Design report

Alexander Abele

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01 Introduction

FLIR is the world‘s largest commercial company of thermal imaging cameras.

FLIR Systems, designs, develops, manufactures, markets, and distributes technologies that enhance perception and awareness. We bring innovative sensing solutions into daily life through our thermal imaging systems, visible-light imaging systems, locator systems, measurement and diagnostic systems, and advanced threat detection systems. Our products improve the way people interact with the world around them, enhance public safety and well-being, increase energy efficiency, and enable healthy and entertained communities. [1]

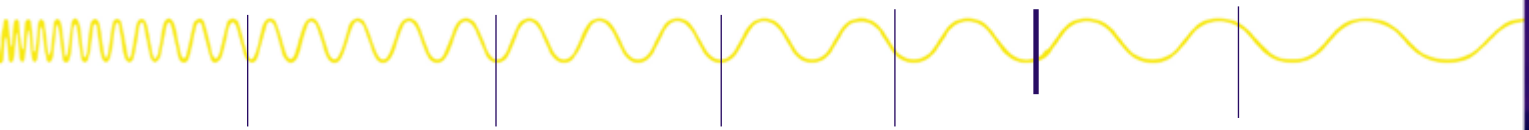
The company was etabslished in 1978 and started with high performance, low cost infrared imaging systems for airborne applications. Later they introduced handheld systems for commercial applications to detect and measure temperature differences. Due to high demand and the opportunities this technology offers they invented a wide range of products and cut the costs. Today FLIR is able to provide tools for a volume market which makes them to the market leaders and operates in many locations around the globe. [2]

>> Strategic design

The challenge is to propose a new application for FLIR and design language for this - framed in a „Common Core“.

The goal of this course is to provide a project that explores and communicates the complexity of designing a product in today´s design identity, core values and desired customers.

What is infrared?



.01NM
Gamma Rays

10NM
X Rays

1000NM
Ultraviolet

.01CM
Visible light

~ .05CM
Infrared

1CM
Radio wave

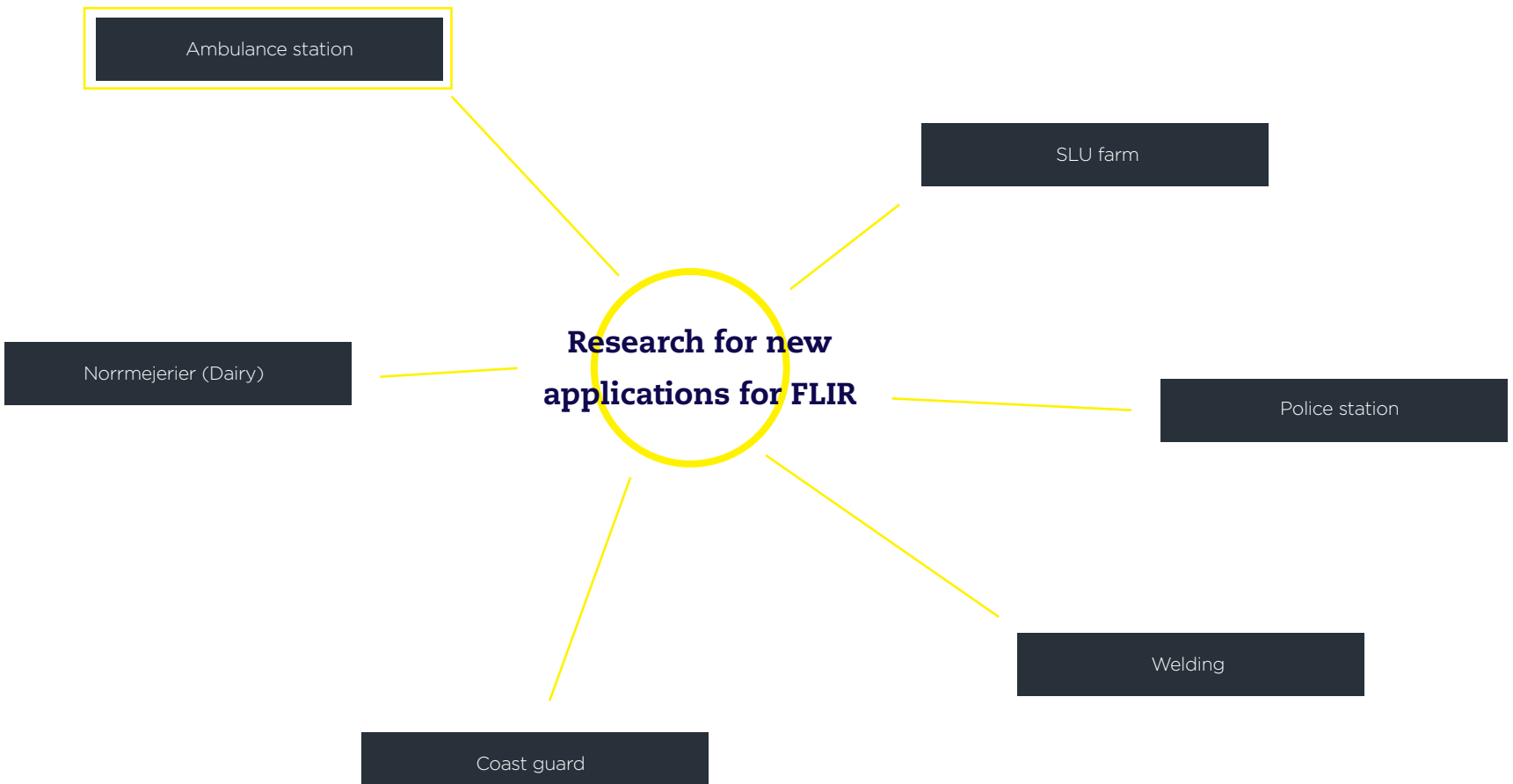
Normally, our vision is limited to a very small portion of the electromagnetic spectrum. Thermal energy has a much longer wavelength than visible light. So long, in fact, that the human eye can't even see it, just like we can't see radio waves. With thermal imaging, the portion of the spectrum we perceive is dramatically expanded, helping us „see" and „measure" thermal energy emitted from an object. Unlike visible light, in the infrared world, everything with a temperature above absolute zero emits heat. Even very cold objects, like ice cubes, emit infrared.

