

HUSH

A PROJECT BY MENDEL DE KOK



HUSH



ACD REPORT - MASTER INTEGRATED PRODUCT DESIGN

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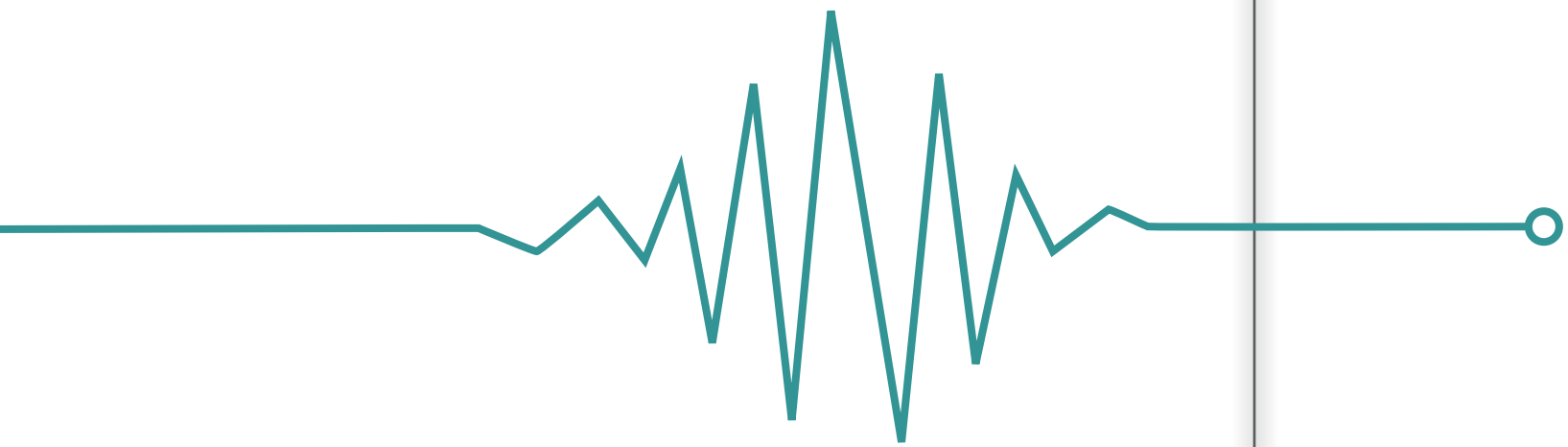
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“IT TAKES SOME
SILENCE
TO MAKE SOUND.”

Jason Mraz



ABOUT THIS REPORT

Five months ago, Erasmus Medical Centre Rotterdam asked TU Delft master's students for help on solving a problem. Five months ago, the author of this report also started her master's degree at TU Delft, Faculty of Industrial Engineering. The result: A fruitful cooperation, documented in the report that lies before you. This report is about a product as a *solution* and a *statement*. The report tells about the last few weeks of the five months that preceded. It communicates the final result as well as all relevant stages of the design process and the motivation of the design itself. Enjoy.



ERASMUS BUILDING PLANS

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CHAPTER 1

INTRODUCTION



THE ASSIGNMENT

ASSIGNMENT BY ERASMUS

Erasmus Medical Centre in Rotterdam has been experiencing problems with the loudness and over-abundance of alarms inside Intensive Care Units (ICU's). Erasmus MC wants to make their ICU's as silent as possible, creating a shift from a noisy and tiresome environment to a silent and quiet one.

The given assignment by the Erasmus MC was to create concepts for a silent ICU. The concepts should be integrated in the current routine of the people using the ICU and relate to their emotional experiences.

APPROACH

To find a solution to the noisy ICU, research has been conducted on ICU history, ICU culture, technology, the current problem and existing solutions. Brainstorming sessions took place with coaches and students on concepts and the development these concepts. In the last stage, user feedback was acquired and an explanatory video was made and commented upon by Erasmus representatives before coming this final report.



ERASMUS INTENSIVE CARE UNIT



DESIGN VISION

THE PROBLEM IS NOW, SO SHOULD THE SOLUTION BE

At this moment, there is an excessive amount of loud and disruptive alarms that cause numerous of problems (which will be discussed in chapter 3). These alarm settings can hardly be adjusted by the nurses or the hospital, because regulations forbid manufacturers from allowing these settings to be adjusted.

What makes it more disturbing, is that there are already numerous articles stating how to improve the alarm systems design, and articles that explain how policies can be changed. It is certain that in a decade or two, designs and policies will indeed improve.



PRESENT DAY

GAP

In a decade or two more, these new machines will have replaced the old ones. They will incorporate much more functionalities, and current alarm issues will not apply anymore.

However, until all hospitals have replaced their old machines with modern ones, the problem will exist. In this report a solution is presented that will not only make this transition to modern technology less painful, it will help bring the problem into light.

THE PROBLEM IS NOW, SO LETS MAKE A SOUND.

GAP

1 TO 2 DECADES



HUSH

WHAT IT IS

HUSH is a simple add on for hospital speakers.

WHAT IT DOES

HUSH mutes alarm sounds.

HOW IT IS USED

HUSH can be changed of shape and stuck onto speakers.

