**ĐẠI HỌC QUỐC GIA TP. HỒ CHÍ MINH**

**TRƯỜNG ĐẠI HỌC CÔNG NGHỆ THÔNG TIN**

**KHOA KHOA HỌC MÁY TÍNH**



**ĐỒ ÁN**

**ĐỒ HỌA MÁY TÍNH**

Giảng viên lí thuyết: **THS. CÁP PHẠM ĐÌNH THĂNG**

Sinh viên thực hiện: **NGUYỄN HOÀNG QUÂN 17520936**

**LÊ VIẾT TRUNG 17521173**

**HUỲNH MINH TUẤN 17521212**

Lớp: **CS105.K21.KHCL**

**TP. Hồ Chí Minh, 7-2020.**

**LỜI CẢM ƠN**

Lời đầu tiên chúng em xin được bày tỏ lòng biết ơn sâu sắc nhất tới **ThS. Cáp Phạm Đình Thăng**, Khoa Khoa học máy tính, trường Đại học Công nghệ thông tin – ĐHQG – TP.HCM. Thầy đã tận tình hướng dẫn nhóm em những kiến thức căn bản và thiết yếu để hoàn thành đồ án này.

Trong quá trình thực hiện đồ án không thể tránh khỏi sai sót, mong thầy và các bạn thông cảm.

TP.Hồ Chí Minh, ngày 30, tháng 7, năm 2020.

**Nguyễn Hoàng Quân – Lê Viết Trung – Huỳnh Minh Tuấn**

**NHẬN XÉT CỦA GIẢNG VIÊN**

**MỤC LỤC**

[**LỜI CẢM ƠN** 1](#_Toc441509506)

[**NHẬN XÉT CỦA GIẢNG VIÊN** 2](#_Toc441509507)

[**MỤC LỤC** 3](#_Toc441509508)

[**CHƯƠNG 1: GIỚI THIỆU** 4](#_Toc441509511)

[**CHƯƠNG 2: CHỨC NĂNG** 5](#_Toc441509518)

[**CHƯƠNG 3: MỞ RỘNG** 32](#_Toc441509523)

[**CHƯƠNG 4: HƯỚNG PHÁT TRIỂN** 39](#_Toc441509518)

[**CHƯƠNG 5: KẾT LUẬN** 40](#_Toc441509523)

**CHƯƠNG 1: GIỚI THIỆU**

Đồ họa máy tính là một ngành khoa học Tin học chuyên nghiên cứu về các phương pháp và kỹ thuật để có thể mô tả và thao tác trên các đối tượng của thế giới thực bằng máy tính.

Về bản chất: đó là một quá trình xây dựng và phát triển các công cụ trên cả hai lĩnh vực phần cứng và phần mềm hổ trợ cho các lập trình viên thiết kế các chương trình có khả năng đồ họa cao.

Với việc mô tả dữ liệu thông qua các hình ảnh và màu sắc đa dạng của nó, các chương trình đồ họa thường thu hút người sử dụng bởi tính thân thiện, dể dùng,... kích thích khả năng sáng tạo và nâng cao năng suất làm việc.

Thuật ngữ đồ họa máy tính (Computer Graphics) được đề xuất bởi nhà khoa học người Mỹ tên là William Fetter vào năm 1960 khi ông đang nghiên cứu xây dựng mô hình buồng lái máy bay cho hãng Boeing. Các chương trình đồ họa ứng dụng cho phép chúng ta làm việc với máy tính một cách thoải mái, tự nhiên.

Tuy nhiên, việc dạy và học kỹ thuật đồ họa thì không là đơn giản do chủ đề này có nhiều phức tạp. Kỹ thuật đồ họa liên quan đến tin học và toán học hầu hết các giải thuật vẽ, tô cùng các phép biến hình đều được xây dựng dựa trên nền tảng của hình học không gian hai chiều và ba chiều.

