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Kunnskap for en bedre verden

Bacheloroppgave

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Multifunctional Humanoid Robot

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Dato: 24.05.16

Bachelor Thesis

NTNU
Kunnskap for en bedre verden

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Candidate(s):
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Abstract:

This thesis explores how to turn a robot into a multipurpose social robot. The robot will be used for education, exhibition displays and everyday socialization. To establish proof of concept for each of the methods, they will be tested in real applications with a limited size.

For education the hypothesis is if it is possible to have the robot perform one task beneficiary to students and teacher without decreasing academic value.

To test this hypothesis the robot holds a short lecture for fifth and sixth graders, and the attendants answers a questionnaire twice, both before and after the lecture. The improvement in answers is compared to a group who has a teacher giving a lecture with the exact same content. The result showed that the robot does not perform inferior to the teacher in improving knowledge and the robot consumed far less time to hold the lecture. The conclusion is that a short robot given lecture does not decrease academic value.

For exhibition the robot dances, moves and makes sounds to capture the attention of by passers, then let them try interactions in form of the robot tracking a red ball and the robot mimicking their movements via Kinect for Windows. If they are interested in working with robots or automation, the robot has a presentation about the automation engineering programme at NTNU Ålesund including admission requirements and deadlines. The conclusion is that the robot can be used to draw attention, which can be utilized to inform about engineering educations.

To test the hypothesis of the possibility to create a bond between a robot and a human, there was conducted a small scale vocal interaction experiment. The robot will create a user profile for each test subject, containing a profile image with a name tag, which is used to recognize the person in front of it. The experiment is split into two parts. Part one extracts keywords of importance from a series of questions during a dialogue between the robot and the test subject. Part two is a conversation tailored from the information gathered in part one, where the dialogue will be about the test subjects interests, age, activities and more. The result showed that in most cases the test subjects felt the robot knew them. Concluding with that the concept of a relation between huamn and robot with individual deviations.

All the functions is implemented in a user friendly graphical user interface made for controlling the robot.

Keywords: Social robot, educational robot, exhibition display robot

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Preface

This thesis is submitted for completion of the automation engineering bachelor degree at NTNU Ålesund (Norwegian university of science and technology Aalesund) for all three students. The work took place from January and lasted out May 2016.
The supervisors for the thesis are associate professor Girts Strazdins and associate professor Ibrahim A. Hameed. Employer is NTNU Ålesund, faculty of engineering and natural sciences.

This thesis is a chance for us to work with a fun research project before heading out into the working life.
A talking, dancing robot really speaks to our inner child, and what is better motivation than that?

> *In every real man a child is hidden that wants to play.*
> - Friedrich Nietzsche

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We would like to thank:

- Our supervisors Girts Strazdins and Ibrahim A. Hameed.

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  For letting us display the robot at the NTNU stand during Hype dataparty.

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  For taking time to participate in the long term interaction experiment.

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Except for our personal computers and the red ball, the equipment used is paid for by NTNU, and will continue in their ownership. No other sort of funding is given.
All software is used legally free of charge.

Table Of Contents

1 Abstract

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2 Terminology

Abbreviations

API Application Program Interface
IDE Integrated Development Environment
MVS Microsoft Visual Studios
FPS Frames Per Second
NLTK Natural Language Toolkit
NLP Natural Language Processing
GSR Google Speech Recognition
NCC Nao Control Center
GUI Graphical User Interface
CPU Central Processing Unit
cmd Command Line
SDK Software Development Kit

3 Introduction

When applying for the thesis project the description was as following:
"We would like to create a robot, which would interact with visitors at exhibitions. For example, a robot that can detect faces, turn towards them and give them a candy. Such a robot would be fun and attract more people, showing that we can do practical robots. You can come with your own ideas on how to make this interesting. We have different robot platforms available, waiting for you to make something interesting."

As entertainment and advertisement for the automation engineering and computer science programs at NTNU Ålesund, an industrial arm robot had been displayed at an exhibition going through a predetermined pattern. The feedback it produced from visitors suggested that interaction would be a lot more entertaining.

The original assignment, making a pure exhibition display robot were made to meet these suggestions drawing more attention to the engineering programmes. At this time NTNU Ålesund had no complete robot appropriate for this and building one were intended to be a part of the assignment.
Building a robot would have taken a lot of the projects time, so when the project started and the Nao robot was given as a recourse it freed a lot of time, so it was possible to focus on software development. Having more time available, the sub tasks of using robot in education and long term interaction were included by collaboration with the supervisors.

NTNU Ålesund has no previous studies with social robots, so even though there are a lot of completed studies with similar traits conducted by other faculties, this thesis should lay a foundation for getting NTNU Ålesund up to date on the international level in social robots studies.

3.1 Background

Robots have for a time been very important and useful in the industry. Over time the domain of the robots has increased remarkably. It also covers ground in the educational systems as well, where the robot is increasingly popular as a tool for educational purposes.

There have been conducted studies using intelligent robots interacting with children with autism as therapy. Tests shows improvements in basic social skills.(Robins et al., 2005).

Robots are also used as proxies for students to sick to attend class. A VGO offers this possibility. Students operate a mobile robot stationed at school from a computer at home, the robot is equipped with a camera, microphones and a display. Thus making it possible to interact with classmates and the teachers at school.(VGo, 2016).

There is positive response from children with robot aided tuition. That pupils are quite satisfied with robot aided education(Lee and Lee, 2008) And it enhances the pupils motivation(Lee et al., 2008). This is good background information, and its a good indicator that students are positively predisposed to robots.

Robots belong in class rooms because; keep up with technological development, good way to introduce programming to students, demystifies robot technology. As a bonus it might boost interest, and augment understanding in science, mathematics and programming. With exposure to robotic in an early age, it might be easier to adjust to the labor market of the future. With reports that suggests almost half of today's jobs will disappear (Elster and Larsen, 2015), and replaced by digital and automated technique.

This report will focus on the goal and hypothesises that is presented in the next subsection.

3.2 Goal and Hypothesises

Goal: The goal is to make a "proof of concept" for each of the 3 hypothesises, and end with a user friendly front end application utilizable by users and developers.

Hypothesises

1. May a humanoid robot be used successfully to draw attention to an engineering education at NTNU Ålesund?
2. Is it possible to use a robot in an educational purpose that is both beneficiary to both students and the teacher?
3. Is it possible to get the feeling that there is a relation between a robot and a person based on preliminary vocal interaction?

4 Theoretical Background

Google scholar is used as database for the articles.

4.1 Robots in education

According to "A pilot study of intelligent robot aided education."(Lee and Lee, 2008), students are highly satisfied with robot aided education. "r-Learning services for elementary school students with a teaching assistant robot."(Han and Kim, 2009) concludes that both the students and the teachers have some sort of preferred benefit by a robots presence.
Evolving on the idea that both student and teachers may prefer a robots assistance, and students already enjoying a robots interaction, the next step would be to prove that a robot does not actually decrease academic value.

4.2 Long term interaction with robots

According to "Building up child-robot relationship for therapeutic purposes: From initial attraction towards long-term social engagement."(Díaz et al., 2011), Nao should present more human skills (e.g. verbal and non verbal communication skills, motor competences and assertive tasks). A natural way to build on this conclusion is to use vocal interaction to try and create a bond between the robot and a human.

4.3 Data mining/information extraction

Data mining, also called knowledge discovery in databases, in computer science, the process of discovering interesting and useful patterns and relationships in large volumes of data. The field combines tools from statistics and artificial intelligence (such as neural networks and machine learning) with database management to analyze large digital collections, known as data sets. (Clifton(Encyclopædia-Britannica), 2016)

4.4 Application

4.4.1 Python

Python is an easy to learn, powerful programming language. It has efficient high-level data structures and a simple but effective approach to object-oriented programming. Python's elegant syntax and dynamic typing, together with its interpreted nature, make it an ideal language for scripting and rapid application development in many areas on most platforms.

The Python interpreter and the extensive standard library are freely available in source or binary form for all major platforms from the Python Web site, https://www.python.org/, and may be freely distributed. The same site also contains distributions of and pointers to many free third party Python modules, programs and tools, and additional documentation.

The Python interpreter is easily extended with new functions and data types implemented in C or C++ (or other languages callable from C). Python is also suitable as an extension language for customizable applications. (Python, 2016c)

4.4.2 Multithreading

Multitasking, the running of two or more programs (sets of instructions) in one computer at the same time. Multitasking is used to keep all of a computer's resources at work as much of the time as possible. (Encyclopædia-Britannica, 2016)
Multithreading is dividing programs/tasks into multiple data stream processes(threads) and concurrently processing them by the CPU.

4.4.3 Qt

Qt is a cross-platform application development framework for desktop, embedded and mobile. Supported Platforms include Linux, OS X, Windows, VxWorks, QNX, Android, iOS, BlackBerry, Sailfish OS and others. Qt is not a programming language by its own. It is a framework written in C++. (Qt, 2015)

4.4.4 Natural Language Toolkit

NLTK is a leading platform for building Python programs to work with human language data. It provides easy-to-use interfaces to over 50 corpora and lexical resources such as WordNet, along with a suite of text processing libraries for classification, tokenization, stemming, tagging, parsing, and semantic reasoning, wrappers for industrial-strength NLP libraries, and an active discussion forum. (Natural-Language-Toolkit, 2016)
NLTK is used for information extraction from natural language in digital sentences and text as databases.

4.5 Speech recognition

Speech recognition, the ability of devices to respond to spoken commands. Speech recognition enables hands-free control of various devices and equipment (a particular boon to many disabled persons), provides input to automatic translation, and creates print-ready dictation. (Zwass(Encyclopædia-Britannica), 2016)
Python has a Speech recognition API which is a *Library for performing speech recognition, with support for several engines and APIs, online and offline.* (Python, 2016b)

4.6 Face detection

Face detection is the recognition of human faces in digital pictures done by computing. Several companies develop face recognition software and market it as a product, including Cognitec, Ayonix, Looksery, Google and Omron.

4.7 NAO robot

Larger parts of the information about the Nao robot is derived from the Aldebaran Robotics website.

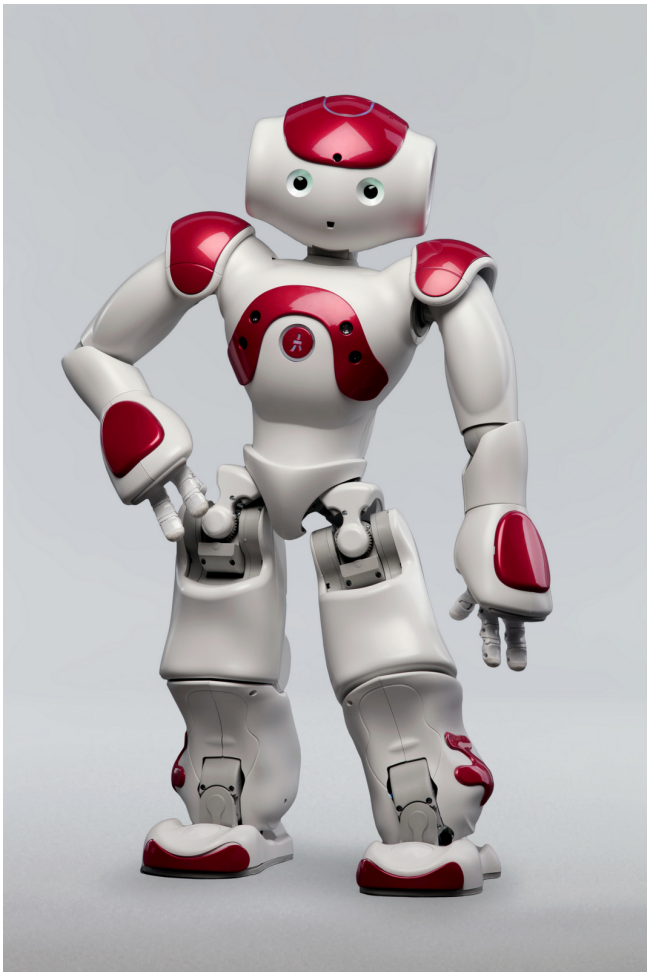

Figure 1: NAO

Nao is Aldebarans first humanoid robot. Nao was first introduced in 2006. Nao is standing tall at 58 cm and is under continuously development. NAO is currently on his 5th version. At this point there has been sold over 7,000 NAOs throughout the world. NAO is an endearing, interactive and personalizable robot companion. Everyone can construct his own experience with specific applications based on his own imagination and needs.(Aldebaran-Robotics, 2016c)

The fruit of a unique combination of mechanical engineering and software, NAO is a character made up of a multitude of sensors, motors and software piloted by a made-to-measure operating system: NAOqi OS.
NAO has seven senses for natural interaction:

Moving:

25 degrees of freedom and a humanoid shape that enable him to move and adapt to the world around him. His inertial unit enables him to maintain his balance and to know whether he is standing up or lying down.

Feeling:

The numerous sensors in his head, hands and feet, as well as his sonars, enable him to perceive his environment and get his bearings.

Hearing and speaking:

With his 4 directional microphones and loudspeakers, NAO interacts with humans in a completely natural manner, by listening and speaking.

Seeing:

NAO is equipped with two cameras that film his environment in high resolution, helping him to recognise shapes and objects.

Connecting:

To access the Internet autonomously, NAO is able to use a range of different connection modes (WiFi, Ethernet).

Thinking

We can't really talk about "Artificial Intelligence" with NAO, but the robots are already able to reproduce human behaviour.

(Aldebaran-Robotics, 2016a)

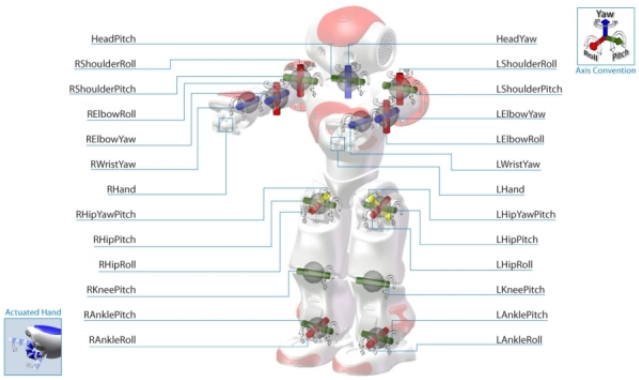

Figure 2: NAOs joint names

4.8 Nao Software

The Nao robot has it's own operating system called NAOqi OS which is a GNU/Linux distribution based Gentoo. NAOqi OS organizes and runs programs and libraries to ensure that the main program NAOqi SDK can function properly, and give life to the Nao robot.
All modules and behaviors that comes with the Nao robot is given by the NAOqi SDK.
Platforms that can be used to program the Nao and use pre-programmed modules and behaviors are Choregraphe, Python SDK and C++ SDK. Python SDK and C++ SDK both support that code can run on remotely on a computer or locally on the Nao robot. It is also possible to use java SDK, but then the code can strictly be run remotely from a computer.

4.8.1 NAOqi

The main software that runs and controls the robot is the NAOqi framework. It consists of C++ libraries that can be used to make a program for the robot.
NAOqi SDK is made to answer robotic-needs which include: parallelism, resources, synchronization, and events.
NAOqi SDK takes care of parallelism, by making it possible to program the robot to talk and move both hands simultaneously, and setting up resources for different platforms so they can access modules on the robot. Synchronization: Ensures that certain tasks are not executed simultaneously. Events:A flag is raised when a certain condition is meet, for instance when the robot detects a face.

4.8.2 Choregraphe suite

To program Nao, Aldebaran have created a platform named Choregraphe suite. Choregraphe is a multi-platform desktop application which at this moment is on version 2.1.14. Choregraphe is made to create animations, behaviours and dialogues, to test these on a simulated robot or a real one. It is possible to monitor and control your robot, and to create your own python code to enrich behaviours. This platform is based on visual programming, thus making it easy for inexperienced programmers.
"Choregraphe allows you to create applications containing Dialogues, services and powerful behaviors, such as interaction with people, dance, e-mails sending, without writing a single line of code." (Aldebaran-Robotics, 2016b)

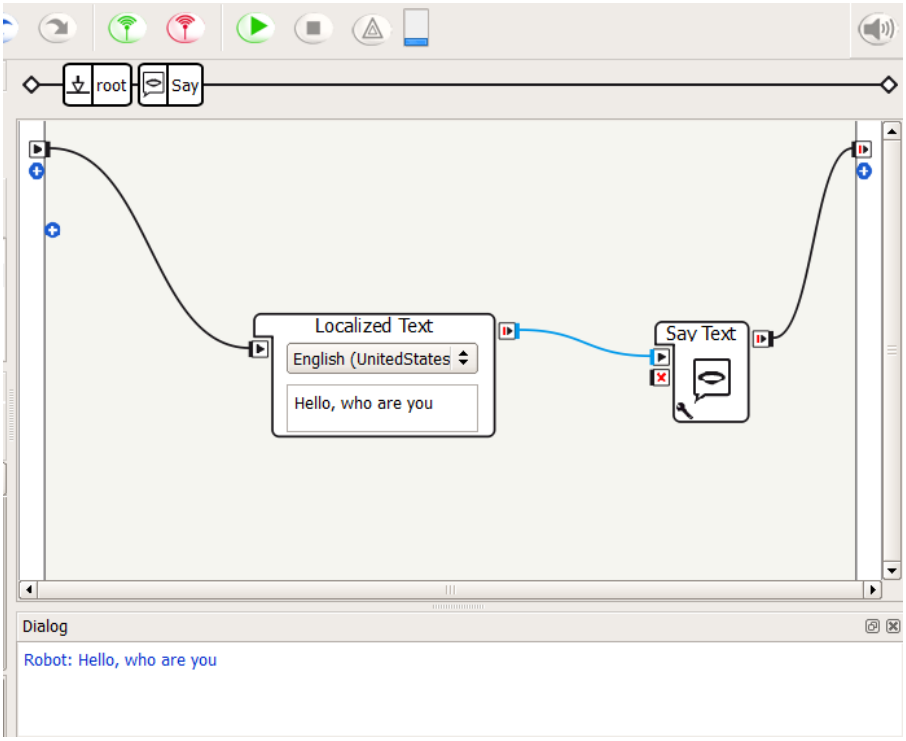

Figure 3: Example with Choregraphe

From figure 3 there is a simple example to make the robot say "hello, who are you" with Choregraphe.