And visible light doesn't affect the thermal world, so you can see equally well in highly lit and totally dark environments. An infrared camera is a non-contact device that detects infrared energy (heat) and converts it into an electronic signal, which is then processed to produce a thermal image or video, on which you can perform temperature calculations. [3]

02 Concept ideation

Ideation workshop with FLIR to find new application areas

The project started with a presentation from Flir about the history of the company and their product portfolio. We got also an introduction about the technology and what their systems can do or can´t do. With this informations we started several brainstorm rounds and ideated in many directions. Afterwards we clustered all ideas in groups and named new application areas. In smaller groups we did a further research in special directions and presented the results to the others. At the end we got interesting and promising insights for the field resarch in the next project phase.


Ambulance station
SLU farm
Norrmejerier (Dairy)
Research for new applications for FLIR
Police station
Welding
Coast guard

Moodboard

Handheld device

Stationary device

Design opportunities

Handheld device

A handheld device for the paramedics that support their work and help them to find invisible injuries. It could also help them to document emergencys and they can send important informations and pictures to the hospital. The surgery get directly an overview of the injured person and can make important preparations.

- Vein detection and inject support
- See the invisible and get an overview

Stationary device

Different medical areas have their own needs. One idea could be to design a specialised system for them (Dermatologist, dentist, orthopaedist etc.). The second idea is to find similar needs and design an add on device they can use on their existing systems.

- Operation lamp with a Flir camera
- Add on device for existing systems

In public space

A big problem with breast cacer is, that the person comes often to late to the doctor when the problem is already there. To have a more often preliminary examination with an easy accessibility would improve the situation. It could be also useful for gyms where people can control their training success or to check injuries before going to a doctor.

- Get in contact with a doctor from a distance and tangible advices
- Reduce the waiting time in medical practices

Redesign a handheld device and adept it to the target group.

Adapt the product to the users‘ needs.

Which technology or feature is needed?

In emergency situations | doctors office | hospital?

First Concept

03 Concept development

Can a thermal heat camera support the paramedics?

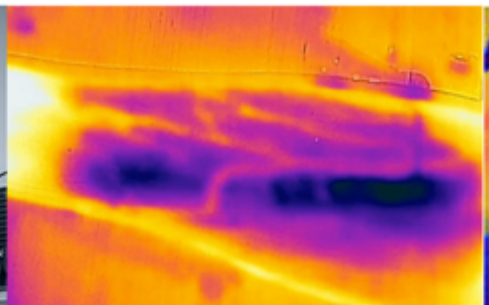
„With a life-threatening emergency, the survival of a victim often depends on professional medical help and their work experience.“

Ronny Friberg 2017

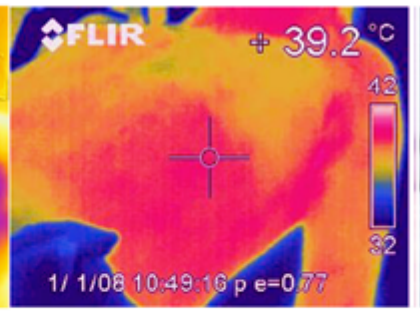
Where can a thermal heat camera support the paramedics?

From all field researches I was most inspired from the paramedics and theirs needs. I have a passion for medical design and I saw there a lot of opportunities not only for the ambulance station even more in several healtcare setiings.

From the ambulance station visit we learned a lot about their work routines and problem areas. In emergency sitations they have just little time to get an overview from the patient and which injuries they have to treat before they arrive at the hospital. Their job is especially to bring the patient as fast as possible to the hospital and collect as many informations as possible for the ambulatory care.



