

National Formosa University

Mechanical Design Engineering

Computer-Aided Design Internship bg3 Final

Report

鋼球運動系統

Marble Machine System

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指導教授：嚴家銘

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# Catalog

Catalog . . . . .	i
Chart Catalog . . . . .	ii
Chapter 1 Preface . . . . .	1
1.1 Design Motivation . . . . .	1
1.2 Design Purpose . . . . .	1
Chapter 2 Application Software. . . . .	2
2.1 Onshape . . . . .	2
2.2 Inventor . . . . .	2
2.3 V-rep . . . . .	4
Chapter 3 Design Introduction . . . . .	6
3.1 Introduction . . . . .	6
Chapter 4 Process . . . . .	7
4.1 Process . . . . .	7
Chapter 5 Issue & Solution . . . . .	8
5.1 Design . . . . .	8
5.2 V-rep . . . . .	8
5.3 Report . . . . .	8
Chapter 6 Assignments . . . . .	15
6.1 Assignments . . . . .	15
Chapter 7 Conclusion . . . . .	16
7.1 Conclusion . . . . .	16
Chapter 8 References . . . . .	17

# Chart Catalog

Figure 2.1	Lift . . . . .	2
Figure 2.2	Vortex-rotating-disk . . . . .	3
Figure 2.3	Screw-and-Flywheel . . . . .	3
Figure 2.4	Assembly . . . . .	4
Figure 2.5	Simulation . . . . .	5
Figure 3.1	Simulation . . . . .	6
Figure 4.1	Process . . . . .	7
Figure 5.1	Start.bat . . . . .	9
Figure 5.2	For loop . . . . .	10
Figure 5.3	Advisor . . . . .	11
Figure 5.4	transform-mistake . . . . .	12
Figure 5.5	transform-correct . . . . .	12
Figure 5.6	modify-chapters . . . . .	13
Figure 5.7	image . . . . .	14

# Chapter 1 Preface

前言

## 1.1 Design Motivation

After grouping, among the eight subjects given by the teacher, we discussed and studied each subject. Finally, we selected the topic of the marble machine system. Because the marble machine system is the suitable for our ability, we decided to design the system by ourselves. After the research in many aspect, decided to build a playground for the marble machine system, and watch the  $bo_{bo}$  always rolling. It's soothing that make everyone calm.

## 1.2 Design Purpose

The purpose of this topic is to skillfully use Onshape to draw components and V-rep simulations, promote our own strength and apply the system to the future practical applications. For the reason, we search for the related videos on the web and refer to the topic of the senior sister. However, we refer to most of the data to be single. It makes us want to make more mechanism to coordinate with each other and design our own marble machine system.

# Chapter 2 Application Software

軟體

## 2.1 Onshape

Onshape is a computer-aided design (CAD) software system, delivered over the Internet via a Software as a Service (SaaS) model.

Onshape makes extensive use of cloud computing.

Onshape allows teams to collaborate on a single shared design, the same way multiple writers can work together editing a shared document via cloud services.

Onshape upgrades are released directly to the web interface, and the software does not require maintenance work from the user.

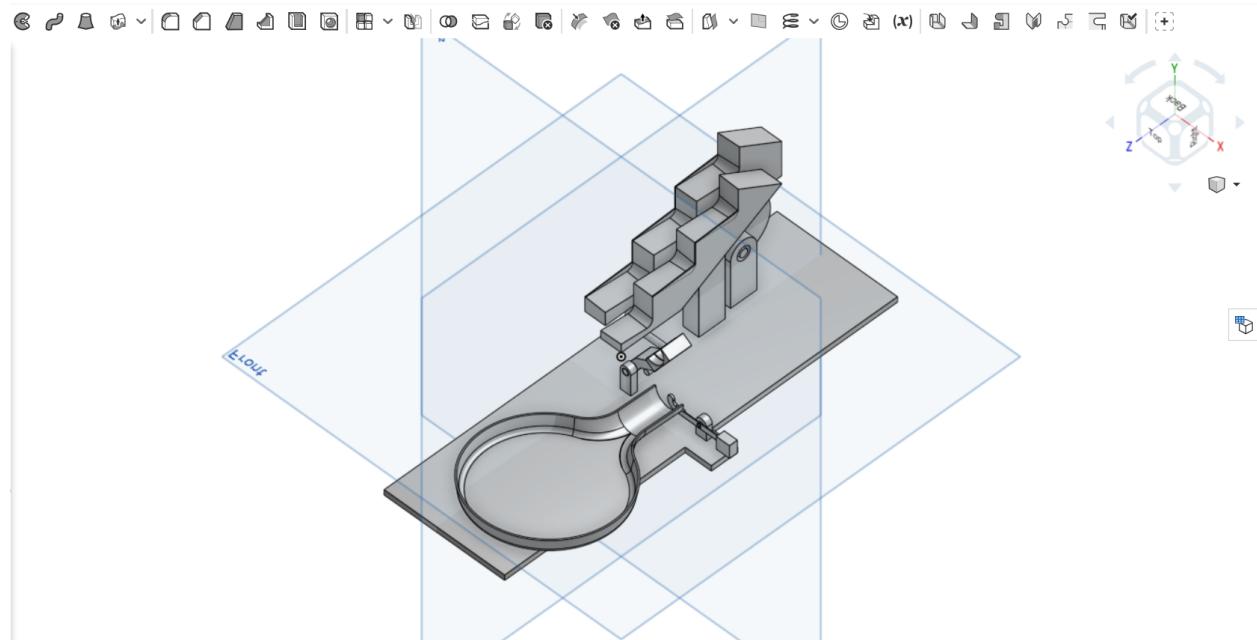


Figure 2.1: Lift

## 2.2 Inventor

Autodesk Inventor is a computer-aided design application for 3D mechanical design, simulation, visualization, and documentation developed.