4.8.3 Python SDK for Nao

The Python SDK is a platform for software development to program the robot text based in python with a third party IDE. It gives access to all C++ libraries and modules that is already allocated on the robot, and to develop modules that can run on the robot or remotely on a Computer.

```
import qi

session = qi.Session()
session.connect("tcp://nao.local:9559")
tts = session.service("ALTextToSpeech")
tts.say("Hello, World")
```

Figure 4: Simple example with python sdk

4.8.4 Naos face detection

NAO have a finished pre-programmed functions for face detection and recognition, NAOqi's library ALFaceDetection. When a face is detected, a list of angular coordinates for important facial features like eyes, eyebrows, nose and mouth is stored. It is important to know that NAO does not have a 3D representation of the face that is stored, but it can calculate the distances between the important facial features, which can be called key points of the facial features. Calculations makes it possible to still recognize a stored face if it is rotated.

For recognition to be optimal every picture for learning the face of a person should be done when facing NAO directly, with good light conditions. If the face is panned, rotated or tilted, NAO will struggle to recollect the features of the face, and therefore be inaccurate when recollecting which person who is in front of him. (Foo, 2016)
NAOqi SDK utilizes face detection developed by Omron. (Aldebaran, 2016)

4.8.5 Naos speech recognition

Nao have the built in system for speech recognition, which is split into two NAOqi libraries, ALDialog and ALSpeechRecognition. the Dialog library works by programming a structure of questions and responses. The SpeechRecognition library works in a way that one can define which words Nao should look for, like restricting a vocabulary to specific words.

4.9 Shell script

Shell script is a text file that contains commands for a unix-based operating system.
& = start process as a new thread.
Example:
python absolutepathtofilename.py & //start new process
echo 'process started' //prints out to terminal "process started"

4.10 Bézier

A Bézier curve is a parametric curve publicized by the French mathematician Pierre Bézier, who was using them to design automobile bodies. Today Bézier curves are frequently used in computer graphics and animation for create smooth curves in both 2D and 3D.
Using Bézier curves with the vectors of the Nao robot movements results in a smoother and more natural look.

5 Resources And Methods

5.1 Resources

5.1.1 Software

Microsoft Visual Studio 2015 Community Edition
Visual Studio is a complete set of development tools for building ASP.NET Web applications, XML Web Services, desktop applications, and mobile applications. Visual Basic, Visual C, and Visual C++ all use the same integrated development environment (IDE), which enables tool sharing and eases the creation of mixed-language solutions. In addition, these languages use the functionality of the .NET Framework, which provides access to key technologies that simplify the development of ASP Web applications and XML Web Services.(Microsoft, 2016b)

Qt Creator IDE Community Edition
Qt Creator allows you to visually design a GUI saving it as a .ui user interface and .rc resource file. Within the Qt Creator project you are able to choose which platform it is intended for(Windows, linux, OS X).

Microsoft PowerPoint
Used to create and perform digital slide show presentations containing text and media such as images, graphs, video and sound.

PuTTY
PuTTY is a free implementation of SSH and Telnet for Windows and Unix platforms, along with an xterm terminal emulator. (PuTTy, 2016)

Kinect SDK 1.8
The Kinect for Windows Software Development Kit (SDK) enables developers to create applications that support gesture and voice recognition, using Kinect sensor technology on computers running Windows 7, Windows 8, Windows 8.1, and Windows Embedded Standard 7. (Microsoft, 2016a)

Python and libraries
Python 2.7 32 bit version with following libraries:

- PyQt4

  PyQt4 contains the sources for converting the .ui file and .rc resource from Qt Creator to python files. It also must be imported in python for the GUI functions to work.

- PyAutoGUI

  Allows control of the keyboard and mouse with a python script.

- SpeechRecognition 3.4.3

  This is a library for performing speech recognition with support for Google Speech Recognition, Wit.ai, IBM Speech to Text, and AT&T Speech to Text.

- ftplib

  Used for extracting audio file from the robot unto the computer.

- cpickle

  Library for serializing and de-serializing objects in python.
  Making it possible to save objects as a data stream on the computer and load it. (Python, 2016a)

- PyKinect

  Enables interaction with the Kinect SDK using Python.

- PyGame

  Pygame is a cross-platfrom library designed to make it easy to write multimedia software, such as games, in Python. (PyGame, 2016)

- NumPy

  NumPy is a library containing mathematical functions and array objects.

- PyOWM

  A client Python wrapper library for the OpenWeatherMap web API, used to retrieve weather information. (Sparpaglione, 2016)

- NLTK

  An API for natural language processing.

- Cleverbot

  About Cleverbot
  The site Cleverbot.com started in 2006, but the AI was 'born' in 1988, when Rollo Carpenter saw how to make his machine learn. It has been learning ever since!
  Things you say to Cleverbot today may influence what it says to others in future. The program chooses how to respond to you fuzzily, and contextually, the whole of your conversation being compared to the millions that have taken place before.
  Many people say there is no bot - that it is connecting people together, live. The AI can seem human because it says things real people do say, but it is always software, imitating people. (Cleverbot, 2016)
  The library is also dependant on an Internet connection to get the responses.

5.1.2 Hardware

Aldebaran Robotics Nao (H25)
The robot introduced in section 4.7 at page 11

Computer
A computer with all software dependencies installed and the front end application.

Wireless Router
Any wireless router able to connect to the Nao robot and computer is acceptable.
Nao's available Wifi security options is WEP, WPA & WPA2.

Kinect for Windows
Motion sensor made by Microsoft. Using both camera and an infrared laser projector it tracks people in 3D.

Microphone
A microphone as alternative to the Nao robots internal microphone, preferably with noise cancelling.

Red Ball
A simple red ball with a diameter of 6 cm.

5.2 Methods

5.2.1 Development Process

Weekly routines and meetings

Every Thursday the group coordinator writes a short report of what the group have worked with and their progress. The report is then stored on our common database for the group to remember all the minor stages through the project which might be forgotten later in the progress.
A weekly meeting with the group members and supervisors is held each Friday at 10.am. The meetings is for updating the supervisors on the progress and plan further development. (Meeting summaries in appendix I)

5.2.2 Social Interaction

Speech Recognition

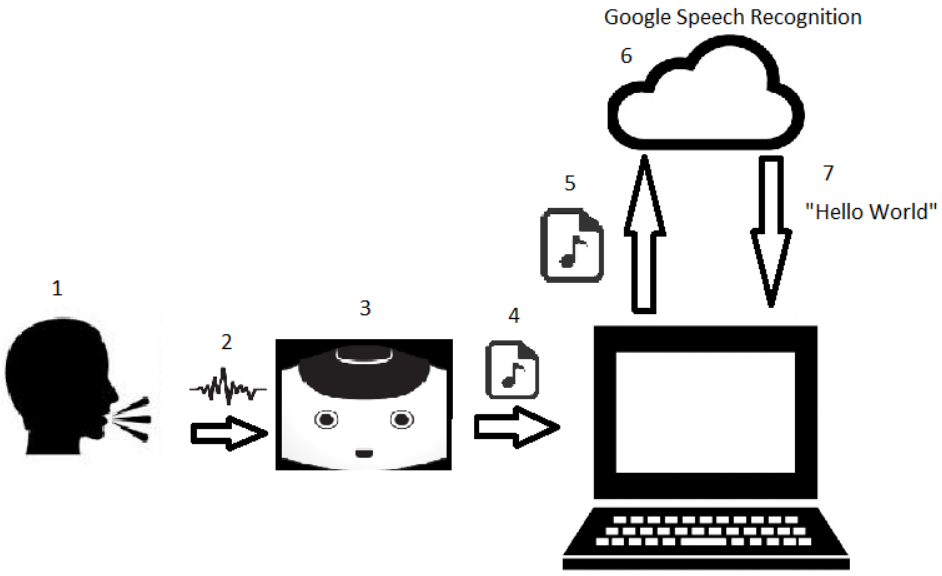

Figure 5: How Speech becomes a string

Description of figure 5:

1. Person speaking
2. Sound waves
3. Nao Robot recording sound waves
4. Recorded sound waves stored inside Nao and Sent to local computer
5. Computer sends sound file to Google Speech Recognition API
6. Google Speech Recognition checks sound file and converts it to text
7. Text string is then returned to local computer

There are two ways speech recognition is being used.

1. NAOqi: ALSpeechRecognition

   Nao have a speech recognition library which compares a pre-determined vocabulary to the sound input working internally on Nao

2. Google Speech Recognition

   Sending a sound file to Googles online speech recognition API and retrieving the text. As seen in figure 5 on page 19

ALSpeechRecognition is used where you could anticipate few variations in possible answers, and personal names.
Googles speech recognition is then, of course, used were a wider array of possible answers is anticipated.

Keyword Extraction
Complete sentences are not of interest, but the key information is. When the text returns from Speech Recognition it needs to be treated in a way that it is possible to extract the important words in a sentence.

Example: Extract a hobby using String manipulation

A way of extracting keywords from the answer to the question: *what would you say is your hobby?*

Code Step 1: Create object and text. Start extracting hobby.

```
from HumanInteractionKeyword import KeywordExtraction
    if __name__=="__main__":

        key=KeywordExtraction()
        text= "my hobby is to play piano"
        hobby=key.searchText(text,"hobby")
```

Code Step 2: KeywordExtraction()-searchText()

```
from nltk import sent_tokenize, word_tokenize, pos_tag, ne_chunk

class KeywordExtraction(object):

    def searchText(self,text,questionType):
        if text:
            if text.strip():
                tokens=nltk.tokenize.word_tokenize(text)
                for t in range(len(tokens)):
                    tokens[t]=tokens[t].capitalize()
                pos=nltk.pos_tag(tokens)
                sentence=nltk.ne_chunk(pos)
                ans=self.sortSentence(questionType,sentence,text)
                return ans
            else:
                return "nothing"
        else:
            return "nothing"
```

Code Step 3: KeywordExtraction()-sortSentence()

```
    def sortSentence(self,questionType,sorted,text):

        if questionType == "hobby":
            return self.get_human_hobby(sorted,text)

        if questionType == "age":
            return self.get_human_age(sorted)

        if questionType == "yesno":
            return self.simpleChoose(text)
```

Code Step 4: KeywordExtraction()-get_human_hobby()

```
def get_human_hobby(self,sentt,text):
    sniffer=["on my spare time", "my hobby is","i like",
             " to ","trying to","when i have the time","play","playing"]
    hobby= self.cutString(sniffer,text.lower())
    if hobby!="":
        return hobby
    else:
        return "nothing"
```

Code Step 5: KeywordExtraction()-cutString()

```
def cutString(self,sniffer,text):
    f=False
    check=False
    for s in sniffer:
        check=self.findAword(text,s)
        if check==True:
            c=len(s)
            text=text[c:len(text)]
            f=True
    if check==False and f==False:
        return text
    if f==True:
        return text
```

Code Step 6: KeywordExtraction()-findAword()

```
def findAword(self,haystack, needle):
    if haystack.startswith(needle+" "):
        return True
    if haystack.startswith(needle+""):
        return True
    if haystack.endswith(" "+needle):
        return True
    if haystack.endswith(""+needle):
        return True
    if haystack.find(" "+needle+" ") != -1:
        return True
    return False
```

Process 7: Program flow explained

1. Object of type KeywordExtraction, named key is created.
2. A String is created: "my hobby is to play piano".
3. a variable called hobby is set to be equal the result of what the function searchText() in KeywordExtraction is equal to.
4. The text is sent with a tag named "hobby" which has it's importance later
5. The text is now inside the function searchText() and gets treated by the NLTK library. (the NLTK does not have any importance for this spesific Example, but will be talked about in Example 2.)
6. The text is sent on to the next function sortSentence(). Here you can see it takes a parameter called questionType in this example that parameter contains "hobby". Since there is a if case where the questionType equals "hobby" it moves on to the function get_human_hobby()
7. Now we are inside get_human_hobby(). Here you can see the variable sniffer which is a list of typical words to say when asked what your hobbies are.
8. Sniffer and the whole text is sent on to the function cutString().
9. cutString() starts going trough the list piece by piece using a for-each loop.
10. for each piece it sets the variable "check" equal to what the return value from the function findAword() results to.
11. findAword() checks if the keyword in question exists inside the whole text we wrote in the start.
12. In this example we can see that the first keyword in sniffer: "on my spare time" does not hit, and simply moves on to the next one, the next one is: "my hobby is" this on the other hand exists in our text: "my hobby is to play piano". This result makes findAword() return "True".
13. Check becomes true inside cutString() and the length of the keyword is cut out of the text. This results in that the variable "text" is now equal to: " to play piano". This function repeats itself until the for-each loop is finished.
14. When the for-each loop has ended, cutString() returns whatever is left of the text file. In this example it returns: " piano" back to get_human_hobby()
15. get_human_hobby() receives the return value and checks whether it is empty or not, in this case it contains something and sends it back to sortSentence()
16. sortSentence() then sends it further back to the function searchText()
17. searchText() finally sends the answer back to where it came from, in our main function. Where it is stored inside the variable hobby whcich now contains the value " piano"

User Profiles

The profiles for the users are stored locally on the computer as objects stored by a cPickle on the project directory. The profiles are stored as a dictionary list in cPickle, where the key to the dictionary is the users name and the value is the whole profile object. The user profiles contains the user information as keywords from the interactions. This is for later use as recollection of the user, it is for NAO to pick out what topics the user is interested in.

Example: Create, update and store a user profile

This example will also be using functions from the previous example: "Extract a hobby using String manipulation" at page 20.

Code step 1: Creating a profile containing information

```
from HumanInteractionKeyword import KeywordExtraction
from PersonProfile import PersonProfile

if __name__ == "__main__":

    key=KeywordExtraction()
    profile=PersonProfile()

    text= "I am 27 years old"
    text1="my hobby is to play piano"
    name="Ola"

    age=key.searchText(text,"age")
    hobby=key.searchText(text1,"hobby")

    profile.cPickleCreateProfile(name,profile)
    profile.setFirstName(name)
    profile.setAge(age)
    profile.setHobby(hobby)
    profile.cPickleUpdateProfile(profile.getFirstname(),profile)
```

Code step 2: PersonProfile()-__init__()

```
import cPickle
class PersonProfile(object):

    def __init__(self):

        self.profile={"FirstName":"","Surname":"","Age":"","Hobby":""
                ,"Activity":"","City":"","Country":"" ,
                "Work, Sudy or Unemployed":"","Workplace":""
                ,"Education":"" ,"Relationship":"","Litterature":""
                ,"Movie":"","Relaxation":"","Pet":""}
        self.filename=""
```

Code step 3: PersonProfile()-cPickleCreateProfile()

```
    def cPickleCreateProfile(self,name,obj):
        file=open("C:\pewpew\profiles.pkl","rb+")
        existingProfiles=cPickle.load(file)
        file.close()
        existingProfiles.update({name:obj})
        file=open("C:\pewpew\profiles.pkl","rb+")
        cPickle.dump(existingProfiles,file)
        file.close()
```

Code step 4: PersonProfile()-cPickleUpdateProfile()

```
    def cPickleUpdateProfile(self,name,obj):
        file=open("C:\pewpew\profiles.pkl","rb+")
        profiles=cPickle.load(file)
        file.close()
        profiles[name]=obj
        file=open("C:\pewpew\profiles.pkl","rb+")
        cPickle.dump(profiles,file)
        file.close()
```

Process and result 5: Program flow explained

1. Shown in Code step 1 we can see that We import the PersonProfile() class, and create a object of it.
2. We are adding a few details about the user profile to show how information is added then updated later.
3. Shown in Code step 2 one can see that creating the PersonProfile object it automatically runs the __init__(self) function. Inside of it you can see a variable of type dictionary called "self.profile" which creates a unique dictionary for the specific object.
4. Shown in Code step 3 it is shown that cPickle opens a file named "profiles.pkl" and it's filepath on the computer.
5. "profiles.pkl" works the storage of all user profiles that has been created so far.
6. The dictionary list gets loaded into the variable existingProfiles. ExistingProfiles then gets added an additional item with a key and a value. In this example key equals "Ola" and the value equals the object profile we created.
7. When the user profile has been added, the whole list overwrites the old list (which now contains one extra item). Now the profile has been created.
8. Shown in Code step 4 the function cPickleUpdateProfile() opens the user profile storage from cPickle and searches for the profile name from the dictionary, which is now the variable "profiles".
9. When found, it overwrites the old object (which is the value of the key) and then dumps it back into the storage again.
10. Inside the updated user profile there has now been added two values inside the profile objects dictionary seen in Code step 2. Age has been updated to: 27 and hobby has been updated to: piano.

Facial Detection and Recognition
The Face recognition engine used to know which person is in front of him, is Naos internal one. When Nao detects a person he knows the system returns the first name of the person. For the interaction the program runs a constant thread that keeps Nao looking for what person is in front of him. The first name value that's returned is used for creating and updating an user profile.

Robotic Learning
To test learning algorithms a feature is created that makes NAO learn as it speaks to more and more people. It is used in two basic incidents where NAO learns about the human world. One of these is "Activities", Where NAO asks if the person partake in any activities, if so it continues with asking what activity they partake in. Nao will check whether it knows that the activity is a sport. When the activity is unknown for Nao as a sport, it will ask if it is a sport, if so, Nao updates its database to include the activity as a sport.

Long term Interaction Experiment
The robots part of the dialogue is made by using NAOqi's ALTextToSpeech engine for Nao to talk, and the combination with Google Speech Recognition and NAOqi's ALSpeechRecognition for listening.
The experiment is to test if it is possible for a person to feel like a robot can learn about a person and feel like a robot can have a relation to a person. The experiment is divided into two parts.
Part one consists of the Nao robot learning about a persons' personal details, such as hobbies, age and activities.
Part two is created in a way that it feels like Nao is talking to a acquaintance by referring to the information gathered in part one.
The experiment is executed in a silent room where the participants has a sit-down with Nao. The participants is given a sheet explaining how the experiment will be conducted and how the dialogue will take place (Appendix G). The participants is asked to write short manuscript of the things they are going to answer to each question. The reason is to let the participants be a bit prepared before starting, in case they do not understand what Nao said and to crosscheck if Nao recorded the correct answer.

