University of Ottawa

GNG2101- Introduction to Project Development and Management for Engineers and Computer Scientists

Project Deliverable C - Conceptual Design, Project Plan and Feasibility Study

Submitted by

Team Z1

Tristan Brady (300105281)
Divine Ciroma (300110246)
Can Berk Atabey (300149626)
Haneen Abujayyab (300006742)
Sankalp Chopra (300074582)

Date: 5/24/2020

Table of Contents

List of Tables

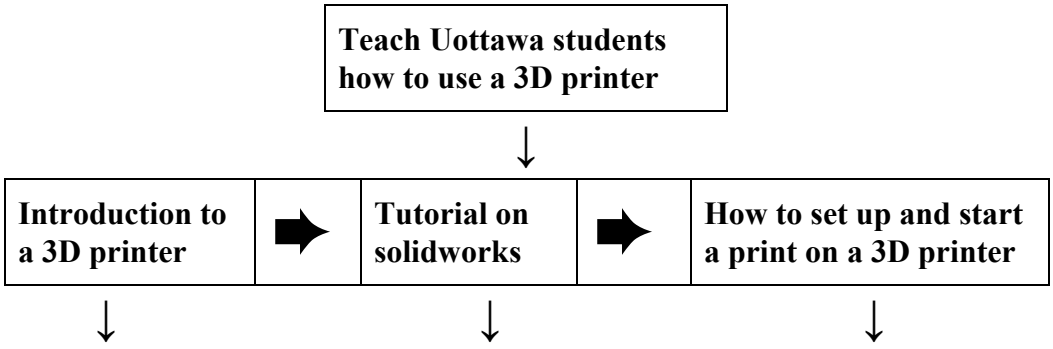
List of Figures

Introduction

The following document is intended as a technical document to clearly identify our team's chosen conceptual designs and the steps taken to come up with each concept. This document will also provide an in-depth functional decomposition on our intended product. Each team member will provide 3 concepts that will be derived from the previously identified customer needs in project deliverable B. Each concept will then be evaluated using a concept scale. The end goal of this overall document is to come up with 2 feasible concepts then to combine them into one chosen group design concept. The group concept will then be visually identified using a sketch. This document will be concluded with the concept relationship to the target specifications.

Functional decomposition

Figure.1 Function detailed decomposition



Pre-lab introduction videos	**Small pre lab quiz & Bank of question and answers**		**Solid works introduction and rundown**	**Small assignment to test solidworks knowledge**		**Interactive element to show how to set up and use a 3D printer (ex: VR game)**	**Small Quiz to test students overall knowledge on 3D printer**

Information:

3D printer Introduction	→	Start of pre-lab quiz	→	Give feedback on answers	→	Solid works tutorial	→	Start main tutorial videos	→	Interactive Segment after tutorial videos

↓ ↓

Material:

Open laptop / mobile device	Use VR or laptop for interaction

Energy:

Power on Laptop /Mobile	→	Process mobile app/ website by logging in credentials	→	Turn on VR or other devices	→	Turn off all devices and repeat process

Electric / Radio Frequency **Remove Material**

Audio Power **HUD Power / Battery Power**

Conceptual Design

CEED is looking for a product that provides an interactive environment of beginner 3D printing to undergraduate students with quizzes or pre-labs.

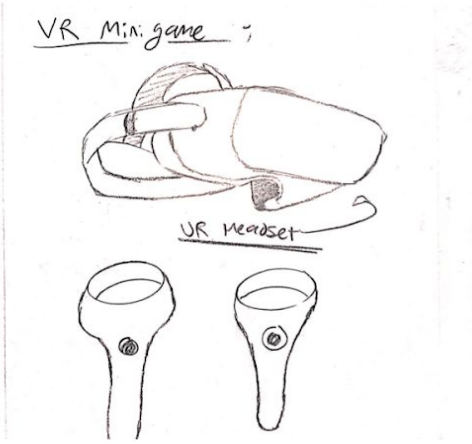
- ➢ This environment is based on customer needs.
- ➢ Functionality is the most important aspect of this product.
- ➢ This software has to be easy to understand and use.
- ➢ It will included a pre lab as well as instructive videos on how to use a 3D printer

The concepts generated will be based on the interactive element of the overall learning process for University of Ottawa students when it comes to beginner 3D printing. The instructive videos and pre lab will be taken into account for every concept since our customers CEED have already developed these videos.