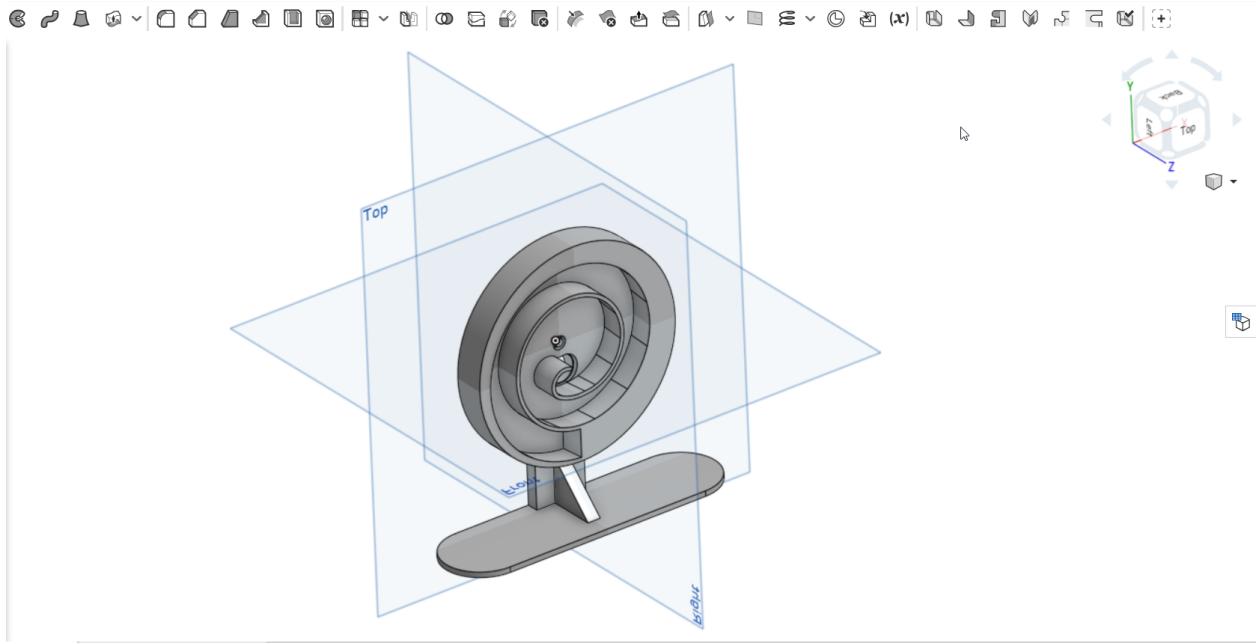


Figure 2.2: Vortex-rotating-disk

Inventor allows 2D and 3D data integration in a single environment, creating a virtual representation of the final product that enables users to validate the form, fit, and function of the product before it is ever built. Autodesk Inventor includes powerful parametric, direct edit and freeform modeling tools as well as multi-CAD translation capabilities and in their standard DWG™ drawings.

