ENGG1100 (17-18) Introduction to Engineering Design I
Engineering Faculty
The Chinese University of Hong Kong
Homework 2: Computer Aided Design Using SolidWorks

In this homework, you are going to design a ball catcher, which is capable of catching a ball by a servo, using SolidWorks. Please draw the parts and assemble them according to the instructions below.

Your task:

- Design and assemble the catcher to catch a ball with the materials provided.
- Your holder should fulfill ALL functional requirements.
- All restriction should be followed.
- Complete "ENGG1100_17-18_HW2_Answer Sheet.docx" to briefly explain your design. An example is shown in the appendix.

(Note: Apart from the functionality, marks would also be given to the appearance of your design.)

Materials provided:

- All related 3D parts and a homework-ready project car model. ("ENGG1100_17-18_HW2_parts.zip" ➔ "Given_Assembly.SLDASM")
- M3 12mm screws and M3 hex nuts. ("ENGG1100_17-18_HW2_parts.zip" ➔ "Screw Models")

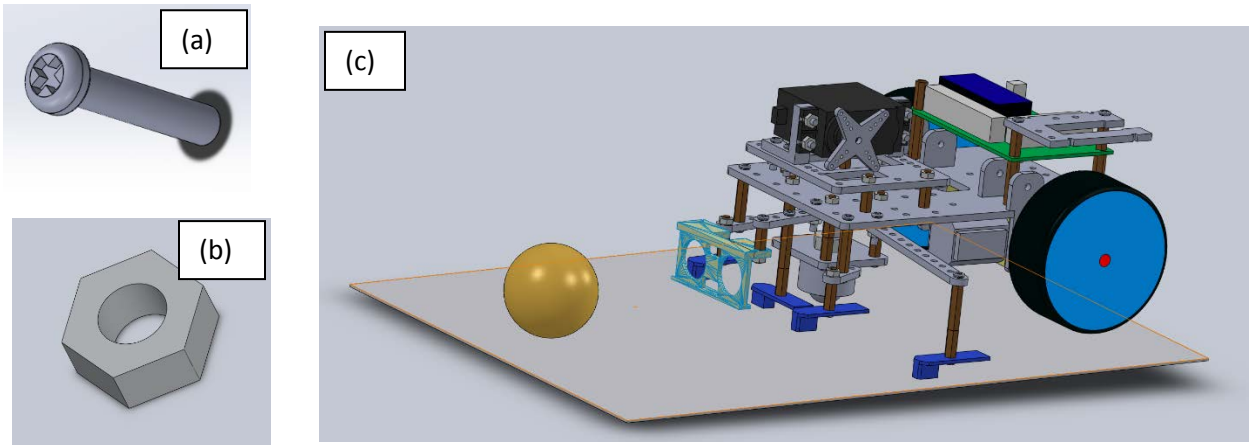


Fig.1 The materials provided.
(a) M3X12 screw, (b) M3 hex nut, (c) Project car.

Note 1: The files provided may not be the same physical components given to you in the project.
Note 2: Some features (e.g. threads on the screws) are simplified for faster rendering.

Functional requirements:

- The catcher should be large enough to a ball can be caught and released.
- Student should use what they have learnt to design, assemble and check the model so it will not have any collision with other parts of the car.
- If a piece of the catcher for laser cut is longer or larger than an allowable dimensions of a laser-cut part, student should separate the piece into several parts, and use screws to secure them together as one large model.

Tolerance requirements:

Assume that you are going to fabricate the clamp by 3D printing. Since the printed part will shrink, you have to set the dimensions with some tolerances.

- If you want to install the M3 screw firmly, you may set the hole diameter to 3mm (for laser cut) or larger than 3.1mm (for 3D printing).
- If you want to let the M3 screw rotating freely at the cylindrical hole, you may set the diameter to 3.3mm.

(Note: It may vary according to different materials, different printing machines or different fabrication methods or companies.)