Vein detection



Internal bleedings

Key facts:

- They have to get as much information as possible before reaching the hospital
- Stay as short as possible at the accident scene
- The main examinations will be done in the ambulance
- In emergency sitations it is important to give the patient injections
- Hypothermia is a serious problem in the nordic countries.
- Experience is important to for the paramedics to get a quick overview about what injuries the person got and how they can treat the patient

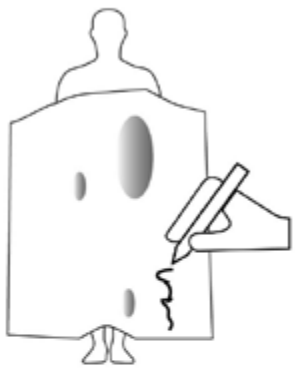
detection of veins

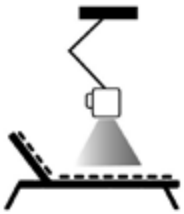
localise pain

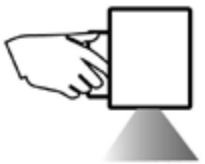
internal bleedings

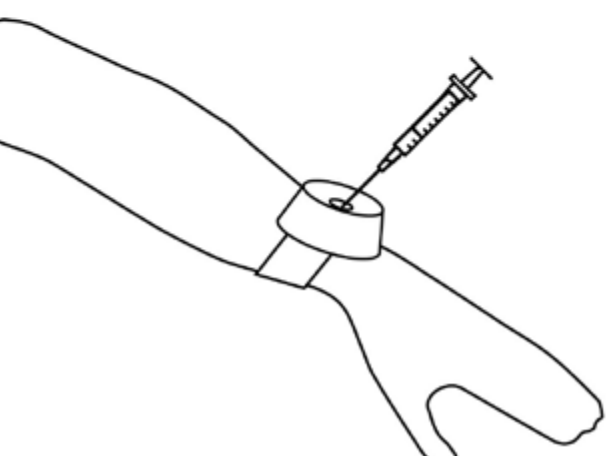
localise bone fractures

get a quick overview



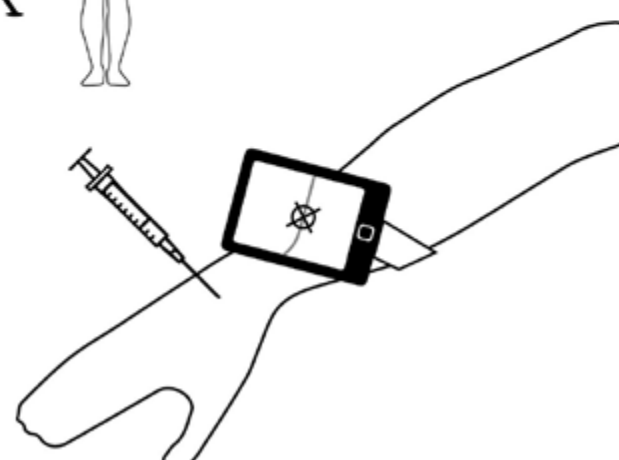






- a thermal imaging camera device that can support the paramedics in emergency sitautions
- adapted to their usage and environment
- a handheld product with a simple handling for emergency applications
- it should help them to get a better overview of the injured person
- a support to document the situation and the possibility to sent important information to the hospital

- to find reasonable application scenarios not only for the paramedics
- to adapt a handheld tool that can also be used in doctor offices or hospitals
- to include more functions that makes the product versatile and popular
- create a marketing campain and user scenarios for a better spreading
- to design reasonable add ons for the device for better usabilities



Thermal heat cameras could be a big thing in healthcare settings. There are a lot of tests and researchers to find areas where the technology is helpful and supportive.

A preliminary examination for breast cancer is one of the biggest opportunites the technology can provide and the first medical practices using it. But there are no adepted products on the market and people working with selfmade prototypes. Incorrect information about what the technology can or can´t do is a problem to move forward. Furthermore the majority haven´t heart about this technology and therefore the products on the market haven´t been successful so far.

Infrared Imaging for Emergency Medical Services (Surgical and Mechanical Departments of Parana Federal University

STROKES

Stroke is the third leading cause of death in America and the No.1 cause of adult disability. Many strokes are preventable and treatable with prompt medical attention. The cutaneous vessels of the medial forehead, medial canthus and supraorbital ridge are branches of the internal carotid artery. Under normal circumstances, there is a remarkable symmetry in the heat patterns from these regions. However, when the lumen of the internal carotid artery is significantly compromised, blood flow through these terminal branches is reduced and cooling of the forehead on the side of the lesion can be detected. Associated with unilateral body IR hyporadiation, as it can be see above, it confirmed the acute carotid occlusion.

Thermography had its greatest use in detecting carotid occlusive disease among a group of high-risk, asymptomatic patients. Such patients include those with hypertension, diabetes and hyperlipidemia. Thermography was helpful to the physician to better interpret early the symptoms of cerebrovascular insufficiency making a quickly triage and assistance.

