
Faculty of Engineering

# ANTI-SNORING DEVICE CONTROLLED BY ARDUINO UNO

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**Bachelor of Engineering (Hons) in**

**Electronics (Telecommunications)**

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**UNIVERSITI MALAYSIA SARAWAK**

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# Anti-Snoring Device Controlled by Arduino Uno

**BRANDON PHUA JUN MING**

A dissertation submitted in partial fulfillment
of the requirement for the degree of
Bachelor of Engineering (Hons) in
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# ABSTRACT

This project present the solution for sleeping disorder by using an Anti Snoring Device Controlled by Arduino Uno. The purpose of this project is to create a device that eliminate or reduce snoring through electronic concept; detection of snoring and feedback of the system. Detection of snoring operated through analyzing snoring noise and vibration produced by the user. The feedback of the system is use to awake the person which indicate that they need to change their sleeping position. This project focusing on the changes in sleeping position in order for the user to adjust the airway path and prevent from sleeping on their back. In fact, the tendency of snoring is higher if the user sleep in supine position (on back) compared to lateral position (on side). In addition, this project provide the solution of snoring without contribute any side effects to the user. This device operated inside the designated pillow, which is the final product of this project.

# ABSTRAK

Projek ini membentangkan tentang penyelesaian untuk masalah tidur dengan menggunakan alat anti-dengkur yang dikawal oleh Arduino Uno. Tujuan projek ini adalah untuk mewujudkan satu alat yang menghilangkam atau mengurangkan berdengkur melalui konsep elektronik; pengesanan berdengkur dan tindakan yang direspon melalui sistem. Pengesanan berdengkur dikendalikan melalui menganalisis bunyi berdengkur dan getaran yang dihasilkan oleh pengguna. Respon daripada sistem membuatkan individu tersebut untuk bangun dan menukar kedudukan tidur mereka. Projek ini memberi tumpuan kepada perubahan dalam kedudukan tidur agar pengguna untuk menyesuaikan laluan saluran udara dan mengelakkan daripada tidur di membelakang. Malah, kecenderungan berdengkur adalah lebih tinggi jika tidur pengguna dalam kedudukan membelakang berbanding kedudukan sisi. Di samping itu, projek ini menyediakan penyelesaian berdengkur tanpa menyumbang apa-apa kesan sampingan kepada pengguna. Alat ini dikendalikan di dalam bantal yang ditetapkan, yang merupakan produk akhir projek ini.

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# LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| A | - | Ampere |
| AC | - | Alternating Current |
| DC | - | Direct Current |
| PSG | - | Polysomnography |
| BMI | - | Body Mass Index |
| V | - | Volt |
| W | - | Watt |
| OSA | - | Obstructive Sleep Apnea |

# CHAPTER 1

# INTRODUCTION

## 1.1 GENERAL

Anti-snoring device controlled by Arduino Uno is a solution to snoring problems as it works by stopping or eliminate snoring through electronic concept. The concept of this device is divided into two parts ; detection of snoring and feedback of the device system. This device operated by detecting snoring through analyzing breathing noise and vibration using sound sensor and vibration sensor. Both sensors are set to certain level of frequency range to detect vibration and sound produced by the snorer. The feedback for this device will be done using solenoid.

This device works inside a designated pillow, used to place the electronic parts in order for the device to function well and efficiently. When the snoring sound is detected, the sound sensor will detect it and the transducer will convert the snoring sound signal to electrical signal. This sound signal of snoring will be proved by vibration sensor. The pillow has a port for solenoid, placed on the upper middle part as it is the optimum position for the actuator to function effectively on all surface area of a pillow. Hence, the system will awake the snorer through the force of solenoid repetitively. Besides awake the user, the actuator are functioned, indirectly tells the user to change their sleep position in order for them to adjust the airway path and prevent the user to sleep on their back. This project focus on the awareness of self

snoring to avoid the snorer affecting people around them such as spouse, family members or roommate. Plus, this device is made for snorer who cannot tolerate with any oral appliances, surgical treatment and any other related treatments. This anti-snoring device is for home-monitored device and personal used only.