When part one was finished the test subjects was given a form to answer as a revision of how they felt the conversation went (Appendix E).
When the test subjects have finished the revision survey they are once more introduced to Nao, to partake in the second part of the test. When the test subjects have finished part two, they once more have to fill out a second revision survey (Appendix F).
The experiment will:

1. Measure how much information of the test subjects Nao gathers, the information is graded on a scale from 0 to 2.

   0 = Completely wrong
   1 = A whole sentence is returned, not only the keyword
   2 = Only interesting keyword(s)

2. Let the participants grade the understanding of the robots questions, how much they feel the robot knew them, and how they felt the conversation was natural or stressed, on a scale from 0 to 3.

The experiments survey population consists of ten random people with age ranging from 20 to 30 years old, both male and female.

5.2.3 Exhibition Robot

For exhibitions the Nao robot will use a lot of movements, sound and lights to show what it is capable of. In form of dancing well known dances, balancing on one leg, laying down and getting up it will attract attention. To complement this theatrical mode the Nao robot is going to have interaction in form of:
- Placing itself according to a object. For this project a red ball since NAOqi already has functions for this.
- Mimicking a human with help from Kinect for Windows.
To enlighten the spectators about engineering studies it hold a short PowerPoint presentation about the automation engineering studies at NTNU Ålesund. If someone wants to know more about how the Nao robot works, it will hold a 1-2 minutes PowerPoint about itself. This way the exhibitor does not need to know all the specifics of the Nao robot.
Operation modes for the robot meant for display implemented in the front end application:

- Demo mode

  A predetermined pattern of movements, animations and dances. If this mode is stopped it continues to run through the current animation to prevent stopping in an unfavorable position. There is no types of interaction in this mode.

- Kinect mode

  Using the PyKinect library it is possible to retrieve the skeleton data from Kinect. The data is used to control the left and right elbow roll, shoulder roll and pitch, and head pitch. The feet are left out to keep it from falling over.

- Red ball tracking

  Programmed is the size of the red ball, 6cm. knowing this the Nao robot always try to place itself 0.5 meter from the ball. It will walk forward/backward and turn around to accomplish this. The red ball tracking function is a part of NAOqi.

Exhibition Test
The field test is made during the "Hype Dataparty" arranged by Sunnmøre data og kultur, as part of the NTNU exhibition. The population at this event was 100 people mainly consisting of males 12-15 years old and support crew. The goal is to get attention and make people talk about the robot unprovoked by us, the exhibitors.
The Nao robot will dance and move around to draw attention. When a small group have gathered they will be given the option to use the interaction in form of red ball tracking and mimicking via Kinect.
The success is based on observation on how people react, if spectators are enjoying themselves and if the robot capture the attention of large groups at a time.

5.2.4 Lecture Robot

The Nao robot will use its features, mainly talking, to teach about a subject. A PowerPoint presentation will run in the background working as subtitles for the Nao robot, including some images and video for some specific lectures. In this way the audience will get both audio and visual input about the subject.
The function to pause the lecture is linked to the Nao robots front head sensor, if activated the presentation will come to a halt when the active slide is completed. To continue, reactivate the front head sensor. To stop a presentation activate the rear head sensor on the Nao robot, and it will stop and close PowerPoint when the current slide is completed.

Lecture Experiment
The experiment is conducted with guidelines from NSD - Norwegian Centre for Research Data, for research including people under the age of 18. It is registered in their project database as project number 48068.
The survey sampling were eleven pupils in fifth and sixth grade in elementary school. The collaborating teacher is one of the usual teachers for the pupils in the survey sample.
The survey population will take a pre-lecture questionnaire about the functions of a robot, and be asked to draw their image of a robot. After the pre-lecture questionnaire they will be divided into two groups.
One group, six pupils, three at a time, will see the Nao robot giving a lecture. The other group, five pupils, first three of them followed by the last two, will get a lecture from a teacher. Both lectures is about the Nao robot's specifications, abilities and function including how and why it works. The Nao robot uses the "Nao presentation" from the front end application.
The teachers PowerPoint presentation is keywords, data and the same images as the "Nao presentation", but the teacher has to formulate its own way to convey the information. (Appendix H, Nao_general.pptx) After the lecture the survey population will answer a post lecture questionnaire, with the same questions and drawing task as the pre-lecture.
The survey population will formulate their own written answer to each question. Result data will be based on certain keywords in the answers for each question, allowing misspelling and synonyms.
Pre and post-lecture questions and favorable keyword(s):

1. How do robots see us? What are their eyes?

   Keyword: Camera

2. How do robots hear us? What are their ears?

   Keyword: Microphone

3. How do robots speak? What is their mouth?

   Keyword: Speaker

4. What do robots use to move? What are their muscles?

   Keyword: Motor

5. How can robots avoid bumping into things? How do they sense obstacles?

   Keyword: Sensor

6. How can robots think? What is their brain?

   Keyword: Computer

7. How can humans instruct a robot to do a specific task?

   Keyword: Programming or code

8. How can a robot be connected to other robots?

   Keyword: Any name or description of a cabled or wireless network

The post-lecture questionnaire contains an added question different for the groups. Robot lecture recipients is asked "Did you like having the robot in the classroom?". The teacher group is asked "What do you think a lesson would be like if it were given by a robot?".

5.2.5 Front End Application

To create a user friendly front end application, everything from the hypothesises methods (and more) is implemented in a graphical user interface.
The graphical user interface is designed with Qt Creator Community edition.
From the PyQt4 Python library, pyuic4.bat and pyrcc4.exe will convert the .ui and resource file from the Qt Creator project to Python code.
To utilize the functions run following commands in command-line or powershell:
completeFilepath/pyuic4.bat completeFilepath/UiFile.ui -o completeFilepath/outputUiFile.py
completeFilepath/pyrcc4.exe completeFilepath/resourceFile.qrc -o completeFilepath/outputResourceFile.py

5.2.6 PowerPoint

Python has a standard library, subprocess, allowing it to send commands to Windows Command Line (cmd). cmd are able to open a PowerPoint file directly in slide show mode with the command: "start powerpnt /s filepath", where filepath is the complete filepath to the PowerPoint presentation.

Code 1: Initialize a PowerPoint slide show with Command Line from Python.

```
def __init__(self, filepath):
        global fp
        fp="start␣powerpnt␣/s␣" + filepath

def startPresentation(self):
        global fp
        p = subprocess.Popen(fp, shell=True, stdout = subprocess.PIPE)
        stdout, stderr = p.communicate()
        if p.returncode == 1:
            print "something␣went␣wrong␣with␣cmd-line"
```

Lectures/presentation accessible from the front end application:

1. Nao Presentation (Appendix H, Nao.pptx)

   The presentation used for the experiment. It goes to mid level depth on features, functions and operation of the Nao robot. Where it is possible, the Nao robot displays images of the features and functions explained. The presentation contains some humour and music/dancing to keep the attention.
   Length: 12 minutes.

2. Robot presentation (Appendix H, Robots.pptx)

   A presentation where the Nao robot explain and show other robot than itself, including medical, industrial, bomb disposal, household, space traveling, humanoid, android and logistic robots. Contains images, videos and some humour.
   Length: 17 minutes.

3. Nao presentation short edition (Appendix H, Nao_short.pptx)

   A shortened version of the Nao presentation, for exhibition purposes.
   Length: 2 minutes.

4. Automation engineering study programme at NTNU Ålesund (Appendix H, EngineeringPres.pptx)

   A presentation about the automation engineer study programme at NTNU Ålesund, for exhibition purposes.
   Length: 2 minutes.

The python library PyAutoGUI is used to navigate through the slide show, by emulating left and right arrow key. It ends the presentation by emulating the escape(Esc) key.
There is no errors with controlling the slide show with keystroke emulating as long as the computer has a one screen configuration. When using multiple screens the mouse cursor has to be in the correct screen frame to affect the slide show.

5.2.7 Class diagram

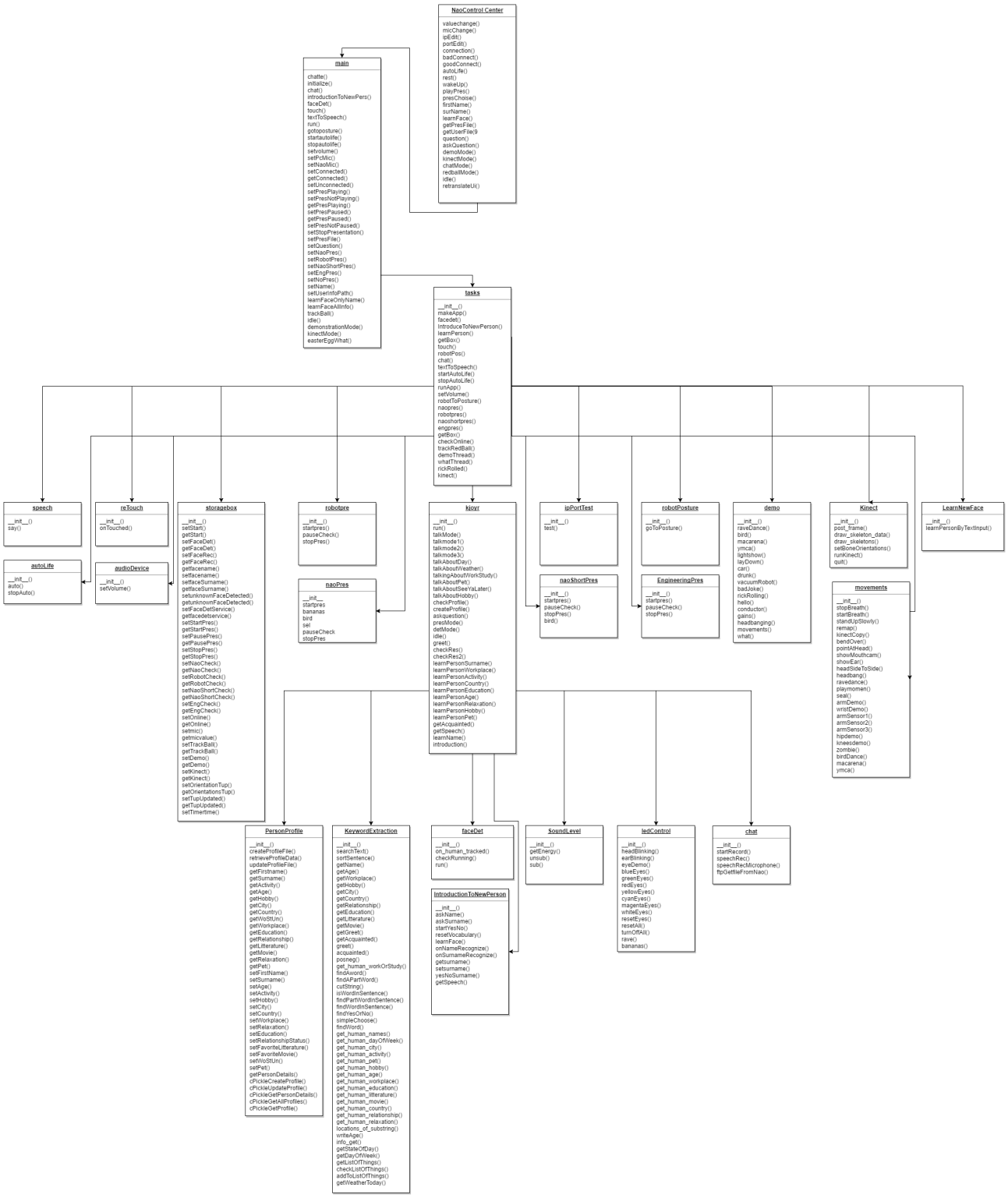

Figure 6: Class diagram

Robot animation and movements

The custom dances and movements is made with Choregraphs timeline block and extracted to python code with Choregraphs "extract with Bezier" function. Using Choregraphs 'Animation mode' it is possible to move the robot to the desired posture and save it in a time slot. This saves a lot of time compared to calculating every wanted angle of joints. The Bezier option makes the movements more smooth and natural.

In NAOqi there is over 600 pre made animations called behaviours in 'ALBehaviorManager'. Some of them are just a second long and some are as long as half a minute. The 'Behaviours' class in the application contains methods to easily start a portion of these behaviours.

The 'movements' class contains the custom made movements, dances and the motor control method for the Kinect mode.
The Nao robot will by standard implemented functions adjust to some degree the movements, to avoid colliding with its own body and limbs.

6 Results

6.1 Long Term Interaction Experiment

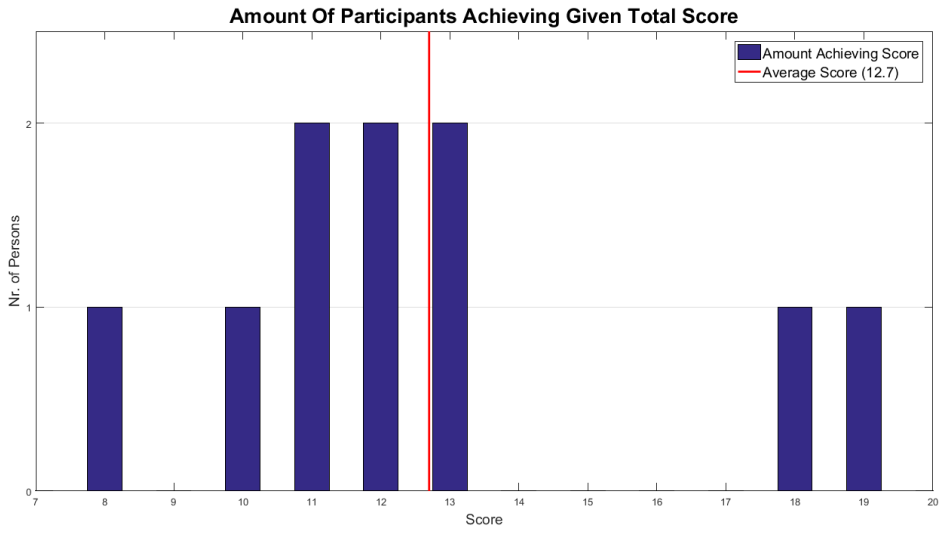

Figure 7: Amount of Participants Achieving Given Total Score

After the experiment a score is given. Ten keywords where to be extracted and the best score possible was 20 points. the mean value is shown as a red line at 12,7 points. So the result of keyword extraction is at 63.5% hit. Figure 7 shows how many person achieved a certain total score.

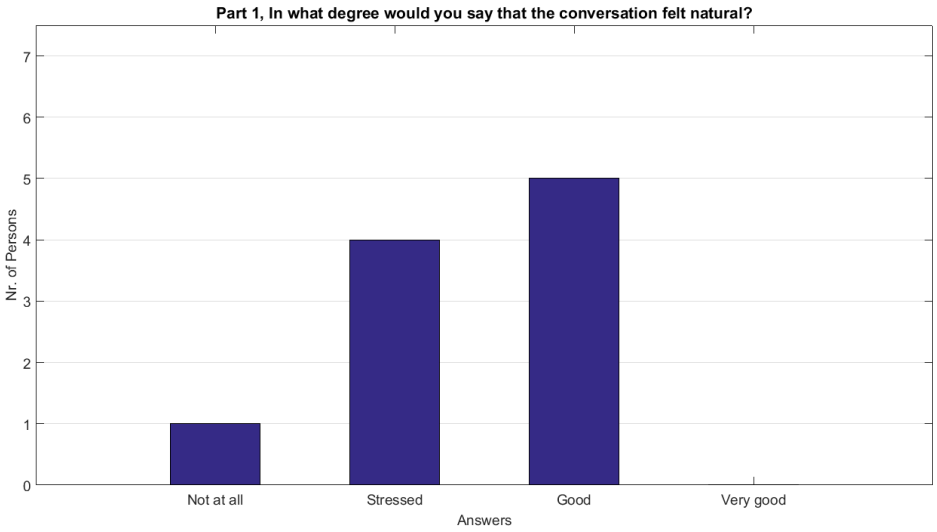

Figure 8: Experiment Part 1, Question 1.

Figure 8 shows how many test subjects graded the alternatives to the question "In what degree would you say the conversation felt natural?" in part one.

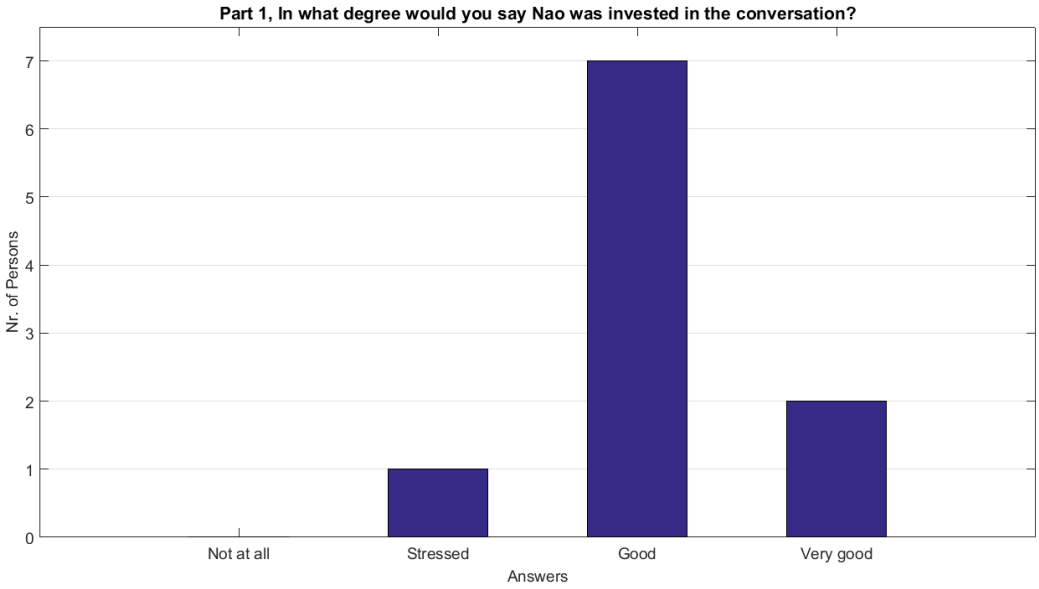

Figure 9: Experiment Part 1, Question 2.

