

# A study on the Dik Universe

Development of a bigger dik

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Electronics and Computer Engineering, TEPE4-1005fuk, 2018-08

Bachelor Project



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## **AALBORG UNIVERSITY**

### STUDENT REPORT

**Title:**

Project Title

**Abstract:**

Here is the abstract
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**Project Group:**

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# Preface

Here is the preface. You should put your signatures at the end of the preface.

Aalborg University, December 4, 2018

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# Chapter 1

## Introduction

Here is the introduction. The next chapter is chapter ??.  
a new paragraph

### 1.1 Examples

You can also have examples in your document such as in example 1.1.

#### **Example 1.1 (An Example of an Example)**

Here is an example with some math

$$0 = \exp(i\pi) + 1 . \tag{1.1}$$

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### 1.2 How Does Sections, Subsections, and Subsections Look?

Well, like this

#### **1.2.1 This is a Subsection**

and this

#### **This is a Subsubsection**

and this.

**A Paragraph** You can also use paragraph titles which look like this.

**A Subparagraph** Moreover, you can also use subparagraph titles which look like this. They have a small indentation as opposed to the paragraph titles.

Is it possible to add a subsubparagraph?

I think that a summary of this exciting chapter should be added.

## Chapter 2

# Problem Analysis

### 2.1 Problem Description

#### 2.1.1 State of hearing aid

Hearing aid technologies have never been improving as fast as they do now. Ever since major smartphone manufacturer companies started investing into wireless wearable technology research, price of PSAP (personal sound amplification products) has decreased while the amount of features has increased. Throughout recent years wireless earphones became predominant in the global market due to new generation of Bluetooth technology. This improvement even further reduces power consumption of wireless technology. The only three differences between hearing aids and PSAPs were:

- The battery life. Due to a far higher number of features and consistent audio stream PSAPs consume a much higher amount of power.
- Hardware design differences. PSAPs are not oriented around sound localization to inform the user about where the sound is coming from regarding natural sources. PSAPs are often not oriented to be invisible to others, they are more often purposely made to stand out and be recognized among its competitors. Fit customization is also often minimal on PSAPs.
- Regulation requirements to produce the hearing aid and license requirements to sell it.

Most other differences lay in software and could be eliminated through a software update.

It is believed that legislative issues could be solved if manufacturers would put effort to reach for an agreement with legislators although it would require a lot of changes since current hearing aid selling process consists of far more than just taking the product off the shelf and swiping it through the register - it is normally performed at hearing clinics, hearing aid is thoroughly adjusted to fit the consumer's ear for long periods of time, warranty for these devices also is taken in a far more serious manner: it comes with included follow-up office visits, checks and cleaning procedures to maintain the highest level of performance. Some companies do express interest to merge the two markets. According to "The State of Hearing Healthcare 2017" by Lindsey Banks, "If Apple Air Pods or Samsung Gear IconX could add in hearing aid functions, that's instant access to over half of the U.S. over night."

<https://www.everydayhearing.com/hearing-loss/articles/state-of-hearing-healthcare-2017/>  
((puthashhere))tech

The value of argument regarding battery life of these two hearables should also heavily decrease in the coming years. At the end of October 2017 Samsung has announced that a considerably new generation of battery has been developed. Currently used lithium-ion batteries seem to have been pushed to it's limit and yet it still takes a fairly long time time to charge in a fast-paced society. This problem has pushed electronics manufacturers to develop energy efficient processors. A new graphene-based battery technology should enable 45 percent more capacity and 5 times faster charging speeds.

These reasons should lead to a breakthrough in battery life factor of next year's electronics. If not at 2019, by 2020 hearing aids should receive this battery update. Combined with improvements in Bluetooth technology, these reasons should encourage both hearing aid and consumer audio manufacturers to encourage an increased number of features in coming year's hearing aids as well as PSAPs and might bring the markets closer together.

## 2.2 Initiating Problem

## Chapter 3

# Development

### 3.1 Component List

#### 3.1.1 Introduction

To create the basis for development of this project two microphones and a structure to keep a constant distance between them were necessary.

#### 3.1.2 Microphones characteristics

Firstly a decision had to be made whether to use a directional or omnidirectional microphone. Since omnidirectional microphones provide less plosive and wind sounds, does not build up bass it was considered a good option. The fact that it provides equally good audio quality at every angle made it the best choice for the aim of this project.

Voice frequency ranges vary heavily depending on whether it sources from a male or a female. Fundamental voice frequency varies from 100Hz to 900 Hz for men and 350Hz to 3KHz for women. Including peaks to conserve natural sounding voice, a wider frequency range has to be considered. It rises to 8 KHz for males and 17KHz for females [Seaindia]. Yet different researches often come up with different results. For example, in phone communications it is accepted to transmit frequency range between 400Hz and 3400Hz. This is the reason some peoples' voices transit poorly over the phone yet for most cases it works fine. This example allows to conclude that smaller frequency ranges could be acceptable but to conserve all of the properties of the human voice microphones do need to be capable of recording at 17kHz.

**Our requirements for the microphones were:**

- **Affordable price**

Since the university did not have any planned funding for this semester, it was agreed to aim for budget options. This way it would not be necessary to work towards an agreement with the University to receive funding - some members wanted to have microphones for themselves.