## 1.2 OBJECTIVES

The main objectives for this project are :

i. To design the anti-snoring device controlled by Arduino Uno.

ii. To develop the anti-snoring device controlled by Arduino Uno

iii. To test the development of the anti-snoring device.

## 1.3 SCOPE OF STUDY

In this project, there will be two part for the design process. First is the design of the circuit schematic where it includes all of the major components used in this project. Next will be the design of the pillow. In this design, all the electronic part will be located according to design of the pillow. After the design process, following process is to develop the anti-snoring device based on the designed circuit and pillow. The development of this device will lead to the final process which is to evaluate the device through several experiments in order to test the device in terms of its reliability and efficiency.

## 1.4 PROBLEM STATEMENT

Snoring is a sleeping disorder that caused by narrowing in the upper part of the airway path during sleep [13]. During sleep, tongue muscle is relaxed, the airway become narrower, which causes the tongue to be easily being sucked back into the throat. Eventually, air passing through the partial obstruction of the upper airway causing the soft palate and other throat tissues to vibrate, create the sound of snoring. In addition, factors that leads to snoring are obesity, gender, increasing age, sleeping posture, nasal blockage and consumption of alcohol, cigarette and other sedatives. Obesity is one of the common factor where the excessive body fat accumulate in the neck and throat causes the airway become narrow result in the difficulties during breathing. Snoring commonly happened in man compared to woman and get worsen with increasing age due to throat muscle sag and vibrate. Sleeping posture could affect the level of snoring based on our position during sleep.

Snoring are most likely to occur when the snorer sleep on their back, the tongue easily fall backwards into throat and narrow the airway. Nasal blockage caused by allergies can result in difficulties breathing using nose due to limited air passing through nose, ended up breathing by mouth. The consumption of alcohol, tobacco and usage of sedatives before bedtime relaxed the muscles in the throat and worsen the snoring. Figure 1 shows the diagram of the narrowing in the upper airway.

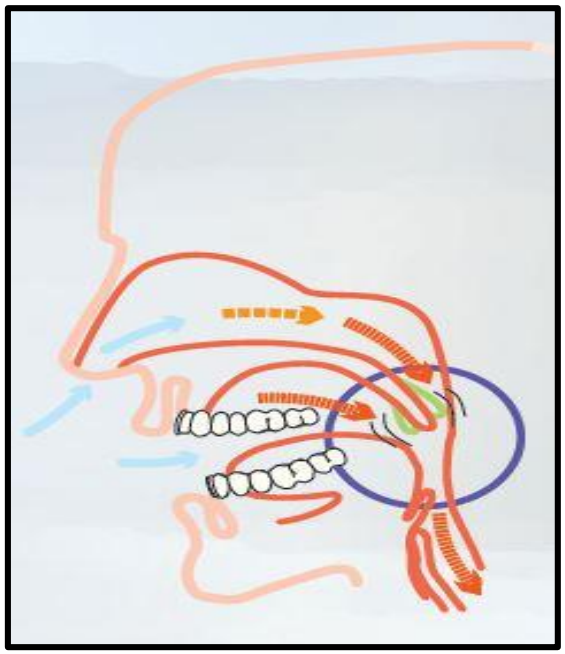

*Figure 1 : Narrow upper airway [12]*

Snoring usually is associated with a serious health risk potential. These health risk includes stroke, heart failure, daytime fatigue, high blood pressure, obesity, and diabetes [13]. In fact, untreated snoring worsen to more serious sleeping disorder called sleep apnea. Sleep apnea is defined as total respiratory stop where the person stop breathing during sleep. Most common sleep apnea is Obstructive Sleep Apnea (OSA). Obstructive Sleep Apnea occurred when the breathing pauses for at least 10 seconds, causes the person to awakes, reopen the airway and start breathing as normal. This cycle happened repeatedly for numerous time during the night. Therefore, it is important to prevent continuity of sleep apnea at early stage. According to [6], stated that the number of prevalence habitual snoring in Malaysia is high. This problem remain the same even though with the existence of various kind anti-snoring device. Therefore, the anti-snoring device controlled by Arduino is proposed in this project.

