachypnea as a rate of greater than 30. Sleep apnea is when a person's respiratory rate is zero.

Over time, the stethoscope has suffered many updates for the enhancement of sound’s amplification, expressed with a higher percentage of right diagnoses .Throughout the twentieth century, the stethoscope was improved to make it easier to use while maintaining sound quality. Tiny sounds from the patient's lungs are amplified by the stethoscope's disc and tube, making them sound louder. The amplified sounds move up the stethoscope tube to the earpieces, where the listener listens. It compares the front of your chest to the back of your chest as it listens to your lungs. The sound of airflow changes when airways become blocked, narrowed, or clogged with fluid. They'll even have an ear out for strange noises, such as wheezing.

In this paper, We created a solution that combines any traditional stethoscope with a broadband microphone and detect the sound of the respiratory system on a Nodemcu EPS8266. An bylink application and LCD detect and display whether it is normal breathing, which is shown by a green light led blinking, or abnormal respiration, which is shown by a red light led blinking. An Arduino is one of those Embedded System Devices called as an Embedded Development Board. Given the high cost of a stethoscope and the fact that the Embedded Development Board has made it possible to produce devices with some of the characteristics of a smartphone while being more portable, it makes sense to use embedded systems to build a less expensive and more powerful electronic stethoscope.

1.2 Problem Statement

Face-to-face medical consultations are challenging due to mobility limitations imposed by the pandemic's global lockdown scenario. However, the healthcare sector is evolving, and telemedicine is being used to make health care services more available. Telemedicine combines medical research with information and communication technology. However, since no clinical examination is necessary with telemedicine, we can only diagnose common diseases, which may lead to more incorrect diagnoses. Cardiovascular and respiratory diseases affect the vast majority of Malaysia's population. For proper diagnosis, a physical examination is needed.

Individually, digital stethoscopes on the marketplace are often unaffordable, especially in developing countries and impoverished populations. They're a great tool for doctors, but we need them in telemedicine to diagnose and treat respiratory problem patients virtually and continuously.

1.3 Project Objective

In this study, there are few objectives that will achieve.

I. To design hardware of respiration system to monitor the respiration rate of thepatient using a smartphone app.

II. To develop software program and app for smartphone of respiration system that monitor respiration rate of patient using Arduino.

III. To ensure that it is affordable price for a patient from struggling communities whoare frequently need a proper respiratory diagnose.

1.4 Scope of Project

In order to archive the objective of the project, there was several important criteria that need to consider:

I. To create a setup that combines any regular stethoscope with a broadband microphone and then use a Nodemcu EPS8266 to recognize respiratory system sounds.

II. An app was created that detects the device, records the data, and displays the graphof a patient's respiration rate.

III. There will be a green led light up for a normal respiration rate which is between 15 and 20 breaths per minute.

IV. A red led will light up if the respiration rate is abnormal, which is defined as more than 25 breaths per minute or fewer than 12 breaths per minute.

V. This project is easily use by all age group in this technology world and also affordable price for struggling communities who needs continuous monitoring.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This section discusses and summaries overall Respiration Analysis System concept and theory of the project. The main goal of this chapter was to clarify previous and current studies. The theory and concept used to solve the project's problem were discussed in this chapter. The primary sources of knowledge are journals, papers, and case studies. These resources were chosen based on their similarity in project scope.

2.2 Review of Current Situation

In Malaysia, respiratory diseases are the leading causes of hospitalization and death. Asthma prevalence in children and adults is estimated to be 8.9% to 13% and 6.3 percent, respectively4; chronic obstructive pulmonary disease (COPD) prevalence is estimated to be 3.4–6.5 percent, based on meanings used. COPD is a curable and avoidable lung condition caused mostly by smoking. It is characterized by progressive and partially reversible airway obstruction and lung hyperinflation, as well as severe extrapulmonary (systemic) manifestations that can lead to the severity of the disease And comorbidities. Select the patient's disease.