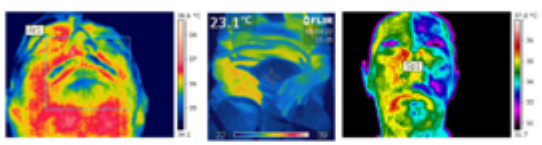


Figure 12. IR images show cerebrovascular insufficiency indicating early symptoms of carotid occlusive disease. Left is thermal asymmetry in the face, center asymmetry in arms and hands and right another facial thermal asymmetry.

MIGRAINE

"Cold patches" in the front head region (carotid territory) are associated with vascular-related headaches. The vascular "cold patch" must be included as a diagnostic aid to vascular headache. Too frequently the diagnosis of headache has been subjective and treatment has failed because some subtle secondary vascular component has been missed. For example, scalp muscle contraction headaches have been treated without success until a vascular component has been considered. With the inclusion of thermographically isolated "cold patches," these omissions can more often be avoided.

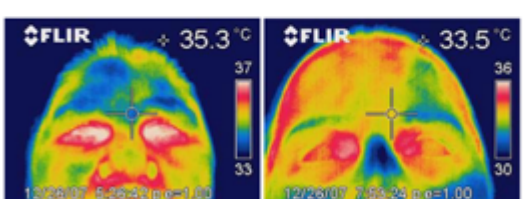


Figure 13. IR images of forehead show vascular cold patches indicating vascular headache.

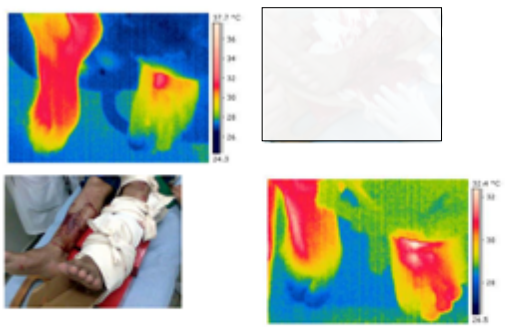


Figure 9. Top left IR image shows low blood flow to the left foot due to tibia fracture. On repositioning the fracture normal perfusion is restored and the left foot becomes warmer than the right due to inflammatory process as shown in the lower right IR image.

PEDIATRIC EMERGENCY

Hypothermia is associated with increased mortality and morbidity, with a dramatic decrease in survival at core temperatures below 34 °C. Almost two thirds of trauma patients had a core temperature of less than 36 °C. Trauma in itself, as well as bleeding with tissue hypoperfusion, alters thermoregulation and results in hypothermia. Some of the preventable factors that contribute to the high incidence of hypothermia in the trauma population are prolonged exposure in the field and administration of cold intravenous fluids. Hypothermia, together with acidosis and coagulopathy, has been identified as a component of the "lethal triad" in injured patients. Figure 10 shows monitoring by infrared imaging a hospital transference of a newborn to a pediatric intensive care. The newborn maintained his temperature during the transference.

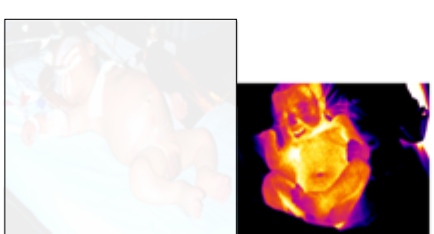


Figure 10. Normal IR image of a monitored newborn undergoing hospital transfer.

DISASTER PLANNING

A disaster occurs somewhere in the world almost daily. A recent group of disasters, starting with the September 11th terrorist attacks and continuing through the tsunami affecting countries throughout the Indian Ocean, the South Asia earthquake in Pakistan, and the 2005 Gulf Coast hurricanes have focused people's attention upon this topic.

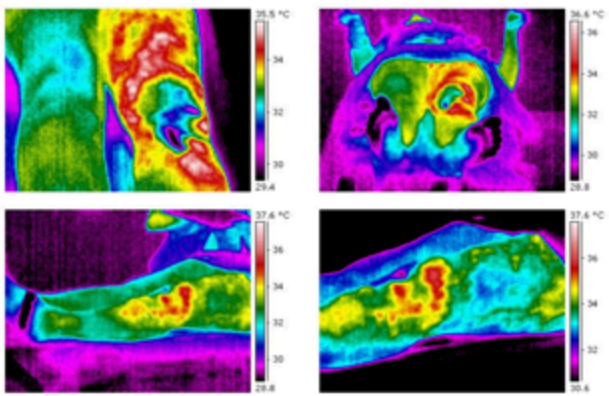


Figure 7. IR images of left distal femur fracture showing increased local temperature.

g) Spinal cord trauma

Patients with severe high level spinal cord injuries present hot lower body extremities at trauma scene due to the massive vasodilatation occurring below the level of the injury which is attributed to a quickly decreased level of sympathetic activity. High spinal cord injury impairs thermoregulation because it disconnects the thoracic cord from central thermoregulatory centers thus preventing central control of cutaneous blood flow, sweating, piloerection and shivering. Above we documented a cervical trauma caused by diving into shallow sea water. This is the major cause of spinal cord trauma. He was attended at the beach.