## 1.5 SIGNIFICANCE OF STUDY

Generally, snoring problem are uncontrollable to those who experiencing it. Hence, the function of this device is to alert the snorer by responding through the solenoid that pushes the pillow, indicate that the person is snoring. It will wake up the snorer through the actuator once snoring sound is detected. The solenoid will acknowledge the snorer by awake them based on the level of snoring sound produced. This process is crucial to enhance the improvement quality of sleep for the snorer. Good quality of sleep is important for health and life. Good sleep can enhance productivity, concentration and performance on the following day.

There are various types of snoring device available on market today. Frequently used device is the oral devices such as Mandibular Advancement Device (MAD) and Tongue Retaining Device (TRD). However, usage of these device can have a side effect for the user causes decreased to the usage of the device due to intolerance. For example, usage of Mandibular Advancement Device (MAD) can lead to jaw pain and facial pain due to the teeth which are forced to bite down on the device. Besides, some

complaints about uncomfortable use when excessive salivation collected at the mouth. Unlike the anti snoring device controlled by Arduino, this device help the snorer to obtain a good sleep without any side effect. This device works electronically without causes any disruptions, pain, and uncomfortable to user. In other words, it overcome the side effect of using the existing anti snoring device.

Anti-Snoring device controlled by Arduino is an easy to use device allowing the user to sleep without need to bite or using any device on mouth or facial. This method allows the user to sleep in comfortable condition. Moreover, it allows user to sleep at fully relax mode and efficiently through the night. It only operated when snoring occurred, with the intention to wake up the user and change their sleeping posture. The snoring might probably caused by nasal blockage, perhaps the user will have to clear the blockage during awaken by the device. Or the snoring might be caused by other external factors. This device is at its best to overcome snoring without any side effect or surgical treatment.

## 1.6 PROJECT OUTLINE

The project outline discuss the summary of every chapters that will be done for the whole process of this project. The brief information for each chapter are described as below.

**Chapter 1** : Introduce the basic concept of the project. In detail, this chapter discuss about the introduction of the device, problem statement, project objectives, scope and significance of study.

**Chapter 2** : This chapter discuss the findings and project overview based on past research which have been done which related to this project and allow the conclusion

to be test and verified by others. It includes the operation of the existing anti-snoring device and the detection of snoring, and information on the equipment and the component.

**Chapter 3** : Describes the procedure to achieve the research objectives. This chapter summarize blueprint of the project and it tells how and what methods use to carry out the project. It also discuss the progress flow of the project and device works in terms of flowchart.

**Chapter 4** : Present the data analysis and result based on the experimental approached. The problems encountered during experimental process will be discuss in this chapter. Plus, this chapter discuss the result and outcome obtained through the evaluation of the device.

**Chapter 5** : Summarize the overall position of the findings in the project. It also explain the recommendations on improvements for future use.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 INTRODUCTION

This chapter describe the literature that have been done by past researchers which strongly related to this project. Various studies conducted by previous researches discussed in this chapter.