Tristan Concepts:

Concept 1 (VR minigame):

The VR minigame is based upon the fact that even if the student cannot physically touch and interact with the 3D printer in the comfort of their home, they will be able to experience the same interaction through a virtual reality. This minigame will include putting in the SD card into the 3D printer, choosing what colour of PLA they would like to use, as well as, operating the controls on the 3D printer to properly set up a successful print. This way, they will be accustomed to starting a print and will be able to apply their new found knowledge successfully.



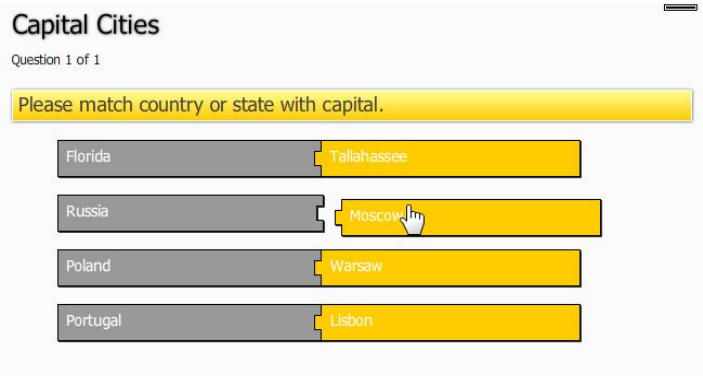
Pros:

-Very interactive
-Easy to use and navite
-Highly useful as a learning tool

Cons:

-Requires VR equipment
-Very hard and time consuming to make

Concept 2 (Drag and drop Quiz):



The drag and drop quiz will be made up of steps for starting and operating a 3D printer. It will be held after the interactive video and the solidworks portion of the beginner 3D printer lab. The purpose or the drag and drop quiz will be to see if the student has fully understood the proper steps and the order of those steps for operating a 3D printer. This type of quiz is very interactive because of the instant feedback it gives the student. If the student so desires they take the quiz again to try and improve their score. This way they will never forget the proper steps it takes to use a 3D printer.

Pros:
-Very interactive
-Instant feedback
-Is free for student and developer
-Doesn't take too long

Cons:
-Doesn't allow for questions
-Isn't hands on

Concept 3(Question and answers pool):

The QA style interactive part of the beginner 3D printing tutorial will be based around the fact that the student wants to get answers to his or her question while watching a certain segment of the tutorial videos. This concept will be aimed towards having predetermined questions and answers for seperate parts of the tutorial videos. This allows the student to have instant answers and will deepen their understanding of certain tasks and concepts related to 3D printing. This QA style interaction is aimed at mimicking what a student would ask a TA during a 3D printing lab and having an answer based on what the TA doing the lab would reply.

Pros:
-Very interactive
-Informative
-Free for student and TA

Cons:
-No physical interaction
-The question and answers are predetermined leave free

Table 1.1 Tristan's concept analysis

Criteria	Concept#1	Concept #2	Concept #3
Interactive	**5**	**4**	**5**
Cost for student	**2**	**5**	**5**
Cost for developpement	**3**	**5**	**5**
Informative	**3**	**3**	**5**
Aesthetics	**5**	**3**	**3**
Easy to use	**3**	**5**	**5**
Total points	**21**	**25**	**28**

Point system:
1-Failed to meet requirements 2-Marginal 3-Okay 4-Acceptable
5-Meets requirement

Haneen's concepts:

Concept 1 (An android and iOS supported mobile app):

This concept features a mobile app that can be downloaded by students and users through their mobile phones or tablets. The app will feature interactive games, videos and tutorials that will provide the user with the required beginner knowledge of 3D printing. The app will also provide mini quizzes for the users to test their knowledge.