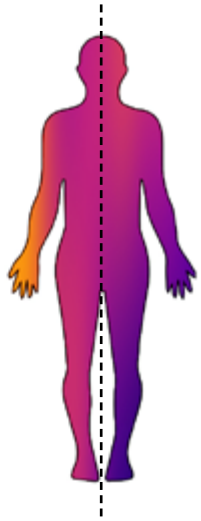
Figure 8. IR images show abnormal heating of lower extremities due to spinal cord injury.

h) Vascular trauma

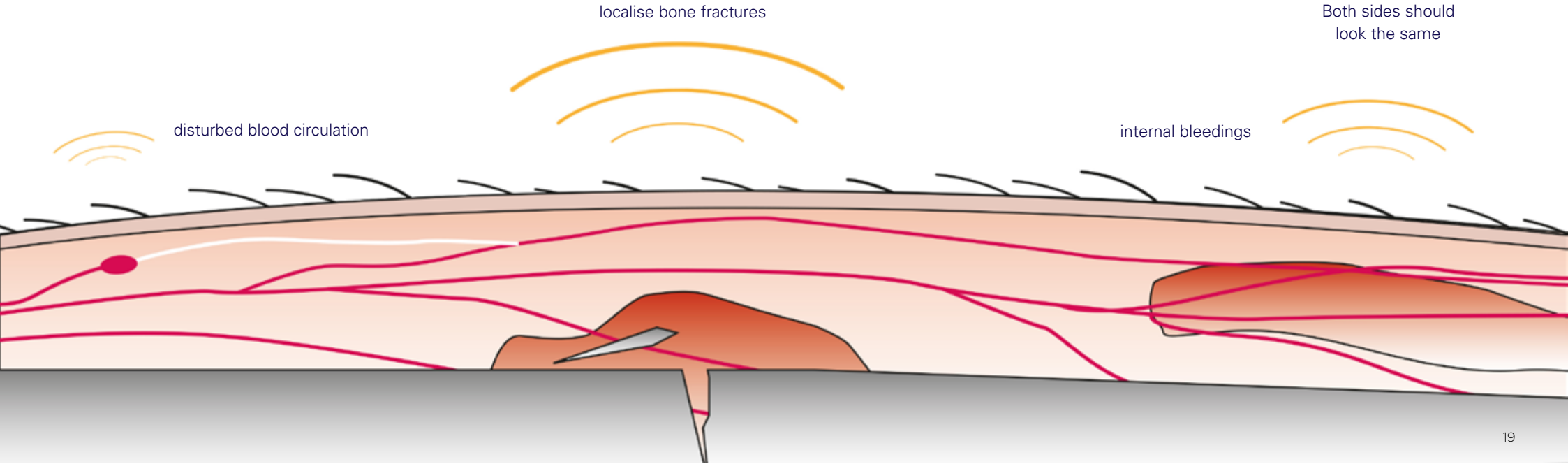
Diminished or absent pulse is not a sensitive prognostic sign, as up to 25% of patients with major vascular injuries requiring repair have normal pulses distal to the injury. In this case infrared imaging helped identify foot low perfusion after tibia fracture although there was a palpable dorsal foot artery pulse as seen on the image as a hot spot at its topography. After fracture stabilization by repositioning, the flux return to normal and the foot becomes warm with a good perfusion. Because the inflammatory process of the fracture, its blood flow is greater than the non-injured contralateral foot.

The skin has the information and the infrared camera can tell the story what is happening.

detection of veins
localise pain
internal bleedings
localise bone fractures
chronic inflammation
disturbed blood circulation
stroke diagnosis
overview in extreme situations



Both sides should look the same



Paramedics

Pär Lindgren
Johan Anderbom

Emergency doctor

Dr. Caroline Grupp

Trainee

Maren Balle

1

„A flexible use in different situations is important. A combinantion of vein detection and thermal imaging in a small device would be perfect“

1

„The product has to be easy to clean and waterproof. A black color is not useful because we can´t see dirt and blood on the device.“

1

„Only a picture that shows the problem and remove all other information“
- to much information is not apreciated
- is it life-threatening or not? Can the hospital prepare something?

