Modelling Human Behavior and State

A machine learning approach

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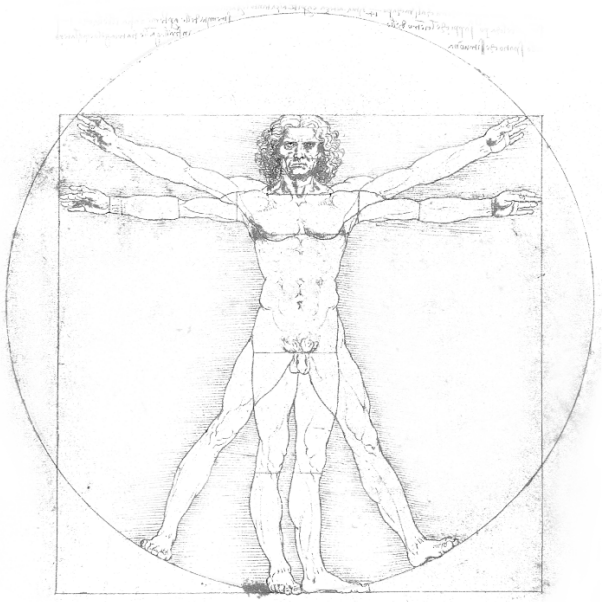

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Abstract

Short intro to the project (1/2 pages)

- what is it about (problem)
- what has been done to ready the problem (method, data)
- findings (main findings)
- precautions for the findings
- conclusion
- implications

Preface

TODO: When / Where / COINMAC / Kyushu University

Tell me, have you heard the story of *Darth Pelagius the Wise*? I thought not. It is not a story the *Jedi* would tell you. Ironic, he had the power to save others, but not himself.

Acknowledgements

I would like to thank Professor Jim Torresen and Vice Dean Ryo Kurazume for the oppurtunity to write this masters thesis at the lab here in Kyushu. TODO: friends, family [2]

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Abbrevations

Nomenclature

Chapter 1

Background

Some background on the project

1.1 Motivation

With an ever aging elderly population an increasing amount of elderly also want to live at home.

Asymmetry in gait after stroke. -> detect and report?

1.2 Elderly Care

1.2.1 Facilities

Elderly people are often put in homes to better get help with their needs.

1.2.2 Living at Home

Home nursery

1.3 Multimodal Elderly Care System

A system to assist elderly living at home.

As we are ever growing older, and staying at home until a greater age, we need to effectivize the way in which healthcare workers provide the care.

This project describes a system for obtaining vital data from a subject for the purposes of modelling the subjects state. It also implements methods for predicting

future states based on predetermined risk factors, contextual input, and the observed subject's historical data.

Contextual information: The users contemporary environment represents situational hazards and could provoke, or lessen the possibility of, certain events. For example, a day with high temprature and humidity coupled with activity could provoke dehydration and cause a fall. If such conditions are correctly assessed, preventative measures could be taken, such as suggesting to lower the temprature, take refuge in the shade, or asking to provide a glass of water.

RGBD Sensor Widley used already implemented robotic systems. Using this sensor will give us a plethora of different alternative robotic platforms to base the system on. There are also many preexisting datasets for activity recognition using RGBD sensor to train the system on. An RGBD sensor has also been used to extract vital information from the video stream. The RGBD sensor is also especially developed for estimating human pose, which can help in recognizing human positure and as mentioned activity. In addition the sensor is versatile, and can be used for mapping and navigation as well.

Jetson TX2 In our experiments the Jetson TX2 board was used to preform human detection in the RGBD image using the OpenPose software developed by the CMU Perceptual Computing Lab.

Pose detection 2d pose detection was done with the help of the OpenPose pretrained network. We then extract the 3d keypoints by projecting and scaling a rigid skeleton onto the depth image. Unobserved points are estimated using previous data, or confined to obstructed space and the kinematics of the skeleton.

Tracking the tracking of each person in the scene is done using face recognition and a simple kalman filter to predict the next location of each person. The faces are pre-stored on the system, and only anonymized information is sent over the network.