Size and volume restrictions:

- The total volume of all designed parts for 3D printing (excluding the provided materials) should not exceed **40000mm^3**. All 3D printing models should export as STL file format **individually**.
- The size of each designed part for laser cut should not exceed **100mm x 200mm**, and total area of all parts to be laser cut should not exceed **150000mm^2**. Each laser-cut part should be **3mm thick**. All laser-cut parts should be exported as DWG file **individually**.

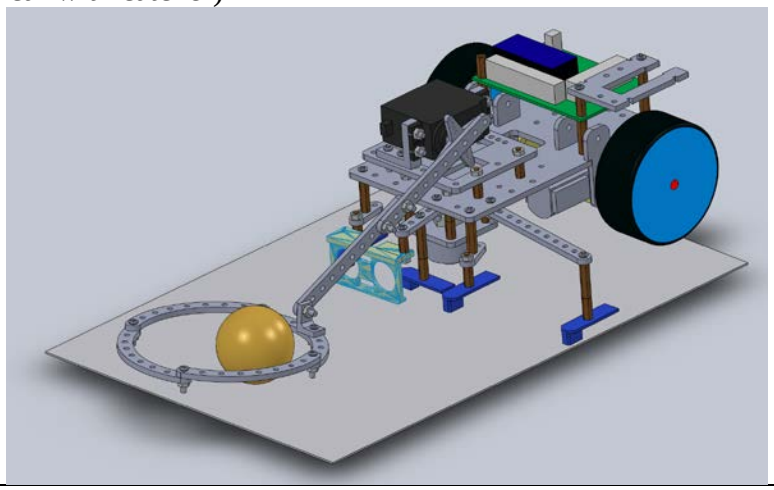
Appendix – An example

Note:

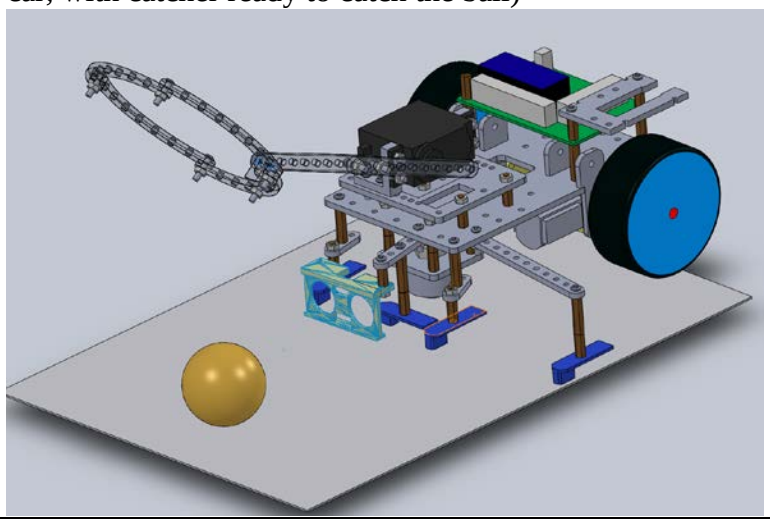
- Models of different shapes of acrylic pieces are provided in "ENGG1100_17-18_HW2_parts.zip" ➔ "Acrylic Models".
- You can use them as part of your catcher design, but you still need to list them in sections 1–6 (e.g., parts 1 and 2 in the following sample).
- Most likely you will need to draw at least one additional part (e.g., part 3 in the following example).
- Package only the files in the section 6 along with the answer sheet in a zip file, and submit it via Blackboard.