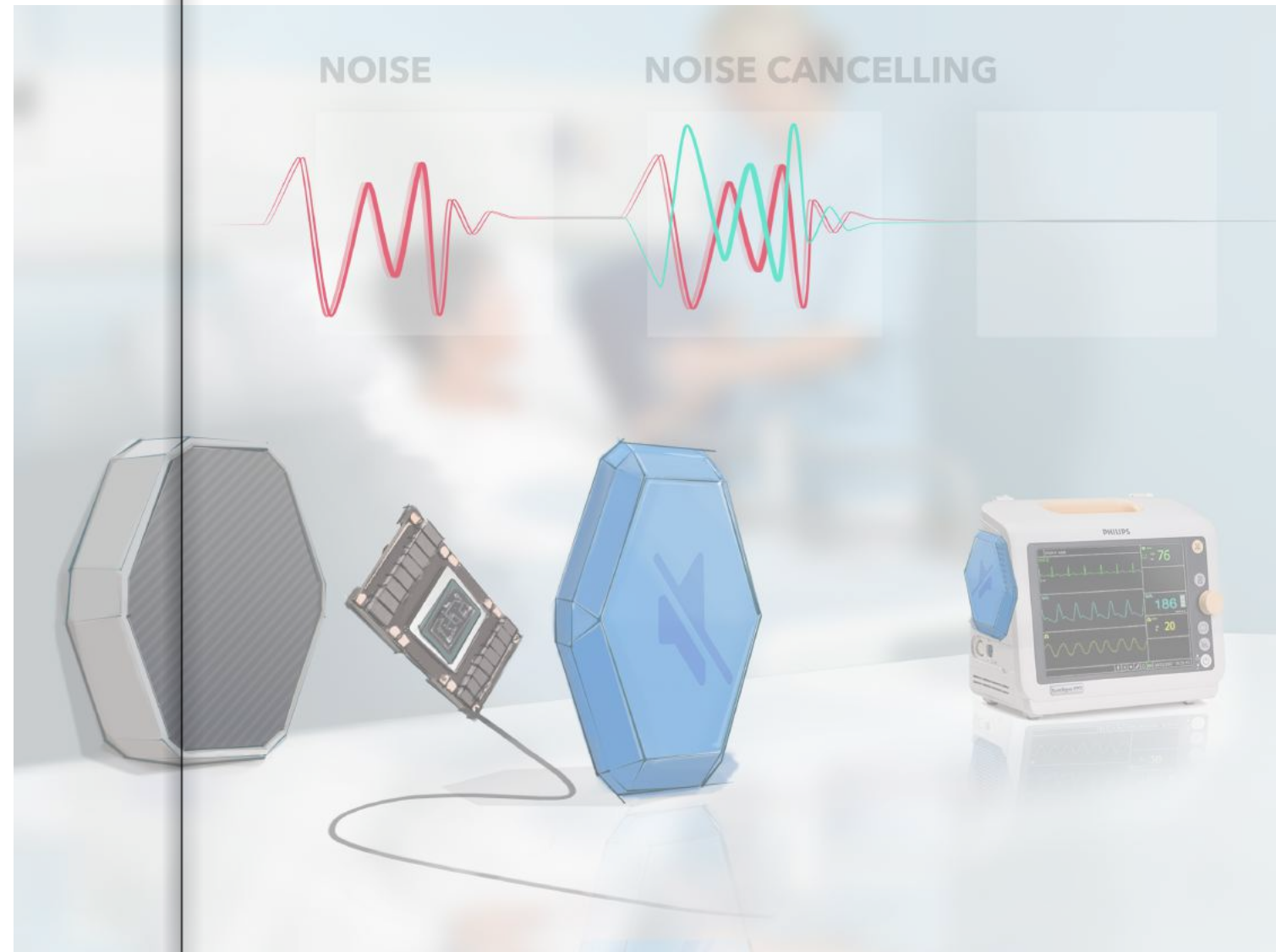
HOW IT WORKS

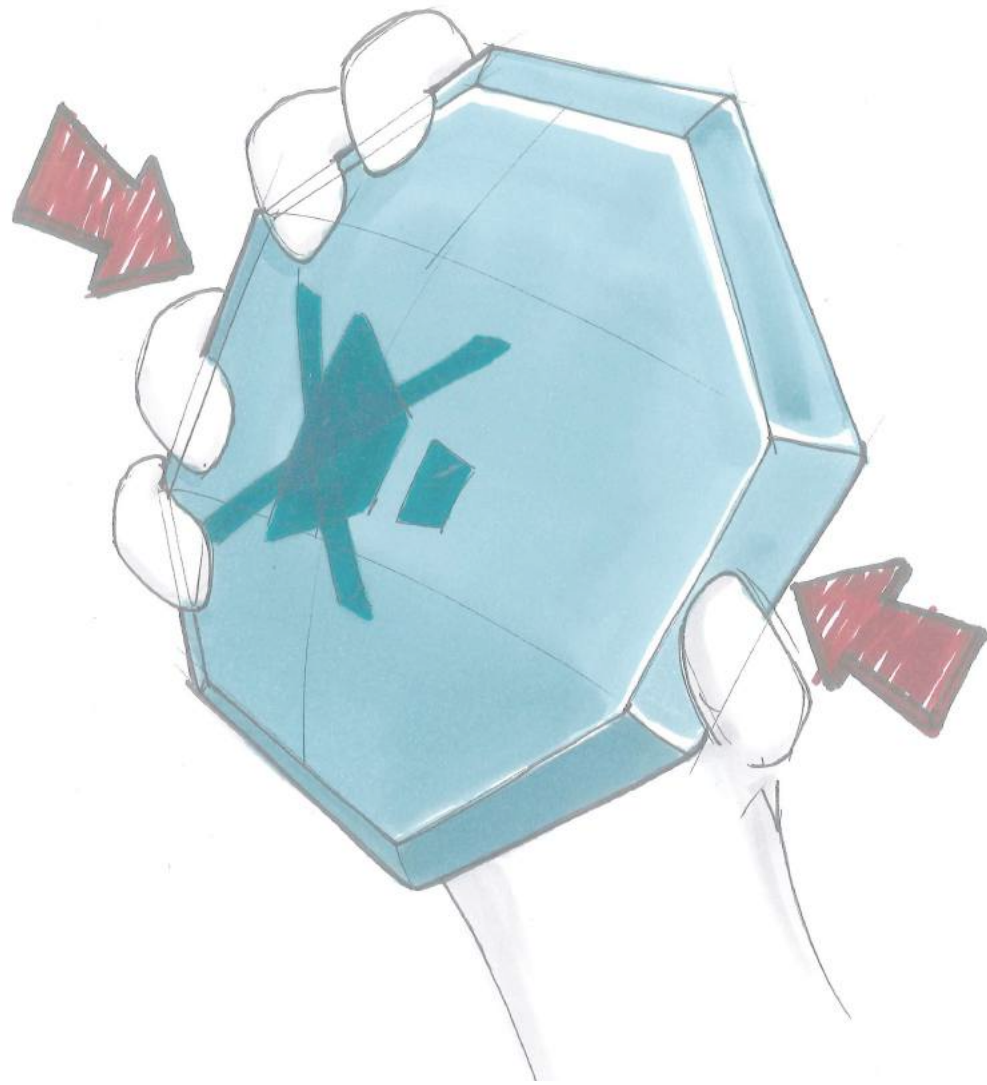
HUSH is made of sound dampening putty that is reusable and sticky. A water-resistant top-layer of film allows it to be cleanable. Later versions of HUSH will include noise cancelling technology.

WHY HUSH?

HUSH is not only a good short-term solution. It is a statement. A voice from hospitals to legislators urging for change.

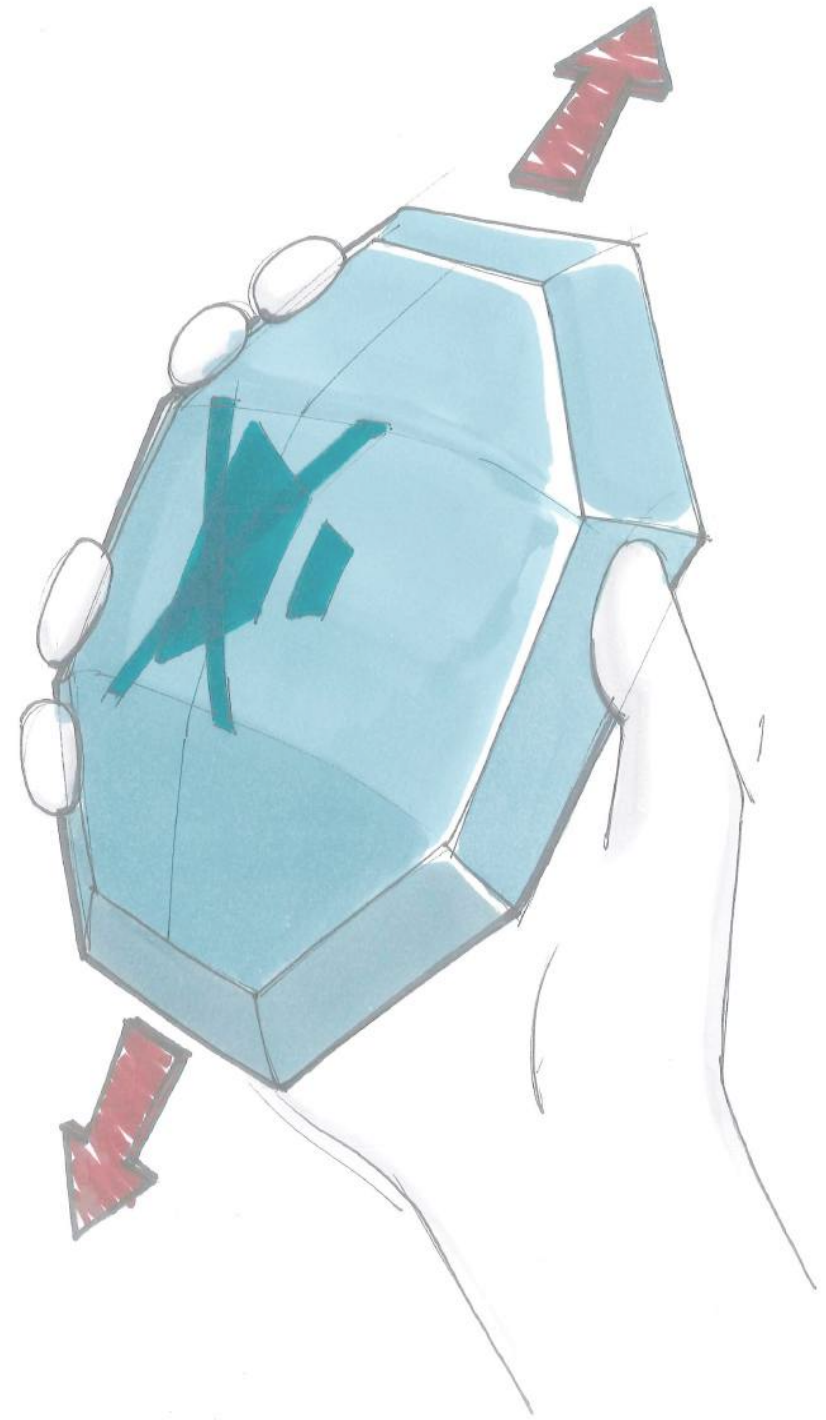
It is the start of a change.