The software also supports tracking using multiple RGBD cameras, and will yield a more precise result.

RoI extraction is done simply by making a box that contains all detected keypoints. We do the same for respective face and chest RoIs.

Mood extraction using the Face RoI detected, we run a mood recognition algorithm on the subject. This is done on system to prevent personal information being sent over the network.

Vitals are extracted using spacio temproal methods described in MiT methods, and built upon by various others.

Human Activity Recognition was traind on various RGBD datasets.

Propose decision tree or unsupervised learning model to detect anomalies in the daily routines.

Bottom Up We then want to be able to predict what the person will experience in the near future, AND be able to take preventative measurements so that doesn't

happen. We could imagine a decision tree, and then suggest the available descisions that does not lead to the event we're trying to avoid – kind of like a chess bot that would always choose the maximum possibility route for winning. However the problem is creating the decision tree. We need data, and know at exactly which moment a decision is being made. We could look at the life of the subject as a series of predetermined, reliably recognizable actions. Then, we think of the actions as edges, or decisions, that lead to new states. In each state, we would also have a set of parameters describing the persons vitals and environmental conditions. If all actions are possible in any state, we need to record the similarities beteween different peoples strings of actions. We want the likeleyhood of a person taking a certain action given a set of parameters, and wether or not that action led to a fall or another undesirable event or not.

For this a Hidden Marov Model could be used. The problem is obtaining the training data. We could make the training data synthetically to train the model, and then retrain it using actual data when the system is live. However, this might be immoral, in that we would have to actually get the system to fail to learn anything. If the system never fails, we could be stuck in a local optimum where unneccessarily many restrictions are suggested to the subject.

Chapter 2

Earlier work

Chapter 3

Planning the project

Chapter 4

Method

USE A DESCRIPRIVE TITLE! (ie. Robot Brain Implementation) See your choises in birds eye perspective. how you can discuss what youve done.

What was made, why is it good. document all choices. The rule is that a different scientist with the same resources should be able to get the same results based on your description. Dont write about the methods in general, but exactly what youre doing. discuss your own approach. Show that youre aware there are other alternatives to what you did, and what advantages a different method may have. Did you have any influence over how things were solved. what is strengths and weaknesses about your work. what would you do different if you were to do it again? be open about weaknesses, but defend your choices. Refer to other researchers who has done the same.

Chapter 5

Experiments

What did we find out. dont overcomplicate the explanation. this could be the longest part of the thesis. about 15-20 pages? If you have more questions, use that as structure for this section. You can divide this into multiple chapters: subsidiary questions to the main theme, hypothesies, themes. One to three chapters are usually OK. the most important first, main findings. small neuances exceptions and discussions. discuss what youve found. this could be a chapter in itself.

5.1 Results

the main finings, as simply put as possible.

5.2 Discussion

Look at the results critically, weaknesses to the method. discuss how the findings can be explained. reasons to why you found what you found. how it compares to earier research. can reference some earlier theory.

Chapter 6

Conclusion

About 10% of the lenght (means $\tilde{8}$ pages) often the only thing that is read by people who are just looking at the thesis.

- tell in short version what youve found. main findings first. short, simply put. the neuances and details can be fleshed out in the following sections.
- how your findings fit with earlier work and research. (dont repeat too much from the "earlier research" or "theory" chapters.) What fits, and suggestions as to why.
- The way your finings can have significance. Can we see the subject in a new way? should one change something in practice or how one does things because of your research? can the finds benefit society. Youre going to tell the world, and see what youre writing about in a bigger picture. Can other people learn something from this?
- OpenPose [1]

Chapter 7

Future Work

What research is missing, what do we want to know more about, what other methods should be tried out

Bibliography

[1] Zhe Cao et al. 'Realtime Multi-Person 2D Pose Estimation using Part Affinity Fields'. In: *CVPR*. 2017.

[2] Miwako Honda et al. 'Reduction of Behavioral Psychological Symptoms of Dementia by Multimodal Comprehensive Care for Vulnerable Geriatric Patients in an Acute Care Hospital: A Case Series'. In: *Case Reports in Medicine* (2016).

Notes