1. Overview of your design

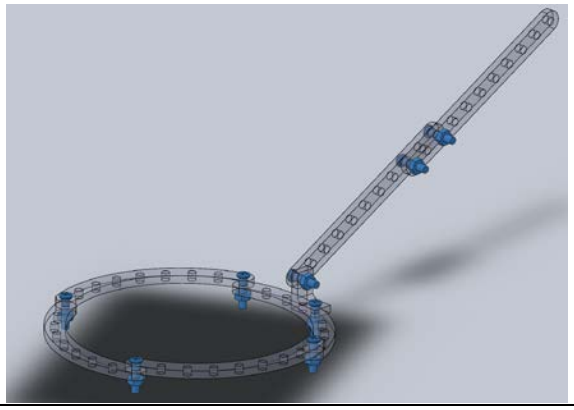
Explain the design of your clamp clearly with the help of images and words.
You may adjust the size of the provided table and extend the number of cells when necessary.

Views describing your design
(Overview of your car with catcher) 

(Overview of your car, with catcher ready to catch the ball)



(Overview of the catcher)



(You may add more views if necessary)	(You may add more views if necessary)

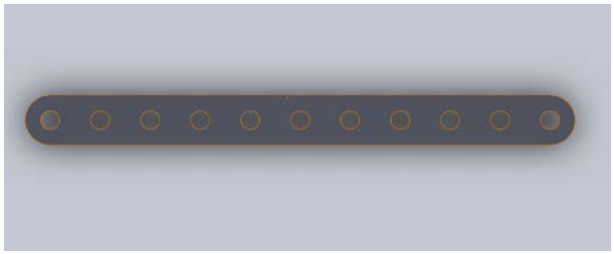
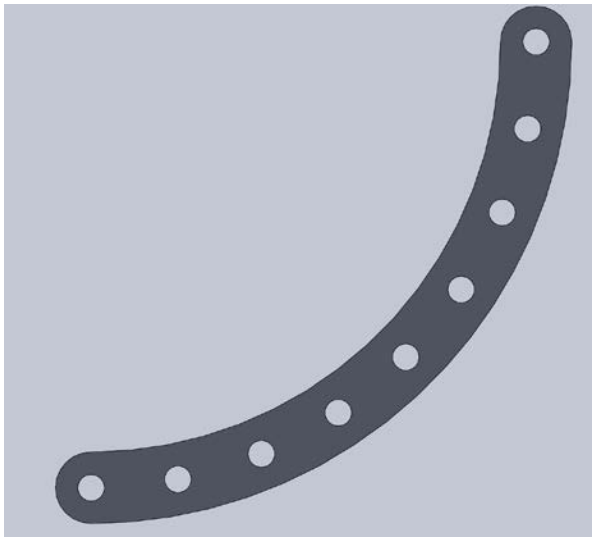
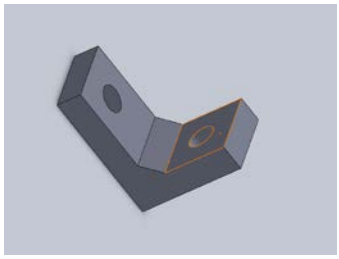
Brief descriptions explaining how the requirements can be achieved with your design:

I designed a catcher with a long arm.
Normally, the servo placed on the car will put the catcher to “ready to catch the ball” position.
When ultrasound sensor close enough to the ball, the servo will rotate and use the catcher to collect the ball.

…
…
…

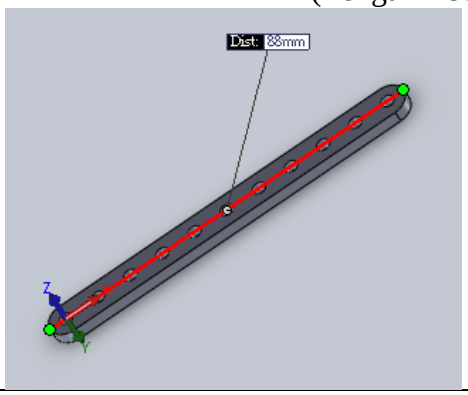
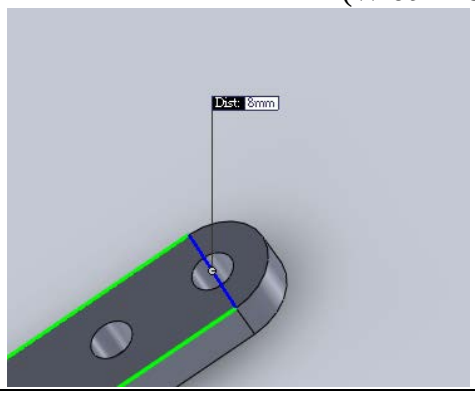
2. Components of your clamp