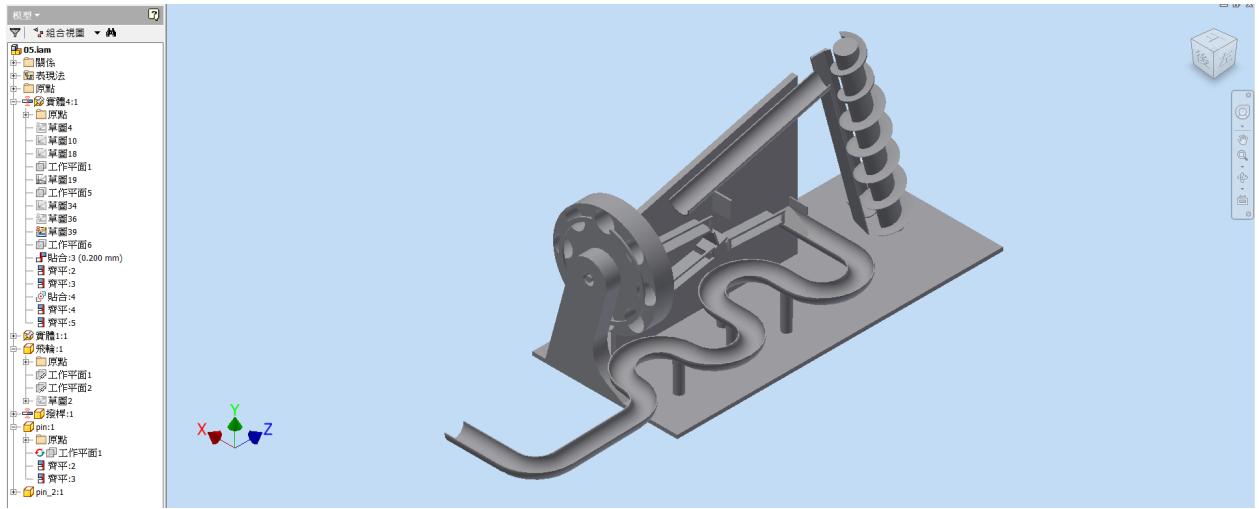


Figure 2.3: Screw-and-Flywheel

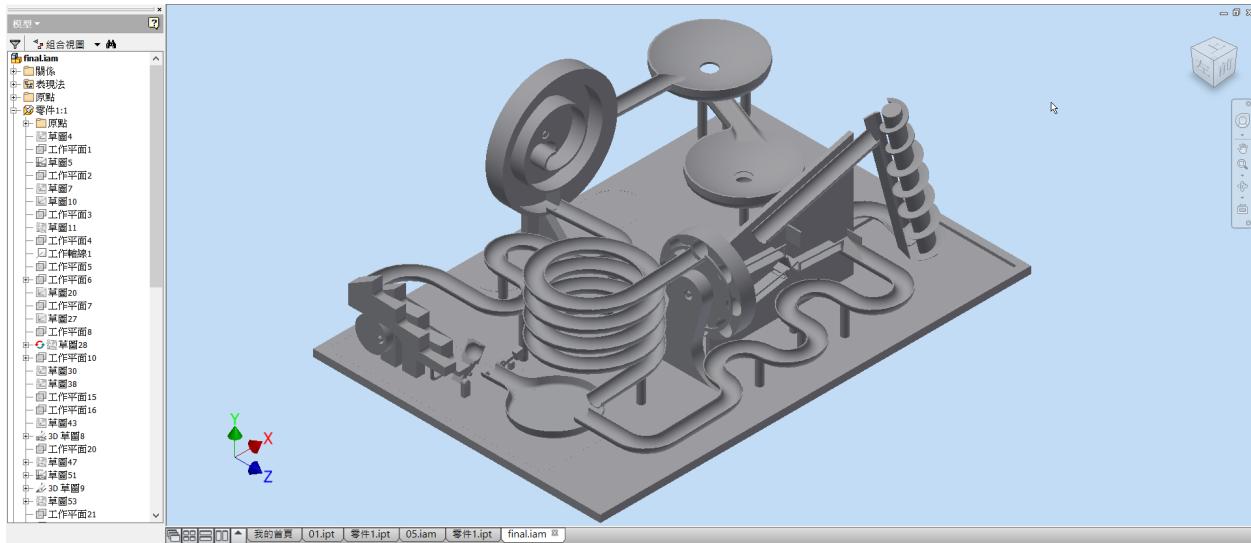


Figure 2.4: Assembly

### 2.3 V-rep

V-rep provides a unified framework combining many powerful internal and external libraries that are often useful for robotics simulations. This includes dynamic simulation engines, forward/inverse kinematics tools, collision detection libraries, vision sensor simulations, path planning, GUI development tools, and built-in models of many common robots.

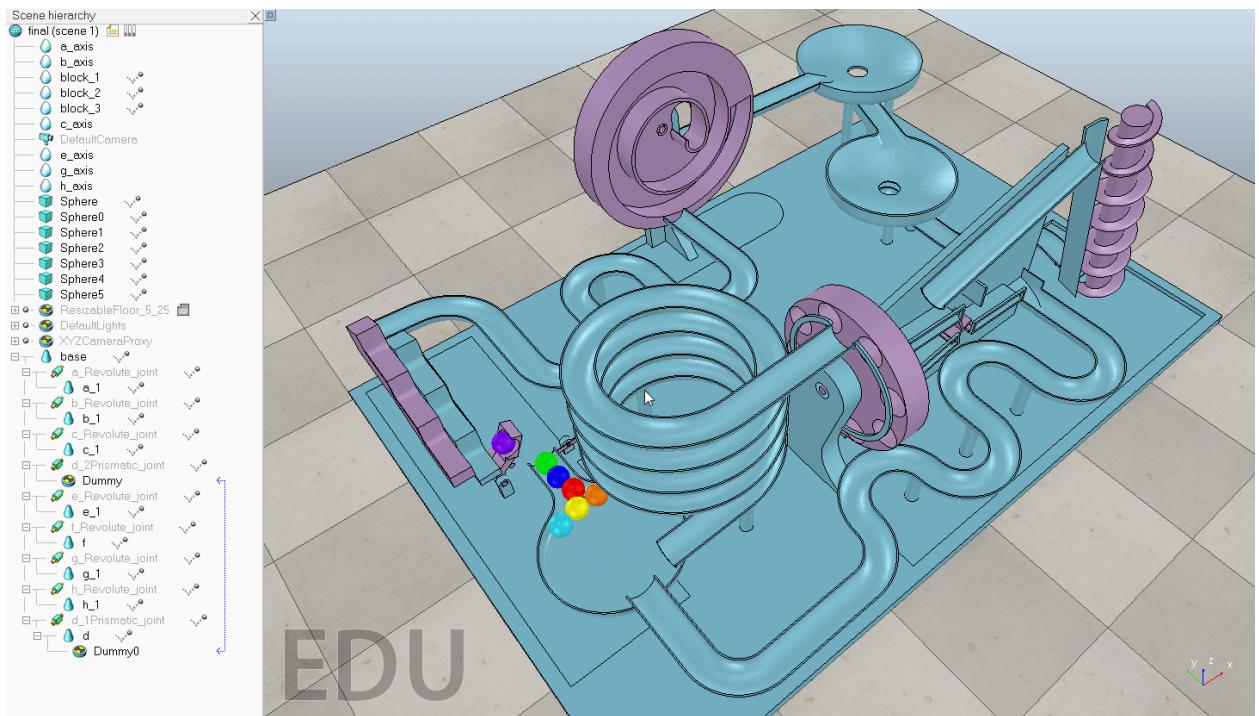


Figure 2.5: Simulation

# Chapter 3 Design Introduction

介紹

## 3.1 Introduction

The four mechanism:

1.Lift: Use the motor to drive the eccentric wheel to make the stairs lifting movement.

