CS CAPSTONE PROGRESS REPORT

DECEMBER 4, 2018

INVENTOR COMMAND PREDICTIVE ANALYTICS

PREPARED FOR

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Abstract

Autodesk has set out to improve user productivity within their Inventor software. This process will include creating a potential walk that the user is most likely to take while working in Inventor. A machine learning approach has been selected and prepared for. The team has worked on a weekly basis in order to prepare for the development of this software. Adoption by the current user base will be the largest metric used to determine success for this add-in. The system will have to work on generating commands based on the last input given. With this achieved, the application will then visually give the user the option to quickly select this generated command. Having accomplished this task, users will be able to complete projects quicker and with less keystrokes/mouse travel. (https://tobi.oetiker.ch/lshort/lshort.pdf)

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1 Introduction

1.1 Scope

This document contains a weekly break down of the progress that has occurred for the Autodesk Inventor Predictive Analytics project.

1.2 Purpose

The goal of this paper is to give insight on how the design of the Autodesk Inventor Predictive Analytics project occurred. Contained within this paper will be descriptions of weekly occurrences, goals that have been met, and stumbling blocks that have been encountered.

1.3 Reference Material

1.4 Definitions and Acronyms

ICPA - Inventor Command Predictive Analytics

2 Progress

2.1 Weekly Summaries

2.1.1 Week 1

Activities: The preliminary weeks discussed the scope of the class. The final Group had not been formed yet.

2.1.2 Week 2

Activities: Project registration opened and groups were created. Our eventual group would be to develop a software for Autodesk Inventor. The sponsor being an Autodesk employee.

2.1.3 Week 3

Activities: Contact with our client Andrew Fiax was made. We set up a time to meet on Friday, late morning. He told us to use a software named Zoom to join the web call that we were to have. The call eventually included all of the student developers along with the main client Andrew and a manager out of Portland in our meeting named Frodo. We discussed the goal of the project in more depth then the description found on canvas. We were told to download Inventor and to become familiar with the software, as well as its API. We also agreed that we would need to set up a slack channel and that Github was fine to host the source code.
Problems: Set up a slack channel for our project which included the client and any other Autodesk employee he wanted

to include on the project. A Github repository was also needed. Finally the start of understanding the API needed to begin.
Solutions: The appropriate steps were taken in order to set up the communication routes between our team and the client. Inventor was installed, and the Inventor documentation was studied in order to start understanding the API.

2.1.4 Week 4

Activities: We began weekly meetings with our teaching assistant Ben. He got us to think about the problem statement. Our meeting with the client occurred again on Friday. We discussed the epic standpoint of the project in more detail this time. Andrew told us that internally they use an Agile system but for the purposes of our class we are using waterfall. He told us that we were in what is known as a sprint 0 and that we were in a spike. He didn't seem to concerned, however he does expect us to come up with a time line that he can understand.
Problems: One problem that was brought up while discussing the epic, was the scope of the developed software. Andrew suggested that it be scaled down to a select portion of Inventor.
Solutions: As a group, along with help from Andrew, the decision was to focus on the sketching portion of Inventor. It is small enough but contains within it a good number of options that build upon one another.

2.1.5 Week 5

Activities: For this week we had our weekly meeting with Ben. We discussed what was needed to complete the requirements document. Ben also got us to think about what type of machine learning approach we are going to use, along with the magnitude of certain routes that we may potentially take. Our weekly meeting with Andrew included a developer name Ludek. Ludek had expressed interest in developing this tool so Andrew brought him onto the project. He has become a resource for us. Ludek is the one who brought Recurrent Neural Networks to our attention. He discovered an academic paper that convinced him that this was the route to take, in order to accomplish our goal of predictive analytics. We discussed some non-functional requirements of the project. Andrew also suggested that we use a tool known as Jira to assist with user story development and tracking deliverables. More studying of the API occurred.

2.1.6 Week 6

Activities: The requirements document first draft was due early this week. Here we discussed the general idea of what type of software would be created, along with how it would be developed. We decided on creating an Add-in, which is a software that has a direct interface with Autodesk Inventor. It will make grabbing key presses simple, along with being able to interact with Inventor's UI. We also established that we will be developing a Recurrent neural network for our project and a bit on what that entails. A paper discussing different potential technologies was also due this week. These included types of data storage and different machine learning approaches. This gave us the opportunity to investigate the benefits of running a recurrent neural network. The two other technologies that were looked at included Markov chains and random forests. Although both could be implemented and generate varying levels of success, the recurrent neural network still appeared to be the best fit for our project. This week our client was unavailable to meet. We did however have our weekly meeting with been, who told us to start thinking about the design document.