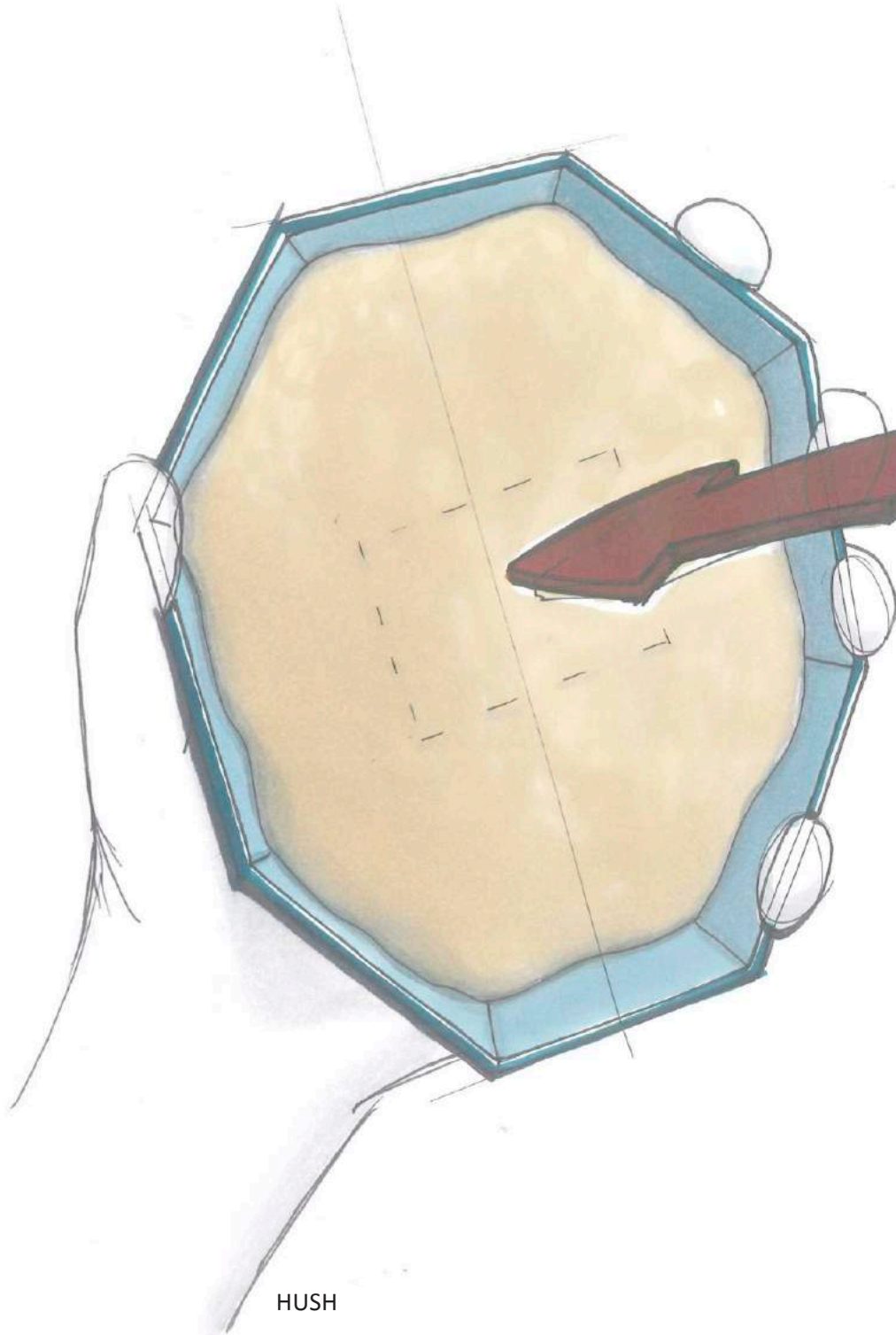


CHANGE SHAPE

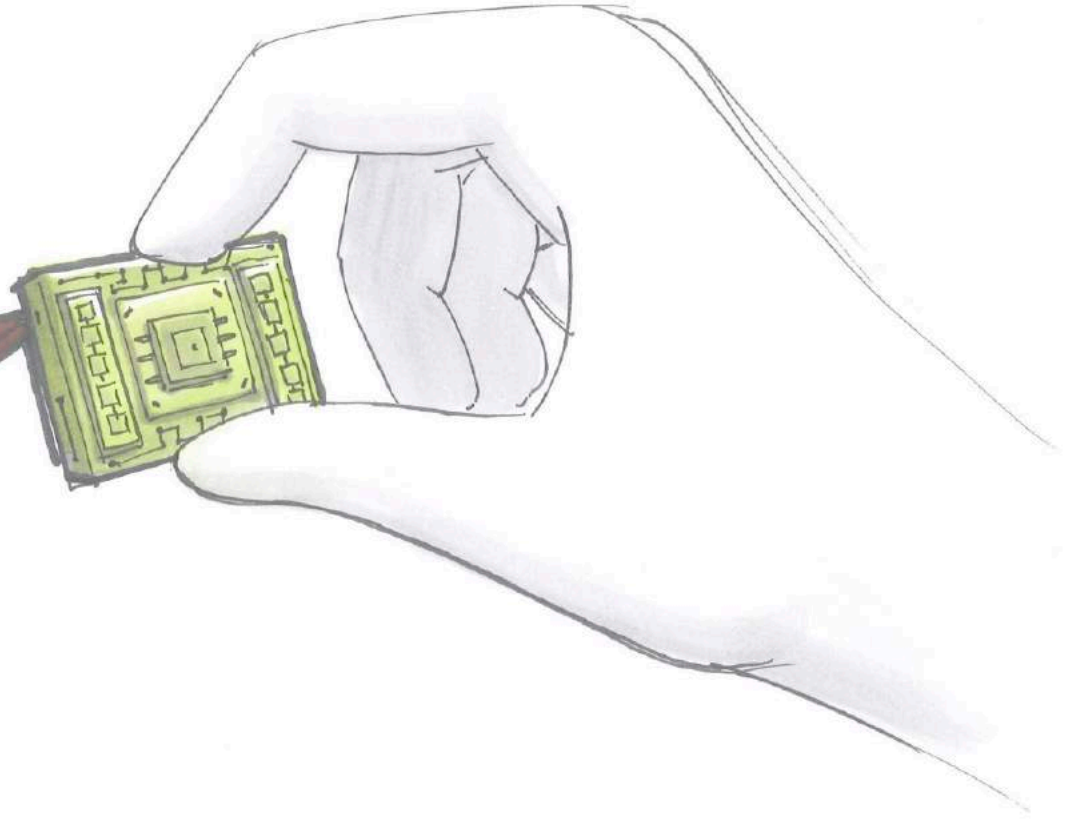
HUSH



HUSH

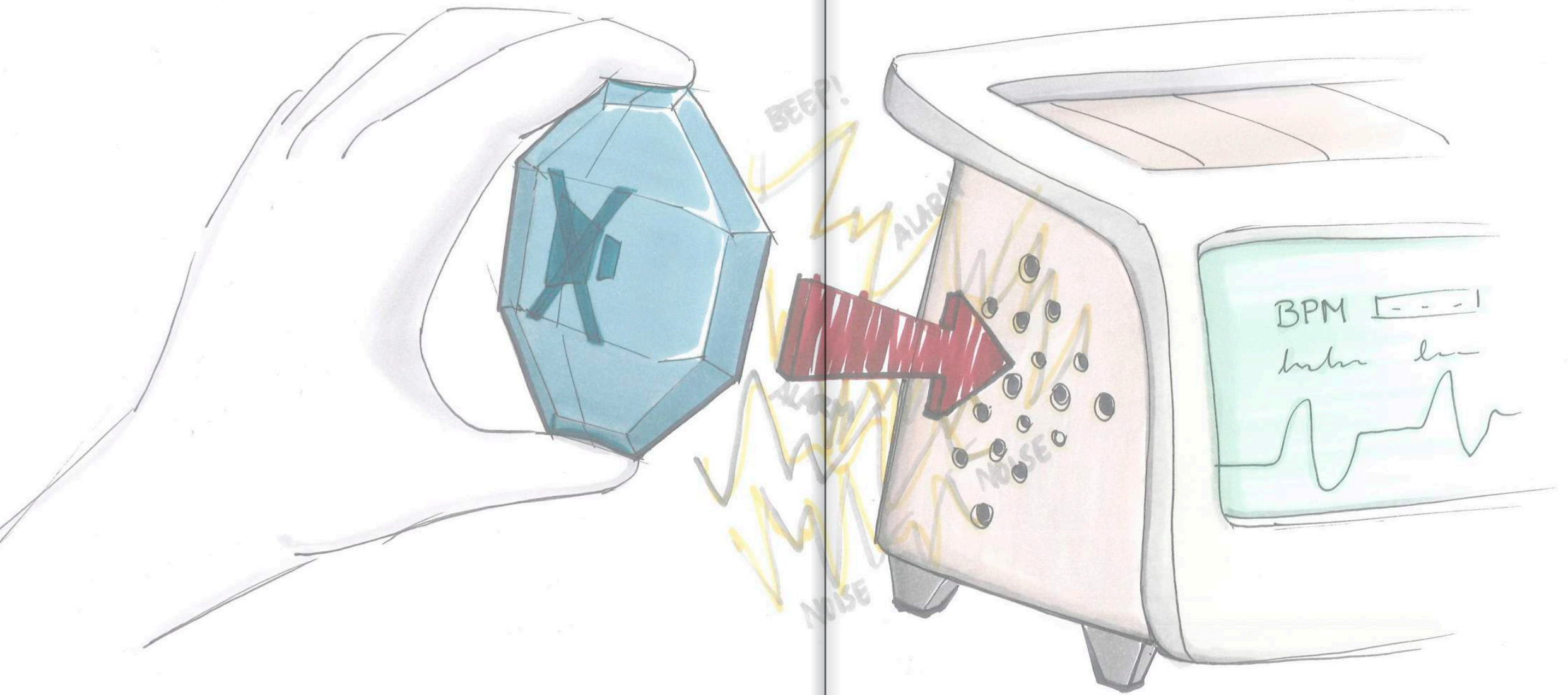


HUSH



INSERT NOISE
CANCELLER

HUSH



STICK ON SPEAKER

CHAPTER 3

PROBLEM STATEMENT



LITERATURE STUDY

This project's vision, problem statement and solution are based on an extensive literature study. The most relevant findings, related to this project, are addressed below.

NOISE IN INTENSIVE CARE UNITS

An Intensive Care Unit (ICU) is a complex and stressful environment for both patients and staff. One of the most prominent problems in an ICU is the noise caused by the loudness and excessive occurrence of alarm sounds from machines that constantly have to monitor and support the patient¹. A study at the John Hopkins Hospital in Baltimore found that there was an average of 350 alarms per patient per day during a 12-day period².

According to a study on the audio environment in an intensive care unit by Sinclair (2011), alarms in ICU's are often too loud and shrill, because they are usually installed on a 'better-safe-than-sorry' logic, where the urgent character of the alarm is not matched by the situation. These alarms are set by manufacturers following the alarm legislation of the established country. The problem with the 'better-safe-than-sorry' logic is that it leads to alarm fatigue, drastically reducing the response rate to the alarms³.

ICU EQUIPMENT

Next to that, a large number of different alarms are sounded in ICU's. This is due to the fact that hospitals are often forced to buy equipment

from several different manufacturers, since these manufacturers do not produce every needed instrument. These same manufacturers implement their own technology, interface and most relevantly: sound. As mentioned before, each manufacturer has to follow the alarm sound legislation of the established country, which often means that the sound can not be edited, turned off or set below a certain noise level⁴. Next to that, the hospitals medical equipment is bought and updated throughout decades of existence. Consequently, the hospital technology consists of different models of different generations of different manufacturers from different countries, all making sounds.

FALSE ALARM RATE

As if that is not enough, it is not uncommon for a hospital ward to have a false alarm rate over 70% and in some cases as high as 99%⁵. These alarms sound from three different places: The machines inside the ICU's, the central monitors outside the ICU (one monitor every two rooms) and the nurses pagers. The alarms cause nurses to become desensitised to alarms that can be critical. Like the story about the boy who cries wolf. In the medical world, the phenomenon is known as alarm fatigue, which was the number one health technology hazard in 2015 for the fourth consecutive time⁶.