2.Vortex rotating disk: The motor rotates the disk to rise the ball.

3.Screw: The motor drives the screw to do oblique upward motion.

4.Flywheel: Use the motor to drive the flywheel to make a rotary motion to raise the ball.

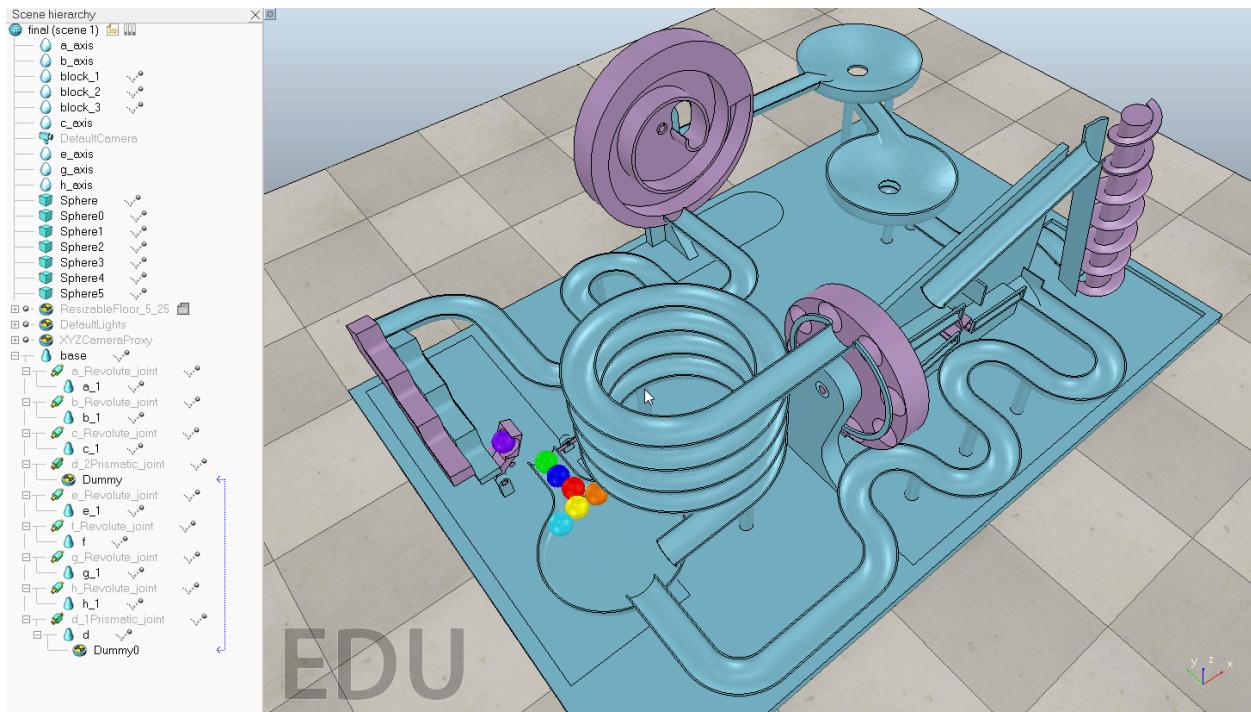


Figure 3.1: Simulation

# Chapter 4 Process

過程

## 4.1 Process

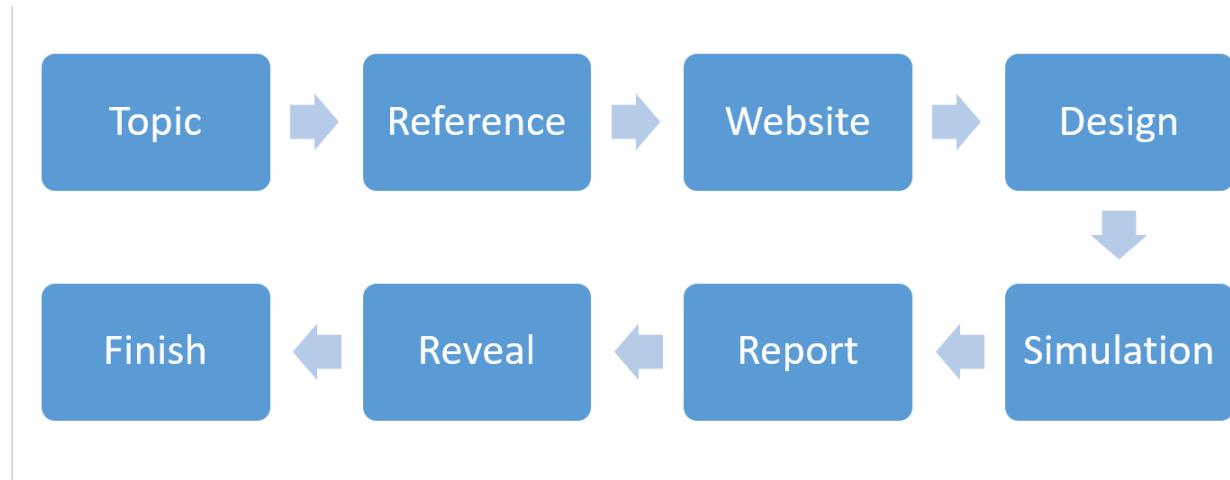


Figure 4.1: Process

Topic: Selected the marble machine system among many topics

Reference: Refer to the video on the web

Website: Edit the final project website

Design: Design and coordinate the mechanism

Simulation: Use V-rep to simulate and move the ball in the track

Report: Make independent study

Reveal: Inform the focus and assignments

Finish: Report completed

# Chapter 5 Issue & Solution

## Q&A

### 5.1 Design

Q: Putting the mechanism to the V- rep is easy to interfere when simulating. And, the ball is easy to get stuck in one place in the process.