Figure 9 shows how many test subjects graded the alternatives to the question "In what degree would you say Nao was invested in the conversation?" in part one.

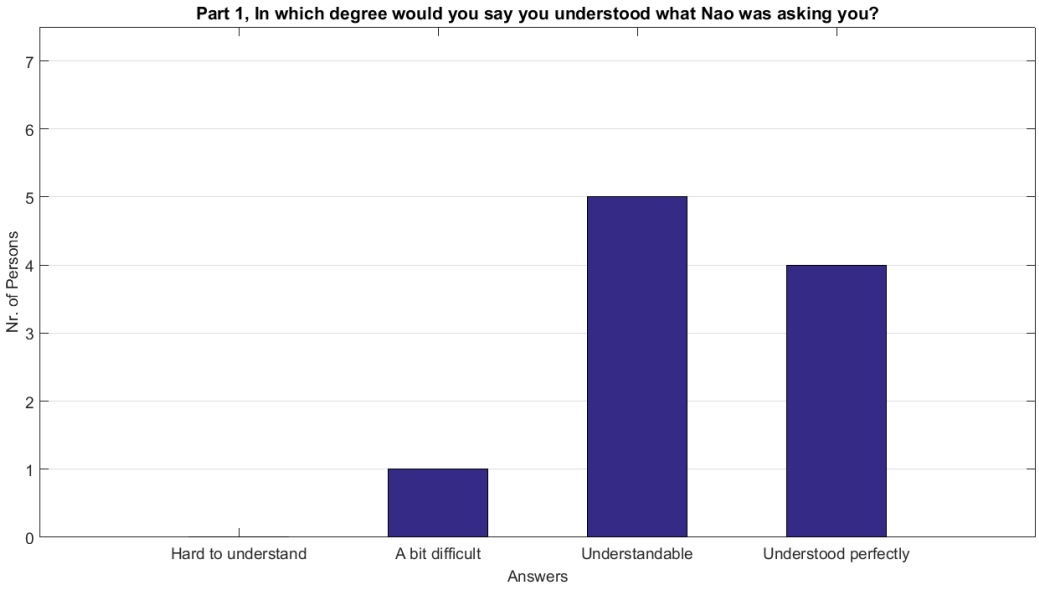

Figure 10: Experiment Part 1, Question 3.

Figure 10 shows how many test subjects graded the alternatives to the question "In which degree would you say you understood what Nao was asking you?" in part one.

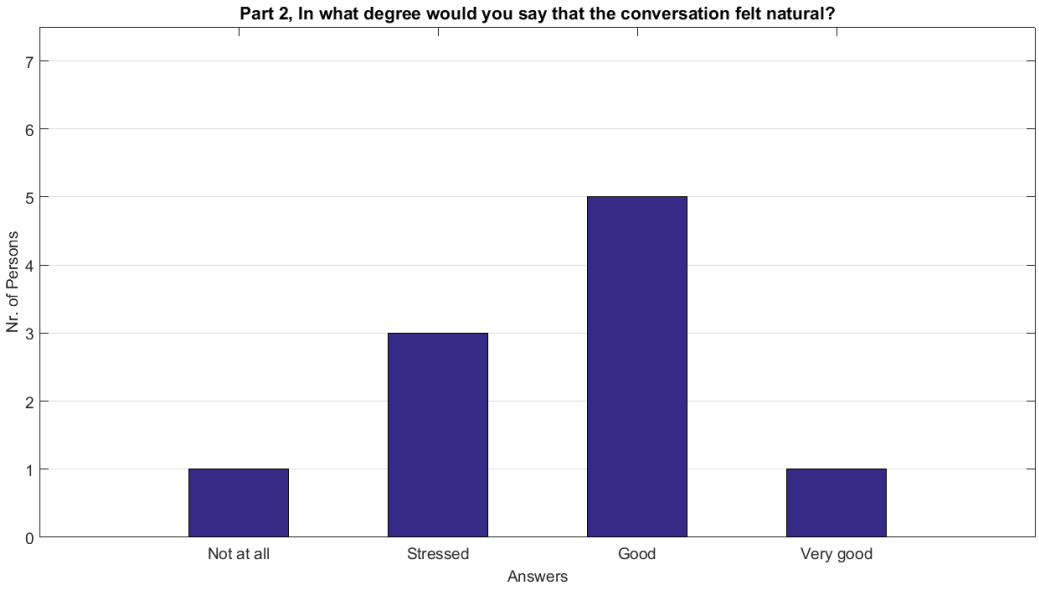

Figure 11: Experiment Part 2, Question 1.

Figure 11 shows how many test subjects graded the alternatives to the question "In what degree would you say the conversation felt natural?" in part two.

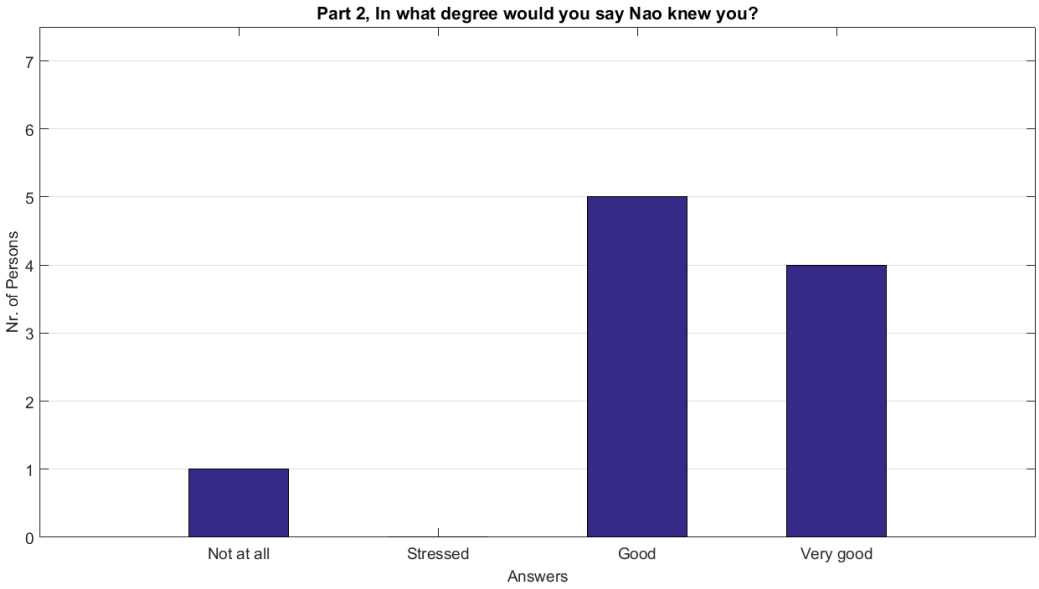

Figure 12: Experiment Part 2, Question 2.

Figure 12 shows how many test subjects graded the alternatives to the question "In what degree would you say Nao knew you?" in part two.

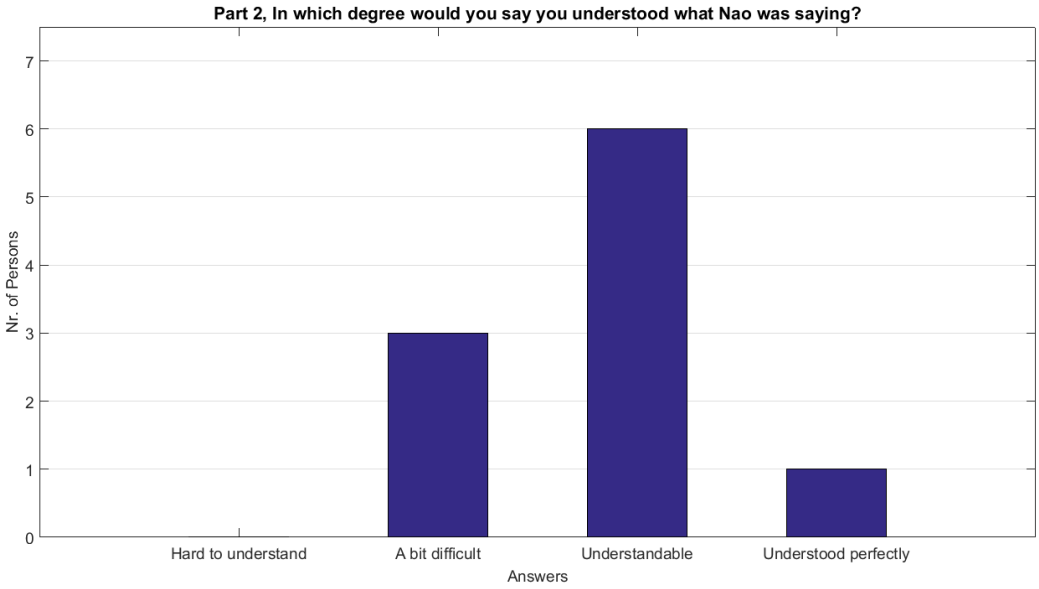

Figure 13: Experiment Part 2, Question 3.

Figure 13 shows how many test subjects graded the alternatives to the question "In which degree would you say you understood what Nao was saying?" in part two.

6.2 Exhibition trial

The robot held the attention of the by passers for 2-5 minutes, with some showing far more interest surpassing 15 minutes. A few(less than 5) went to get their friends so they could show them the robot. The participants showed clear sign of excitement, surprise and fun when they were allowed to try the interactive functions. Being shallow interactions, a minute or two were enough to satisfy their interest level.

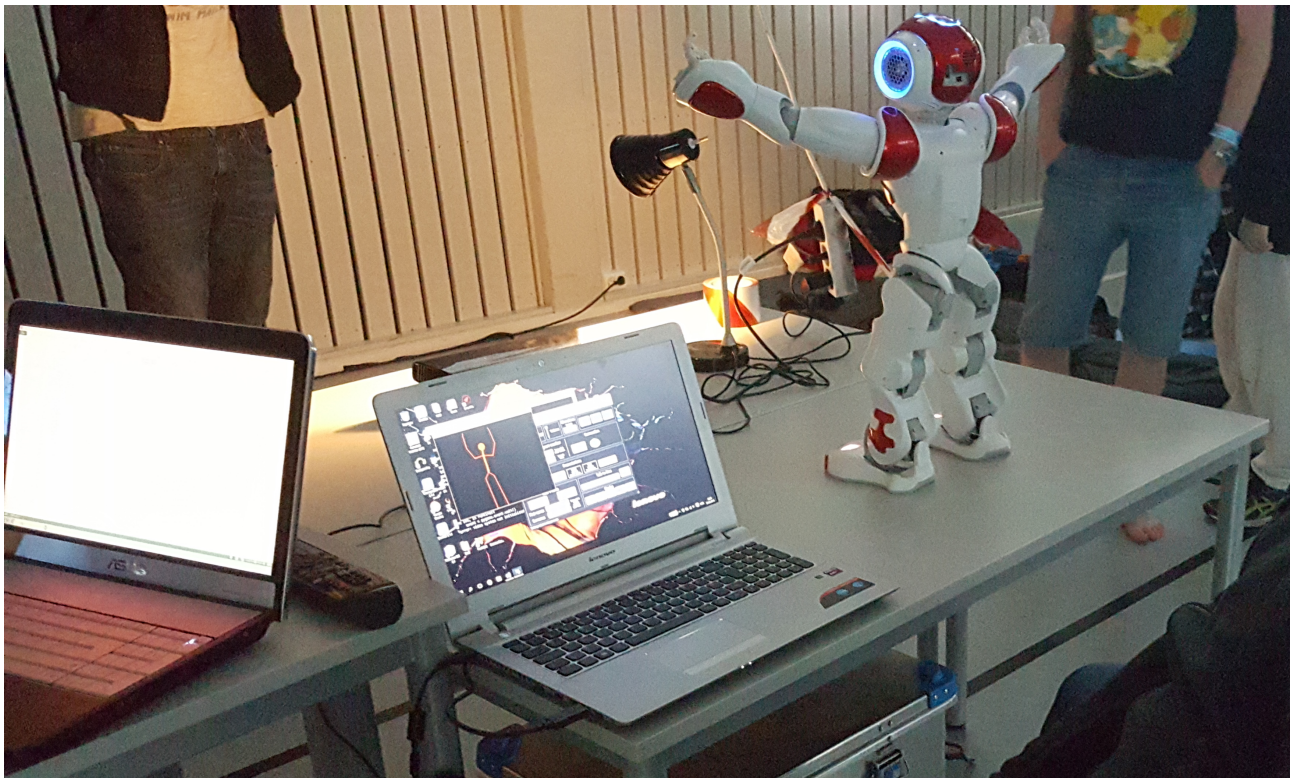

Figure 14: Nao robot following movement using Kinect

6.3 Lecture Experiment

Time usage

Going through the same material and the having far more slides (65 vs. 12) the Nao robot used only about half the time the teacher did on the lecture.

Nao	Teacher
12 min.	20-25 min

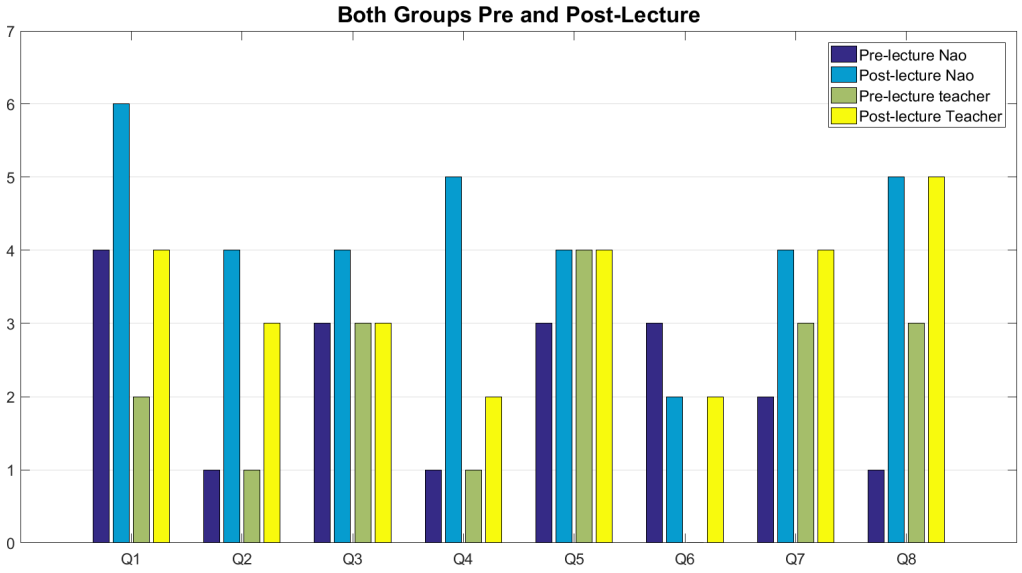

Figure 15: Amount of answers containing keyword

Figure 15 Shows the amount of answers from the questionnaire containing the keywords for both groups pre and post-lecture.

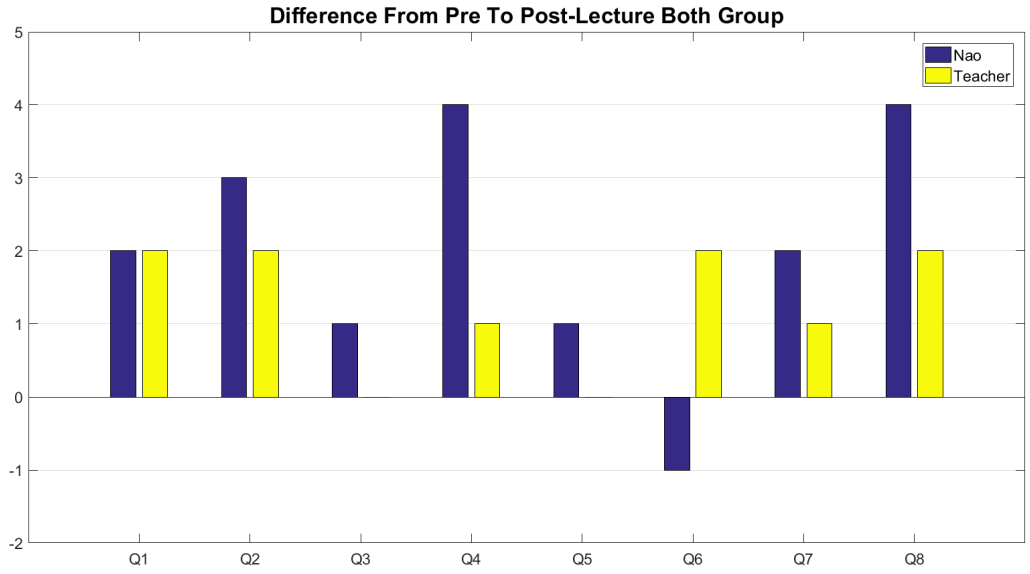

Figure 16: Comparison of answers containing keyword from pre to post-lecture

Figure 16 shows how many of the pupils improved their answer by including the keyword, divided by whom performed the lecture.

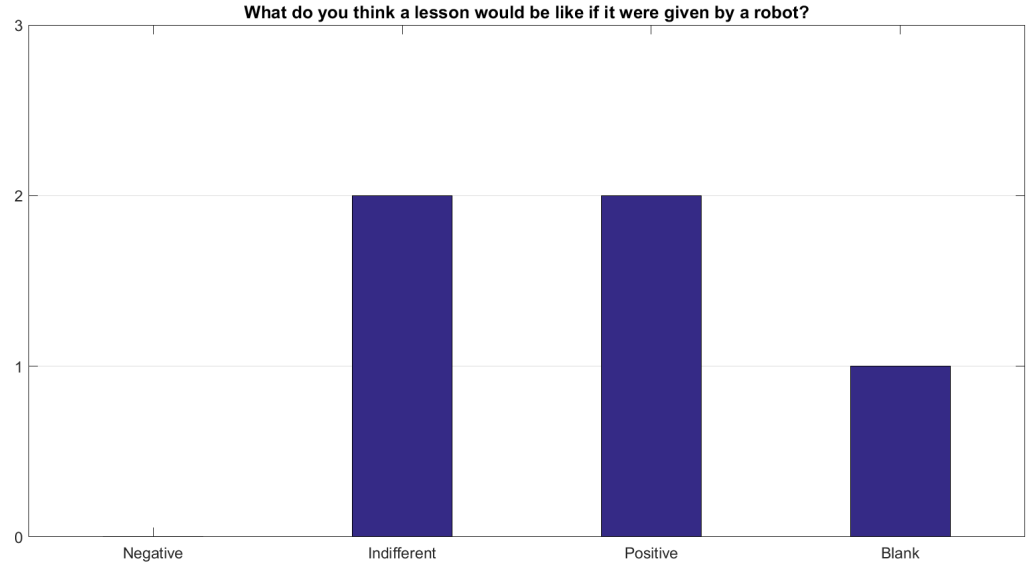

Figure 17: Post-lecture teacher group specific question

Figure 17 Shows the attitude in the answers to the questions *What do you think a lesson would be like if it where given by a robot?* given to the teacher group post-lecture. The attitude were graded in the scale of negative, indifferent/neutral and positive.