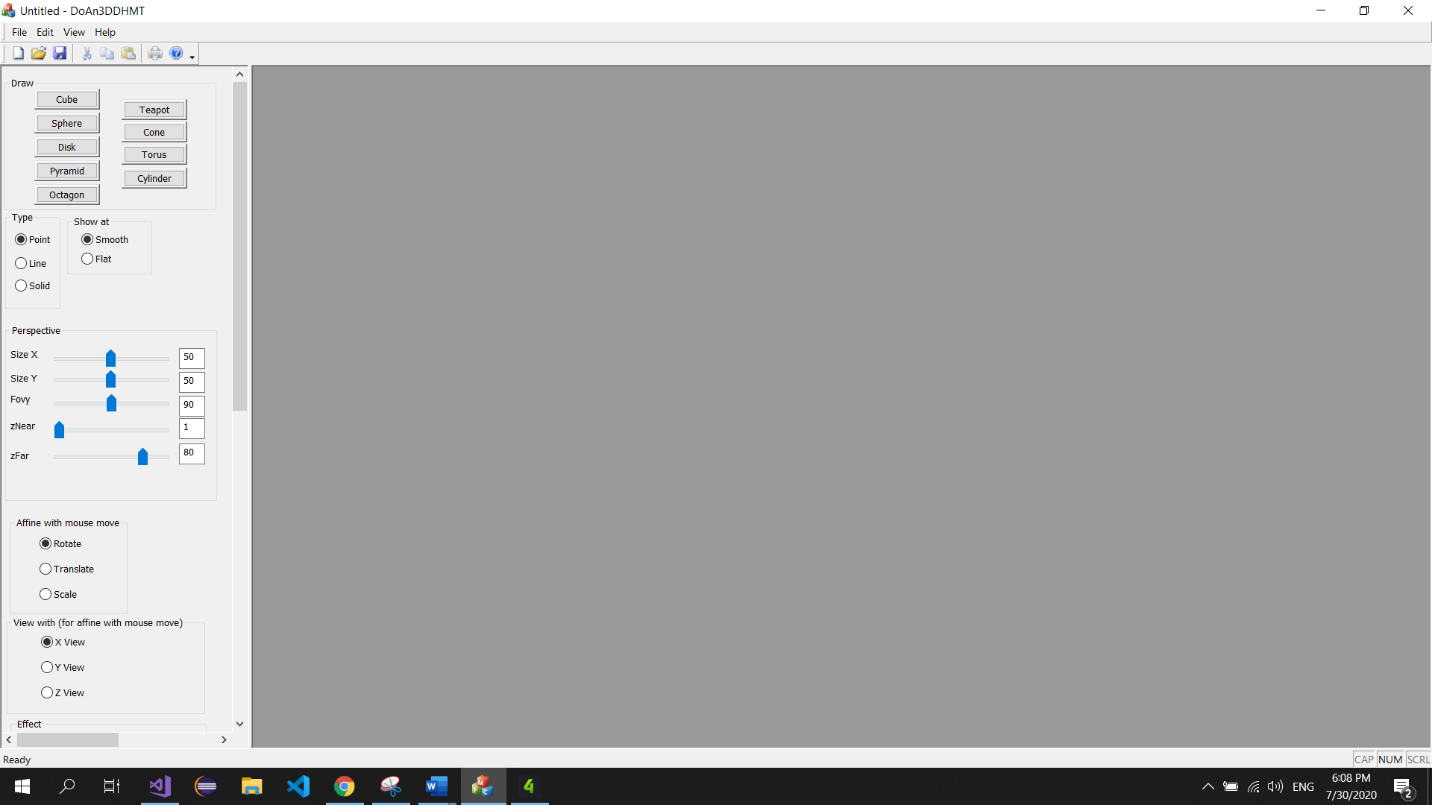
Vì vậy trong đồ án này, nhóm xin giới thiệu một chương trình nhằm mô phỏng lại hình học 3D, các bước hiển thị, chiếu sáng, các phép biến đổi, texture, và chuyển động trong không gian 3 chiều.