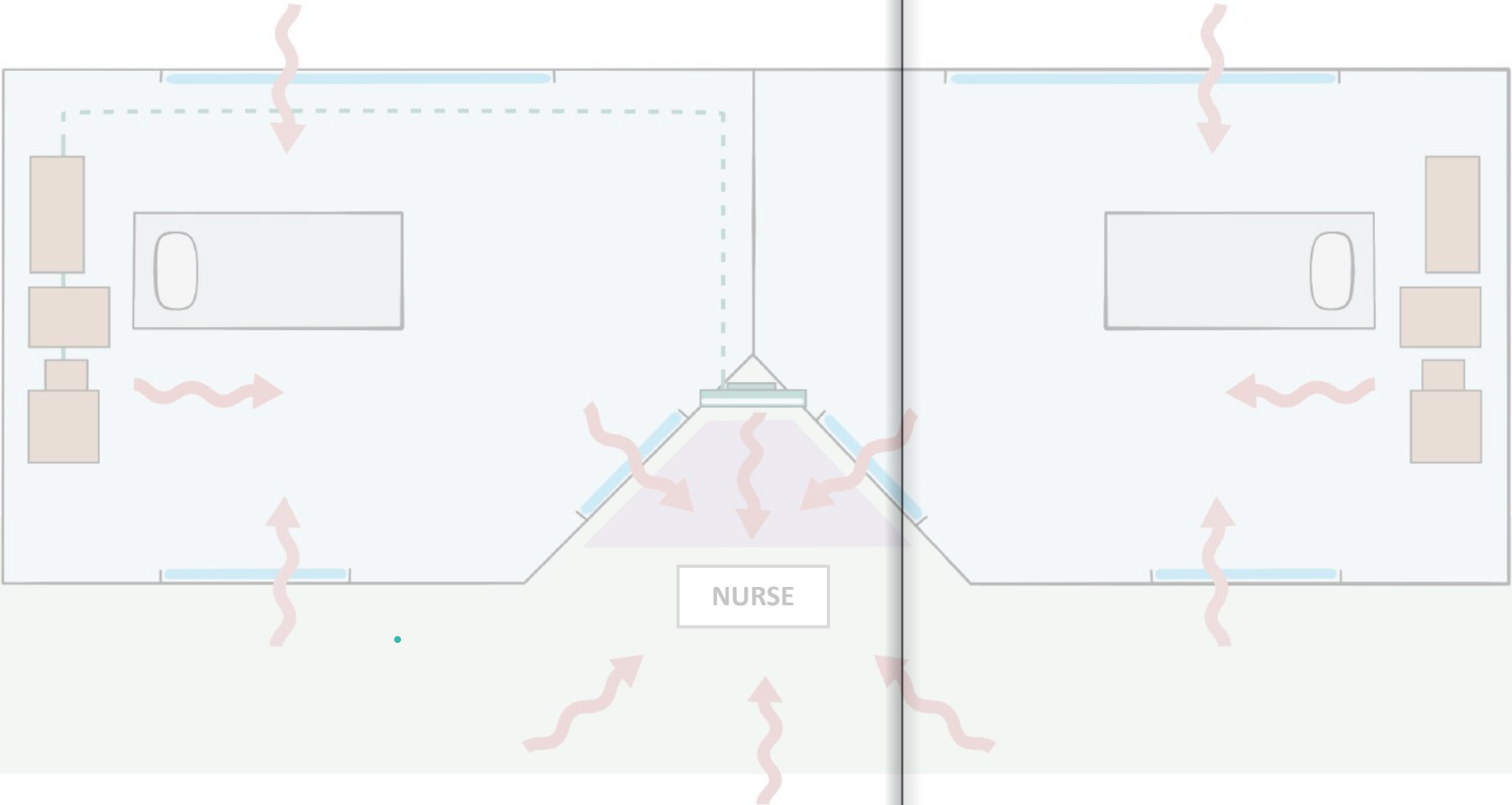
PATIENTS

Depending on their illness, a patient's experience of an ICU ranges from imperceptibility (e.g. due to coma) to full and constant awareness of their surroundings. Problematic noise levels can lead to sleep disturbance and cause delirium⁷. Studies have shown higher mortality rates in ICU patients with delirium⁸ the problem of excessive sounds in an ICU is quite literally a matter of life and death.

SOURCES OF SOUND



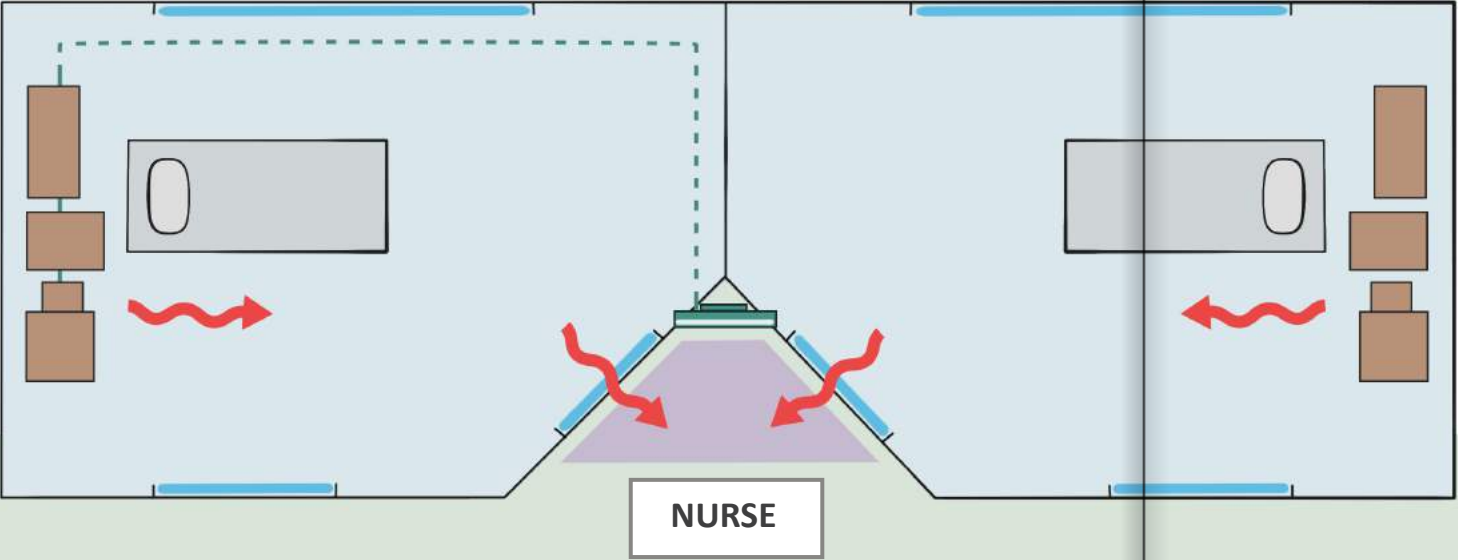
To breakdown the problem into manageable pieces, all main sources of sound are separately examined. The next pages show five different sources of sound.



FIRST SOURCE

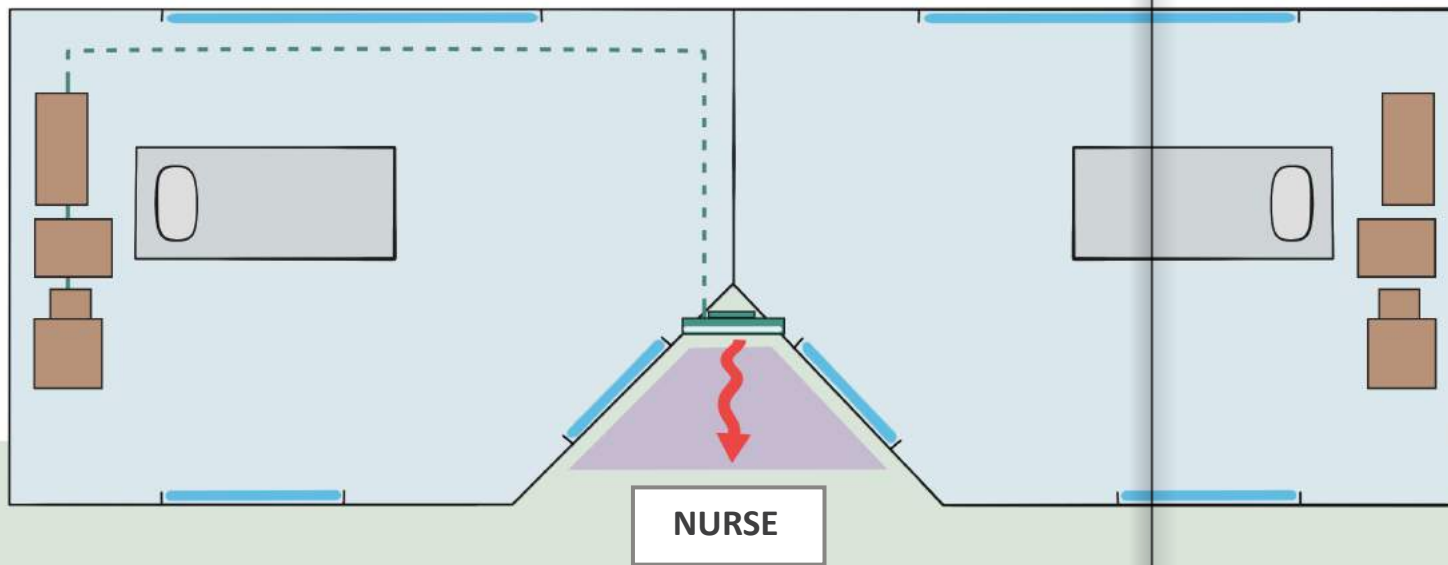
The first source is alarmsounds from the bedside machines. These alarms are sounded in the patients room, but travel through the windows to the overseeing nurse.

This sound problem is addressed by HUSH.