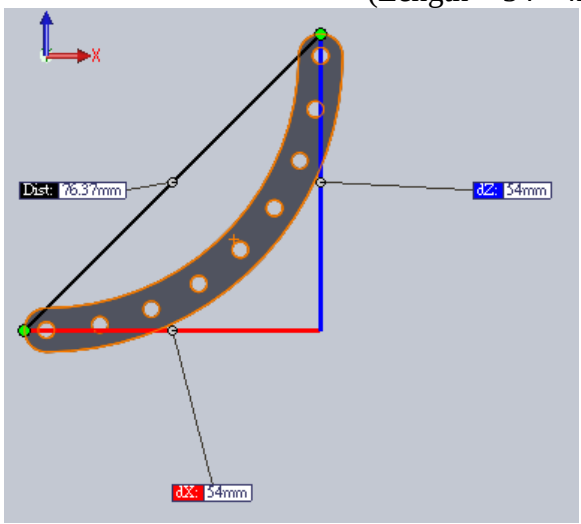
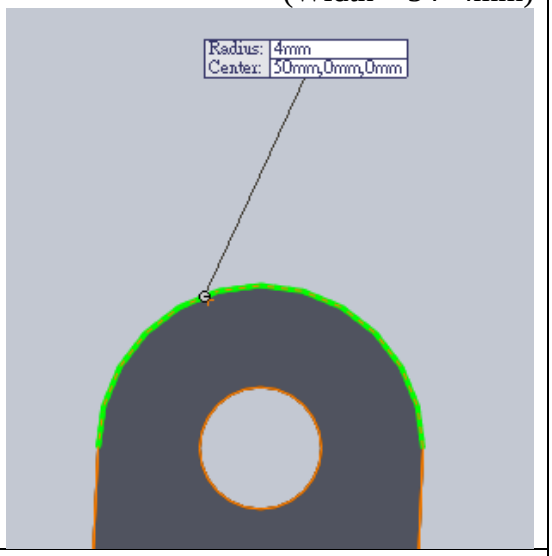
Show the individual components of your clamp with the help of images and words. You may adjust the size of the provided table and extend the number of calls when necessary.

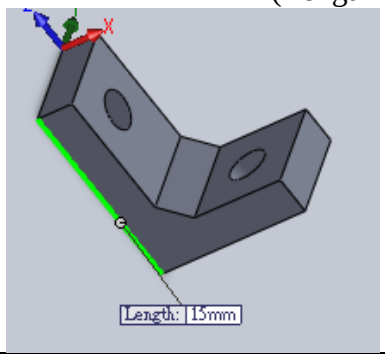
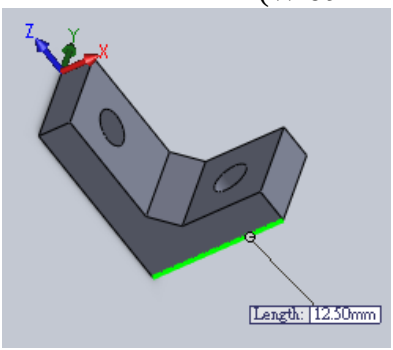
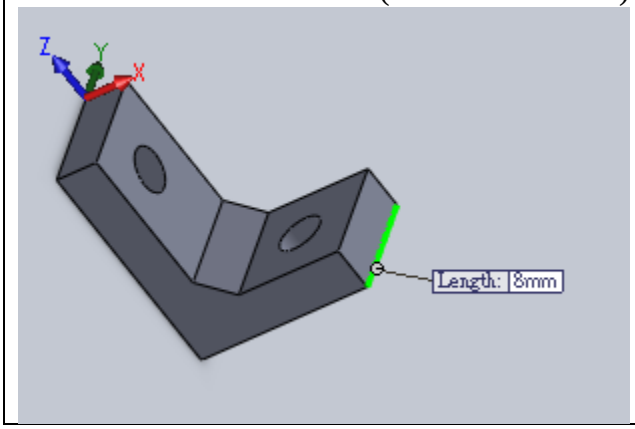
<table>
<tr><td colspan="2">The components which form your clamp:</td></tr>
<tr><td>Part 1
 