Pros:
-Zero cost for consumer and producer
-Interactive and entertaining
-User friendly and easy to use

Cons:
-No physical interaction
-The question and answers are predetermined leave

Concept 2 (Website):

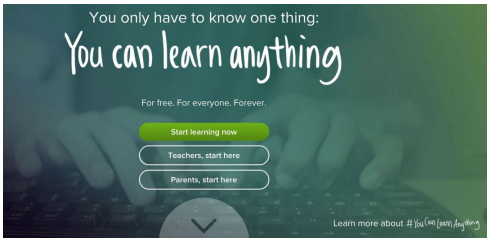
The second concept features a website where registration is required. As soon as the student or user is signed up with their school email, their account will be linked to their instructor's account for monitoring of lab completion and grades. Multiple links will be available providing access to different pages including a prelab page with an introductory video and a quiz. A series of videos will be also available to provide the needed knowledge.

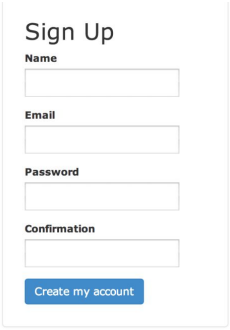
Pros :

-Zero cost for producer and consumer
-User friendly and easy to use
-Easy monitoring by instructor

Cons :

-Not interactive
-Likely to crash frequently





Concept 3 (Holographic Projection):

The third concept features a holographic projector with built in 3d images of the instructor walking through the 3D printing beginner workshop. Students and consumers will be able to get the real sensation of working with a 3D printer, just like they would have done in physical workshop.

Pros :

-Interactive and entertaining
-Informative

Cons :

-Expensive to produce and purchase
-Might be hard for on some consumers to use
-Need to replace whole product if damaged

Table 1.2 Haneen's concept analysis

Criteria	Concept#1	Concept #2	Concept #3
Interactive	**5**	**1**	**5**
Cost for student	**3**	**5**	**2**
Cost for developpement	**2**	**5**	**2**
Informative	**5**	**4**	**5**
Aesthetics	**4**	**4**	**5**
Easy to use	**5**	**3**	**3**
Total points	**24**	**22**	**22**

Point system:
1-Failed to meet requirements 2-Marginal 3-Okay 4-Acceptable
5-Meets requirement

Sankalp's Concepts:

Concept 1 (Local Library Website)

This concept involves the idea of learning the fundamentals of 3D printing via a collaborative partnership between local district libraries and universities, whereby students can log in with their uOttawa emails on a local library webpage and be assessed on basic operations, Solidworks, standard VR and the setup of 3D printers through step by step video tutorials, culminating with a small quiz to assess student learning. Upon completion, students can refer to their local library by appointment and have their 3D concepts quickly reviewed by an expert and processed in the library itself. This ensures that students can learn and experience the first-hand operation of a 3D printer despite not being on university campuses.

Pros :
-User interactive and supporting
-Convenient
-Learning at own pace
-Free to do anywhere (albeit the

Cons :
-Requires partnership
-Library attendant must have 3D printing knowledge
-Available to all district libraries? Hard to set up?

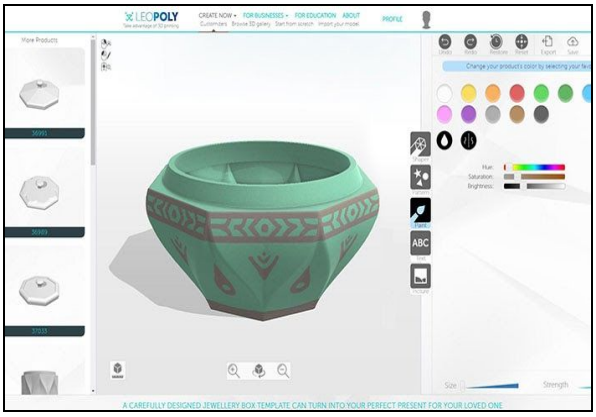
library has a functional 3D printer
(which most have))