Bradypnea is described as taking fewer breaths per minute than is typical for their age and level of operation. According to experts, normal adult breathing rates are between 12 and 20 breaths per minute, under 12 breaths per minute is abnormally slow, and over 25 breaths per minute is abnormally quick. Bradypnea can make you feel lightheaded, dizzy,

and exhausted. Bradypnea can strike at any time of day or night. It's not the same as apnea, which is a temporary cessation of breathing that most people experience while sleeping. Bradypnea is not the same as dyspnea, which is the medical word for heavy or laboured breathing. A separate word is tachypnea, which refers to an abnormally rapid breathing rate. Bradypnea and tachypnea have different symptoms and causes.

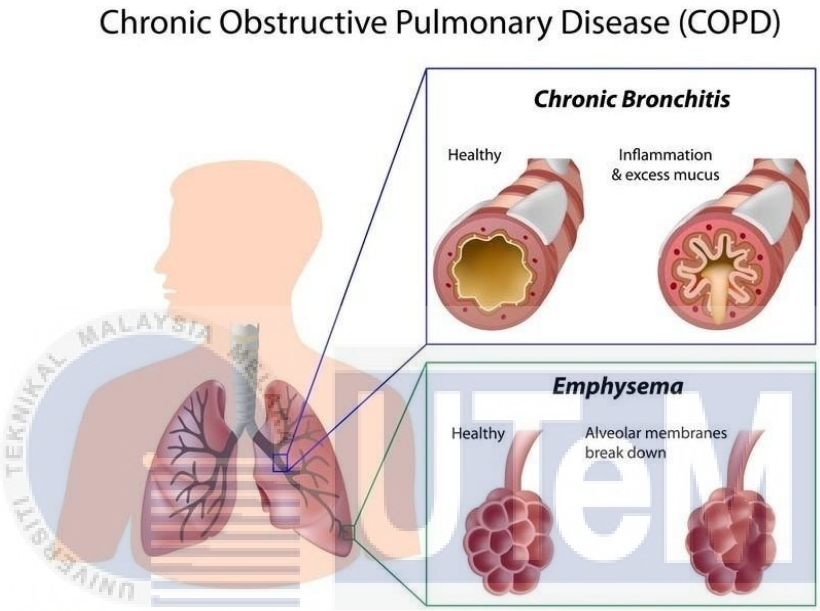

Figure 2.1 : Comparison on healthy and affected Chronic Obstructive Pulmonary (COPD)

Asthma is a prevalent lung condition that affects 300 million individuals worldwide. According to reports, approximately 1.5 million Malaysians of all ages suffer from asthma. Asthma prevents 50% of children from going to school, one-third of adults cannot work, and many of them are hospitalized because their symptoms are not treated. Bad asthma control is a result of sub-optimal care and a lack of awareness about the disease.

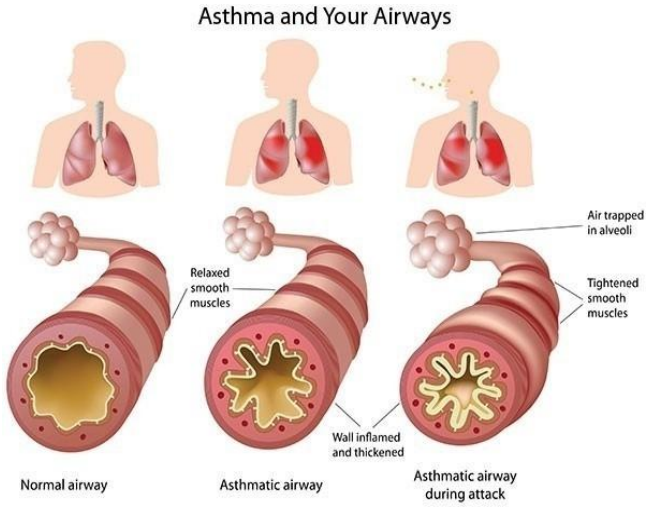

Figure 2.2: Comparison on healthy and affected airway

Bronchopulmonary dysplasia is a lungs problem that causes preterm babies who needed oxygen or ventilation in their first few months of life.Because of the severity of the lung injury, many of these babies may need long-term oxygen therapy for an extended period of time.