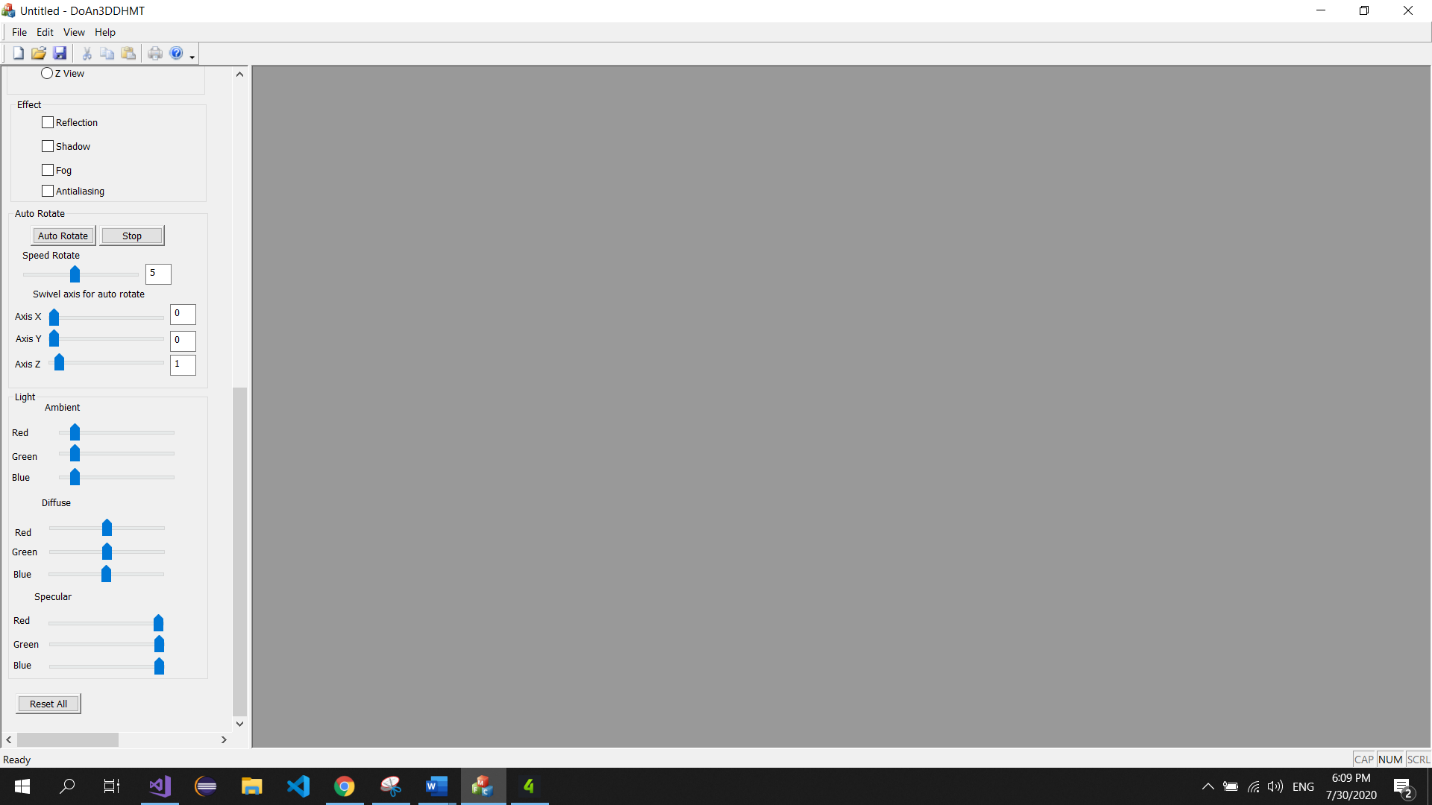
**CHƯƠNG 2: CHỨC NĂNG**

**1. Công cụ và các thư viện hỗ trợ**

Để thực hiện được đồ án, nhóm sử dụng các công cụ và thư viện hỗ trợ như sau:

* Ngôn ngữ lập trình: C++
* IDE: Visual Studio 2017
* Thư viện GUI trên C++: MFC
* Thư viện cho việc xây dựng đồ họa 3D: Opengl

 **2. Giao diện của chương trình**



Bên trái màn hình là các nút, các thanh điều chỉnh phục vụ cho việc vẽ các khối hình, các thao tác điều chỉnh trên các khối hình. Bên phải làm màn hình xám – là màn hình hiển thị các khối hình và các kết quả khi thực hiện các phép biến đổi trên hình.

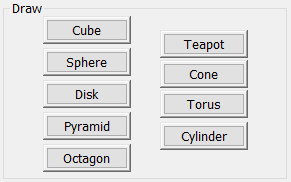
Sử dụng thanh cuộn bên phải để cuộn chọn chức năng.

Sau khi sử dụng các chức năng, nếu muốn khôi phục tất cả về trạng thái ban đầu khi khởi động chương trình, nhấn vào Reset All để thực hiện khôi phục.

**3. Vẽ các khối hình cơ bản**

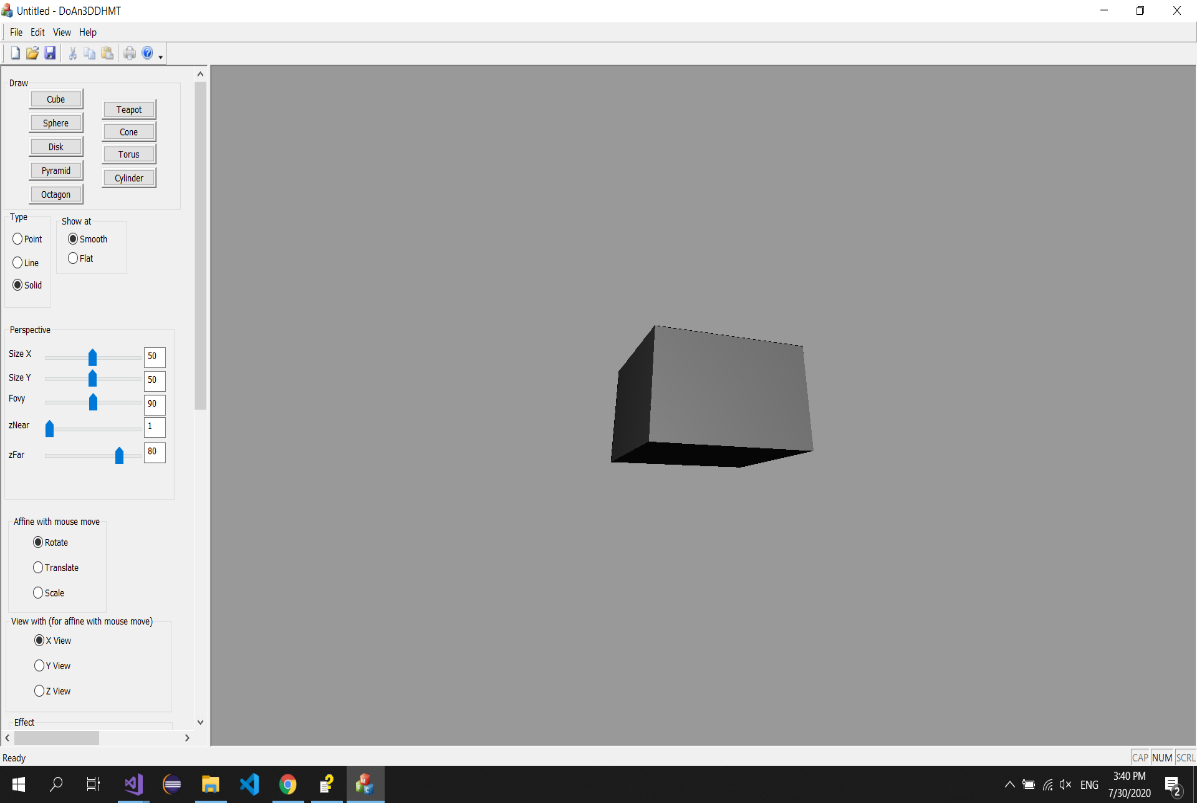
Nhóm sử dụng các hàm có sẵn trong thư viện Opengl như GLUT, GLU để vẽ các khối hình.