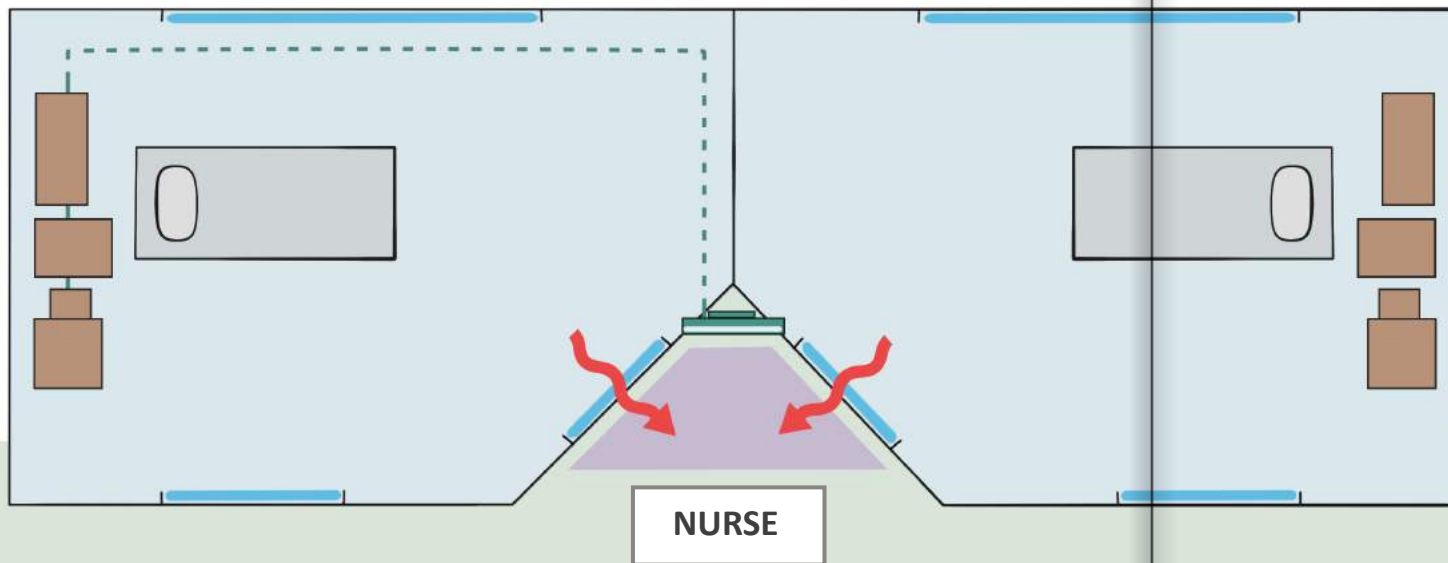
SECOND SOURCE

The second source of problem is alarmsounds from the nurses monitor. These monitors are connected to the bedside machines and echo the same alarm as those machines do.



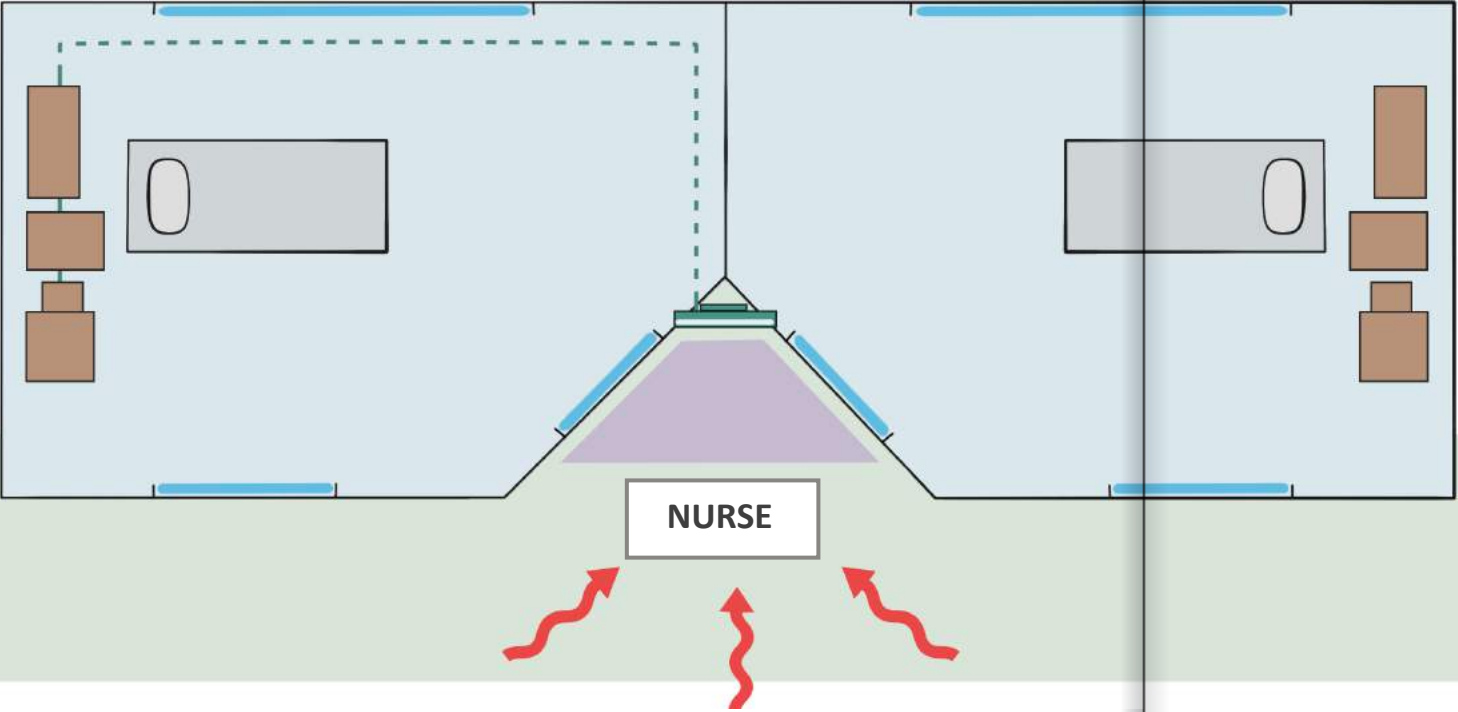
THIRD SOURCE

The third source of problem is part of the first source: Alarmsounds from the patients room through the windows. These windows are not made soundproof in order for the nurse be able to hear a patient call.



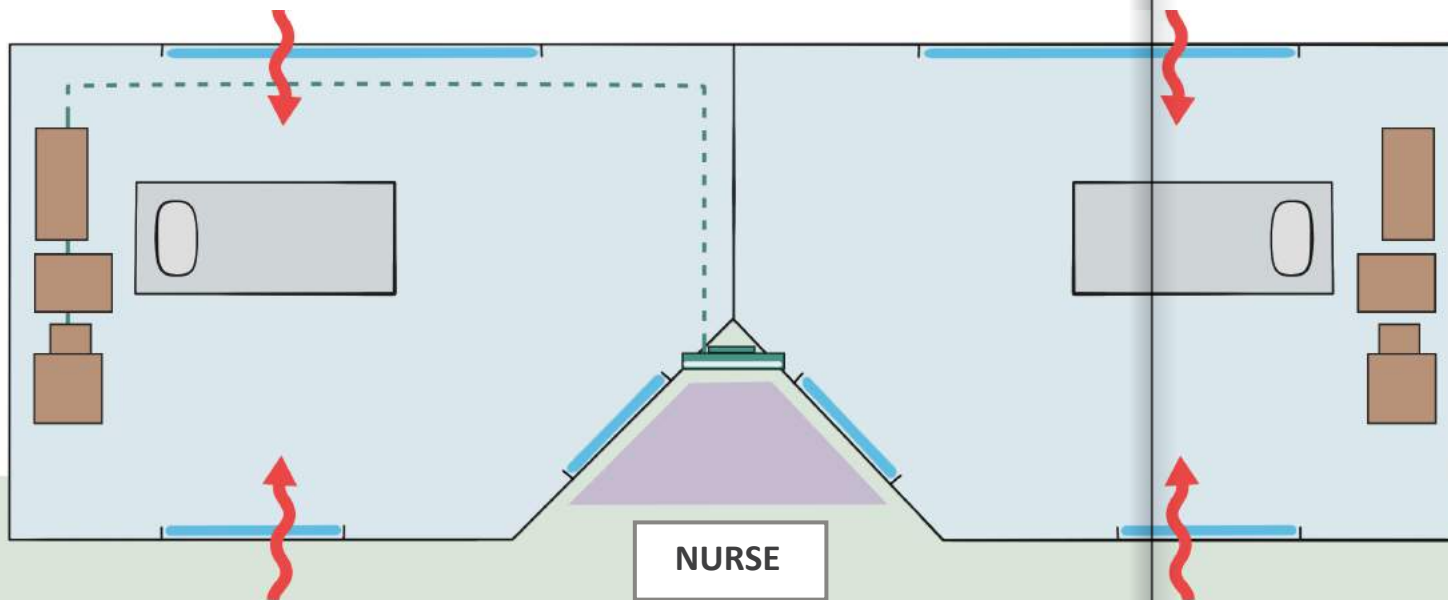
FOURTH SOURCE

The fourth source of problem is all sounds in the hallway from other rooms, monitors and pagers. These sounds are difficult to solve with one simple solution and are not further elaborated upon.



FIFTH SOURCE

The fifth source of problem is all sounds entering the patients room from the hallway and outdoors. These sounds are both difficult to solve with one simple solution and and not directly burdensome to the nurse. This source of problem is not further elaborated upon.





CHAPTER 4

CONCEPTS





INTRODUCTION

Based on the literature study and the problem sources of chapter 3, a bill of requirements and 3 concepts were made. The concepts are shown, because they may provide interesting future solutions.



PROGRAM OF RECOMMENDATIONS

The table on the right shows the program of recommendations. The program is made to get a general outline of all conditions and gives ground for assessing the concepts.

No specific values were given to the program of recommendations, because -as will be shown in the next few pages- every concept is quite different from the other.