1

„We really wanna have free hands because there are only two paramedics and a lot of stuff to do in a short time.“

2

„Is it a blood disorder or an internal bleeding, that´s important to know for the treatment with medications“

2

„Easy to carry and a quick availability - the tool would be a good and helpful tool for many situations.“

2

„I think a screen is important to do the diagnose because every situation and patient is different“

3

„There is a need for paramedics to get a better and faster diagnosis (ultrasonic device, iPad...)“

3

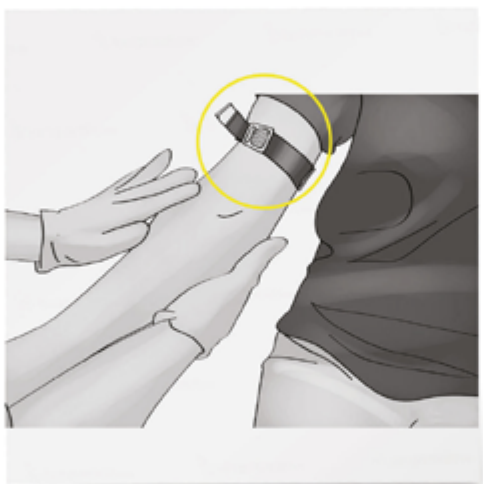
„To take pictures from the patient and the accident is helpful for the documentation“

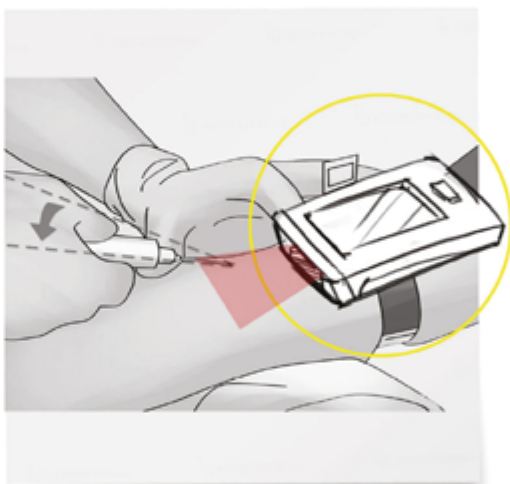
Infrared light is a simple and strong technique to find veins.

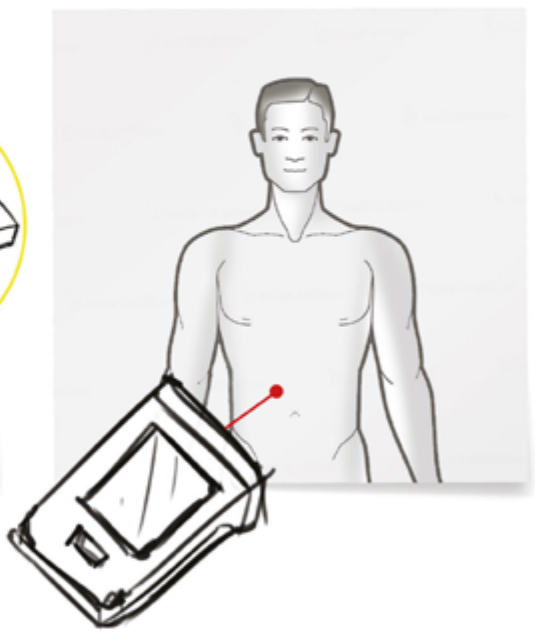
Penetrates skin up to 10 mm,
the reflection of the vein is visible.

Infrared light
small and handy

Infrared light + cameras, sensors
to big and bulky







Innovativ

Traditional

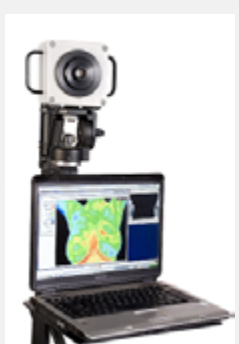
Extreme

There is no product on the market for a medical application area. The general products are not specialised for this target group.

New product

A specialised product for the new target group. The intelligence software is innovative and extreme in this market area.

Known from the first video cameras



Known but specialised for a professional usage

Known

HYGIENIC

RELIABLE

FLIR

The World's Sixth Sense™
in medical applications

INTELLIGENT


FLIR


FLIR


FLIR

Common Core
Surprise exercise

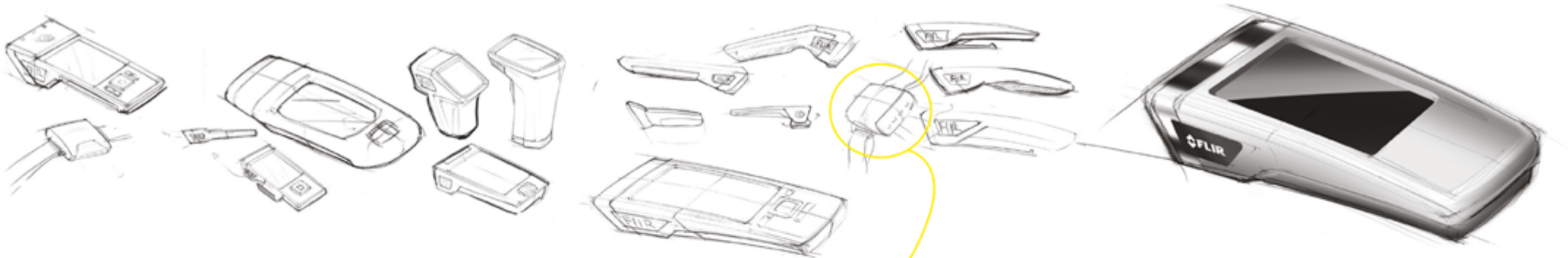
FLIR Scout II

Common Core
Surprise exercise

Belt buckle

04 Concept finalisation

Concept variation



① Portable all in one device

② Detachable part for vein detection

③ Bigger tablet (storable in a bag)