Concept 2 (Similar to Inkscape, VP online)

This concept mimics the uses of Inkscape and VP online, two online simulation platforms whereby students can learn to create multidimensional model designs via a step by step process using various tools and graphics. Through the use of a free and open source graphics editor and visual paradigms, one can first learn of the basic knowledge of a 3D computer and its operations through an informative point/online chatting process and then build their 3D multidimensional products online. Despite the lack of virtual feedback, this concept would allow for students to learn at their own pace and prompt creativity in their creation.

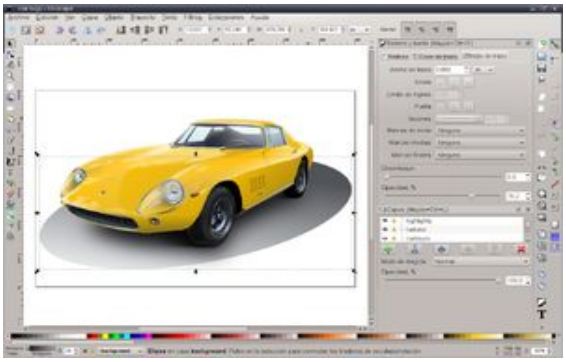
Pros :

- Step by step process allows for students to learn at their own pace and relearn concepts they don't understand
- User interactive
- No monitoring necessary
- Easy to maintain and update
- Free to Download Online



Cons:

- Does not allow for questions
- No physical interaction
- No physical product available



Concept 3 (Mobile IOS/Android App with Human Interface)

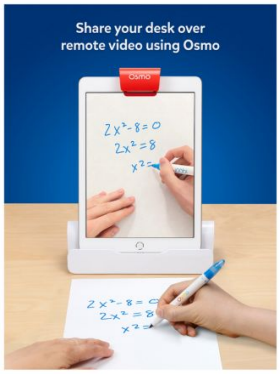
The third concept on this list is an IOS and Android compatible mobile app upon which a university grad student or CEED professional can have a face to face 3D printer tutorial. This would allow for more of a face to face, one on one session which would culminate with the professional assessing a student on his knowledge of 3D printing analysis. The instructor could teach students via video conference (zoom) or other such means. On the app, there would be multiple smaller subsections such as review and ample diagrams portraying the design flow and operations/tutorial of a 3D printer.

Pros:

- Face to face conversation would allow for better learning for most students
- User friendly and interactive
- Allows for students to dedicate time and pay attention to the process
- Free to download online

Cons:

- App would be complex to code
- Monitoring would be required
- No “physical” interaction with product
- Bugs in the product would be an issue



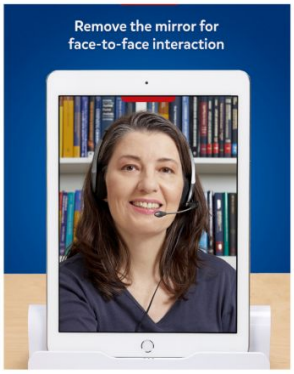


Table 1.4 Sankalp's concept analysis

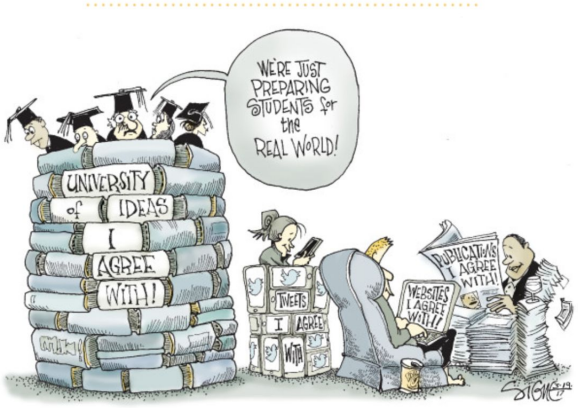
Criteria	Concept#1	Concept #2	Concept #3
Interactive	**4**	**4**	**5**
Cost for student	**5**	**5**	**4**
Cost for development	**2**	**1**	**2**
Informative	**5**	**3**	**3**
Aesthetics	**3**	**5**	**3**
Easy to use	**4**	**3**	**5**
Total points	**23**	**21**	**22**