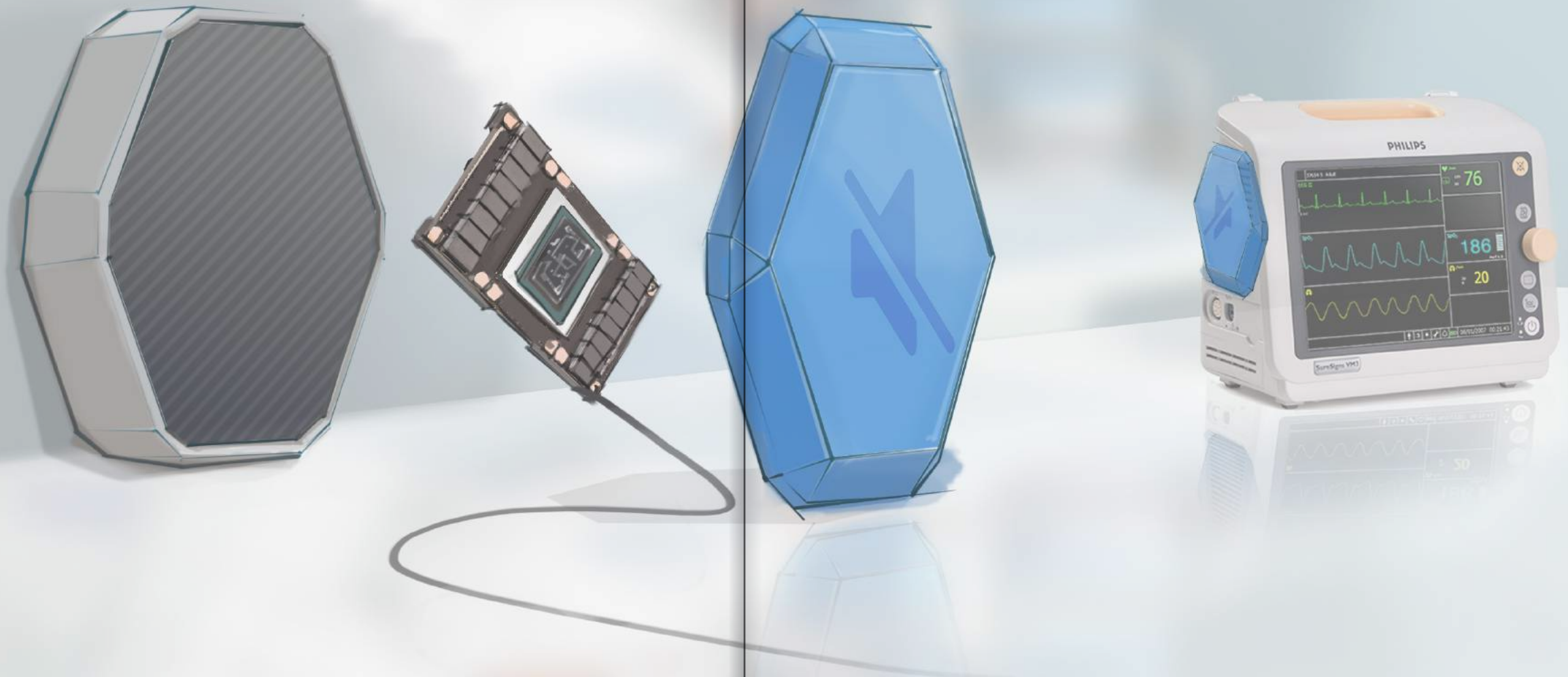
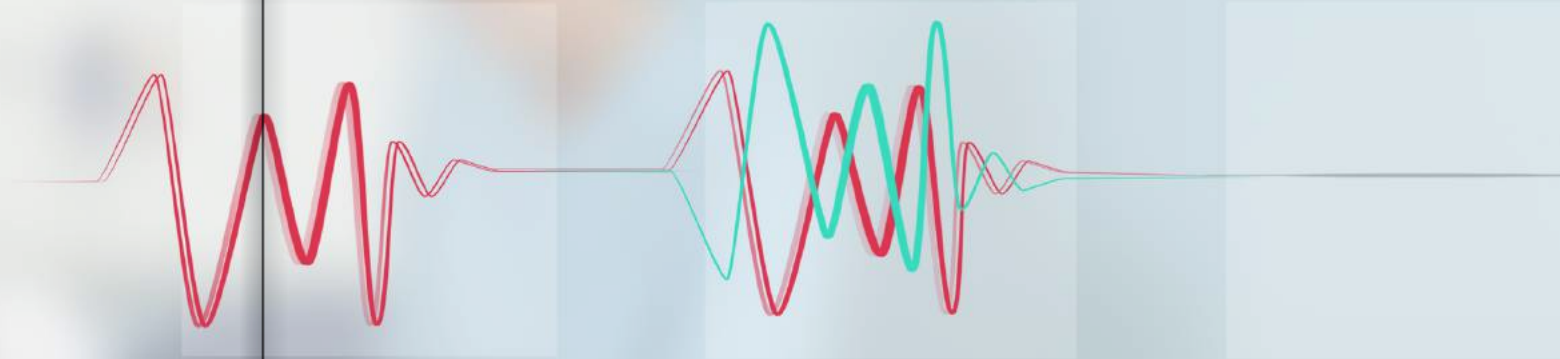
CONSIDERING	REQUIREMENT	WISH
NOISE	NOISE REDUCTION	NOISE CANCELLATION
	IMPROVEMENT FOR NURSE	IMPROVEMENT FOR NURSE AND PATIENT/FAMILY
	SHORT TERM SOLUTION - 2 YEARS	SHORT TERM SOLUTION - NOW
USE	EASY TO USE	
	EASY TO IMPLEMENT	
		USABLE IN ANY ICU
	MINOR CHANGE IN NURSES ROUTINE	NO CHANGE IN NURSES ROUTINE
	USABLE IN ALL ICU SITUATIONS	
	CLEANABLE	EASY TO CLEAN
		USABLE IN OTHER HOSPITAL-RELATED LOCATIONS/WARDS
COST	LOW DEVELOPMENT COSTS	
	REASONABLE COST/LIFESPAN RATIO	
MISCELLANEOUS	STAY WITHIN LEGISLATION	
	NOT TO SLOW DOWN INTERNATIONAL NOISE REDUCTION DEVELOPMENTS	SPEED UP INTERNATIONAL NOISE REDUCTION DEVELOPMENTS
		SMART OPTIONS

NOISE

NOISE CANCELLING

THE NOISE CANCELLING ADD-ON (HUSH)

This is the first of the three concepts and is based on the first source of alarm problems: the bedside machines. It is the absolute source of noise problems. Later this chapter, it will show why it is chosen as the best concept. The 'noise-cancellation' part of HUSH is changed into a future product-version, because of costs, development concerns and time matters.





MONITOR THE ALARMS

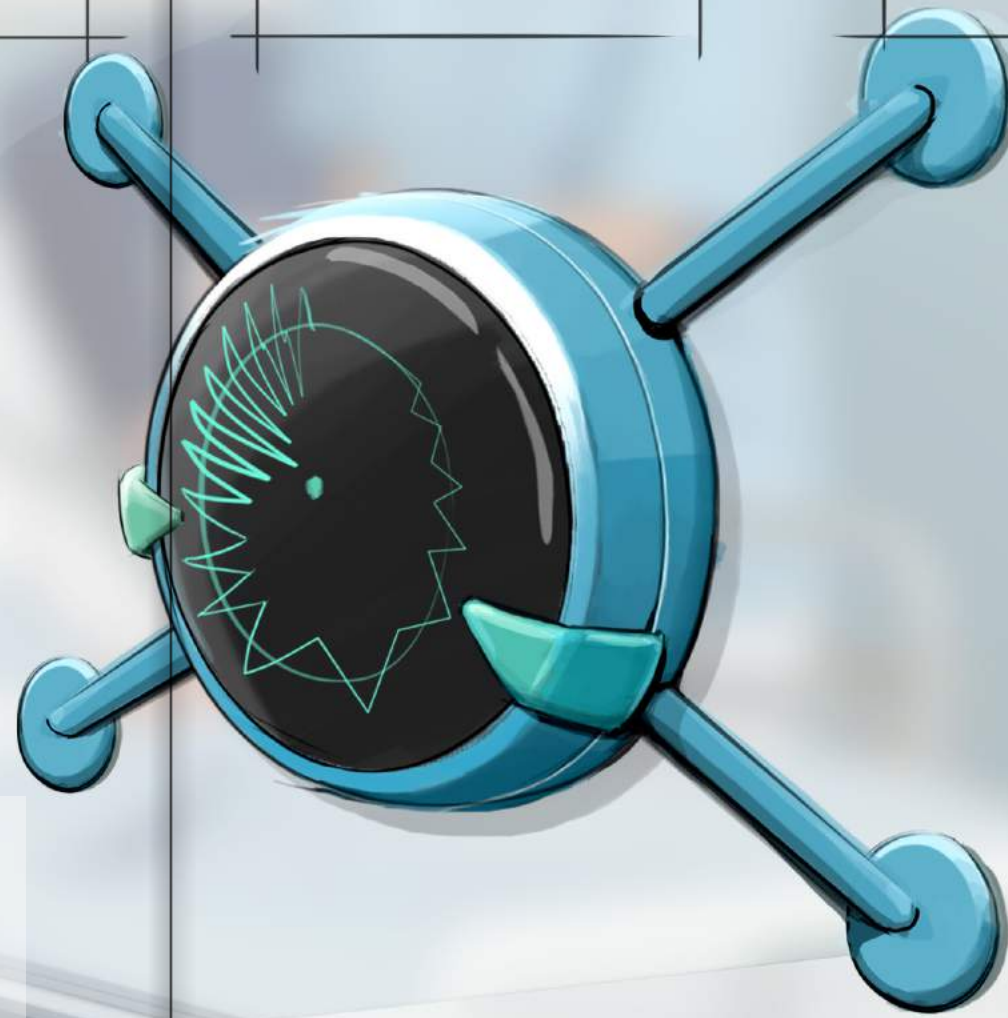
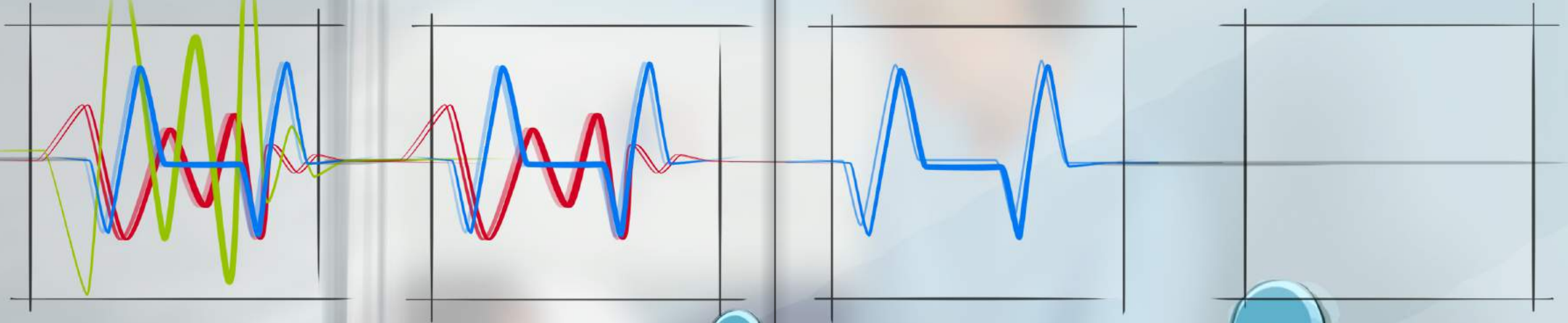


THE SMART MONITOR

This concept is based on the second source of alarm problems: the central monitors. The problem with these monitors is that they are not smart. They do not show what is wrong when it rings an alarm, they do not distinguish between critical alarms and insignificant ones. Neither does it allow for remotely turning of the alarms inside the ICU.