A: Increase the slope or height of the track

### 5.2 V-rep

Q: Components cannot be separated

A: There must be a gap between the part and the part, and put them together to be one part.

Q: Turn on body is respondable, the components cannot operate on the normal track, it will flutter.

A: Because the interval between the solid and the solid cannot be 0, there must be gap.

Q: Turn on body is respondable for the track, the simulation will be very lag.

A: Turn it to collide with the ball.

### 5.3 Report

Q: “Pandoc” Path not found

A: Need to set “path2” and start “path2” in “start.bat”

Q: “LaTeX” Modify name can’t skip a line

A: Use “for” loop to compile it

Q: The teacher’s name can’t be displayed in pdf

A: In “advisor\_zh:”, skip a line, add “-” and space to write

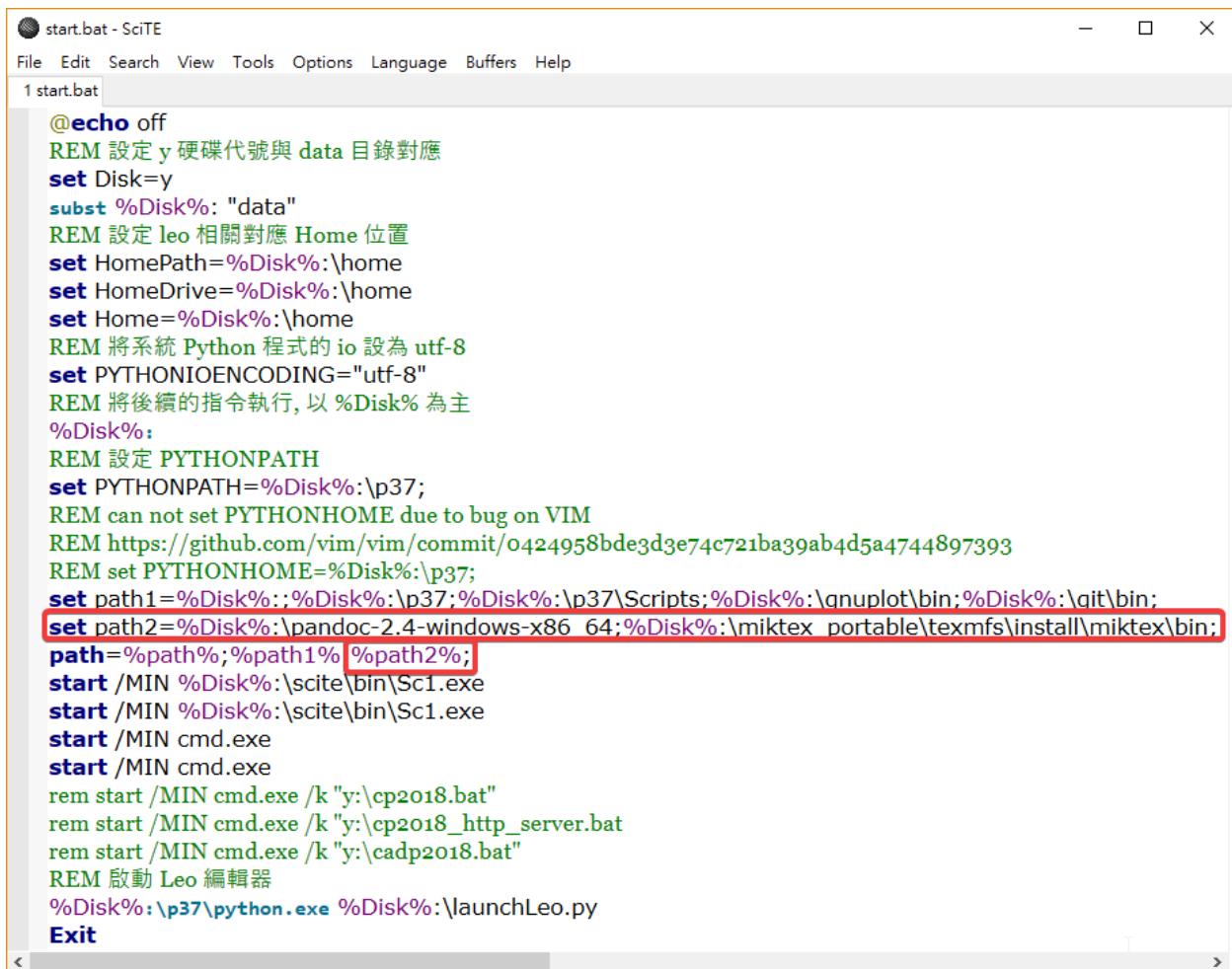
Q: Can’t transfer pdf in “Leo”