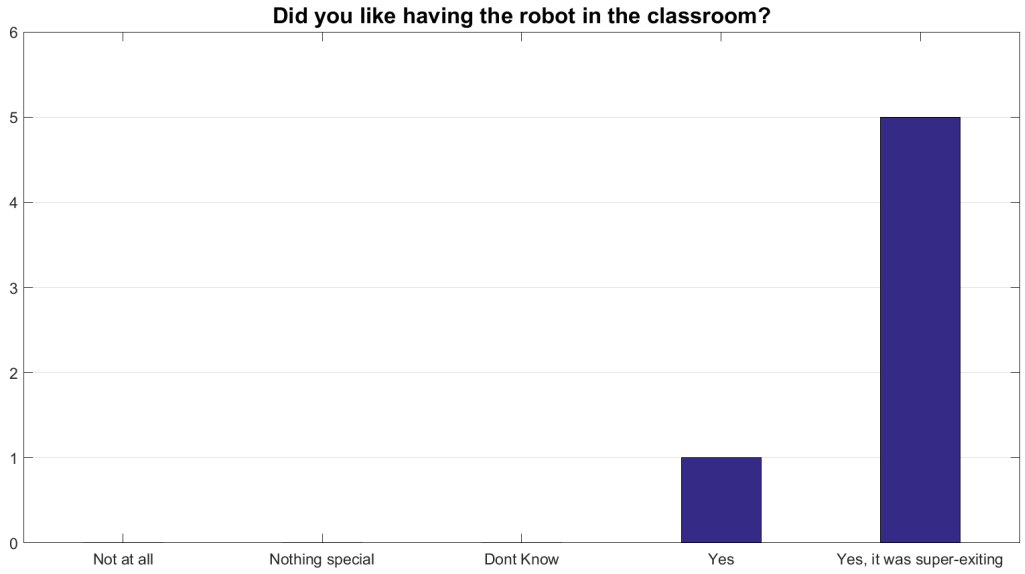

Figure 18: Post-lecture Nao group specific question

Figure 18 Shows how the test subjects answers to *Did you like having the robot in the classroom?* given to the robot group post-lecture. The answer were multiple choice with the options: "Not at all", "Nothing special", "Don't know", "Yes" and "Yes, it was super-exiting".

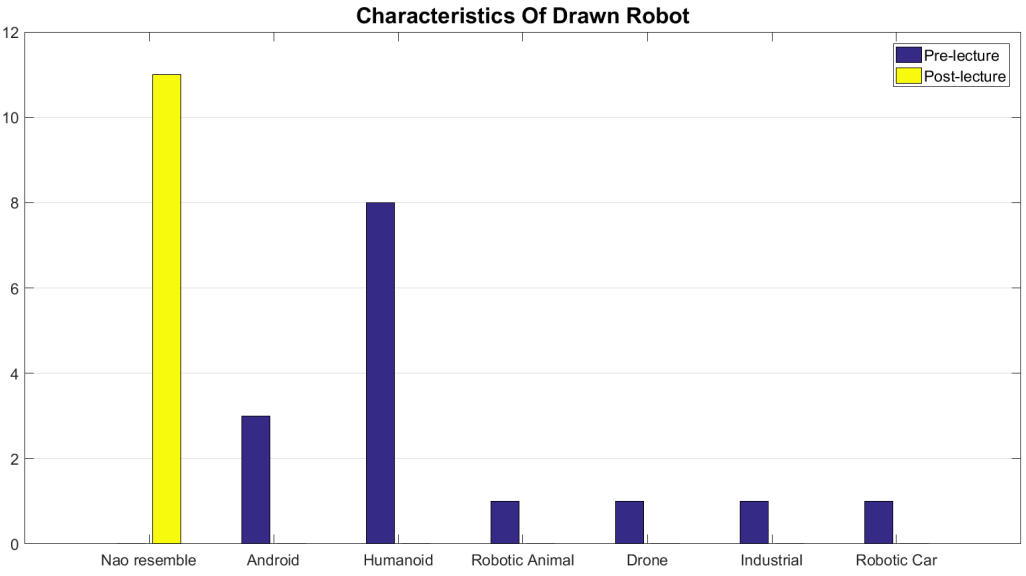

Figure 19: Generic type of robot drawn

Figure 19 shows what kind of robot the kids drew. The number of pre-lecture drawing of robots does not match the number of participants because some drew more than 1 robot, and all drawn robots are included. Post-lecture everyone drew a drawing resembling the Nao robot, even the teacher group who had only seen images of it.

Figure 20: Nao presentation for all who had teacher lecture or wanted to see it again

During each presentation one observer made a subjective assessments about; How much fun the kids are having, the degree of noise, number of pupils not paying attention.

Ratings:

Level of noise: 1 = silent; 2 = some chatting; 3 = loud chat; 4 = out of control.
Level of fun: -1 = bored; 0 = no emotions; 1 = some excitement; 2 = very excited.

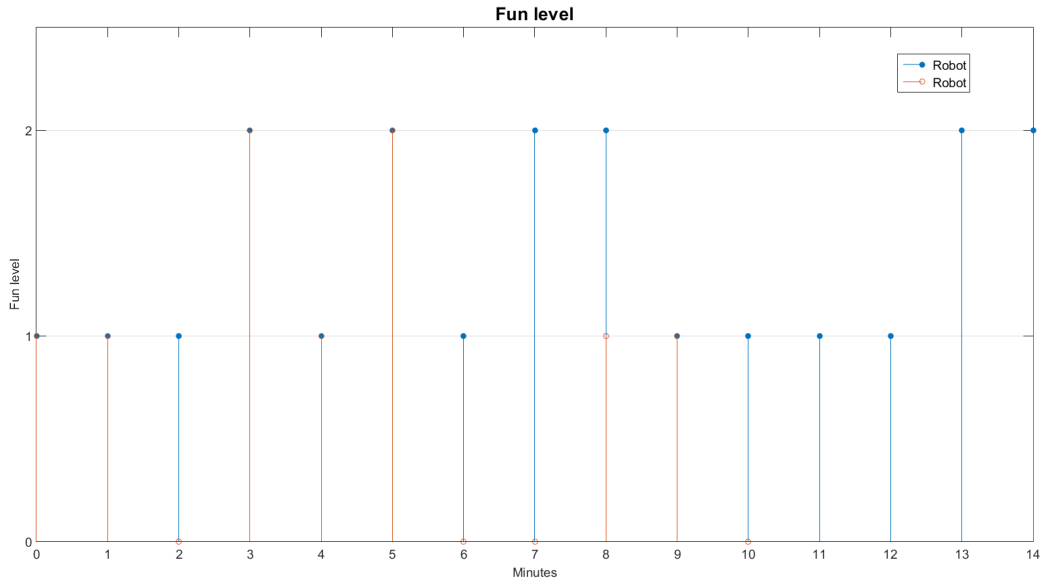

Figure 21: Estimated fun level with the robot as lecturer

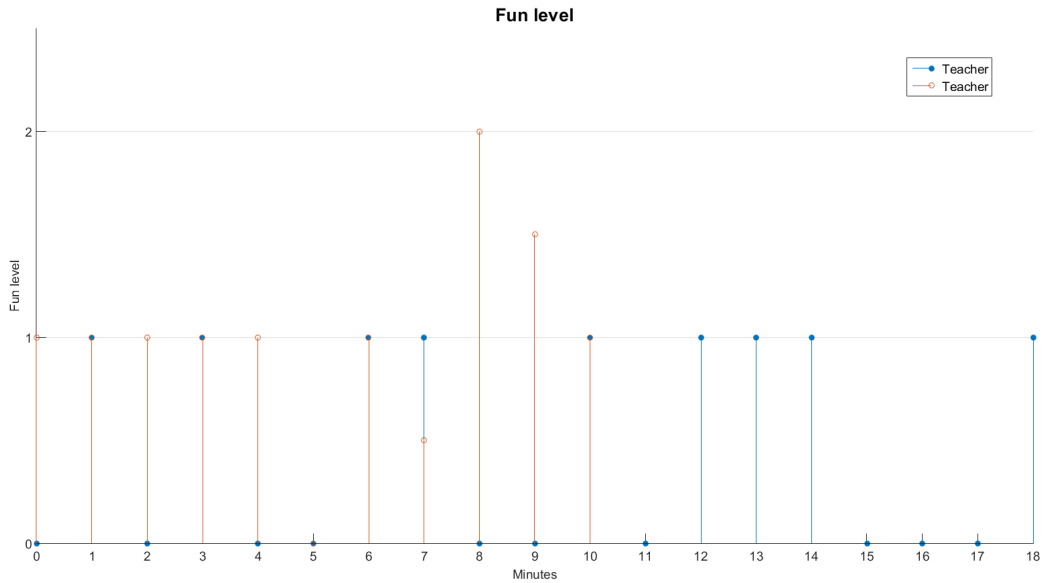

Figure 22: Estimated Fun level with a teacher as lecturer

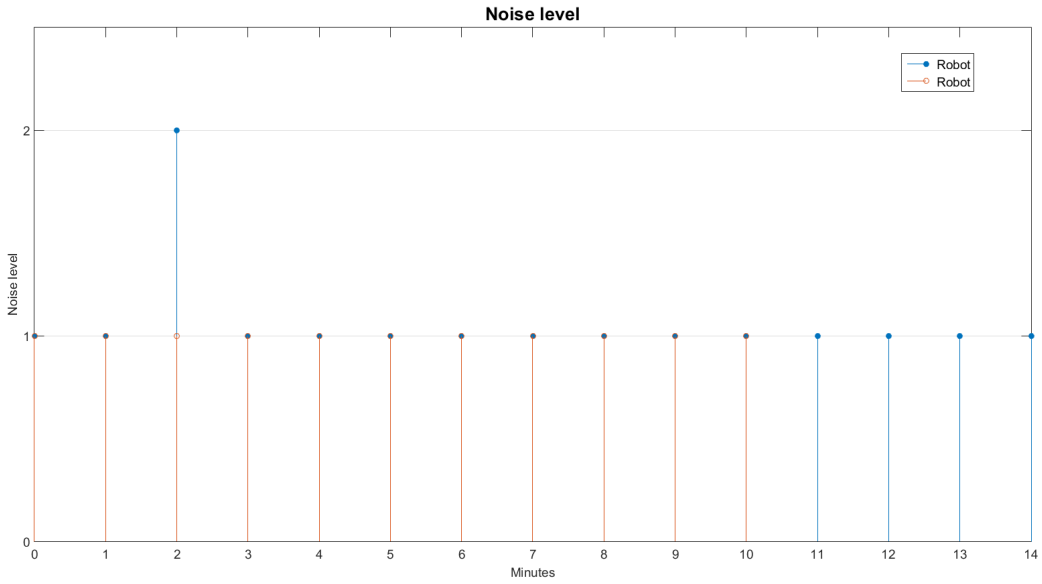

Figure 23: Estimated noise level with a robot as lecturer

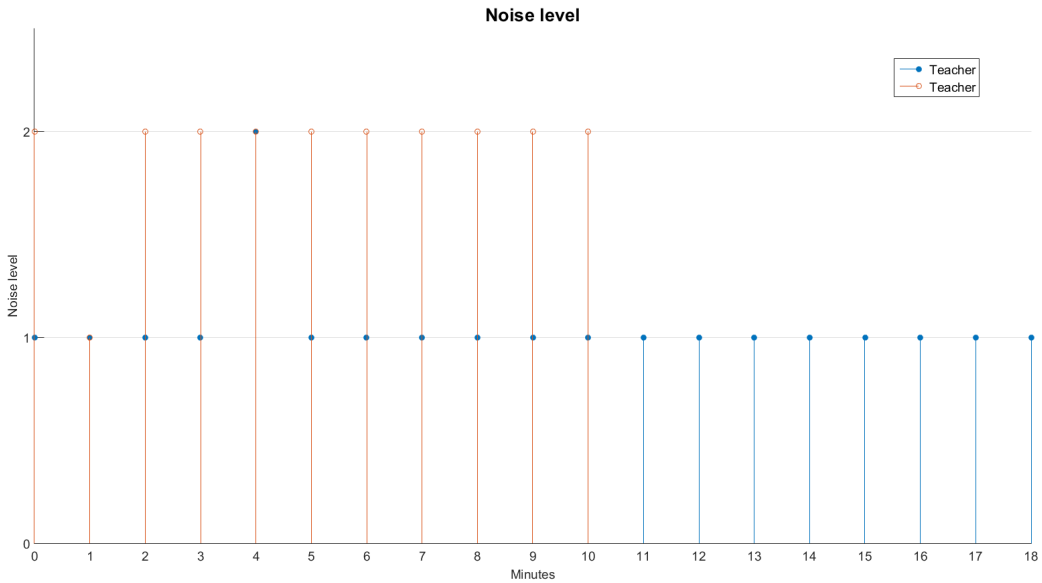

Figure 24: Estimated noise level with a teacher as lecturer

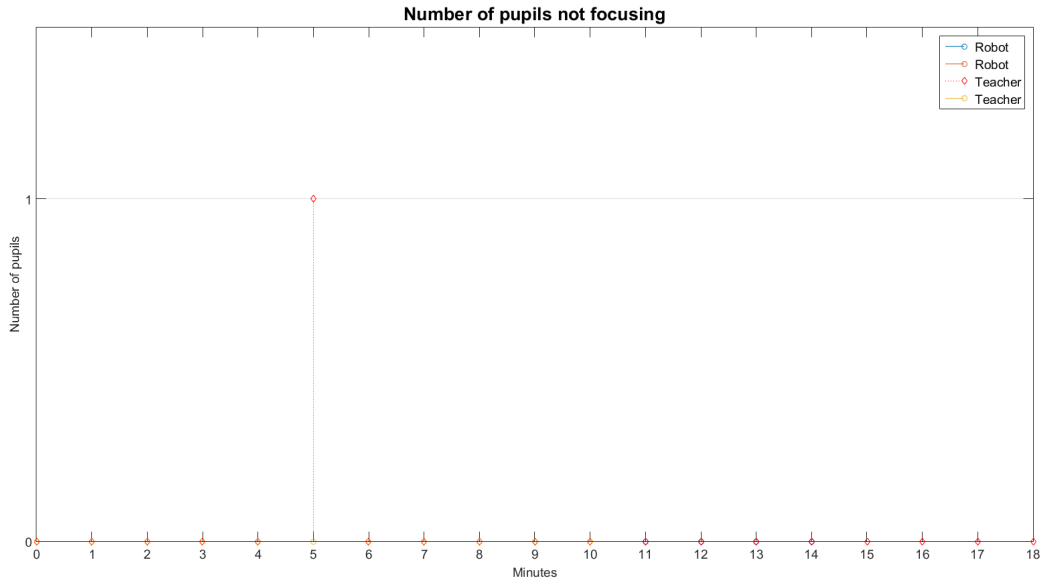

Figure 25: Number of pupils not paying attention

6.4 Front End application

Graphical User Interface

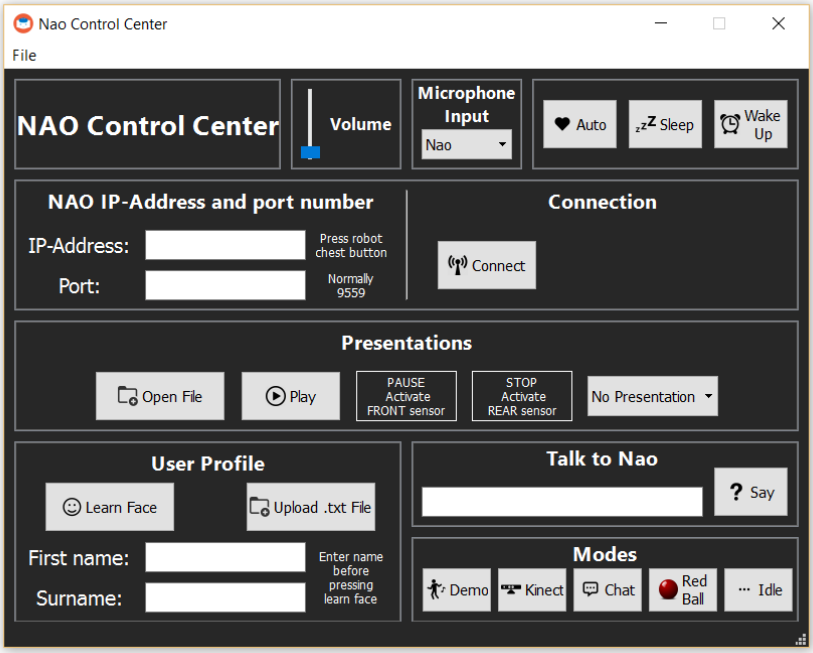

Figure 26: Nao Control Center Graphical User Interface

The resulting GUI called Nao Control Center (NCC) implemented some features inspired by the Choregraphe software, as the volume slider, Auto, Sleep and Wake Up buttons.
The Auto button sets the NAOqis "autonomous life"-behaviour state to "solitary", making the Nao robot stand up and turn its head toward faces or sounds.
The Sleep button sets the NAOqis "autonomous life"-behaviour state to "disabled", making the Nao robot sit down and turn off the motor stiffness.
The Wake Up button makes the Nao robot go to a standing pose and turn on motor stiffness, if disabled.
In the bottom there is a status line displaying information regarding the last action on the NCC.
When browsing for files, either for presentations or user profile, only suitable files will be visible (.pptx and .txt).