Trên giao diện chương trình, để vẽ một khối hình, ta bấm vào button có tên loại hình ta muốn vẽ.

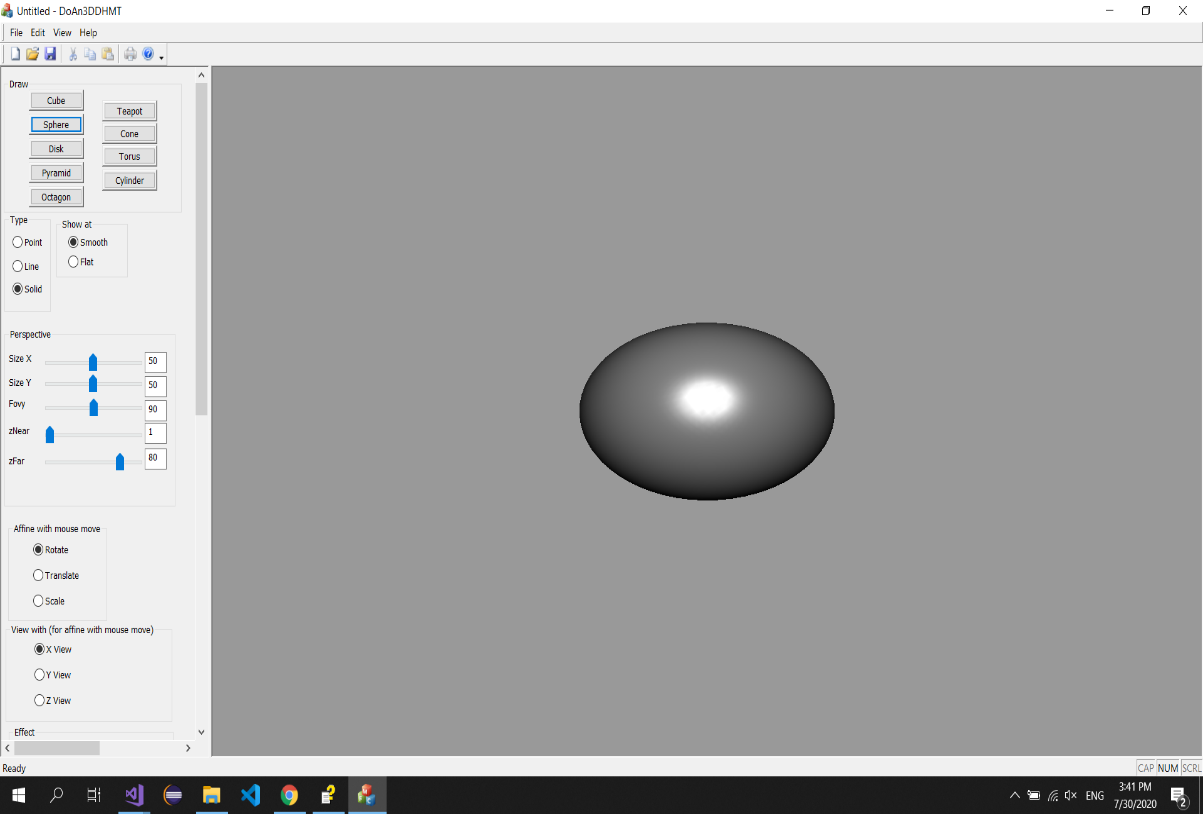


Các hàm sử dụng để vẽ khối hình:

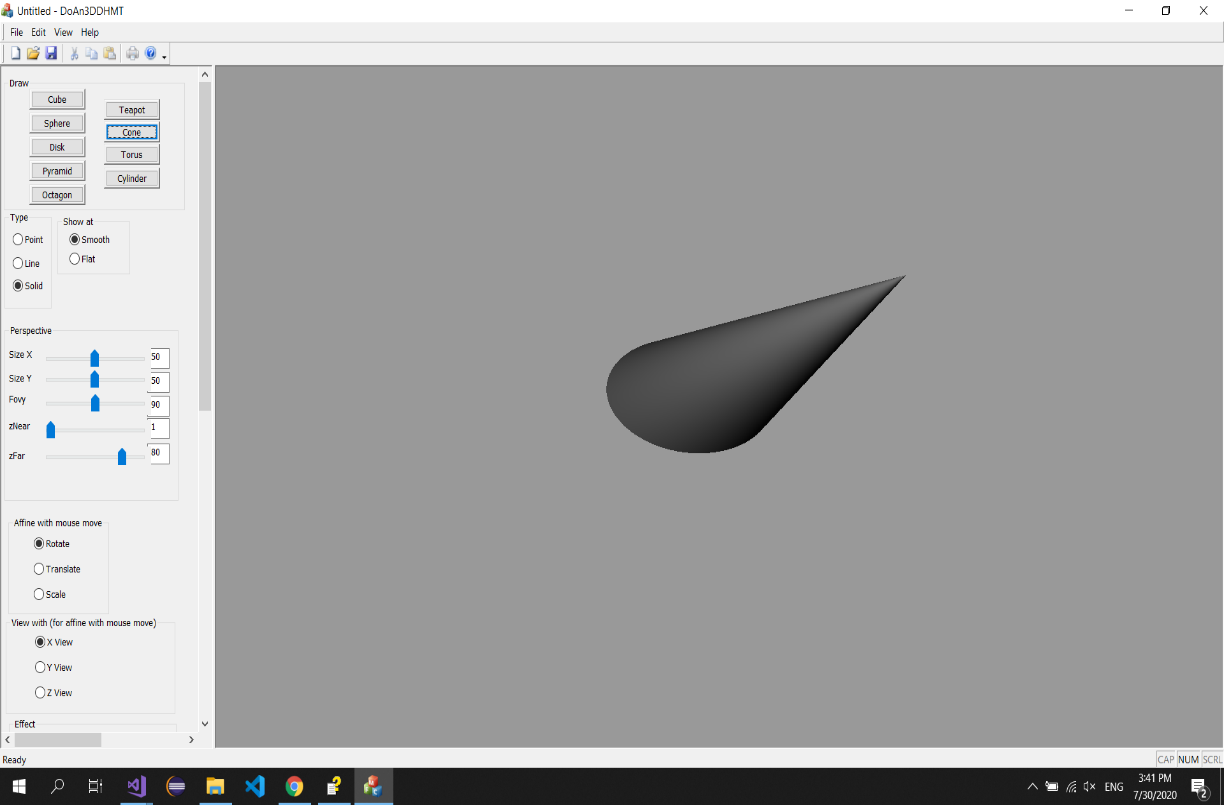
* Hình hộp (CUBE – glutSolidCube)



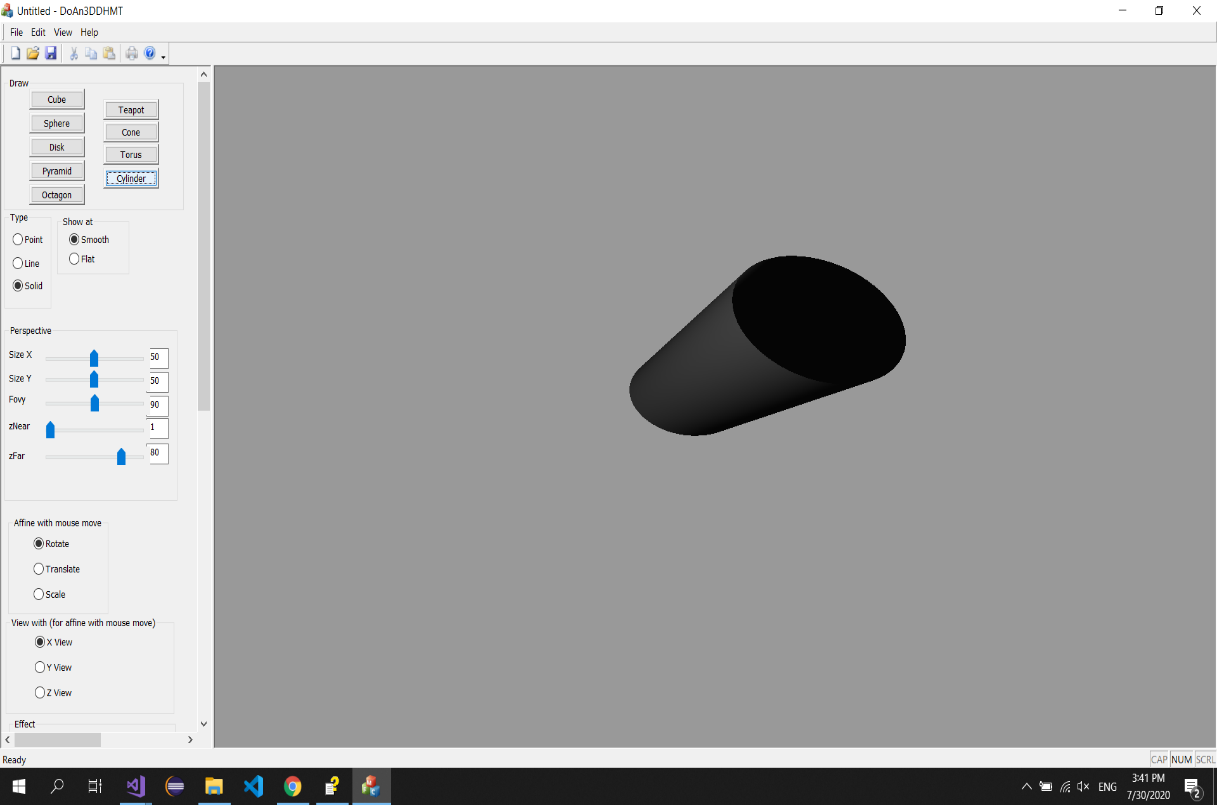
* Hình Cầu (SPHERE – glutSolidSphere)