- **Capability to capture the entire range of human hearing frequency**

Since one of the great benefits of an omnidirectional microphone was its ability to capture clear sound, it would not have been reasonable to purchase microphones that were not able to capture the full clarity of the input. Since the entire human voice frequency fits within our hearing frequency range, there is no need to have any extra requirements.

- **Appropriate size factor**

It would be beneficial and logical if the microphones used in the testing would have potential to be a part of the design prototype. Although due to limited budget there is a low chance of affording the microphones with an appropriate size parameters for a hearing aid or earphones, objective to apply a microphone that could be used in the further stages of development remains as one of lower priorities

- **They must be identical**

Having identical microphones assures that if there was a delay within recording timings, it would not be caused by hardware differences.

- **Capability to connect multiple microphones to a single computer and record both at the same time**

For the sake of simplicity regarding sampling and testing, it was agreed that it would be far easier to sample using microphones that can be connected through Universal Serial Bus port instead of Auxiliary one. This way troubleshooting and initiating microphones should be more clear.

### 3.1.3 Microphones

As requirements for microphones were set, it was first attempted to find them at the University. As it was found that University does not own any microphones that could be applied for the purpose of this project, it was agreed to purchase budget microphones that could come as close to the requirements raised for the project as possible. Bearing in mind that a month-long delivery from Asia is not a viable option, it was decided to order microphones available within an acceptable delivery time .



### 3.1.4 Distancing

To maintain a constant distance it was decided to attempt modeling a rod with two microphone holders at it's ends. The distance chosen between the microphones was agreed on by referring to a research article in this area: 15.2 centimeters .

reference

Other parameters were found by following the measurements found in the datasheet. These steps have led us towards the structure development, which after a few iterations has turned into the structure that was used for sampling .

reference

illustration missing (3D model or real one)

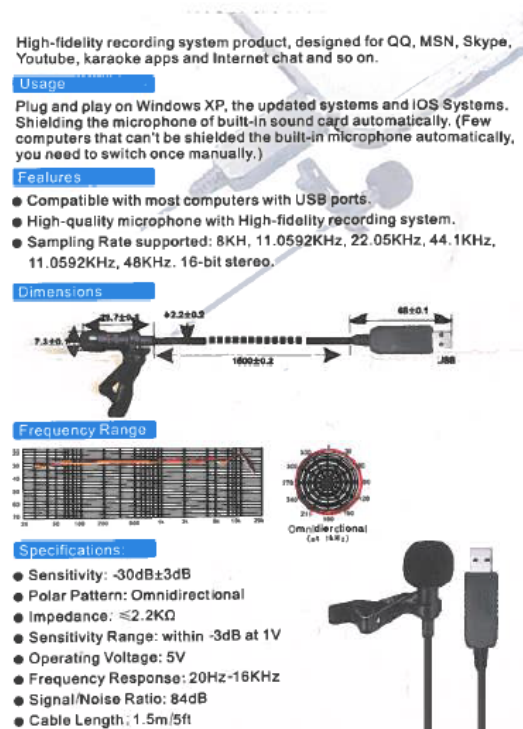


Figure 3.1: Microphones data sheet

[https://www.researchgate.net/publication/228749231\\_Analysis\\_of\\_the\\_Facial\\_Anthropometric\\_Data\\_of\\_Korean\\_Pilots\\_for\\_Oxygen\\_Mask\\_Design](https://www.researchgate.net/publication/228749231_Analysis_of_the_Facial_Anthropometric_Data_of_Korean_Pilots_for_Oxygen_Mask_Design)

## 3.2 Setting up the scene

Sampling was done in a lecture/ conference room with side noise: a server, maintaining the virtual conference platform (B107). This area was chosen because it had represented a real life conversation scenario. It is planned to conduct tests with a working system in a different environments to validate the effectiveness of it. Creating a set of samples in every different environment throughout the development

phase would take a lot of time and therefore was considered unnecessary for the early stages.

Since the sampling ratio of human ear can only reach up to 20kHz, 48kHz sampling frequency of the microphones the Nyquist frequency and therefore guarantees that there will not be any hearable audio quality losses.

### **3.2.1 Analog to digital conversion**

Since the datasheet of the microphone does not provide any information on the Analog-to-Digital Converter that is used to process the data and there is not default ADC that is used for this process, the only potentially successful way to find the details about the ADC used for the signal processing is to open the microphone and look for the information on the ADC itself. Since the structure seemed to be glued together, we will not attempt to find the details of it and just rely on the specifications sheet provided by the manufacturer.

## **Chapter 4**

# **Directional Noise Elimination**

### **4.1 Introduction**

This chapter deals with directional filtering. The idea is presented and tested. The results and conclusions will be shown afterwards.

### **4.2 Concept**

Figure XX shows a scenario where directional filtering could be used. Source 1 and Source 2 are both talking simultaneously. At the Origin, two microphones are recording both signals. Due to the placement of the sources, both microphones will record the sounds, with a certain delay.

### **4.3 Development**

### **4.4 Conclusion**



## **Chapter 5**

# **Neural Network Speech Isolation**



## **Chapter 6**

# **Results**





## **Chapter 7**

# **Future Work**



## Chapter 8

# Conclusion

In case you have questions, comments, suggestions or have found a bug, please do not hesitate to contact me. You can find my contact details below.

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# Bibliography

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## **Appendix A**

### **Appendix A name**

Here is the first appendix