Point system:
1-Failed to meet requirements 2-Marginal 3-Okay 4-Acceptable
5-Meets requirement

Divine's Concepts:

Concept 1(Website)

This concept enables contents such as texts, images, powerpoints and videos to be displayed on the internet. Representative websites are used for various purposes like to inform potential customers about products and services, to represent the company, to enable contact with different departments, for learning purposes in universities or to distribute goods online.



Pros

- It is very easy to navigate through a website, using the search tool
- Very interactive

- It is more accessible as it is designed for the larger audience
- Requires average professional skills, performance and management

Cons

- Websites have tendencies of having heavy online traffic because they are not built to please a targeted audience; the tendency to crash when a lot of people are using it at once is quite high.
- Time is limited in the project; for a very good quality website to be created, it would demand a lot of time to complete successfully.

Concept 2(Digital library)

It features a very managed collection of information with associated services, where the information is stored in digital formats and is accessible over a network. A digital library serves the purpose of guiding students on how to complete the introductory labs; It provides capabilities beyond a traditional library. It would include; videos, texts and audios that can help present abstract ideas that may be hard to visualize or explain. With budget constraints, they can provide an avenue for easy presentation demonstrations and conduction of labs that the university might not have been able to afford, which may lead to students missing out on the hands-on experience that could be valuable in their latter education. However, Digital libraries can enhance those experiences; by performing a virtual lab on 3D printing before a “real world” lab, it allows users to make mistakes without fear of not getting the experiment done on time and correctly.

- Pros

- Round the clock availability: Easy for students to learn at their own pace.
- Structured approach and multiple accesses: It is designed for a more targeted/specific audience
- It is easier to use than most online resources
-It is cheap to maintain
- Enough space and Networking: It reduces the risk of heavy online traffic
- Preservation and conservation of information for a long period

Cons

- Requires a high level of skill to accomplish
- It requires a lot of time and effort to maintain as information becomes outdated over time
- To create an in-depth digital library, it could involve the purchase of some software to unlock some features, thereby increasing cost.
- Bandwidths create some issues that require users to pay a high monthly fee to use the resources, which would highly determine the amount of data that can be transmitted in a fixed amount of

time to the users.

Concept 3 (Simulation software)

Simulation software is a program that allows the user to observe an operation through simulation without actually performing that operation. Simulation software is widely used to design equipment so that the final product will be as close to design specs as possible without being expensive in-process modification. It allows users to gain a better understanding of the lab as if they were in their actual lab sessions.

Pros

- Does not require physical interaction to function i.e info may be visible and tangible
- Reduces risk through gaining a better grasp of what your operation needs.
- It utilizes resources within the production facility and minimizes the amount of waste produced, therefore coming closer to overall production efficiency.
- It gives users the opportunity of studying the behaviour of a system without actually creating it.
- The overall outcomes are generally accurate.
- It helps users explore the various unexpected phenomenon, behaviour of the system.

Cons

- Cloud-based solvers are usually faster than local solvers, as they are not restricted by the computational capabilities of your computer. However, some companies are reluctant to use cloud-based solvers due to confidentiality issues, as data sent through the Internet could be more easily compromised. For most applications this would not be an issue.
- Expensive to build a simulation model.
- Expensive to conduct a simulation.
- It can be difficult to interpret the simulation results.
-It is not interactive

Table 1.4 Divine's concept analysis

Criteria	Concept#1	Concept #2	Concept #3
Interactive	5	4	3
Cost for student	5	4	1
Cost for development	5	4	1
Informative	5	5	4
Aesthetics	4	3	3
Easy to use	5	4	2
Total points	29	24	14