A: Execute to specified path

Q: Unbale to update catalog

A: Modify the catalog name under “button Report pdf”

Q: Images can’t be displayed



The screenshot shows a SciTE editor window with the file 'start.bat' open. The code in the editor is as follows:

```
@echo off
REM 設定 y 硬碟代號與 data 目錄對應
set Disk=y
subst %Disk%: "data"
REM 設定 leo 相關對應 Home 位置
set HomePath=%Disk%:\home
set HomeDrive=%Disk%:\home
set Home=%Disk%:\home
REM 將系統 Python 程式的 io 設為 utf-8
set PYTHONIOENCODING="utf-8"
REM 將後續的指令執行, 以 %Disk% 為主
%Disk%:
REM 設定 PYTHONPATH
set PYTHONPATH=%Disk%\p37;
REM can not set PYTHONHOME due to bug on VIM
REM https://github.com/vim/vim/commit/0424958bde3d3e74c721ba39ab4d5a4744897393
REM set PYTHONHOME=%Disk%\p37;
set path1=%Disk%;;%Disk%\p37;%Disk%\p37\Scripts;%Disk%\gnuplot\bin;%Disk%\git\bin;
set path2=%Disk%\pandoc-2.4-windows-x86_64;%Disk%\miktex_portable\texmf\install\miktex\bin;
path=%path%;%path1% %path2%;
start /MIN %Disk%\scite\bin\Sc1.exe
start /MIN %Disk%\scite\bin\Sc1.exe
start /MIN cmd.exe
start /MIN cmd.exe
rem start /MIN cmd.exe /k "y:\cp2018.bat"
rem start /MIN cmd.exe /k "y:\cp2018_http_server.bat"
rem start /MIN cmd.exe /k "y:\cadp2018.bat"
REM 啟動 Leo 編輯器
%Disk%\p37\python.exe %Disk%\launchLeo.py
Exit
```

Figure 5.1: Start.bat

```
template.leo in D:\EAFONG\虎科大\電腦輔助設計與實習\report\users
workbook.leo  yen.leo  yen.leo  template.leo
File Edit Search Settings Outline Plugins Run Window Help
script-button gen-pdf Chapters: main
> └── @settings
    ├── @button gen_pdf
    ├── @edit chapters.py
    └── @path ../
        └── @path markdown
            ├── @edit ieee.csl
            ├── @edit refer.bib
            ├── @edit template_en.tex
            ├── @edit template_zh.tex
            ├── @edit template_kmol.tex
            └── @edit cover_and_abstract.md
            └── @edit reference.md
Log Find Tags Nav Python Console Task
D:\EAFONG\虎科大\電腦輔助設計與實習\report\users\template.leo
reading:D:\EAFONG\虎科大\電腦輔助設計與實習\report\users\template.leo
reading:@editchapters.py
reading:@editieee.csl
reading:@editrefer.bib
reading:@edittemplate_en.tex
reading:@edittemplate_zh.tex
reading:@edittemplate_kmol.tex
reading:@editcover_and_abstract.md
reading:@editreference.md
Minibuffer: Insert State
line: 1 col: 0 fcol: 0 虎科大\電腦輔助設計與實習\report\users\template.leo# @path ../->@path markdown-->@edit template_kmol.tex
260 \wspace{2cm}
261 \fontsize{20}{30}\selectfont{
262   $title_zh$\par
263   \textbf{$title_en$}\par
264 }
265 \wspace{\fill}
266 $if(author_zh)$
267 \fontsize{18}{27}\selectfont{
268   學生 : $\par
269   $for(author_zh)$author_zh$$sep$ $\par $endfor$ $\par
270   指導教授 : $advisor_zh$\par
271 }
272 $endif$
273
274 \wspace{1.5cm}
275 \fontsize{16}{24}\selectfont{$date_zh$\par}
276 \wspace{2cm}
277 \end{center}
278 \end{titlepage}
279
280 % Title page
281 $if(title_page)$
282 \begin{titlepage}
```

Figure 5.2: For loop

The screenshot shows the Leo editor interface with the following details:

- Title Bar:** template.leo in D:\EAFONG\虎科大\電腦輔助設計與實習\report\users
- Toolbar:** File, Edit, Search, Settings, Outline, Plugins, Run, Window, Help.
- Buttons:** script-button, gen-pdf, Chapters: main
- Left Panel (Outline View):** Shows a tree structure of files and chapters:
  - @edit refer.bib
  - @edit template\_en.tex
  - @edit template\_zh.tex
  - @edit template\_kmol.tex
  - @edit cover\_and\_abstract.md
  - @edit reference.md
  - @path paragraph
    - @edit preface.md
    - @edit introduction.md
    - @edit related\_works.md
    - @edit conclusion.md
- Right Panel (Text View):** Displays the LaTeX code with some parts highlighted.

```
21 title_zh: 鋼球運動系統
22 title_en: Marble Machine System
23 author_zh:
24 - 四設計二乙 40623203 蔡宜芳
25 - 四設計二乙 40623206 邱妍馨
26 - 四設計二乙 40623207 呂沛蓉
27 - 四設計二乙 40623244 林俊鎧
28 - 四設計二乙 40623248 廖柏誠
29 - 四設計二乙 40623250 湯峻傑
30
31 author_en:
32 advisor_zh:
33 - 嚴家銘
34 advisor_en:
35 date_zh: 中華民國 108 年 01 月
36 date_en: 108, 01
37
38 Huawei, Yunlin, Taiwan, Republic of China
39
40 <!-- watermark: images/watermark -->
41 abstract_zh:
42
43
```

A red box highlights the entry "嚴家銘" in the advisor\_zh: section.

