Optimisation of superquadric parameters through machine learning of shape histograms

Project Plan

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Introduction

The dissertation project can be described as an investigation into shape histograms and how their usage can improve the runtime of the system built as part of A Model-Based Approach to Finding Substitute Tools in 3D Vision Data. The purpose of the mentioned system is to identify substitute tools for specific tasks by performing projections of source models over target objects. Source models can be thought of as the ideal tools for a specific task and target objects are candidate tools that are being examined as their substitutes. The final output of the system is a score that represents the level of suitability of a target object. The projection process is achieved through performing fittings of geometric shapes which best describe the grasping and action parts of the source model over segments of target objects. [1]

In order to optimise the geometric shape fitting process it is possible to devise a trained function which will accept as input a shape histogram and then will return two shape defining parameters and a parameter for tapering. To enable this when the system examines target objects as point clouds it will create shape histograms and will perform a look-up using the already trained function. Thus, instead of performing a free-fitting of the geometric shapes the process will be more directed and in-turn reduce the run-time of the system. The training process for the function will be done offline through machine learning.

Goals

As mentioned in the previous paragraph the product of this work will be an extension of an already built system. The current system is implemented in Matlab and the extension will be made in Matlab. Currently, the idea is to either use artificial neural networks or support vector machines as learning techniques. The merits of using either of them have to be firstly evaluated before a justified decision can be taken. A short research showed that the following libraries can be utilised. For SVM - Statistics and Machine Learning toolbox and for artificial neural network - Neural Network toolbox. This is convenient as it allows me to focus on the project instead of spending time in the implementation

of those learning techniques. Because of the nature of the project it is hard to make an estimation, thus the work was separated in smaller sections. The described work so far is a segment requiring a fair amount of research and implementation time and is an essential contribution towards the final system. Any further work will be regarded as extra.

Methodology

An Agile development approach will be applied as it will best fit the properties of the project and will allow me to comprehend new complex concepts through more extensive communication with both my dissertation advisor and the system author.

- Background research on machine learning techniques, superquadrics and shape histograms
- Familiarisation with Matlab and any related toolboxes (libraries)
- Developing a prototype to test initial understanding and later iteratively improving it
- Keeping a record of design decisions, advisor notes and extracts from already read journals/papers.

Resources Required

- Computer
- Matlab and any related toolboxes

Risk Assessment

A possible risk scenario in which I will not be able to timely deliver a particular project milestone or the whole project can be related to malfunction or issues with the libraries described in earlier sections. This, however is highly unlikely as they are Matlab libraries which are highly used across different applications. In case of any problems they will be communicated with the dissertation advisor immediately so that a suitable resolution is established and project delivery is not jeopardised.

Timetable

This is to serve more as a template and for communication purposes. It is expected that dates from that chart will vary but in general that schedule should be followed.

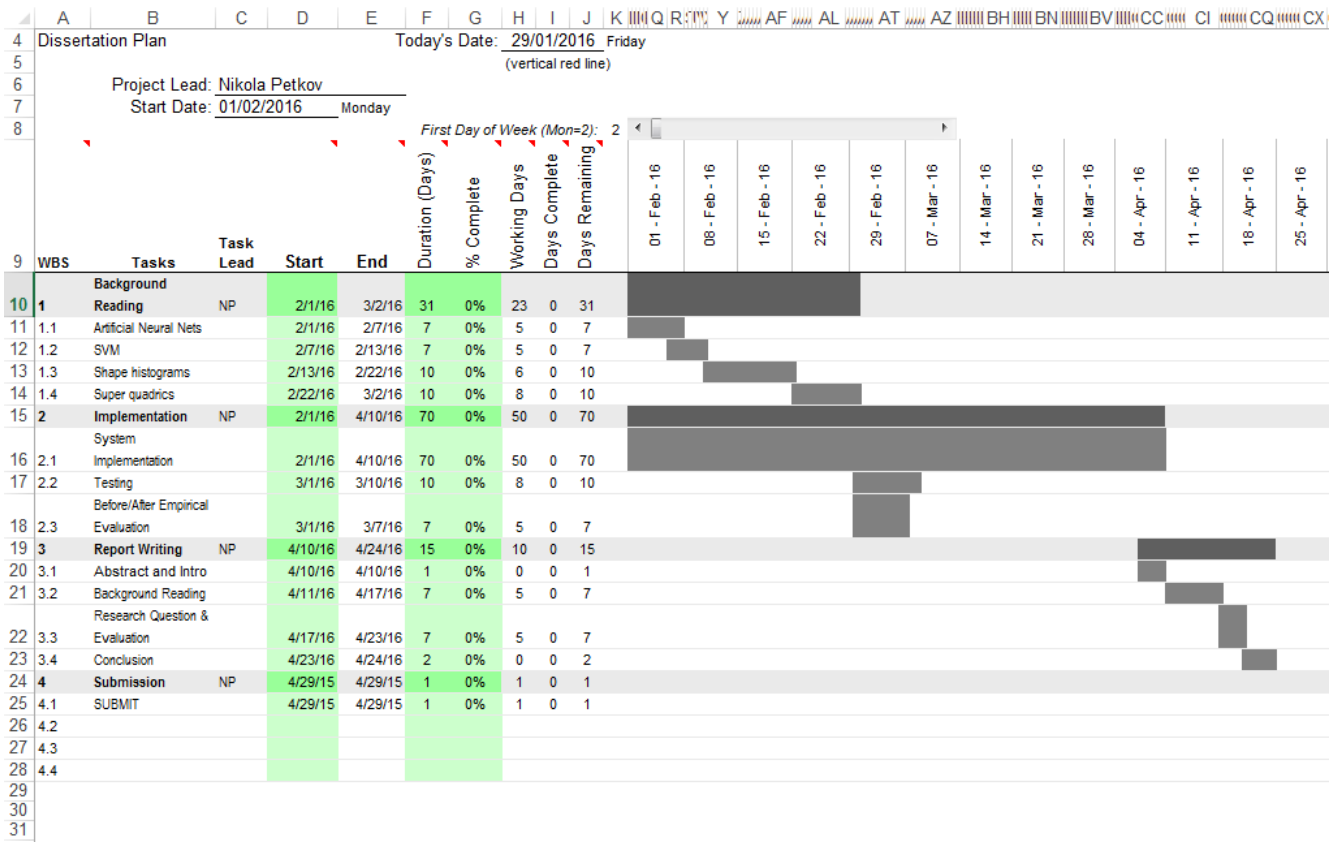

Figure 1: Project Activities

References

[1] Paulo Abelha Frank Guerin and Markus Schoeler. A Model-Based Approach to Finding Substitute Tools in 3D Vision Data. 2015.