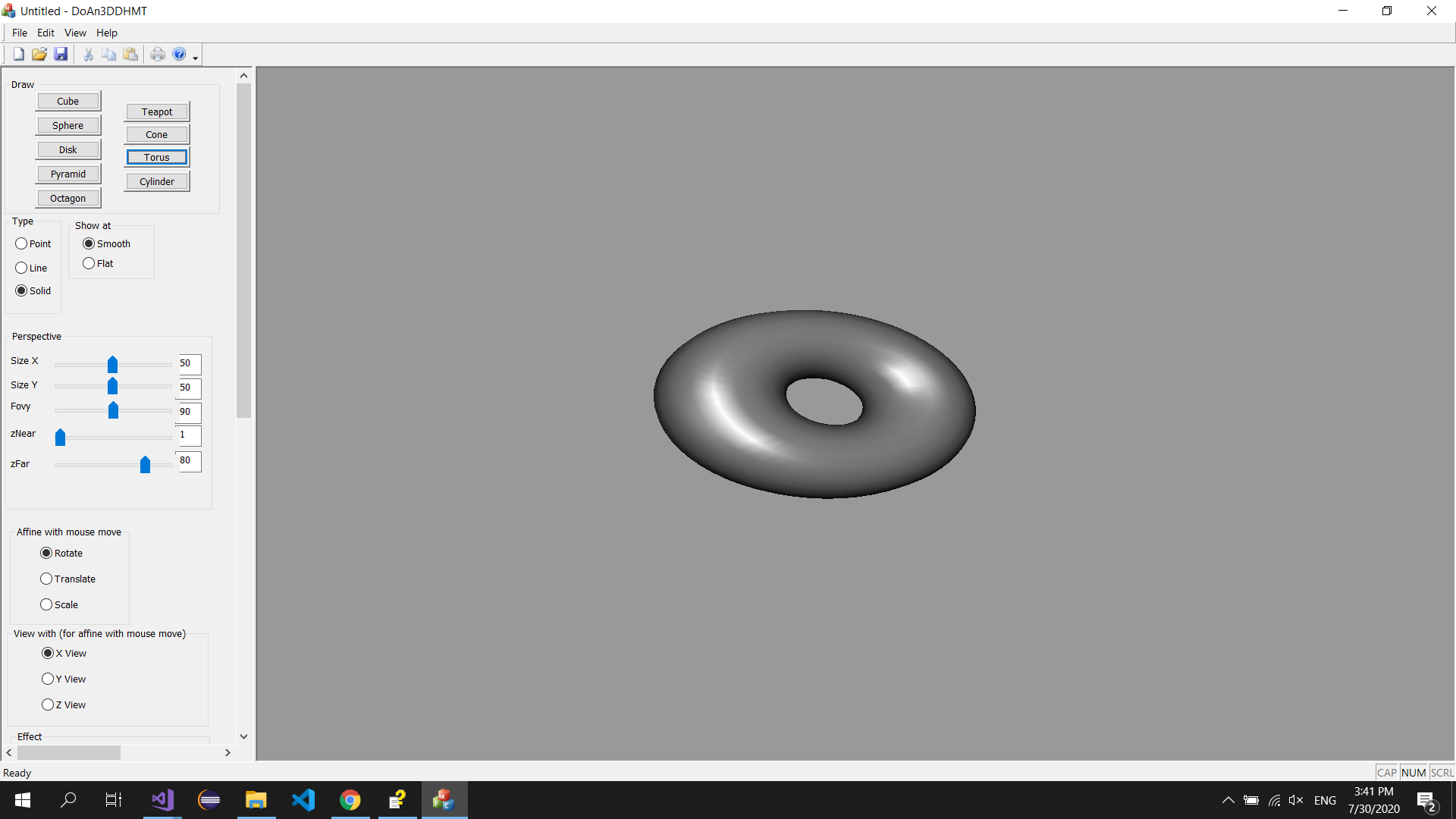
* Hình nón (CONE – glutSolidCone)