The connection frame is to connect to the Nao robot with inserted IP-address and port.
A successful connection will display a green Nao head symbol, and the Nao robot will confirm the connection by saying "connection established".

Figure 27: Result of a successful connection

An unsuccessful connection will display a red Nao head symbol.

Figure 28: Result of a unsuccessful connection

Functions:

1. Presentations frame

   This is the section to control the presentations/lectures the Nao robot should perform.
   You have to specify which presentation/lecture with the drop down menu, and the path to the corresponding PowerPoint .pptx file. When this is in place you will be able to start the presentation/lecture. Since the PowerPoint presentation will occupy the screen, the stop and pause buttons are moved to the Nao robots front and rear head tactile sensor.

2. User Profile frame

   This is for forcing the creation of an user profile, a supplement for conversing to the Nao robot and having your user profile created that way.
   The mandatory inputs are first and surname. A .txt file containing personal information is optionally added and nNLTK will extract useful information for the user profile.

3. Talk to Nao frame

   This will take the text inserted and generate a response by using Cleverbot, the Nao robot will say the response.

4. Modes frame

   Change the running behaviour for the Nao robot. Idle is the standard pose standing up, movement while idle will be based on the state of NAOqi's "autonomous life"-behaviour.

Everything in the GUI is elaborated more in the Nao Control Center User Manual (Appendix B).

7 Discussion

7.1 Application

When given the project and the Nao robot, the first question that needs to be answer was, which platforms to utilize for reaching our goal.
There are 4 realistic alternatives: Python, C++, Java or Choregraphe.
Since the application would be to a certain degree complicated, it was preferred to use a platform with text based programming. It would also be preferable to have the application to run locally on the robot, without being dependent to a computer.
Java is text based, but there is no support for java code to run on the robot. Programs created with Choregraphe does run locally on the robot, but Choregraphe is visual programming.
This leaves Python and C++.
Python has a close resemblance to java, which all group members has experience with. And every code example on the aldebaran website is written in python. Python was chosen to develop the application for these very reasons.
Since the operating system on the robot is Linux based, it could be that the only thing that is required is to write a start-up script(shell), and place the file in the init.d directory. The script will in turn start the Python application.
If logged on with PuTTY(ssh) with code and script in order and then reboots, the python program will start at start-up, the second the user logs off with PuTTY the program stops.
In the end, controlling the robot remotely from a computer with Python as programming language, and visual studios as IDE, offers all the tools required to solve the project, so shell scripting is not used.

Kids and AI chat bots Since Cleverbot is an AI there is no way of controlling the responses where it is implemented in the project.
It may be rude, inappropriate or incorrect so kids and others may be offended by it.
The A.L.I.C.E chat bot let you control every possible output response to avoid this, but it is very time consuming making and updating its response database.

7.2 Graphical User Interface

The Nao Control Center GUI is easy to use for everyone, and if not it has a user manual explaining every feature.
It has some weaknesses, the window and text size does not resize, so it may look weird if run on a abnormal screen resolution. The GUI is part of the application code, so every underlying function running over time must be run as a thread or it will appear like the GUI is frozen.
Qt Creator IDE may be used to expand the GUI and the new additional Python code may be merged with the existing.

7.3 Exhibitions

Even if the robot got a lot of attention but the focus of the audience never shifted to engineering and education. One factor may be that the robot is fun and cute so it is likable even if the audience do not want to work with robots.
In a real exhibition event the exhibition display will most likely be part of a stand or a booth with posters, banners and other sorts of information, and the robot would certainly draw attention to that exhibitor.

Kinect
The Kinect were the lowest prioritized part of the project, and the school only had the first edition of Kinect available for use. Lacking functions of Kinect v2 only some joints is controlled when Kinect is used. The feet are excluded totally to keep it from falling over.
To get the best interaction with Kinect it should be changed to the v2 version of the Kinect and completely rebuilt, including control of wrists, fingers, having the robot walk and changing eye colors dependant on the mood of the tracked person(smiling/frowning).
Even though the Kinect interaction was not to our preferred standard the testers enjoyed it.

7.4 Lectures

Since there is an ongoing robotic evolution in industry where robots are replacing humans, but lacking authority and the possibilities to adapt to every context, a robot could not replace a teacher. A teacher is a human with a non perfect memory, and in elementary school they often teach in several subjects with aging textbooks as sources for knowledge.
A theoretical case:
What if the teacher could just say: "robot, geography, Norway.", and the robot would present the country with updated facts, history, maps and images. One person, expert on a given subject could update the information on similar robots in every classroom in a country simultaneously distributed by Internet.
Then the robot will be a definite helpful tool for the teacher. This vision is a basis for the experiment.

Lecture Experiment
The survey sample size were too few to make any representative statistics, and is rather used to make a proof of concept. Constantly comparing robot to biologically anatomy may have confused the participants on some of the questions. On the question "How can robots think? What is their brain?" few had the keywords in both groups, and may have been clearer if formulated as "What component controls a robots actions?".
The most significant aspect is the time consumption, the teacher used approximately twice the time of the Nao robot. The Nao went through the lecture with no input or regard of the attendants actions. It managed to hold the attention for the complete lecture with boost to excitement and some laughter from the jokes. The teacher presentation held a more serious tone throughout the lecture, while the pupils interacted with raising hands and asking questions when they felt the need.

Pre- and post-lectures tests

From the pre- and post-lecture test, to measure if the pupils learned something from the presentations and to see if there was any differences between teacher- and robot class.
From figure 15 and 16 it shows that there is improved results in both classes, and the pupils attended robot class has the highest improvement.

Post question about robot in class

Figure 17 shows that pupils after teacher class that no one were negative to have a robot in class for giving a lecture.
From figure 18 shows that everybody who was in the robot class, is positive to have a robot in the class room. And most of them thought it was super exciting, and would like a robot in the class room.

Observer notes

Focus:
The students in all classes were very much paying attention to all presentation. From figure 25, there was only one student in one of the teacher class that was not focusing for a little moment.
So the differences are negligible.

Level of noise:
From the figures 23 and 24.
There were little noise in the classes, just some chatting and laughter. Level of noise were to some degree higher in the class with the teacher; because of interaction, asking questions, pupils came with suggestions on how things works.
The level of noise did not reach a point that it affected the presentations in a negative way.

Level of fun:
From the figures 21 and 22.
The pupils were quite excited with both presentations, little bit higher with robot.
The excitement that the pupils had in the robot class; through dancing, jokes, music and an acrobatic number when the robot stood on one foot.
The teacher created excitement through; interaction, asking the pupils questions, facilitate an atmosphere where the pupils were very engaged and they came with suggestion on how things are working.

These notes was written by two observers, and each observer took notes of one robot presentation and one teacher presentation. So differences between the two teacher- and robot notes can simply be that humans don‘t see things the same way.

Improvements and error source

To come closer to a significant result from the tests, and make sure it is not a random result. There should be more groups, and each group should receive more lectures.
It is reasonable so suspect that pupils can have a different attitude towards the robot over time(with more lectures).
Therefore it's necessary to carry out a higher number of presentation with the robot with the same groups. To see if there is anything to this suspicion. However, seen at another study in which they measured the students and teachers satisfaction level with a robot in the classroom.(Lee and Lee, 2008) Their study span 2 hours each day for 4 days. Our participants were in 5th grade, and their participants were from 4th and 5th grade. The conclusion was that students was highly satisfied with robot-aided education. so this can indicate that the pupils don't get bored too soon, and our suspicion may be unfounded.
The average number of pupils per teacher in Norwegian schools is 16,8.(Utdanningsdirektoratet, 2015).
To make the test more representative, the number of participants should be higher.

7.5 Social Interaction

Long Term Interaction Experiment

As seen in figure 8 the response of how the test subjects experienced the conversation was not satisfactory for all of them. Some of the test subject said that some of the questions had a unnatural sequence. In figure 11 the feedback was better. The test subjects thought that the second conversation was was better formulated in a way that it felt more natural and talked about things which people would talk about.
As seen in figure 9 it shows that the majority of the test subjects felt that Nao was invested in the conversation, which means that they felt Nao cared for what they had to say and felt Nao was curious of what they would answer.
As seen in figure 10 and in figure 13 it shows that the participants did not have much difficulty with understanding what Nao was saying to them. The graphs also show some deviations in both a good and a bad way.
Shown in figure 12 it was asked if they felt Nao knew them from the keywords that was talked about. Important to note that in cases where the scores where low in figure 7 gave worse feedback, which is understandable. The results show that in 90% of the time Nao gave the test subjects felt Nao knew them good or very good.

The user profile creation worked perfectly, and each person got their profile image, with their name as a tag for creating their own repository of data containing personal information.
Using vocal interaction and storage of their profiles for seems to be a good way for creating a bond between people and robots. The experiment shows that people are able to interact with robots and start to feel that the robot can know them. The test subjects liked the idea that a robot can remember a person and his interests for later references, such as knowing their hobbies and showing an interest in their life. After the experiment most of the test subjects was eager to talk more to Nao, for Nao to learn more about them. As the study *Building up child-robot relationship for therapeutic purposes: From initial attraction towards long-term social engagement.*(Díaz et al., 2011) concluded with, that vocal interaction is needed, to increase a interaction experience, of which we retrieved good feedback from the test subjects after the experiment.

The profile creation and it's storage of personal data worked perfectly in itself. Retrieval of the information for part 2 of the experiment worked perfectly as well.

Observations during and after the experiment depicted that people quickly start to feel comfortable with talking to a robot. That people start to learn to hear what a robotic voice says.
During the experiments it became clear that the text manipulation to extract keywords was not solid enough yet. There where occasions where the test subjects built their sentence up in a way that was not thought out beforehand. Which shows that to create a perfect keyword extraction demands more time. On the other hand, since it was a calculated factor that the possibility of unknown ways to build up a sentence would occur, the program is built in a way that it is possible to recollect all the data that is stored. In that way information can be inserted later on and the algorithms will work better for each time used.

7.6 Information Security

For commercial use there should be some layer of security for the profiles that Nao creates. In a scenario where a person grows up with a robot, learns all kinds of personal information, information the person would not want other people to get hold off. If it happens that NAO gets hacked and the personal information gets stolen, there might be some bad outcomes, worst case scenarios would be identity theft, stealing information that might give the hacker access to your accounts of different varieties.
In this project it is not implemented any security to protect any information for the issue that was just described, but the information is deleted once the experiment is completed.

8 Conclusion

8.1 Research objectives

May a humanoid robot be used successfully to draw attention to an engineering education at NTNU Ålesund?
The robot draws attention, but to itself not an education. To use it as advertisement for study programmes the robot has to be used in a clear context of what its purpose is.
The conclusion for the the question *May a humanoid robot be used successfully to draw attention to an engineering education at NTNU Ålesund?* is a compromise: The robot can be used to draw attention, which can be utilized to inform about engineering educations at NTNU Ålesund.

Is it possible to use a robot in an educational purpose that is both beneficiary to both students and the teacher?
Because the robot did not perform worse than the teacher, the concept of using a robot to give a short lecture in a special topic does not decrease academic gain is proven.
As the tests indicate the pupils are paying attention, they get excited, and above all else they are learning from it. Not to mention the differences in time consumption, were the robot uses about half the time.

Is it possible to get the feeling that there is a relation between a robot and a person based on preliminary vocal interaction?
The experiment gave positive results concerning that people can feel like a robot can be used for daily conversations, for talking about and learning personal information. Most test subjects felt that talking to a robot did not feel unnatural and a bond was created. Because 90% of the test subjects felt the robot knew them, the concept is proven, with individual deviations.

8.2 Front end application

The resulting GUI, Nao Control Center, is an user friendly front end application including all elements of the hypothesises and more to control the robot. There is no need to know programming to use it. It can be expanded with the original IDE, Qt Creator, to include any function additions. The conclusion is that the GUI meets every criteria set, both direct and underlying.

8.3 Suggested future work

Lecture Experiment
Broaden the experiment so the results can be significant.

Long Term Interaction Experiment
Do a more vast experiment over a longer period of time, with a more dynamic flow.
Too further broaden Naos knowledge about it's surroundings it would be a good idea to create family trees, work relations, who works out with who, or common interests. This would create the feeling Nao knows who is the persons friends or family members.

Power Point Lecture
Make it so that it won't be necessary to know how to program python to be able to create a PowerPoint presentation with the robot.

Speech Recognition
Look into improvements to speech recognition application so that it can process data in real time

Lecture Interaction
Add interaction possibilities to robot so that pupils can ask questions during lectures. Would recommend to create a hybrid between the lecture experiment and the Long term interaction experiment.

Kinect V2
To use Kinect V2 for building on the project that exists today, for creating more features to what Nao can mimic.

Natural Language Processing
To broaden the usage for later experiments, there will be needed more time with programming more intricate algorithms. So it would be smart to keep working on Natural Language Toolkit.

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10 Appendix List

Appendix A Preproject report
Appendix B Nao Control Center GUI User Manual
Appendix C Nao Quick Start Guide
Appendix D Qt Creator's "Nao Control Center" .ui file and resources
Appendix E Revision NAO dialog test part 1
Appendix F Revision NAO dialog test part 2
Appendix G Pre-Sheet for dialog test
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FORPROSJEKT - RAPPORT

FOR BACHELOROPPGAVE

TITLE:
Social robot

CANDIDATENUMBER(S):			
DATE:	CHOURSECODE: **IE303612**	SUBJECT: **Bacheloroppgave**	DOCUMENT ACCES: - Åpen
STUDY:		NR. PAGES/APPENDIX: /	BIBL. NR: - Ikke i bruk -

CONTRACTING ENTITY/SUPERVISOR(S):
NTNU in Ålesund Girts Strazdins, Ibrahim A. Hameed

ASSIGNMENT/SUMMARY:

Denne oppgaven er en eksamensbesvarelse utført av student(er) ved NTNU i Ålesund.

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Content

1 INTRODUCTION

The reason for the choice of assignment is the desire for a task with a lot of programming, computer vision and that it should be programmed something physical.

Contracting entity is NTNU in Ålesund where Girts Strazdins and Ibrahim A. Hameed are supervisors.

Issues: Program a social robot that autonomously shall have a social interaction with humans. Since modules on the robot can exclusively be programmed in C ++ or python, we must learn two new programming languages.

2 CONCEPTS

NAO	The "NAO" model robot made by Aldebaran robotics
Choreograph	The software used to program the NAO-robots behaviour
Python and C++	Programming languages

3 PROJECT ORGANIZATION

3.1 Project group

Studentnumber(s)
130162 130169 130751

3.1.1 Project group tasks - organizational

The responsibility for the completion of the project is equally divided between the members of the group.
Project manager: Ivar Jakobsen
Coordinator: John Olav Rostad
Other members: Håvard Hatlemark

3.1.2 Project manager duties

- Keeping the Progress plan updated.
- Keeping an overall view on the project.

3.1.3 Coordinator duties

- Write and archive meeting abstracts.
- Plan weekly meetings with supervisors.

3.1.4 Other members duties

- Holding the deadline of assigned tasks.

3.2 Supervisor

Contracting entity: NTNU in Ålesund
Supervisors:

- Strazdins, Girts.
- Hameed, Ibrahim.

4 AGREEMENTS

4.1 Agreements with contracting entity

None this far.

4.2 Workplace and resources

- Workplace:
  Our supervisors are currently trying to find an accommodation for our group for us to work alone. This gives us the possibility to leave our workstation without having to pack everything away.

- Recourses:
  - A Linux based computer.

- Access to personnel:
  We will have access to our supervisors during schooldays. Outside that they will be accessible by e-mail.

- Computer Safety/information inaccessible to public:
  The project we are working on is not vulnerable data. There are therefore not any specific rules we need to follow.

- Reporting:
  In the events that there are any problems, the person who discovers them must report at once to the rest of the group and inform our supervisors, if necessary.

4.3 Group Norms – Collaboration rules – Attitudes

Basically we are working together at school with core time from 10:00 to 14:00, where the number of work hours should be between 6-8 per day. Consensus must be achieved before a decision can be reached.

Coming too late must be avoided. If agreed, a member can work elsewhere, but then the project manager must be updated on progress that day.

The project implementation shall be serious, where group members meet at appointed time and behave professionally.

Documenting what you do / find out so that the others on the team can easily acquire the knowledge.

5 PROJECT DESCRIPTION

5.1 Issues - objective - purpose

The project issue is to make a robot function autonomous socially in such a way that it can work as a motivator for students during classes and for homework. The robot is also to be used in social attendances arranged by the school.

effect goals:
- Deliver a product that is autonomous and possible to continue working on.

result goals:
- Create a basic concept in how robots can be helpful in classrooms.
- Develop an autonomous program on the robot.

process goals:
- Using known concepts which we have learned and use them to solve this assignment.

5.2 Demands for solution or project result - specification

- Description of the bachelor assignment: "We would like to create a robot, which would interact with visitors at exhibitions. For example, a robot that can detect faces, turn towards them and give them a candy. Such a robot would be fun and attract more people, showing that we can do practical robots. You can come with your own ideas on how to make this interesting. We have different robot platforms available, waiting for you to make something interesting. "

- From multiple meetings with our supervisors we have come to an agreement in what the project should be focused on. Out from the assignment the demands for the project is:

Requirements:
1. The robot must be autonomous.
2. It should be able to read faces and facial expressions
3. Work as educational assistant.
4. Be interactive and entertaining at events as advertisement for the contract entity, NTNU.

- The finished product must have all the requirements and a complete documentation of source codes and the research that have been conducted.

5.3 Planned approach(es) for Development – method(s)

Planned approach: To start with the group must be able to code in Python and in the software of the NAO robot called Choregraphe. Therefore the first weeks the primary goal is to learn coding the languages.

For the start of the project it is important to start gathering all the information needed to program the robot. The vast libraries of the coding give us a small challenge to find exactly what we need and at what web-pages we can find it. The group will search for information in different aspects of the bachelor. This will give the group the opportunity to learn from each other, and will definitely reduce both workload and time spent.

The group will thereafter start with each project of coding. making classes individually and then sew them together to make the robot autonomous with a high variety of information handling.

5.4 Information Collection – designed and planned

- To collect the information needed for the project we have access to the developer page to the robot we are programming. This page contains different project other developers are programming at this moment. There are programs on this page that are searching for people to start, ongoing and finished programs.