(Qty: 2)</td><td rowspan="2">Part 2
 
(Qty: 4)</td></tr>
<tr><td>Part 3
 
(Qty: 1)</td></tr>
<tr><td>Part 4 (Given parts)
M3 x 12mm Screws
(Qty: 8)</td><td>Part 5 (Given parts)
M3 hex nuts
(Qty: 8)</td></tr>
</table>

3. Dimensions of the components

Show the key dimensions of the individual components. You may show the dimensions with screenshots using the “Measure” tool, or, you may give the dimensions using 2D engineering drawings. You may adjust the size of the provided table and extend the number of cells when necessary.

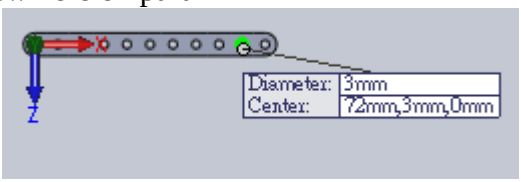
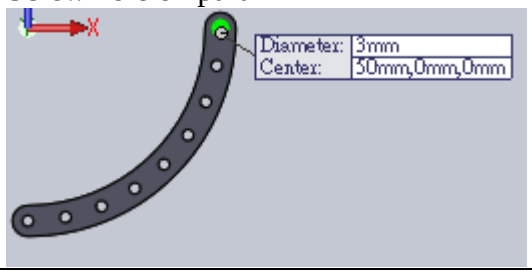
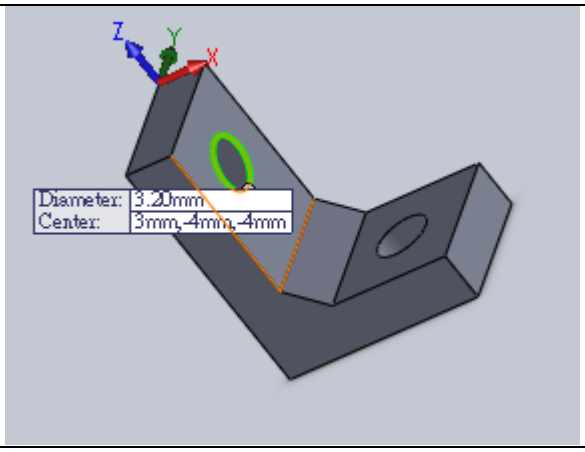
<table>
<tr><td colspan="2">Dimensions of part 1:</td></tr>
<tr><td>(Length = 88mm)
 
</td><td>(Width = 8mm)
 
</td></tr>
<tr><td>(Thickness = 3mm)</td><td>(Other key dimensions)</td></tr>
</table>

<table>
<tr><td colspan="2">Dimensions of part 2:</td></tr>
<tr><td>(Length = 54 +4mm)
 
</td><td>(Width = 54+4mm)
 
</td></tr>
<tr><td>(Thickness = 3mm)</td><td>(Other key dimensions)</td></tr>
</table>

Dimensions of part 3:	
(Length = 15mm) 	(Width = 12.5mm) 
(Thickness = 8mm) 	(Other key dimensions)