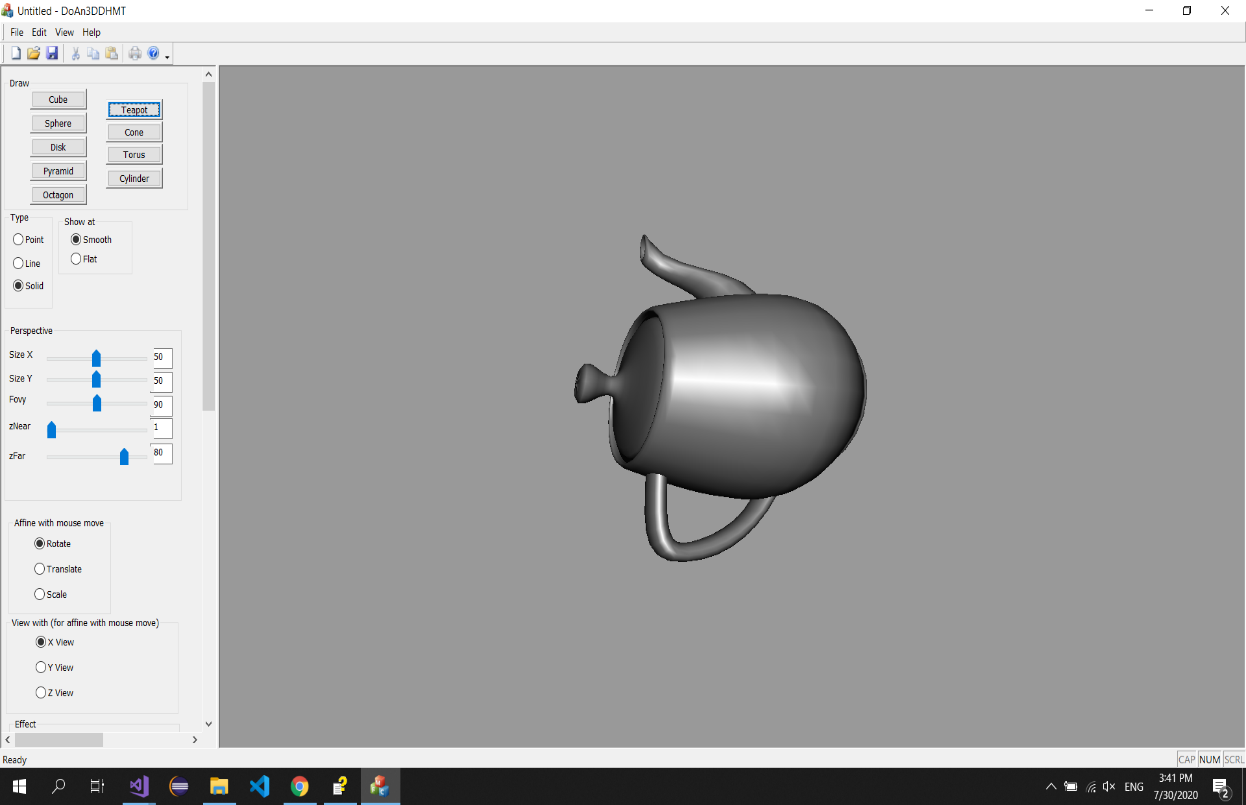
* Hình Trụ (CYLINDER – gluCylinder)



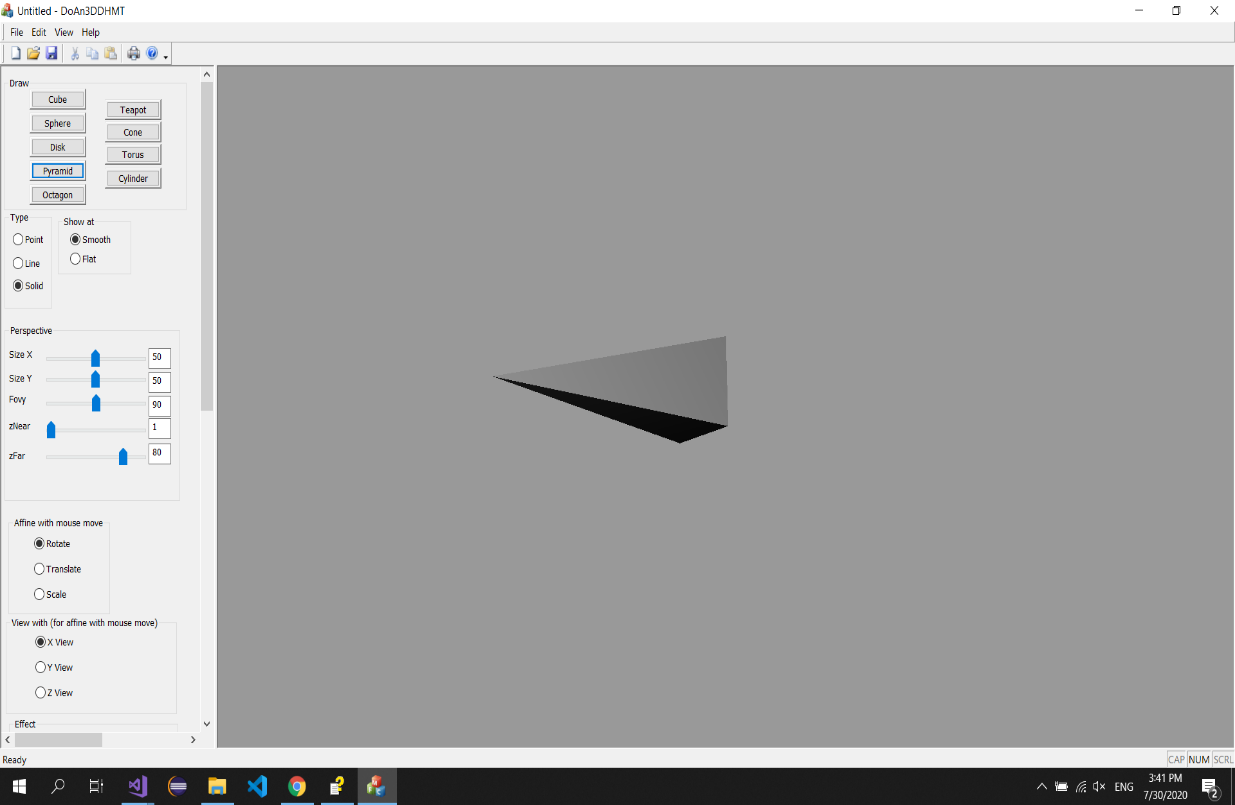
* Bánh xe (TORUS – glutSolidTorus)