- Bottom Status Bar:** Minibuffer: Insert State, line: 32 col: 10 fcol: 10, 大/電腦輔助設計與實習/report/users/template.leo# @path ././->@path markdown-->@edit cover\_and\_abstract.md

Figure 5.3: Advisor

```

1 Report
2 ---
3 Q : Pandoc 找不到路徑
4 A : 需在 start.bat 設置 path2 及啟動path2
5
6 Q : LaTeX 修改名字無法跳行
7
8 A : 利用 for 迴圈編譯他
9
10 Q : 老師的名字無法顯示在pdf
11
12 A : 在 advisor_zh: 跳行加 - 空格再書寫
13
14 Q : 無法在 leo 轉 pdf
15
16 A : 到指定路徑下執行
17
18

```

FileNotFoundError:[WinError2]系統找不到指定的檔案。:./..markdown

Unexpectedexception.handleScriptException  
Traceback(mostrecentcalllast):  
File "y:\p37\lib\site-packages\leo\core\leoCommands.py",line 638,inexecuteScript  
c.executeScriptHelper(args,define\_g,define\_name,namespace,script)  
File "y:\p37\lib\site-packages\leo\core\leoCommands.py",line 606,inexecuteScriptHelper  
exec(compile(script,scriptFile,'exec'))  
File "y:/home/.leo/scriptFile.py",line 7,in<module>  
os.chdir("./..markdown")  
FileNotFoundException:[WinError2]系統找不到指定的檔案。:./..markdown'  
During handling of the above exception, another exception occurred:  
  
Traceback(mostrecentcalllast):  
File "y:\p37\lib\site-packages\leo\core\leoGlobals.py",line 7315,inhandleScriptException  
lines=f.readlines()  
UnicodeDecodeError:cp950'codeccan'tdecodebyte0xe6inposition136:illegalmultibytesequence

Figure 5.4: transform-mistake

```

1 @language python
2 filename = "report"
3 import os, platform
4 import chapter
5 # 更換目錄到 markdown
6 os.chdir("./..markdown")
7
8 # 若在 Linux 環境則使用 ukai.ttc 系統字形
9 if platform.system().lower() == "linux": font = "ukai.ttf"
10 # 在 windows 環境使用 SimSun 字形
11 elif platform.system().lower() == "windows": font = "SimSun"
12 else: font = "Arial"
13 fontsize = "12"
14 margin = "1in"
15 # _pdf-engine 使用 xelatex
16 # lang 請參照 https://tools.ietf.org/html/bcp47, 這裡的 zh-cmn 為 Mandarin Chinese 國語
17 # -V lang=zh-cmn 為一組 key=value 對應的 Variable 設定
18 # N 表示 Number section headings in LaTeX, ConTeXt, HTML, or EPUB output. By default, sections are not numbered.
19 setting = "-_pdf-engine=xelatex -V lang=zh-cmn -N -toc --highlight-style kate -V documentclass=report -filter pandoc-fignos --filter pandoc-tables --template=template.tex -V 'CJKmainfont:(0)pt -V fontsize=(1)pt -V geometry:margin=(2) -bibliography=refer.bib -csl=ieee.csl".format(font, fontsize, margin)
20 print(setting)
21
22 # 選擇所要納入的 Markdown 檔案, 不納入的檔案名稱前方加上 # 即可
23 chapter_list = "#join("./paragraph") + i for i in [
24     "preface.md",
25     "application_software.md",
26     "design_process_and_introduction.md",
27     "issue_and_solution.md",
28     "conclusion.md",
29     "references.md",
30     "#github.md",
31     "#fossil.md",
32     "#onshape.md",
33     "#cmsimfly.md",
34     "#xerxesmd.md"
35 ]

```

FileNotFoundException:[WinError2]系統找不到指定的檔案。:./..markdown

During handling of the above exception, another exception occurred:  
  
Traceback(mostrecentcalllast):  
File "y:\p37\lib\site-packages\leo\core\leoGlobals.py",line 7315,inhandleScriptException  
lines=f.readlines()  
UnicodeDecodeError:cp950'codeccan'tdecodebyte0xe6inposition136:i  
PDF轉換完畢