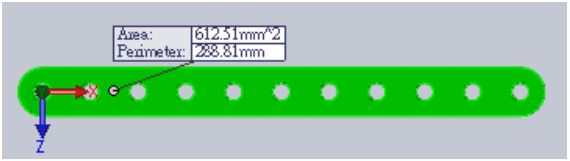
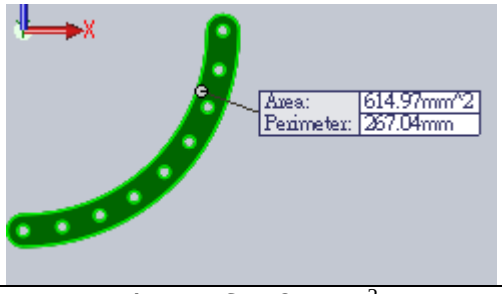
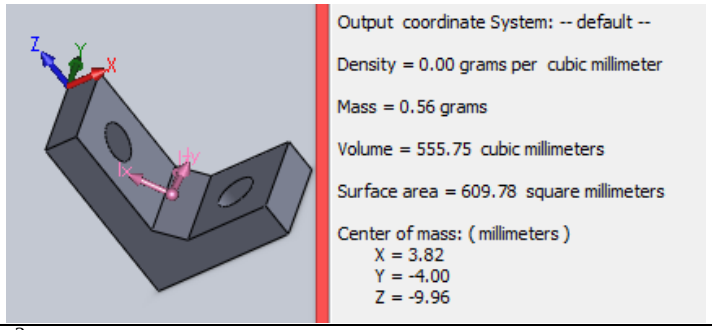
4. Tolerance of components features

Show the key dimensions of the fitting region to illustrate how your set dimension can ensure the correct functionality of the clamp. You may show the dimensions with screenshots using the "Measure" tool. You may adjust the size of the provided table and extend the number of cells when necessary.

<table>
<tr><td colspan="2">Tolerance of components features:</td></tr>
<tr><td>Screw hole on part 1
 
</td><td>Screw hole on part 2
 
</td></tr>
<tr><td>Explanations:
The hole is of 3mm diameter so it is a bit tight with the screw.</td><td>Explanations:
The hole is of 3mm diameter so it is a bit tight with the screw.</td></tr>
<tr><td> 
</td><td></td></tr>
<tr><td>Explanations:
The hole is of 3.2mm diameter so it is OK with the screw.</td><td></td></tr>
</table>

5. Surface area / Volume of the components

Show the volume of the components. The total volume of all the parts should not exceed the given limit. You may obtain the volume of each part using the "Mass Properties" tool under "Evaluate". You may adjust the size of the provided table and extend the number of cells when necessary.

<table>
<tr><td colspan="2">Area / Volume of the components:</td></tr>
<tr><td>Part 1
 
</td><td>Part 2
 
</td></tr>
<tr><td>Area = 612.51 mm^2</td><td>Area = 614.97 mm^2</td></tr>
<tr><td colspan="2">Part 3
 
</td></tr>
<tr><td colspan="2">Volume = 555.75 mm^3</td></tr>
<tr><td colspan="2">Total material usage:
For Laser cut: 612.51*2 + 614.97*4 = 3684.9 mm^2 <150000 mm^2
For 3D print: 555.75 mm^3 <40000mm^3</td></tr>
</table>

6. File list

Show the list of components file. This is to help tutor to locate the file for further design check and put the models to print or cut.

Filename	**Description**	**Required Quantity**
Homework 2 Sample.SLDASM	Fully assembled homework 2 robot car	-
Stick x10.SLDPRT	Part 1 design part	For Reference
Stick curved100.SLDPRT	Part 2 design part	For Reference
Part3.SLDPRT	Part 3 design part	For Reference
Stick x10.DWG	Part 1 design part for laser cut	Laser Cut x2
Stick curved100.DWG	Part 2 design part for laser cut	Laser Cut x4
Part3.STL	Part 3 design part for 3D printing	3D Print x1