2.1.7 Week 7

Activities: This week we had a brief meeting with our client at a new time of 8 AM on Tuesdays. We presented our requirements document draft and he said he agreed with the direction we are taking. He focused more on the user stories and was content with what we had included. His only suggestion was that to keep in mind that each user story should be small. It has been suggested to us to develop the Add-in in C which we will adhere to. Our weekly meeting with Ben occurred and was also brief. Our progress was checked and found to be satisfactory.

2.1.8 Week 8

Activities: As was prearranged we did not meet with our client this week. Our weekly meeting with Ben happened where he discussed what goes into creating the design document. He made it clear that this was the document that we would look to all through out the development cycle if any problems arose. This was to be our guide in developing the software. With that said, the design document is expected to define the properties of software and why those decisions were made. The document will not address how to implement the features.
Problems: Complete understanding on how recurrent neural networks function is stronger then understanding how to implement one. They require a knowledge of certain variables that need to be agreed upon before development can take place. Another thought that occurred to the team was should this project be understood as proof on concept or actual product.
Solutions: More research on recurrent neural networks needs to occur as well as more discussion with the client.

2.1.9 Week 9

Activities: This week was dedicated to the development of the design document for the Autodesk Inventor Predictive Analytic project. We used past examples, including Ben's past document, to guide us in development of our own design document. No meeting with the client occurred this week.

2.1.10 Week 10

Activities: We met with the client this week in order to clear up some foggy areas that needed to be illuminated to complete our design document. These included the UI integration and specifically where the focus of the software is to be set within Inventor. He gave us a description of a text box that was to pop up after a user's command input. Within the text box a number of generated guesses were to be listed in descending order by confidence of the system in the guess. Andrew said he had uploaded a keynote that had been given during one of Autodesk's internal events that discussed a similar project to our own. He thought he may give us some more insight. The video described a very similar project to our own. This project was limited on time, but they were able to develop some promising statistics. This group had used Markov chains to make predictions. Many interesting issues were brought up and it did shed some light on issues that we have yet to encounter. The meeting with Ben was brief as we did not have much to show him design document wise.

3 PLANS

3.1 Short Term Goals

3.1.1 Research

Right now our competency levels are not up to par for the scope of the project. Although we are fairly confident that RNN's is the solution to our problem. Our short term research goals consist of having solid evidence that a RNN is the solution to our problem by the end of winter break. We also recently found a toolkit equivalent to TensorFlow. It is called Microsoft Cognitive Toolkit. Microsoft Cognitive Toolkit utilizes C Sharp which is the programming language used for the add-in. We decided to use the new tool for compilation compatibility. Where TensorFlow would require the user to install a python interpreter and link libraries for the add-in to run properly. Which we believed would be too tasking for the user to do. Thus, another goal is to integrate Microsoft Cognitive Toolkit into our updated Tech Review, and Design Document by the end of winter break.

3.1.2

3.2 Long Term Goals

3.2.1 Engineering Expo

Complete an early access version of our project by May 17^{th}. This does not include our stretch goal where there is a visual element for our predicted command. It will be raw data from the console, which will still show a predicted command. More goals include completing a well documented implementation of our RNN. It will disclose how we found the necessary research and it's development cycle. The development cycle will break the RNN into smaller understandable components for presentation purposes.

4 PROBLEMS

4.1 Impeding Problems

A current issue we are facing is how to handle requiring that end-users download and install external packages. In the case of potentially using TensorFlow for our machine learning implementation it would require that a user have installed the Python Interpreter as well as the TensorFlow libraries, which ultimately takes up considerable space on a user's system; users may find that such requirements are unacceptable.

4.2 Problem Solutions

We are exploring options to mitigate the space requirements imposed by external software, it may be as simple as carefully cherry-picking which modules to use in order to get within an acceptable margin. It may also be the case that our target users, users with considerable experience and time investment into the Inventor software as well as

professional environments, will find that the memory requirements are perfectly acceptable considering the potential benefit to product turn around. Ultimately this issue is one that can be further investigated through the use of public and private survey's across a number of sources. In addition considering the scope of this project, providing evidence that such a system can provide a noticeable benefit in user work flow, it may be determined that at this time such concerns are unnecessary.

5 RETROSPECTIVE

Positives	Deltas	Actions

TABLE 1
Retrospective Table