  This gives us a few programs we will not need to program ourselves, but rather develop to work better.

  There is also web pages that contains the different libraries on the syntax of the robot. The libraries let us know which commands is valid and which is not.

5.5 Assessment - analysis of risk

- Assessing the demands for the project have a few setbacks of what was originally planned. The mood detection that was planned is still not something we understand how to complete. As of this day we have not yet figured out how to do image processing over the programming platform we are using.

- The other demands which is demanded is something we know we will be able to finish. The research so far and small test programs have shown that it should be possible. The drawback might be processing speed when we start getting big programs to run.

- We have Assessed that the most important thing to do for success is to have a strict plan of partial goals that will be needed to finish the project. This gives motivation as small accomplishments gets completed to finish a greater goal.

5.6 Main activities in future work

Num	Main activities	Responsibility	Cost	Time/Scope
A1	**Programming Research**			
A11	Compatibility	Håvard	0	
A12	Simulation	John Olav	0	
A13	Syntax	John Olav	0	
A14	Pre-existing programs	Ivar	0	
A15	Information bank	All	0	
A2	**Pre project report**	John Olav & Ivar	0	
A3	**Programming**			
A31	Mood detection	John Olav	0	
A32	Speech recognition	Ivar	0	
A33	Personal data storage	Håvard	0	
A34	Movement dancing	Ivar	0	
A36	Movement body language	Håvard	0	
A37	Interact with objects	John Olav	0	
A38	Conversation	John Olav	0	
A4	**Field testing**			
A41	Exhibitions mode	Ivar	0	
A42	Make examination forms	Ivar	50 kr	
A43	Make Parental acceptance form	Håvard	50 kr	
A44	Educational mode	John Olav	0	

For time estimates see appendix 1

5.7 Progress plan – management of the project

5.7.1 Master plan

Our progress plan does not stretch far into the future, only 4-6 weeks. In this time, we will discover restrictions and possibilities of which we will have to adapt to reach the goals of the project.

For specific time estimates see appendix 1.

5.7.2 Management Tools

1. We will be using an online cloud solution for storing information about the project, so all can access the information at all times. We made a progress plan on the cloud for the group to have an overview of the projects deadlines.
2. There are no orders for this bachelor so it is not necessary to include in this report.

5.7.3 Development Tools

1. Simulation software V-Rep or
2. Simulation software Webots
3. Development community web-page for Q&A.

The advantage of using webots is that Aldebaran, the creators of NAO, have cooperated with them and made a working platform. The disadvantage is licensing is not free.
V-Rep is free when used for educational purposes. The disadvantage is that the easiest link between Choreograph and V-Rep is a script made by a person on hobby basis, who have uploaded it for free distribution on the web page github.

5.7.4 Internal control - evaluation

- Once a week the coordinator asks the groups of how the progress of their missions is going. If the progress is starting to slow down, the person who has the objective will get the help needed from another person from the group to continue the assignment. Hopefully that will be enough. It will also be necessary to document the work that have been done. This will most likely keep motivation to hold the work process going, and keep the workload fair.

- evaluation: The criteria for an accomplished goal does not have to be perfection. It is rather to get the functions to work correctly. Percentages of failure have not been discussed at the moment. The main goal for the project is to have accomplished the autonomous behavior of the robot. Face- and voice- Recognition will have weaknesses from the hardware, not the programming. That is something we cannot change anything about.

5.8 Decisions - decision process

- Supervisors gives us their preferred assignments for the coming weeks. Then we accept the assignments we believe is manageable in the time limit that is given. For any assignments that will need a lot of work from a single person there will be assessed the current workload and a fair decision will be taken over democracy.

6 DOCUMENTATION

6.1 Reports and technical documents

- Source code
- Statistics of image processing hit/miss for mood detection, if it is completed.
- User manual for the resulting programs.
- Quick start guide, so everyone can get it up and running.

7 PLANNED MEETINGS AND REPORTS

7.1 Meetings

7.1.1 Meetings with the management group

- Meetings with Advisors every Friday at 10.00

- There will be sent a meeting invitation on forehand with a short description on what the meeting agenda is, this is to give our advisors a possibility to prepare.

7.1.2 Project meetings

- Planned meetings: Every Friday at 10.00 am.
  Purpose of this meetings is to give feedback of our progress and get input on how to solve elementary issues we might have underway. The supervisors does also come with new assignments for us to solve for next week.

7.2 Periodic reports

We will deliver weekly reports in our meeting with our supervisors. If requested the coordinator of the group will deliver E-mails of issues or feedback of the project goals as we complete them.

7.2.1 Progress reports including milestones

- Progress Report will be updated as each partial goals for our project is finished. It is stored on a cloud so all of us can edit it.

8 PLANNED DEVIATION HANDLING

If there are unavoidable problems which makes current tasks, goals or partial goals impossible, we discuss it with the supervisors at the weekly meetings. When a current task halts it should be documented with reason to why it halted and the focus should then be directed to another task. The project manager keep tracks of which upcoming tasks are affected by the deviation, and must plan how to adapt the tasks to reach the goal.

9 NECESSARY EQUIPMENT

We are able to do top layer programming with our personal computers, but to access the NAO deeper we need a computer with Linux operating system.

APPENDIX

Appendix 1: Progress plan (in norwegian)

Nao Control Center Graphical User Interface: User Manual

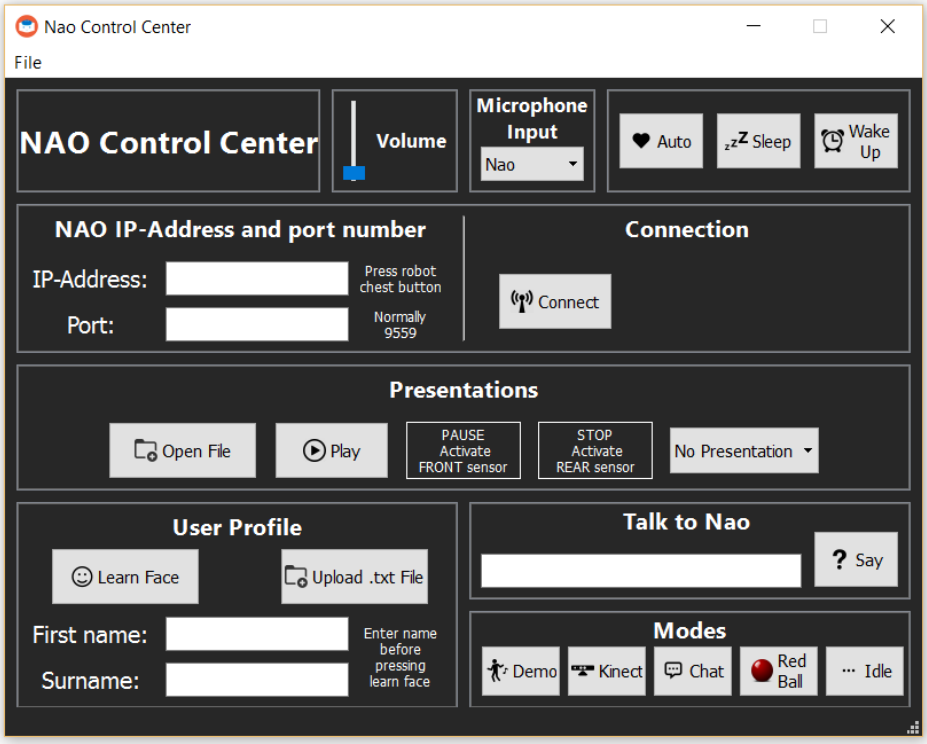

Image 1: The Nao Control Center GUI

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1. Introduction

This user manual is for Nao Control Center GUI, which is a graphical user interface made to easier interact with a "Nao H25" robot from Aldebaran Robotics.

Both the Nao Control Center GUI and this user manual is made as part of a bachelor thesis assignment at NTNU Aalesund.

Hereafter the Nao Control Center GUI will be referenced to as "NCC".

Nothing on NCC will work before you have a successful connection, see chapter "4. Connect to robot"

2. Prerequisites

For NCC to fully operate following prerequisites must be met:

- Aldebaran Robotics, Nao (H25) robot
- Windows operating system
- PowerPoint capable of handling .pptx files
- Python 2.7, 32 bit
    - The project files from the "Social robot" NTNU Aalesund bachelor thesis including all necessary python libraries.
- Kinect for Windows V2
- A red ball approximately 6cm diameter
- Wired or wireless communication abilities

3. Status Line

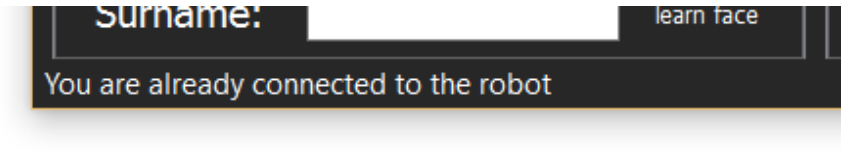

Image 2: NCC Status line

The status line is at the bottom left of NCC and will display information based on the last input on the NCC.

4. Connect to the Nao Robot

The mandatory thing to do before anything else on NCC will work is to check the connection to the robot.

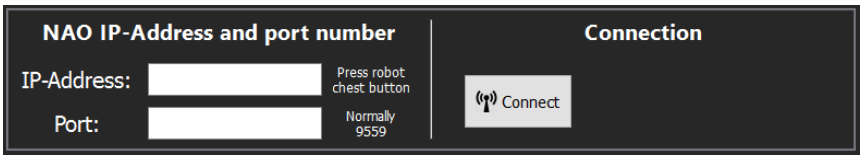

Image 3: NCC Connection frame

4.1. How to connect to the robot:

1. Make sure the computer is on the same wireless or wired network as the Nao robot
2. Press, and do not hold the chest power button on the Nao robot (green blink). The Nao will tell you the IP-address or if it lacks a network connection. Enter the 4 parts of the IP-address separated by dots (123.45.67.890)
3. Enter the port, very likely to be 9559 as this is the factory setting.
4. Press Connect.

4.2. Unsuccessful connection:

Image 4: NCC Bad connection

If you have tried to connect to the Nao robot and failed, you will see a red symbol in the NCC Connection frame as shown in image 3.

Follow the steps in "How to connect to the robots" and try again.

If you still cannot connect to the Nao robot, check if you have more than 1 network cards enabled on the computer. If so disable the network cards not communicating with the network the Nao robot is connected to.

4.3. Successful connection:

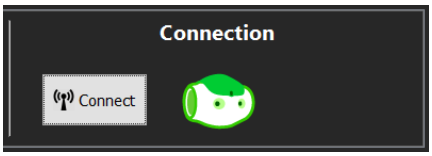

Image 5: NCC Good connection

If you have tried to connect to the Nao robot and succeeded, you will see a green symbol in the NCC Connection frame as shown in image 4.

When this occurs the IP-address and port input will be locked and non-editable.

You are now able to use all the other function on NCC.

5. Volume Slider

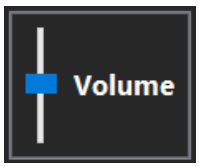

Image 6: NCC Volume slider

The volume slider sets the absolute speaker volume of the Nao robot.

The range is 1-100%

After the volume is changed the Nao robot will respond with the new volume percentage, and it will also be displayed in the status line.

6. Microphone Input

Image 7: NCC Microphone input

Change the microphone you want to use to communicate, either the Nao robot's internal microphone or the computers microphone.

7. Basic Modes

Image 8: NCC Basic Modes

7.1. Auto

The Nao robot will turn the autonomous life behavior to solitary, which means it will stand up, turn on motor stiffness and follow faces and sounds with its head.

7.2. Sleep

The Nao robot turns off autonomous life behavior, goes to a crouching position and turns off motor stiffness.

7.3. Wake Up

The Nao robot will turn on motor stiffness and stand up.

8. Presentations

This where you control the presentations (or lectures) the Nao robot perform.

When you start the presentation Microsoft PowerPoint will start the presentation in slideshow mode, occupying the entire screen. To exit it, press the 'esc' key.

Because it uses PowerPoint, presentations should not be run when the computer is in multiscreen mode. Why? PowerPoint only advances in slides when the correct screen is highlighted with the mouse cursor.

When pause or stop is activated the Nao robot will finish the current slides before it pauses/stops.

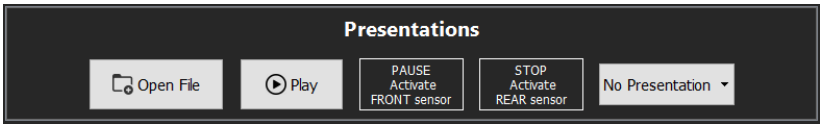

Image 9: NCC Presentations

8.1. Open file

Choose the file path for the .pptx file for the presentation you want to show.

8.2. Play

When a presentation and a file path is selected, play will start the presentation.

8.3. Pause

To pause, touch the front head sensor on the Nao robot.
To continue, press play or touch the front head sensor on the Nao robot.

8.4. Stop

To stop, touch the rear head sensor on the Nao robot.
Stop will end the presentation and reset the progress of it.

8.5. Presentation selection

Select the presentation you want to show from the drop down menu.

9. User Profile

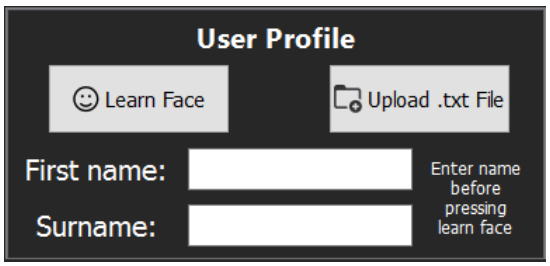

Image 10: NCC User profile

Creation of a user profile with NCC is the most foolproof method.

Both first name and surname must be entered before you are able to learn the face of said person, which have to be the focus off the Nao robot's camera (0.5 – 1 m distance).

Optional is to include a .txt file where the person introduces itself as it would to another person. The key information will be extracted and stored in the user profile.
Example on text:

> *"I am 30 years old, living in Oslo, Norway, working at ABC1. My hobbies are judo and volleyball. My favorite movie is Titanic"*

10. Talk to Nao

Image 11: NCC Talk to Nao

The Talk to Nao interface utilizes Cleverbot (www.cleverbot.com).
Therefor an internet connection is required.
The response is based on the input, and is generated by pressing 'Enter'' key or Say.
Easter eggs, enter: hello, rick roll or What (may contain strong language)

11. Modes

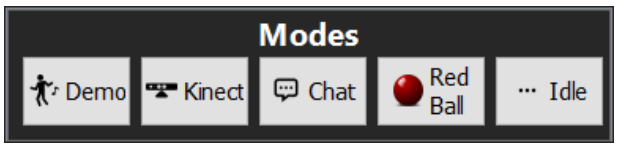

Image 12: NCC Modes

11.1. Demo

Demo mode is a predetermined pattern with a lot of movements, sounds and light change. It is not interactive but a great way to attract attention.
To stop, touch the middle head sensor on the Nao robot or idle on NCC.

11.2. Kinect

The Nao robot will mimic the person in front of the Kinect. It will follow the arm and head movements. The feet are excluded to make sure it does not fall over, but it will change its height based on the person's hip height.
To stop, touch the middle head sensor on the Nao robot or idle on NCC.

11.3. Chat

Speak with the Nao robot through microphone input. It uses predetermined dialogue and Cleverbot (www.cleverbot.com).
To stop, touch the middle head sensor on the Nao robot or idle on NCC.

11.4. Red Ball

The Nao robot will track and try to place itself 0.5 meter from a (6cm diameter) red ball with 5 cm margin in all X and Y directions.
To stop, touch the middle head sensor on the Nao robot or idle on NCC.

11.5. Idle

Ends the Demo, Kinect, Chat and Red Ball modes and leaves the Nao robot in a standing position.

Nao Quick Start Guide

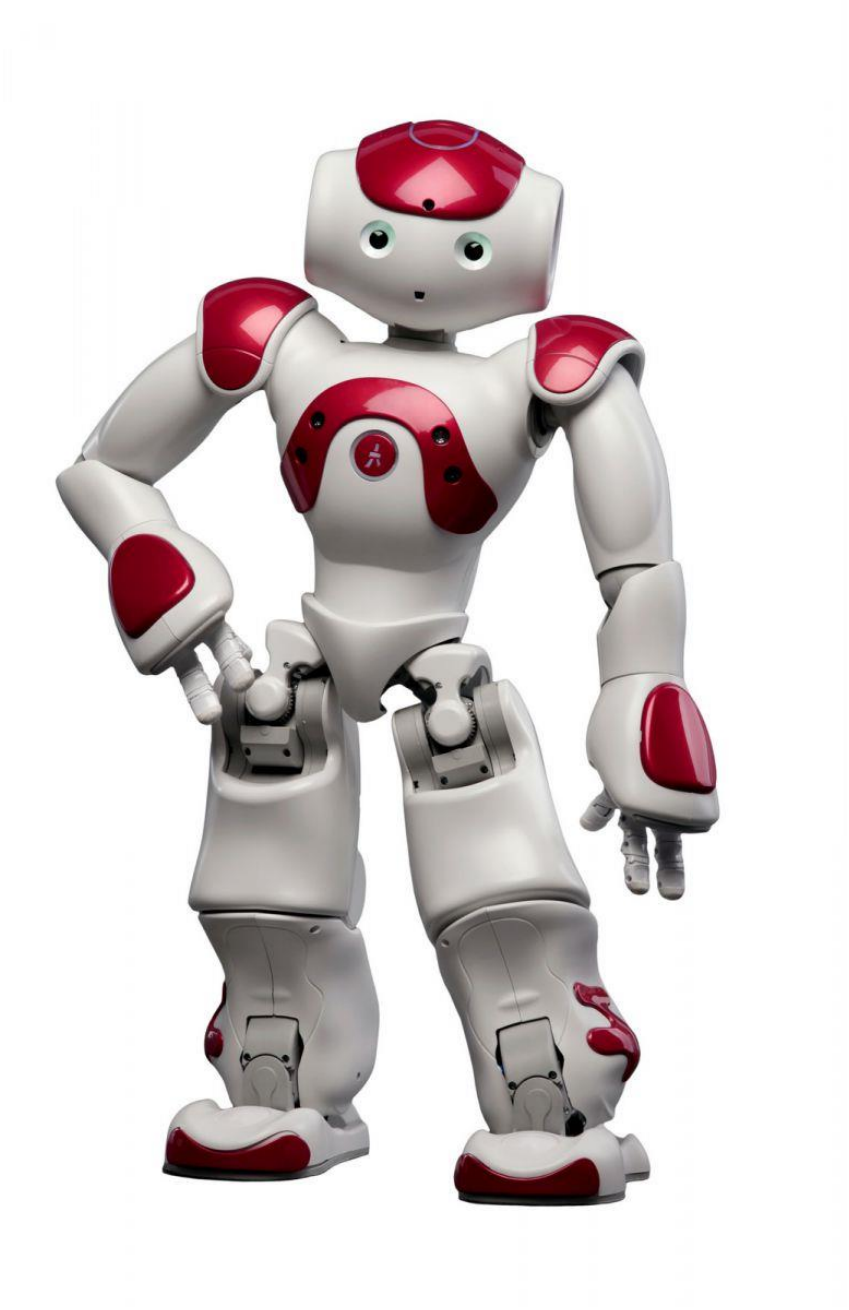

Image 1: Aldebaran Robotics' Nao (H25)

Index

1. Introduction

This quick start manual is made to easier get to know how to set up a "Nao H25" robot from Aldebaran Robotics.