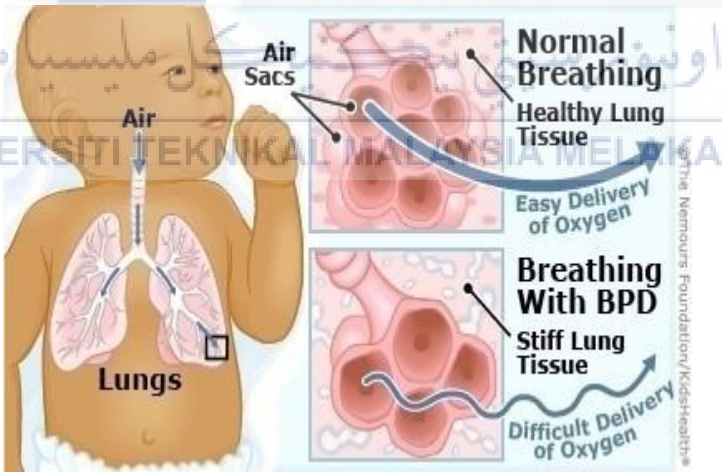

Figure 2.3 : Comparison on normal breathing and breathing with BPD

SARS corona virus 2 (SARS-CoV2), a member of the Corona virus family, causes Corona virus illness 2019, generally known as COVID-19. The sickness was initially found in December 2019 in Wuhan, China's Hubei province capital. Since then, the illness has spread to over 200 nations, causing a pandemic that has killed over 83,000 people and affected over 1.4 million others (as of April 8, 2020).Common symptoms are fever, cough and shortness of breath. Sore throat, runny nose, fatigue, muscle pain, diarrhea, and loss of smell are other symptoms. While the bulk of instances are minor, a small variety of them can development to pneumonia, which may be severe and fatal. The virus is typically spread by droplets produced by affected persons coughing, sneezing, or talking. Whenever two persons are in close proximity to one another, this is the most usual scenario. Droplets can also develop when breathing, although they won't go very far. People may develop the virus if they touch a contaminated surface on various products and then contact their faces. The diagnosis is confirmed by a real-time reverse transcription polymerase chain reaction (rRT-PCR) from a nasopharyngeal swab.