CHOOSE THE FREQUENCY

HEAR PREFERRED SOUNDS ONLY



THE NOISE FILTER

This concept is based on the third source of alarm problems: the noise travelling through windows. As mentioned before, the ICU windows are not soundproof, since the voice of the patient should be heard through the window. The Noise Filter however, filters out only certain sound frequencies of the nurses preference, while ensuring that the patient can still be heard.

EVALUATION

This paragraph elaborates on the pro's and cons of the three concepts. On the next page, a related evaluation considering to the Program of Recommendations can be found.

SMART MONITOR

To redesign the current monitors into a smart monitor requires access to information of the machines. After a meeting with Erasmus hospitals technical physician, it was made clear that getting access information will prove to be rather difficult. Next to that, the new Intensive Care department designs will be incorporated with new monitors. It is not yet clear how smart these new monitors will be, but they might be smart enough to not need extra redesigning. This concept is not elaborated upon because of the difficulties above, and because it would concern the engineering of a computer system, instead of a product.

However, it should be noted that in general, monitors like these do need redesigning. If the monitors would be smart enough to determine the criticality of an alarm, to show the needed information and give control over the sounds and machines, many ICU related problems would be solved.

THE SOUND FILTERER

Developing a product that filters out certain sound frequencies, will require quite some research and engineering. Perhaps, this could be done in collaboration with a company working on a similar subject.

There are two projects in the making that are similar to The Sound Filter: Muzo¹ and Sono² (names are not related to each other). Unfortunately, these products are not yet past the prototyping stage. So the question remains whether it even works at all. According to Erasmus technical physician though, it is extra interesting because it could also dampen sounds from outside (fifth sound source), which would be beneficial for patients.

As interesting as the product may be, developing it will likely be expensive and time consuming. And moreover; every window in the ICU ward would need one.

THE NOISE CANCELLING ADD-ON (HUSH)

Most pro's of HUSH have been mentioned in earlier chapters. To shortly sum them up: It's cheap, easy to use and gives a 'voice' to the user. The downside of HUSH is that it is not exactly clear how well it dampens sound, although user reviews sound promising. Chapter 5 will contain more information on HUSH.

¹ Celestial Tribe. (n.d.). Muzo - Your Personal Zone Creator with Noise Blocking Tech. Retrieved January 10, 2017, from <https://www.kickstarter.com/projects/1280803647/muzo-your-personal-zone-creator-with-noise-blockin>

² Stefanich, R. (2013, October 25). Sono: noise cancellation for your windows. Retrieved January 12, 2017, from <http://www.digitaltrends.com/home/sono-noise-cancellation-windows/>

CONSIDERING	REQUIREMENT	WISH		HUSH	MONITOR	FILTER
NOISE	NOISE REDUCTION	NOISE CANCELLATION		XX	XX	XX
	IMPROVEMENT FOR NURSE	IMPROVEMENT FOR NURSE AND PATIENT/FAMILY		XX	XX	X0
	SHORT TERM SOLUTION - 2 YEARS	SHORT TERM SOLUTION - NOW		XX	X0	X0
USE	EASY TO USE			X	X	X
	EASY TO IMPLEMENT			X	0	X
		USABLE IN ANY ICU		X	0	X
	MINOR CHANGE IN NURSES ROUTINE	NO CHANGE IN NURSES ROUTINE		XX	X0	X0
	USABLE IN ALL ICU SITUATIONS			X	X	X
	CLEANABLE	EASY TO CLEAN		X	X	X
		USABLE IN OTHER HOSPITAL- RELATED LOCATIONS/WARDS		X	X	X
COST	LOW DEVELOPMENT COSTS			X	-	0
	REASONABLE COST/LIFESPAN RATIO			X	X	-
MISCELLANEOUS	STAY WITHIN LEGISLATION			X	-	X
	NOT TO SLOW DOWN INTERNATIONAL NOISE REDUCTION DEVELOPMENTS	SPEED UP INTERNATIONAL NOISE REDUCTION DEVELOPMENTS		XX	X-	--
		SMART OPTIONS		0	X	X

LEGEND	
ENTRY	MEANING
X	yes
0	no
-	unsure
1st symbol:	requirement
2nd symbol:	wish

CHAPTER 5

HUSH



MEANING

HUSH influences the meaning of an ICU, and has a meaning of its own. This paragraph explains the current ICU meaning, how this is changed by HUSH, and what additional meaning it brings.

INTERPRETATIONS OF SOUND

Sounds and their meaning and can greatly influence nurses and patients mental well-being. Each time an alarm rings, it creates a meaning of 'something being very wrong with the patient'. This affects patient, nurse and family in a negative way. While often enough, this is not the correct meaning of the alarm and only nurses know there is no need to worry.

There seems to be an appeal that "when devices alarm, people respond". However, finding reports of nurses not responding to alarms, legislations were made to set alarms even louder, more difficult to ignore, and more disruptive. In fact, auditory alarms are still being used as a way to solve problems such as decreases in nurse-patient ratio and building-layout defects⁹.

The alarm-related meaning of 'something being very wrong with the patient'. Does not need to be screamed to patient and family. Especially not when the same disruptive alarm is already cried to the nurses.

An ICU should be a place for rest and recovery. A place that helps decrease nurses and patients' stress level - and not increase it. It is worrisome how deeply-rooted the international interpretation of sound is. It is the interpretation that alarms should not be changed,

because this is the way it has always been. Nurses do not seem to have a say in this. Not until now.

MEANING OF HUSH

As stated: HUSH gives back power to the nurse. This can mean a great deal, for legislation had taken it away. HUSH changes the meaning of the ICU in two ways: Firstly, less sound means a calm ICU. Secondly the image of colourful HUSH add-ons shows the hospital's discontent with current alarm systems. It is a silent protest.

This protest however, can change the meaning of the hospital again from a calm hospital, into a protesting one. Although this can have an adverse affect on the hospitals ambience, it does make the ICU more quiet and it is only a subtle -but strong- protest. As the quote inside the cover page reads: "It takes some silence to make sound".

PACKAGING

Because of HUSH's meaning, the way it is presented is important. But, there's a fine line between being disruptive and disturbing. The colour and shape are chosen to stand out, without looking too alarming.

Much thought has gone into the packaging as it increases its meaning, and may help convince hospitals to actually use it. An important message it should convey to nurses is that it is easy to use.

The packaging is simple, as is the product. A short instruction note explains how it is used. The note continues to say that if even this doesn't work anymore, one could wear it on its head until lawmakers find their saneness back. Of course, this merely meant as a provocation: The items are not suitable or made for wearing it as a hearing protector. It does however, add to the product's meaning.



TECHNOLOGY

The original hush is made of putty only, with a layer of film. However, later versions will incorporate noise cancellation technology.

This technology is still in its infancy. However, as research shows; the noise cancellation market is developing quickly. It will not take long until not only ambient noises can be cancelled out, but abrupt sounds -such as alarms- too¹.

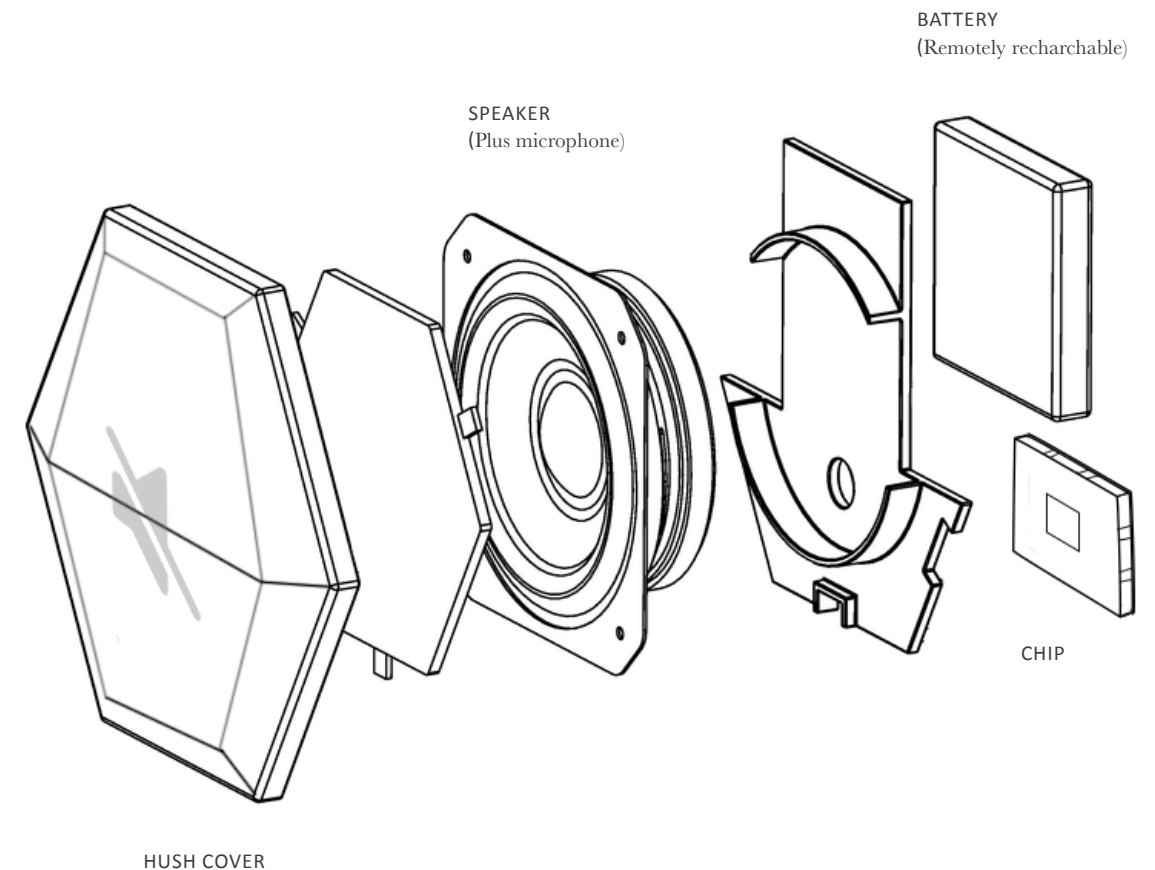
Very few information has been made available for designing noise cancellation equipment. The line-drawing on the right has been made as an indication of what a noise-cancelling HUSH may consist of. The drawing is based on actual speaker designs. It is assumed that noise-cancellation technology will be commonly available material in the near future, and incorporated in many consumer devices².