## 2.2 TREATMENTS OF SNORING AND SLEEP APNEA

Treatments of snoring are divided into two major methods ; surgical treatment and conservative treatment [7]. The conservative is a nonsurgical treatment through natural healthy lifestyle, sleeping posture, and the usage of oral appliances and others medical devices. Commonly, nonsurgical treatment works with the usage of anti-snoring devices. Various kind of anti-snoring devices being implemented nowadays. Such examples of common anti-snoring devices are Continuous Positive Airflow Pressure (CPAP), Mandibular Advancement Device (MAD), and Tongue Retaining Device (TRD). However, not all patients or snorer tolerate with those device. All these device come with different feature and functionality and contribute to different side effect based on their design. Thus, this will result in discontinuity of using the device [4]. While the surgical treatment will be the last option for snorer where the nonsurgical treatment does not work for them or for those who unwilling to undergo surgical method. The surgical treatment are considered as effective way for treating the sleeping disorder. The surgical treatment are classified into intranasal operation, Uvulo-Palato-Pharyngoplasty (UPPP), Laser-Assisted-Uvulo-Palato-Plasty (LAUP), Laser Midline Glossectomy (LMG) and tracheotomy [7].

Therefore, these two major methods are related to very crucial part, detection of snoring. There are various approach used to detect the snoring sound. However, the high cost of polysomnography (PSG) leads to multiple approaches for diagnostic tool [5].

### 2.2.1 COMPARATIVE EFFECTIVENESS OF THE DIFFERENT TREATMENT MODALITIES FOR SNORING

This project present the comparison using three different methods for treatments of snoring. It conduct a study about the effect of treatment on the snoring and sleepiness problem. These methods are surgery (osteotomies), Mandibular Advancement Device (MAD) and Continuous Positive Airway Pressure (CPAP). As much 224 patients undergo detailed evaluation such as Polysomnography (PSG) test to filter the sleep apnea as this study focusing on snoring only. Clinical investigation, and Drug-Induced Sleep Endoscopy (DICE) is conducted to ensure that the patients are qualified for this study. Drug-Induced Sleep Endoscopy (DICE) and PSG test plays an important role in determining the apnea-hypopnea index (AHI). The apnea-hypopnea index (AHI), sleep endoscopy findings and body mass index establish which treatments the snorer belongs. Patients are required to filled the symptom score questionnaire in order to identify the level of the snoring problems. The result of the evaluation will be observed further and treatments are proposed after multidisciplinary consultation. In total of 116 patients undergo the study as 29 patients missing the PSG and DICE test, 61 patients refused to proceed the proposed treatment and 18 patients having an incomplete schedule. The results of the treatment are being observed in duration of 6 weeks and 6 months after. The number of patients for each treatments are :

i. Surgery, 53 patients (46%)

ii. Continuous Positive Airway Pressure (CPAP), 33 patients (28%)

iii. Mandibular Advancement Device (MAD), 30 patients (26%)

As a result, all treatments shows the positive outcome and improvements as the snoring and sleepiness decreased after duration given. This is proved by decreasing in the symptom score. This study is limited to the duration given as longer term studies leads to loss of treatments due to uncontrollable factors such as body weight, usage of alcohol and any others factors that could disrupt the study. Only a few reported an unchanged on the treatment. To be conclude, surgery treatment stated the highest percentage of success compared to Continuous Positive Airway Pressure (CPAP) and Mandibular Advancement Device (MAD) as shown in figure 2.2.1.