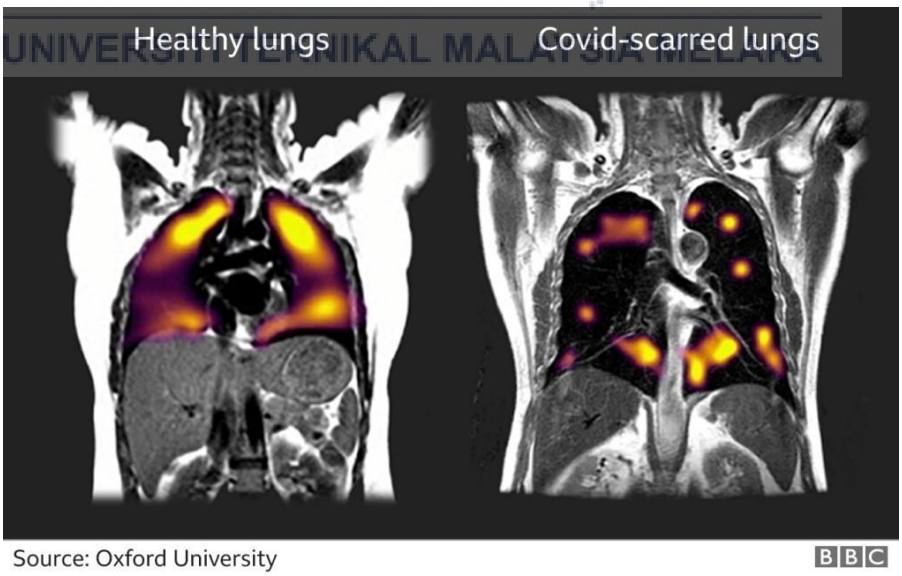

Figure 2.4 : Comparison on healthy lungs and covid-scarred lungs

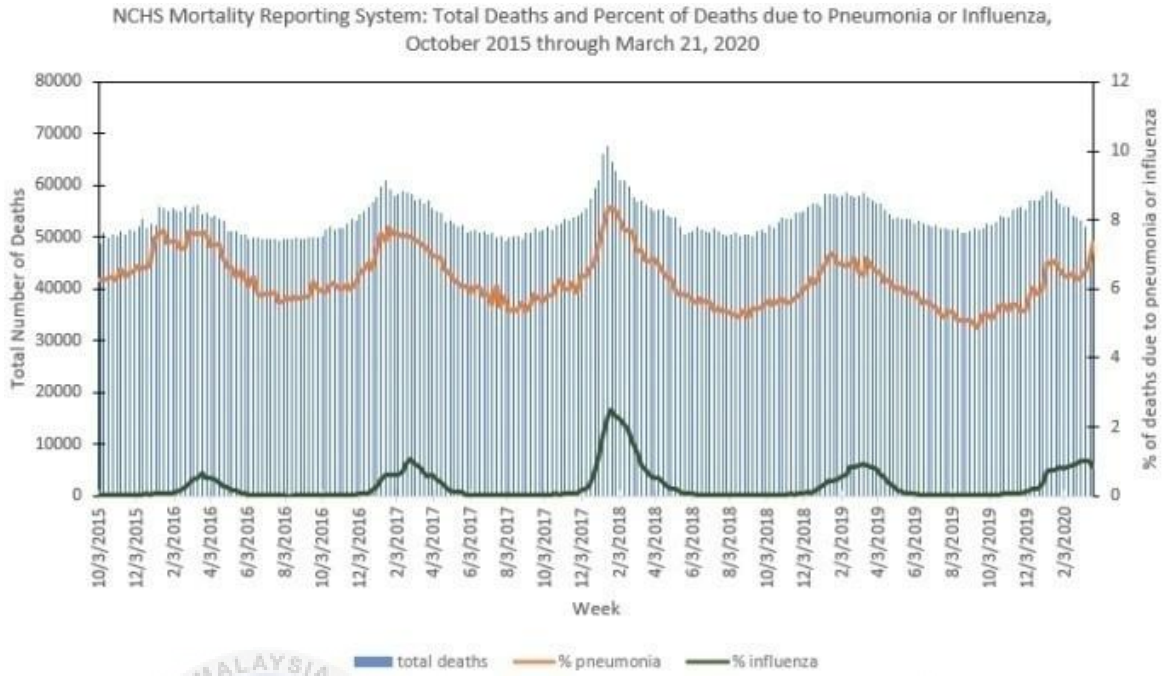

Figure 2.5: Total death and Percent of Dead due to Pneumonia or influenza

2.3 Literature Review: Previous Study on Respiration Analysis System

2.3.1 A Novel Design of a Respiratory Rate Monitoring System using a Push Switch Circuit and Arduino Micocontrolle

The current respiratory rate measurement techniques or instruments, as well as their limitations, will be discussed in this chapter. There are two types of respiratory rate monitoring methods or equipment: those used in hospitals and those used outside of hospitals. The most frequent respiratory rate analysis techniques used in hospitals are impedance pneumography and capnography, but visual inspection seems to be the most preferred.

This project focuses on creating a wearable Respiratory Rate monitoring device that displays Respiratory Rate measurements using a basic electronic circuit, an Arduino microcontroller, and a Bluetooth module. The key idea behind this wearable Respiration

Rate monitoring system is to count how many times the chest contracts and expands during respiration. Inhalation and exhalation are two steps in the human breathing process. As you inhale, your chest contracts, and when you exhale, your chest expands.The concept behind this design is to combine a chest-belt module with an integrated electrical circuit. When the chest expands during exhalation, the switch is pressed, and a signal is sent to the Arduino microcontroller, which is converted to breaths per minute. The value is then wirelessly transferred to any Bluetooth-enabled computer and may be retrieved using a Bluetooth software.

2.3.1.1 Design and Simulation of Respiratory Rate Monitoring System using a Push Switch Circuit and Arduino Micro-controller

This paper consist electronic circuit, which consists of a 4-pin push switch, is the heart of the RR system.The electrical circuit consists of a 4-pin push button and a 1000-ohm resistor linked in series with a 5V supply. The 1000 ohm resistor is then connected to ground, and the push switch is connected to the Arduino uno microcontroller board's analogue input. When the push switch is not pressed, the connection between the two points of the switch is open, enabling no voltage or signal to reach the Arduino microcontroller's analogue input. The voltage loss across the 1000 ohm resistor is 5V. When the switch is pressed, however, the circuit is completed, and 5V is sent to the Arduino micro-controller's analogue input. The circuit will then return to its original state when the push switch is released. The circuit schematic is shown in below