④ Small diagnose pen with connection to a screen

Design process

Sketches & mock ups


Thermal heat camera
Camera
Flashlight
Laser
ON/OFF
Home / photo
button
USB port


Infrared light LEDs
FLIR
FLIR

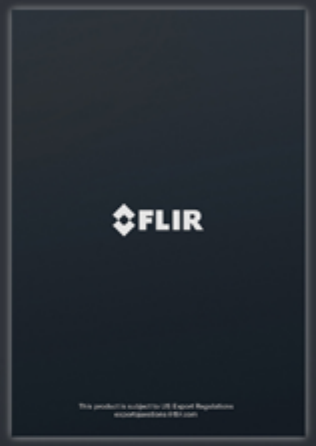
Thermal heat camera

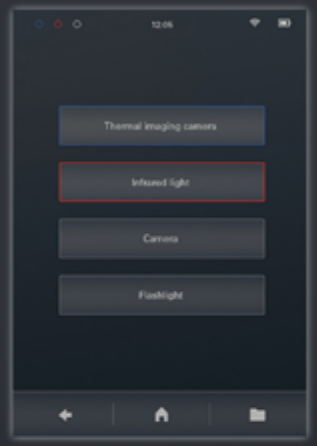
Vein detection

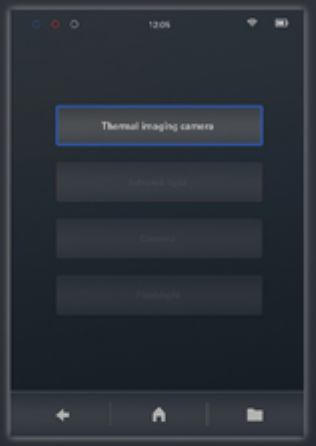

FLIR
HC 150


FLIR


FLIR


FLIR

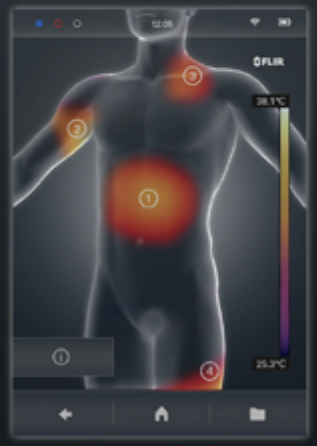

Thermal imaging camera
Infrared light
Camera
Flashlight


Thermal imaging camera


FLIR


FLIR


FLIR
Searching


FLIR


FLIR

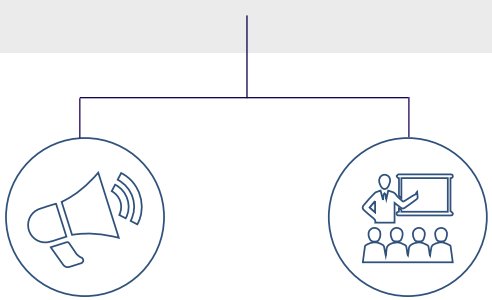

No.
Name
%
Internal bleeding
95
Bone fracture
80
Bone fracture
60
Bruise
95

FLIR | HC 150

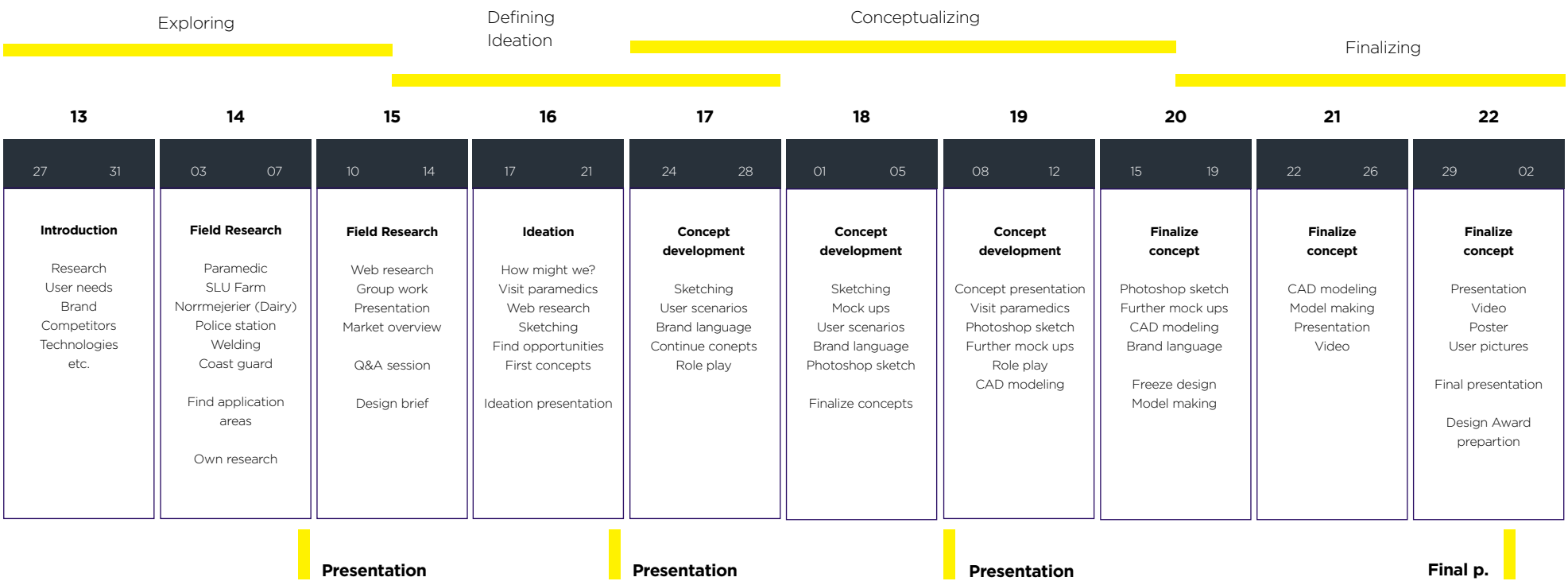
The skin has the information and the infrared camera can tell the story what is happening.

The FLIR Camera HC 150 is a supportive device for the paramedics in their application area. It is a combination of two main functions. The thermal heat camera helps the paramedics to find invisible injuries and to get a better diagnosis from the patient. It is important that they get as much information as possible before they arrive at the hospital. So, the hospital can prepare everything before they will arrive. For the documentation afterwards they can save or send pictures from the HC 150 to other devices. The second function are the infrared light LEDs in the front to find veins in emergency situations. When the blood pressure is low the veins collapse and without a support it is almost impossible to find them. This combination is specialist for the users' needs and the first of its kind.

Marketing strategy



Time table


Exploring
Defining
Ideation
Conceptualizing
Finalizing
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17 21
24 28
01 05
08 12
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22 26
29 02
Introduction
Research
User needs
Brand
Competitors
Technologies
etc.
Field Research
Paramedic
SLU Farm
Norrmejerier (Dairy)
Police station
Welding
Coast guard
Find application areas
Own research
Field Research
Web research
Group work
Presentation
Market overview