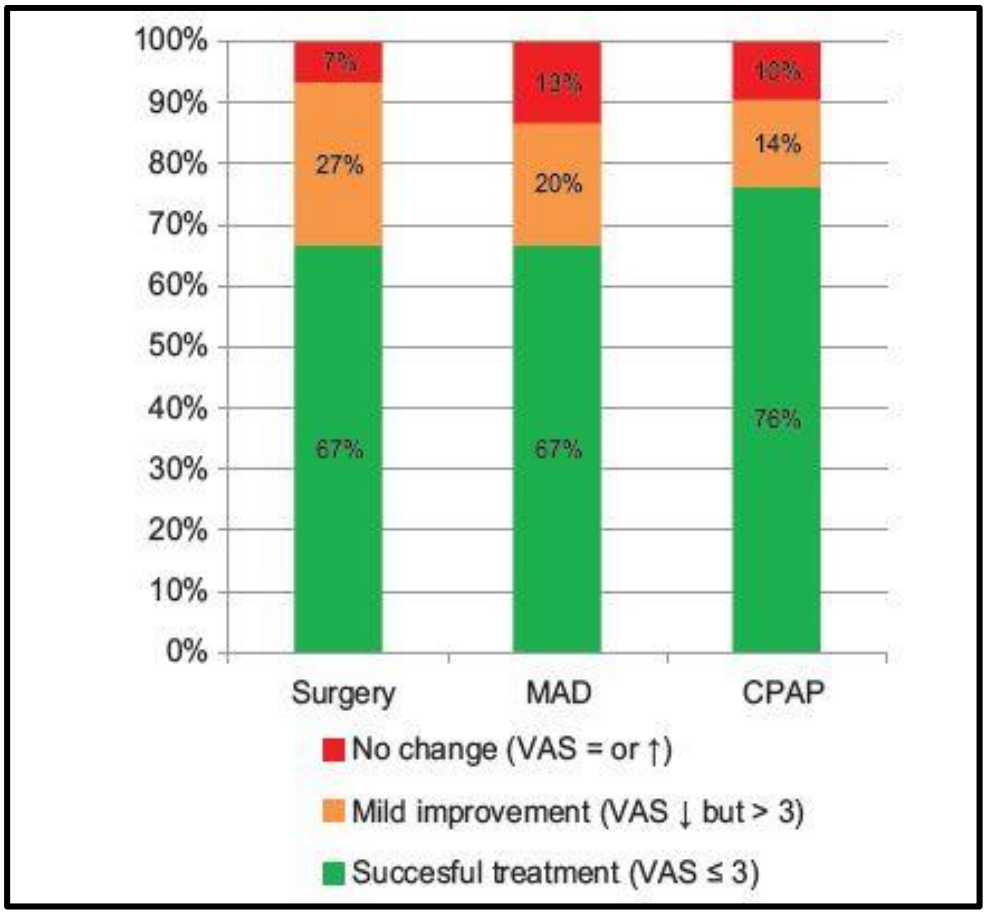


*Figure 2.2.1 : Percentage of different treatments [1]*

Based on the percentage, successful surgical treatments involves other subgroup of treatments such as septoplasty, partial inferior turbinectomies, uvulo-palatopharyngoplasty (UPPP), somnoplasty of the palate, radiofrequency-assisted uvuloplasty (RAUP), and somnoplasty of the tongue base. Hence, it shows only little on no change percentage compared to MAD and CPAP.

### 2.2.2 ORAL APPLICANCES FOR SNORING AND OBSTRUCTIVE SLEEP APNEA

The mechanism of oral appliances resolve the snoring problem by widening the upper airways which help to shape the patterns of sleeping of an individual. Oral appliance for snoring and obstructive sleep apnea was made to test on the effectiveness of sleeping quality. Hence, also to test whether there is any important clinical effect on the usage of the mechanism. The concept of oral appliances is to enlarge the upper airway and to reduce closing pressure of the muscle tone. Basically, oral appliances are classified into Mandibular Advancement Device (MAD) and Tongue Retaining Device (TRD). The design of Mandibular Advancement Device (MAD) use to hold the lower jaw forward while the Tongue Retaining Device (TRD) positioned the tongue forward to prevent it being sucked back into throat. In this study, patients are being selected through volunteering, subjects with more than 40 respiratory events per hour and those who failed other treatment. Other treatment mentioned are Continuous Positive Airway Pressure (CPAP) and surgical treatment.

Generally, usage of oral appliances contribute to some side effects. Thus, in this study, the side effects of oral appliances are classified into two. First, it is the minor and temporary side effect. The effects may occur and resolve simultaneously within short period of time. Furthermore, this minor effect is tolerable and does not affect on the continuous usage of the appliances. Next, continuous and severe side effect which cannot resolve over time. As a result, it cannot be apply continuously due to uncomfortable and it is inefficient. Both side effects includes excessive salivation, tooth pain, jaw pain and etc.