The quick start manual is made as part of a bachelor thesis assignment at NTNU Aalesund.

The images are retrieved from Aldebarans online documentation.

2. Prerequisites

To do the steps in this guide the following are needed:

- Aldebaran Robotics, Nao (H25) robot.
- Computer with Choregraphe Suite installed.
- Wired or wireless communication abilities.

3. Obtaining Choregraphe Suite

To access Choregraph suite, registration as developer is required at Aldebaran community.

https://community.aldebaran.com/

When you are successfully registered as a developer go to "Resources" and then to "software" and download the version of Choregraph Suite matching your computer. On the same web page are the SDKs for C++, Python and java if you are going to program the Nao robot outside of Choregraph.

Install Choregraph Suite.

4. Connection Nao – Computer

Before a Wi-Fi network is defined on the Nao robot, a wired connection is required. There are several ways to perform this connection:

Image 2: Direct connection between computer and Nao

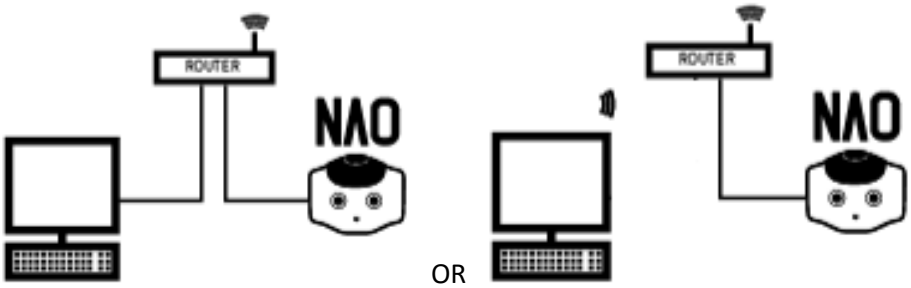

Image 3: Connection between computer and Nao through a router

When a Wi-Fi network is defined no cables are longer needed.

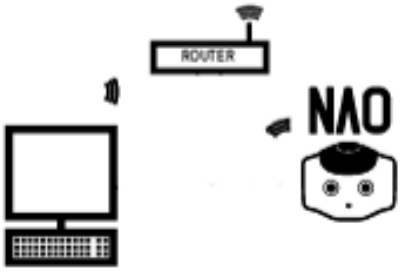

Image 4: Computer and Nao connected wireless through a router

5. Accessing Nao's web page

To change the settings of the Nao robot you need to access its web page.

The standard username is "nao" and password is "nao"

There are two ways to do this.

5.1 Via Choregraph Suite

When the 'Connect to' interface is open, right click the connected robot and click view web page.

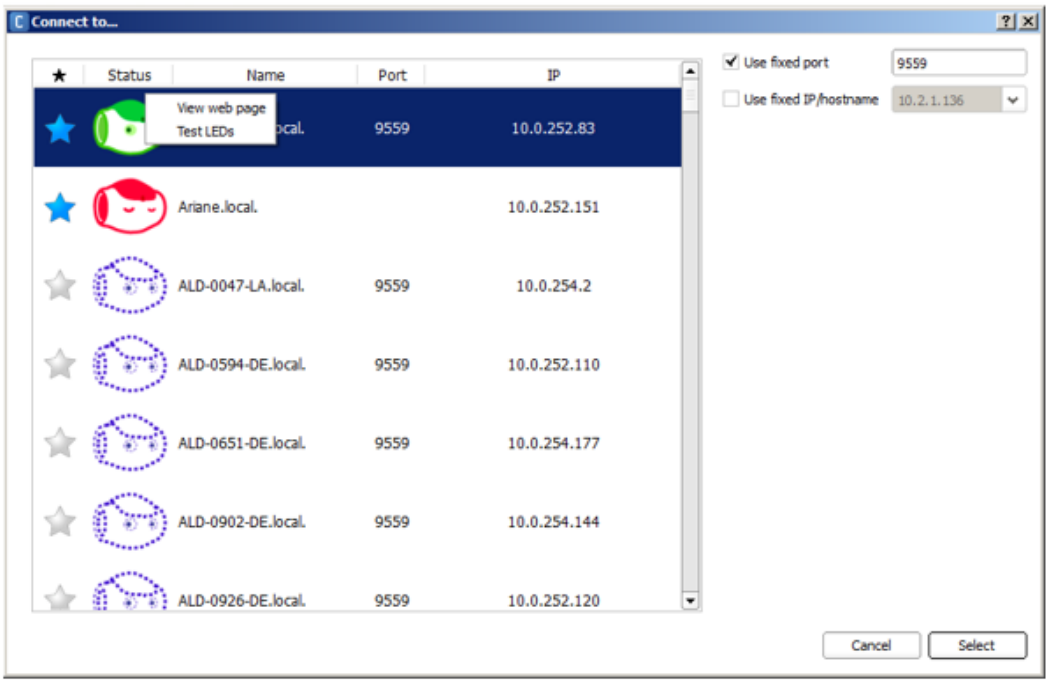

Image 5: Choregraphs 'Connect to' interface

Enter username and password.

5.2Via Web browser

Get the IP-address from the Nao robot by pressing its chest button.

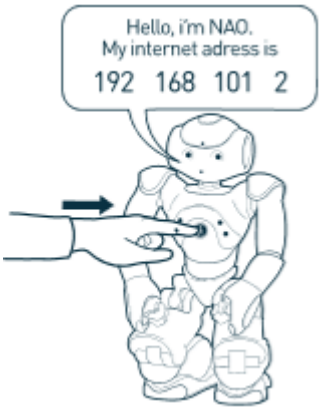

Image 6: Pressing Naos chest button

Type the IP in the address field on your preferred web browser.

Image 7: Typing IP in web browser

Enter username and password.

6. The robots web page

When the steps in either section 5.1 or 5.2 you have successfully entered the robots web page.

Image 8: Robot web page

To access, if needed/preferred, the former web page, click the question mark and then click 'Former robot web page'.

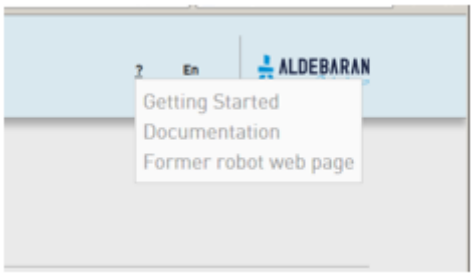

Image 9: Accessing former robot web page

7. Connect Nao to a wireless network

When accessing the robots web page, click the globe symbol to get the network connections menu.

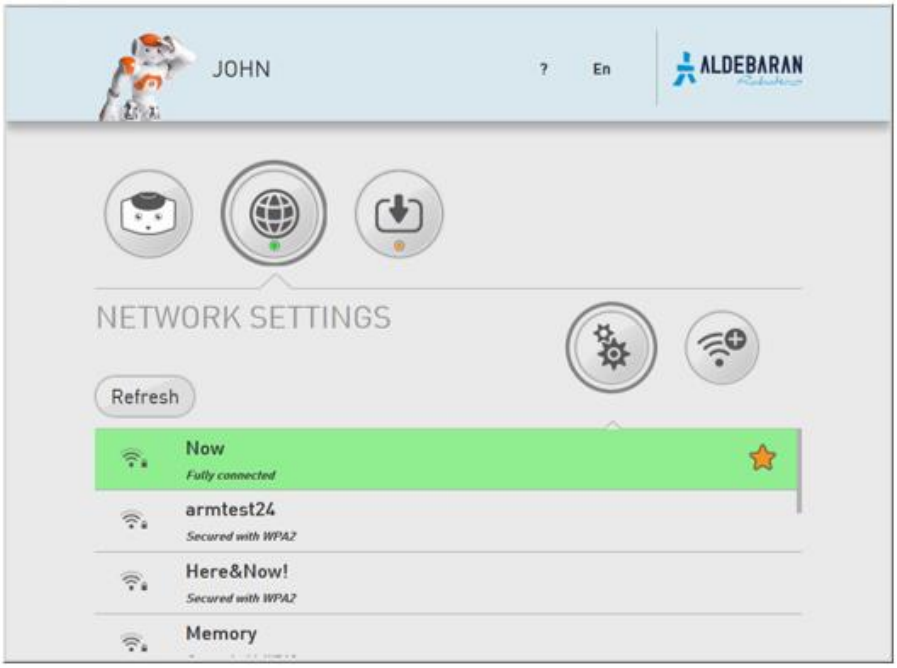

Image 10: Robot web page, network connections

Either select a visible network or click  to add a hidden network.

Insert all necessary information.

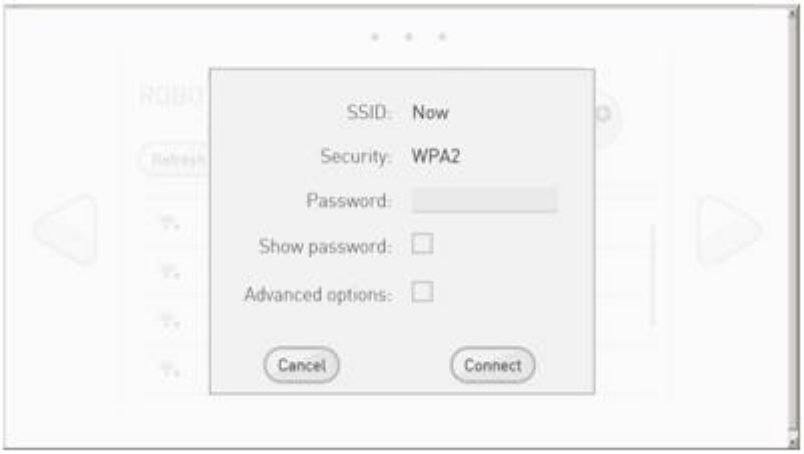

Image 11: Network authentication

8. Nao as a hotspot

It is possible to use Nao as a hotspot and connect to it as a Wi-Fi router. To activate this, you need to go to the 'network' section in the 'Former robot web page' and activate 'Tethering'.

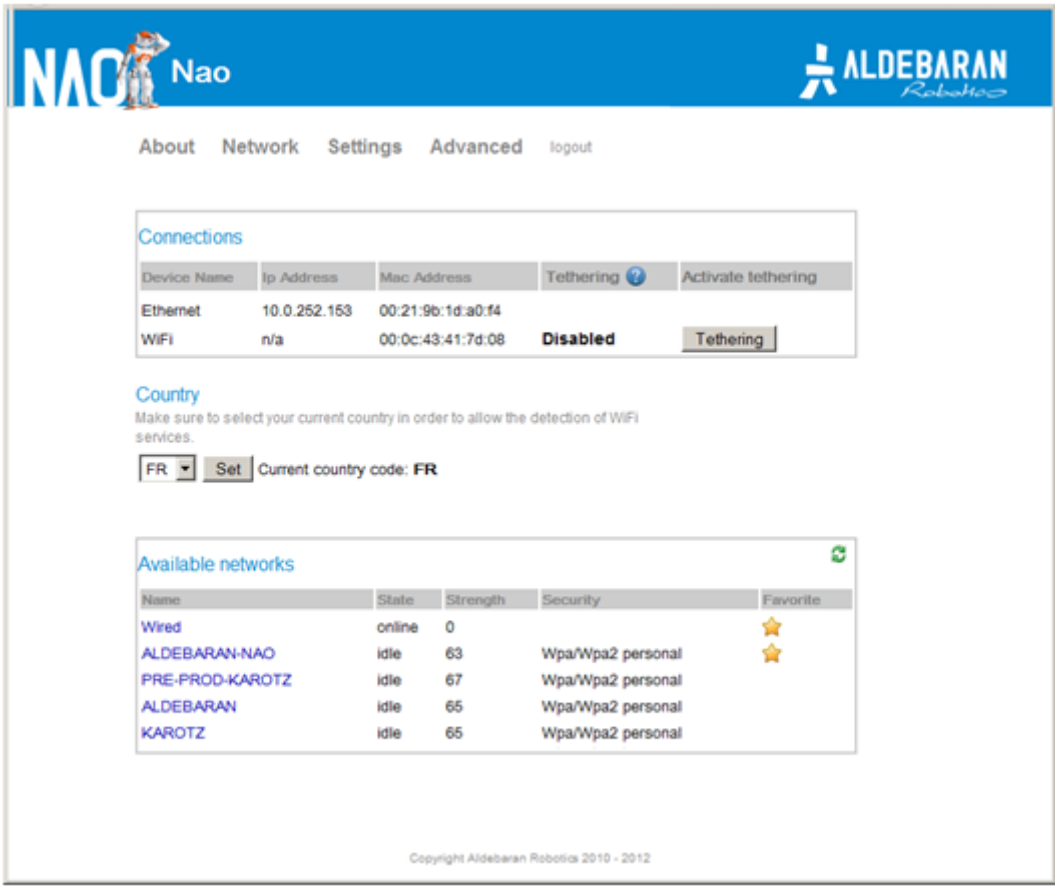

Image 12: Former robot web page, network section

Revision NAO dialog test part 1

In what degree would you say the conversation felt natural:

0 = Not at all, 1= Stressed, 2 = good, 3 = Very good

0	1	2	3

In what degree would you say Nao was invested in the conversation:

0 = Not at all, 3 = Very much

0	1	2	3

In which degree would you say you understood what Nao was asking you

0=Hard to understand ,1 = a bit difficult, 2 = understandable ,3 =Understood perfectly

0	1	2	3

Was there any questions you felt was to intimate to talk about? if so write theese down:

-
-
-
-

If you have any suggestions for what Nao should ask write theese down here:

-
-
-

Revision NAO dialog test part 2

nr

In what degree would you say the conversation felt natural:

0 = Not at all, 1= Stressed, 2 = good, 3 = Very good

0	1	2	3

In what degree would you say Nao knew you?

0 = Not at all, 3 = Very much

0	1	2	3

In which degree would you say you understood what Nao was saying

0=Hard to understand ,1 = a bit difficult, 2 = understandable ,3 =Understood perfectly

0	1	2	3

Was there any questions you felt was to intimate/unatural to talk about? write theese down:

-
-
-
-

If you have any suggestions for what Nao should ask write theese down here:

-
-
-

This the Pre-Sheet for the experiment Study of Nao Social skills. Part 1

Information about how the user must prepare:
The experiment will be conducted strictly in english.
The test subject must answer the questions with a clear voice and answer quickly after the question is asked.

The following text will contain questions that NAO will ask, it would be appreciated if you read through them and write down your answers beforehand, this is for our experiment to have as much information about the test subjects as possible.

lines starting with “U:” is user and lines starting with “R:” is Nao.
In paraphrases a few hints is written down a manual for the test subject to follow

Part 1 Not using GUI:
START
R: Hello, did you want to talk to me?
U: (here you answer with a simple positive remark: yes, correct, sure, ...)

FIRSTNAME:
R: What is your name?
U:(After you hear a bip, say your name clearly, only say your name, nothing else)

R: Did you say (your name)?
U: (if name is correct, answer yes, else answer no)

TAKE PICTURE:
R: Hold your face still until my eyes are green
U: (make sure you stare directly at Naos camera, until you see the eyes turn green or nao starts speaking again)

CREATE PROFILE:
R: hi there (your name) , Give me a second to create your profile…
U: (Look away for two seconds then look back at Nao)

SURNAME:
R: What is your surname?
U: (answer only your surname)

AGE:
R: hi there (your name) … I am 4 years old how old are you?
U: (here you can answer with full sentence (eg. I am 20 years old))

WHAT ACTIVITY DO YOU PARTAKE IN
R: Do you engage in any kind of activity?
U: (positive or negative response)

if yes: R: what kind of activity do you do then?
U:(answer with a whole sentence, preferably a sport)

if it is known: R: i know that sport

if unknown: R: is that a sport?
U: (yes or no)

if yes: R: I didn't know that was a sport, but now i do

else: R: okay then

COUNTRY YOU ARE FROM
R: well since we are in Norway i suppose you where born here?
U: (yes / no)

if no: R: Oh okay, which country where you born in then?
U: (answer whole sentence (eg: i was born in Sweeden)

WORK OR STUDY
R: Do you work or study?
U: (answer with sentence (eg. I currently study / I work / i am unemployed)

if study/work: R: Where do you (work/study) at?

U: (eg. I study at NTNU / i work at Rolls Royce)

EDUCATION:

if study: R: What do you study?

U: (eg. I study Automation engineering)

if work: R: What education did you need to get your job?

U: (eg. Economics)

RELAXATION:

R: so you (work/study/unemployed) , what do you do to relax?

U:(eg: to relax i like to drink tea / i like to play computer games)

HOBBY:

R: so you (previous answer) to relax, what would you say is your hobby?

U: (eg. on my spare time i play guitar / my hobby is knitting)

PET:

R: A lot of people have some sort of pet, do you have any?

U: (yes/no)

If yes: R: That's fun, what kind of animal is it?

U: (eg: i own a dog)

If known pet: R: oh i love (pet)'s

If unknown pet: R: You can have (pet) as a pet? Guess you learn something new every day