Figure 5.5: transform-correct

```

12   fontsize = "12"
13   margin = "1in"
14   # -pdf-engine 使用 latexex
15   # lang 請參照 https://tools.ietf.org/html/bcp47, 這裡的 zh-cmn 為 Mandarin Chinese 國語
16   # -V lang-zh-cmn 為一組 key=value 對應的 Variable 設定
17   # -N 表示 Number section headings in LaTeX, ConTeXt, HTML, or EPUB output. By default, sections are not numbered.
18   settingFlag = "-pdf-engine=latextex -V lang-zh-cmn -N -toc -highlight-style kate -V documentclass=report -filter pandoc-tables -template=template.tex -V \'\\CJMainFont:(0)\' -V fontsize=(1)pt -V geometry:margin=(2) --bibliography=refer.bib --csl=ieee.csl".format(font, fontsize, margin)
19   print(settingFlag)
20
21   # 選擇所要納入的 Markdown 檔案, 不納入的檔案名稱前方加上 # 即可
22   chapter_list = "#join("./paragraph") + i for i in [
23       "preface.md",
24       "application_software.md",
25       "design_process_and_introduction.md",
26       "issue_and_solution.md",
27       "conclusion.md",
28       "references.md",
29       "#github.md",
30       "#fossil.md",
31       "#onshape.md",
32       "#cmsinifly.md",
33       "#pygroof.md",
34       "#pyslvs.md",
35       "#pylinkage.md",
36       "#pyduino.md",
37   ]"
38
39   # 若系統並未正確轉檔, 可以將 os.system 改為 g.es 表示要使用 Leo Editor 的 global 物件中的 echo string 將指令印在 log 區
40   # 然後複製指令, 然後在命令列視窗中的 markdown 目錄中執行, 就可以得到錯誤訊息
41   # 或許可以再從 https://stackoverflow.com/questions/26005583/return-value-of-x-os-system 中的建議改進此一指令
42   os.system("pandoc cover_and_abstract.md " + chapter_list + " reference.md -o ./pdf/report.pdf {}".format(settingFlag))
43   g.es("PDF 轉換完畢")
44
45   print("12")

```

Figure 5.6: modify-chapters

A: Path is wrong. Execute under “images”

The screenshot shows a software interface for editing Gherkin files. At the top, there's a menu bar with File, Edit, Search, Settings, Outline, Plugins, Run, Window, Help. Below the menu is a toolbar with icons for script-button, report-pdf, and Chapter: main. The main area has two panes: a tree view on the left and a code editor on the right.

**Tree View:**

- gh-pages: yen.leo in Y:\tmp\bg3\report\users
- workbook.leo
- yen.leo (selected)
- yen.leo
- template.leo
- script-button
- report-pdf
- Chapter: main
- @clean application\_software.md
  - Onshape
  - Inventor
  - V-rep
- @clean design\_process\_and\_introduction.md
  - process
  - introduction
- @clean issue\_and\_solution.md
  - design
  - v-rep
  - report
- @clean conclusion.md
  - Conclusion
- @clean references.md
  - references
- @edit README.md

**Code Editor:**

```

17 A : 在 advisor_zh: 跳行加 - 空格再書寫
18 ![[Advisor][advisor]]
19 Q : 無法在 leo 轉 pdf
20 ![[transform-mistake][])
21 A : 到指定路徑下執行
22 ![[transform-correct][])
23 Q : 無法更新目錄
24 A : 在 button Report pdf 下修改目錄名稱
25 ![[modify-chapters][])
26 Q : 圖片無法顯示
27 A : 路徑錯誤，要在 images 底下執行
28 ![[fig:transform-mistake][])
29 A : 路徑錯誤，要在 images 底下執行
30 ![[fig:transform-correct][])
31 A : 在 advisor_zh: 跳行加 - 空格再書寫
32 ![[fig:transform-mistake][])
33 A : 在 button Report pdf 下修改目錄名稱
34 ![[fig:transform-correct][])
35 Q : 圖片無法顯示
36 A : 路徑錯誤，要在 images 底下執行
37 ![[fig:transform-mistake][])
38 A : 路徑錯誤，要在 images 底下執行
39 ![[fig:transform-correct][])
40
41 [start-bat]: images/issue-and-solution/start.bat.png (#fig:start-bat)
42 ![[fig:for-loop][])
43 [for-loop]: images/issue-and-solution/for.png (#fig:for-loop)
44 [advisor]: images/issue-and-solution/advisor-zh.png (#fig:advisor)
45 [transform-mistake]: images/issue-and-solution/transform-mistake.png (#fig:transform-mistake)
46 [transform-correct]: images/issue-and-solution/transform-correct.png (#fig:transform-correct)
47 [modify-chapters]: images/issue-and-solution/modify-chapters.png (#fig:modify-chapters)
48
49
50
51
52

```

**Bottom Status Bar:**

Minibuffer: Insert State  
line 40 col 0 foal 0 | Y:/tmp/bg3/report/users/yen.leo# @path. I. --> README --> @path markdown --> @path paragraph --> @clean issue\_and\_solution.md --> report

Figure 5.7: image

# Chapter 6 Assignments

工作分配

## 6.1 Assignments

40623203 蔡宜芳: Onshape Interface and Geometry, Website, PDF

40623206 邱妍蓁: Onshape Drawing

40623207 呂沛蓉: Onshape Sheet Metal

40623244 林俊鎧: Design, Translation, inform

40623248 廖柏誠: Onshape Assembled, Design, V-rep

40623250 湯峻傑: Onshape Constraint and Feature, Design

# Chapter 7 Conclusion

結論

## 7.1 Conclusion

We suffer a lot of setbacks in the process at this time, such as assembly interference. It cause the mechanism not to operate smoothly during the simulation and PDF has been unable to solve the problem. With the help of teacher and seniors, we solved our long-standing problems successfully. There have also been differences in opinions among members. After many intense discussions, make everyone know each other's ideas, unify everyone's opinion and assign appropriate task to each other so that to complete the final project efficiently.

## Chapter 8 References

Marble Machine - Triple Gears Lift (Three Blocks Marble Race)

How to make spiral Marble Machine - cardboard toy)

Stairs lifter (2nd test)

How to Make BIG Marble Run Machine from Cardboard

Onshape

Inventor

V-rep