Q&A session
Design brief
Ideation
How might we?
Visit paramedics
Web research
Sketching
Find opportunities
First concepts
Ideation presentation
Concept development
Sketching
User scenarios
Brand language
Continue conepts
Role play
Concept development
Sketching
Mock ups
User scenarios
Brand language
Photoshop sketch
Finalize concepts
Concept development
Concept presentation
Visit paramedics
Photoshop sketch
Further mock ups
Role play
CAD modeling
Finalize concept
Photoshop sketch
Further mock ups
CAD modeling
Brand language
Freeze design
Model making
Finalize concept
CAD modeling
Model making
Presentation
Video
Finalize concept
Presentation
Video
Poster
User pictures
Final presentation
Design Award prepartion
Presentation
Presentation
Presentation
Final p.

References

>> Literature

[1] http://www.flir.com/aboutFLIR/

[2] http://www.flir.com/about/display/?id=55679

[3] http://www.flir.com/about/display/?id=41536

General research

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http://www.flir.com/science/content/?id=78846

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https://www.pass-thermal.co.uk/thermal-camera-applications-medical

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3292141/

http://www.flir.co.uk/cs/display/?id=62773

http://www.faim.org/medical-thermal-imaging-for-preventative-screening

>> Images

p. 3 http://www.flir.de/uploadedImages/Thermography_USA/Industries/ATS/Images/1344x784-Cooled-InSb-14um-Pitch-SC8300-pcb.jpg

http://www.vlg-energoaudit.ru/down.jpg

p. 4 http://www.ir.com.tw/upload/Image/T1K/FLIR-T1K-IR-Transformers-Under-Load.jpg

http://www.maxplumbing.com.au/wp-content/uploads/2016/08/flir-t640bx-steam.jpg

p. 5,7 Pictures from Pontus Edman, Lu Zheng

p. 8 https://static1.squarespace.com/static/51297e5de4b01fa6748bc904/t/5789b9972994ca114a580337/1468643748114/

p. 9 https://radiantmarketingaz.com/wp-content/uploads/2016/01/healthcare-social-media-e1420745864100.jpg

Moodboard pictures (p. 3-24) - Google, Pinterest

Umeå Institute of Design
The FLIR project
MFA Advanced Product Design

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