Group Concept Analysis

Figure 2. Concept analysis

Criteria	Weight	Tristan Concept #3	Haneen Concept #1	Divine Concept #1	Sankalp Concept #1
Interactive	30%	5	5	5	5
Cost for student	15%	5	3	5	5
Cost for developpement	10%	5	2	5	3
Informative	20%	5	5	5	3
Aesthetics	10%	3	4	4	4
Easy to use	15%	5	5	5	4
Total points	100%	4.8	4.3	4.9	4.8

Chosen concepts:

From the table above, the concept with the highest points were highlighted in green and it made choosing the best concept much easier. The factors that determined each concept's worth was how informative, interactive, easy to use and aesthetically pleasing each concept was. The concepts chosen were Divine's first concept which was an interactive online website and Tristan's 3rd concept which was an online interactive Pool of questions and answers.

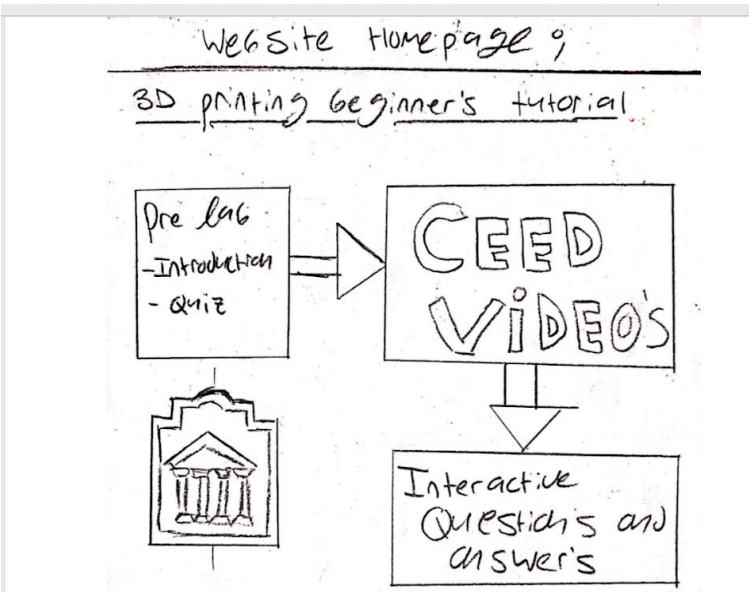
Final design concept

The final chosen design concept was decided to be an integration of Tristan and Divine's concept into one final idea.

Description:

Divine's concept provides resources in form texts, images, powerpoints and videos to be displayed on the internet. Tristan's QA style interactive concept integrates into this idea by being put onto the website after the online videos CEED has already created. The interactions are based upon the fact that the student wants to get answers to his or her question while watching a certain segment of the tutorial videos. This concept will be aimed towards having predetermined questions and answers for seperate parts of the tutorial videos. This allows the student to have instant answers and will deepen their understanding of certain tasks and concepts related to 3D printing. This QA style interaction is aimed at mimicking what a student would ask a TA during a 3D printing lab and having an answer based on what the TA doing the lab would reply.

Visual Representation (sketch/diagram):



Target specifications

Table 3. Target specifications

Metrics #	Metric	Units	Target
1	User Cost	CAN $	< 20-30
2	Product cost	CAN $	< 100
3	Length of visual Tools	Minutes	< 90
4	Length of interaction	Minutes	< 30
5	Product longevity	Years	> 2

Conclusion:

Having arranged all our feasible concepts, we now have a well-defined reference point for the production and development of the online resource. All through the remaining phases of this project, this deliverable will serve as a guide to make sure that our final product meets all customer needs and remains within our target specifications. Furthermore, we established that virtual labs can present abstract ideas that may not normally be easily viewed. Each needs to be examined to make sure that it matches the content being taught, will keep students interested and will provide a form of interaction that normally would not be easily conducted in the lab sessions.