The sound dampening putty of HUSH itself is a product of QuietRock³. It sticks to almost any material, it is non-corrosive to metal and plastics, it will not dry out and is fireproof.

¹ Semuels, A. (2016, April). The Future Will Be Quiet. Retrieved December 02, 2017, from <https://www.theatlantic.com/magazine/archive/2016/04/the-future-will-be-quiet/471489/>

² Euronews. (2015, May 08). New noise cancellation technology. Retrieved December 12, 2017, from <http://www.euronews.com/2013/05/08/new-noise-cancellation-technology>

³ www.quietrock.com. Retrieved Februari 1, 2017.



COSTS

The next page shows a costing calculations sheet for 3 ordering quantities: 50 pieces [enough for testing], 200 pieces [enough for small scale implementation] and 2000 pieces [enough for full implementation]. References for cost estimations are listed below:

Putty (clay substance):

<http://www.atsacoustics.com/quietputty.html>
<https://www.amazon.com/QuietPutty-Acoustical-Pads-Putty/dp/B004ZG422W>

Putty cover (foil)

<http://store.ampaonlineuk.co.uk/Tubular-Rollstock-P406.aspx>

Box filling (for 3 pieces)

<http://www.ecplastictrays.com/custom-plastic-trays/>
<http://us.battlefoam.com/custom-custom-battle-foam-large-foam-tray-bfl/>

Box (customised, for 3 pieces)

<https://www.aliexpress.com/item/corrugated-fiberboard-packaging-decorative-wooden-gift-boxes-Customized-packaging-box-for-perfume-bottles-DH13437/32772731409.html?spm=2114.40010508.4.32.iOUKv7>

<https://www.aliexpress.com/item/50PCS-Lot-Free-Shipping-Gift-box-Retail-Black-Kraft-Paper-Drawer-Box-Gift-Craft-Power-Bank/32524022605.html?spm=2114.10010108.1000014.5.rqavVb&scm=1007.13338.50051.0&pvid=6d3a51e3-d2e4-4a01-ad6e-824a67522940&tpp=1>

<https://www.aliexpress.com/item/customized-packaging-wholesale-trinket-box-UV-Protected-colorful-printed-packing-box-gift-boxes-with-windows-DH13638/32785207301.html?spm=2114.10010108.1000013.53.eaHDw6&scm=1007.13339.33317.0&pvid=acffe394-9ec0-4f27-922d-b04916cf711&tpp=1>

Instruction card

<http://www.kontrastdelft.nl/visitekaartje.php#prijstablink>

Charger (wireless)

https://www.alibaba.com/product-detail/Hot-sell-qi-wireless-charger-receiver_60366387507.html?spm=a2700.7724838.0.0.rP6RMG

Wireless chargers are in the rise, though most of them can only charge from a small distance, it is estimated that in a few years remote charging systems will be the new standard.¹

Noise cancellation (materials)

Estimation based on costs of speakers, batteries and relevant chips. For estimation it is assumed that materials will become somewhat cheaper and more widely available.

Noise canceller (engineering)

Educated estimation.

Hour wages (packaging)

Educated estimation.

Hour wages (marketing)

Educated estimation.

Unforeseen costs

Estimation.

¹ Goh, M. (2016, June 08). State of Wireless Charging - The Present and the Future. Retrieved January 21, 2017, from <https://www.chargespot.com/news/state-of-wireless-charging-the-present-and-the-future/>

COSTING CALCULATION SHEET - HUSH

Amount Cost & Cost per piece	50 pieces		200 pieces		2000 pieces	
	Cost	Cost pp	Cost	Cost pp	Cost	Cost pp
Putty (clay substance)	€ 65,00	€ 1,30	€ 260,00	€ 1,30	€ 5.200,00	€ 1,30
Putty cover (foil)	€ 120,00	€ 2,40	€ 120,00	€ 0,60	€ 120,00	€ 0,06
Headpiece (bent aluminium)	€ 25,00	€ 0,50	€ 30,00	€ 0,15	€ 40,00	€ 0,02
Box filling (for 3 pieces)	€ 100,00	€ 0,66	€ 150,00	€ 0,25	€ 200,00	€ 0,03
Box (customised, for 3 pieces)	€ 80,00	€ 0,54	€ 200,00	€ 0,33	€ 470,00	€ 0,08
Instruction card	€ 20,00	€ 0,40	€ 23,00	€ 0,12	€ 63,00	€ 0,03
Charger (wireless)	€ 80,00	€ 1,60	€ 280,00	€ 1,40	€ 2.400,00	€ 1,20
Noise canceller (materials)	€ 1.000,00	€ 20,00	€ 1.600,00	€ 8,00	€ 1.800,00	€ 0,90
Noise canceller (engineering)	€ 2.000,00	€ 40,00	€ 2.000,00	€ 10,00	€ 2.000,00	€ 1,00
Hour wages (packaging)	€ 30,00	€ 0,60	€ 120,00	€ 0,60	€ 1.200,00	€ 0,60
Hour wages (marketing)	€ 300,00	€ 6,00	€ 600,00	€ 3,00	€ 1.000,00	€ 0,50
Unforeseen costs	€ 200,00	€ 4,00	€ 300,00	€ 1,50	€ 600,00	€ 0,30
Price with noise canceller	€ 4.020,00	€ 78,00	€ 5.683,00	€ 27,25	€ 15.093,00	€ 6,02
Price without noise canceller	€ 940,00	€ 16,40	€ 1.803,00	€ 7,85	€ 8.893,00	€ 2,92

CHAPTER 6

CONCLUSION



USER EVALUATION

As part of this project, ergonomic testing and user evaluation was encouraged. For this particular concept, cognitive ergonomics proved to be most relevant. That is why the perceived meaning and the user's response to the final product were put to the test.

APPROACH

The original plan was to travel to Erasmus MC and document nurses' response to the prototyped product and its packaging. Due to imperfect prototyping, this turned out to be an unacceptable method. A big part of HUSH's meaning is derived from its appearance. As the image of the prototype on the right page demonstrates; this meaning would have been conveyed somewhat clumsily.

Therefore, emails were sent to acquaint nurses and other hospital employees to get a general impression on HUSH's perceived meaning.

USER FEEDBACK

These opinions were expressed most by respondents:

"The design looks nice", "[the packaging] looks like a gift", "If it works, I would use it", "I would use it even if it doesn't work", "Can I use it for home appliances?", "It seems easy", "I don't think noise cancellation works on alarms" and "It is a clear message".



DISCUSSION

This final discussion provides some thoughts, conclusions and advice from the designer.

NOVEL AND NEW

HUSH is a notably simple product. A self-evident design that does not exist yet. The short term version is both uncreative and innovative. Uncreative in its essence, but innovative in its purpose. Its reason of existence can not be compared to available products on the market. Hush is therefore unique.

USEFUL AND USABLE

The problem-description stated that there are too many too loudly noises in the ICU. The vision was to provide a short-term solution that closes the noise-gap and speeds up the process too. The solution qualifies. However; it should be stated that it is unsure to what extend it qualifies. The sound-dampening properties are unclear and the impact of the enclosed statement has not yet proven itself.

Nonetheless, feedback has been fairly positive and has shown that the designed message is received in the intended way.

From a costs point of view HUSH is a legitimate option. The version without noise cancellation is reasonably priced and transpires an optimistic business case. In which the positive prospect of change can provide an extra valuable incentive.

SENSE AND SYNTHESSES

All conclusions, statements and decisions have been based on extended research; partly form desk-research [quartile one included], partly interviews and partly information acquired through the development of the project. This reports view on 'meaning' has been developed though time and through these media. AEE, DCS and TCD are sought to be included in a harmonized way to make this report a logical whole.

DESIGN AND DECISIONS

Decisions have been made in relation to the subjects of

Vision	Function
Concept	Meaning
Appearance	Packaging

As many of these decisions as possible have been attempted to be explained, without causing a tedious and long-winded report. Perhaps some design decisions are missing [such as appearance]. If so, explanation is most likely left out because it was based on: Insights gathered throughout the past months, 'gut-feeling', common logic or expert advice.

RECOMMENDATIONS

Nonetheless, some confirmations of choice are missing and future recommendations can be made considering this Silent ICU project.

First of all: Legislation infringements. Extended research has been done to find rules that forbid nurses to cover medical devices with clay substance. No regulations were found considering this matter. Yet, I

would recommend consultation with experts to prevent hospitals from being fined.

Secondly, most costs - such as engineering and marketing - have been estimated based on desk-research. However, having little experience regarding this matter, an extended cost analysis should be performed to lower risks. Marketing affairs should be investigated to maximize HUSH'S societal impact.

Thirdly, a small-scale test should be performed to rule out unforeseen problems. The product is meant to be used in an extremely critical environment. Though it is designed to be easy, harmless and non-intrusive, safety concerns should not be taken with a grain of salt.

LET'S MAKE IT BETTER, LET'S MAKE A SOUND
LET'S MAKE IT **HUSH**