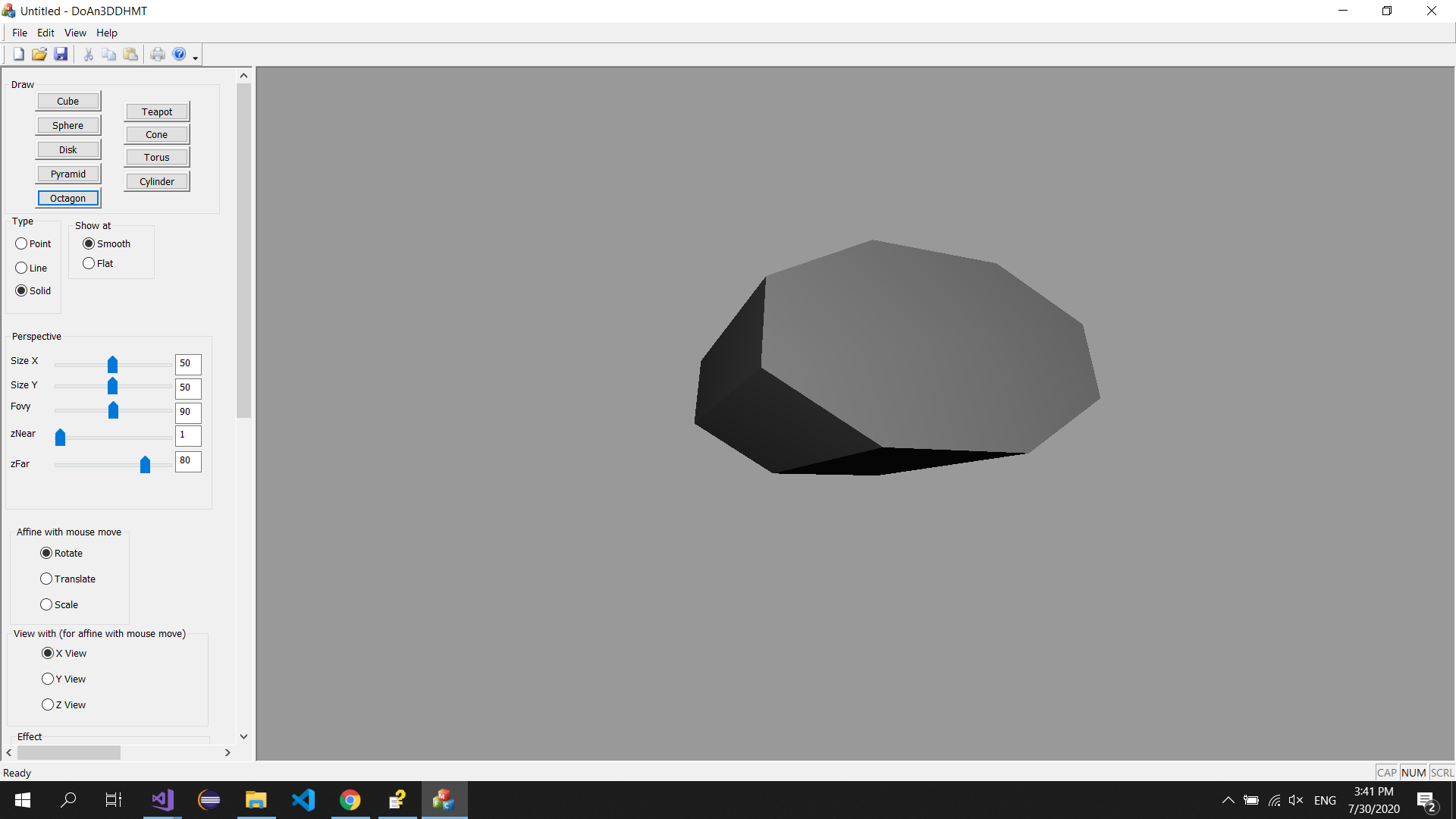
* Ấm trà (TEAPOT – glutSolidTeapot)



* Các hình tự vẽ bằng glVertex3f:
  + Pyramid (PYRAMID)



* + Octagon (OCTAGON)



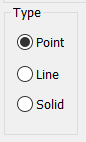
**4. Các kiểu vẽ khối hình**

Các khối hình được vẽ theo 3 dạng: POINT, LINE, SOLID.

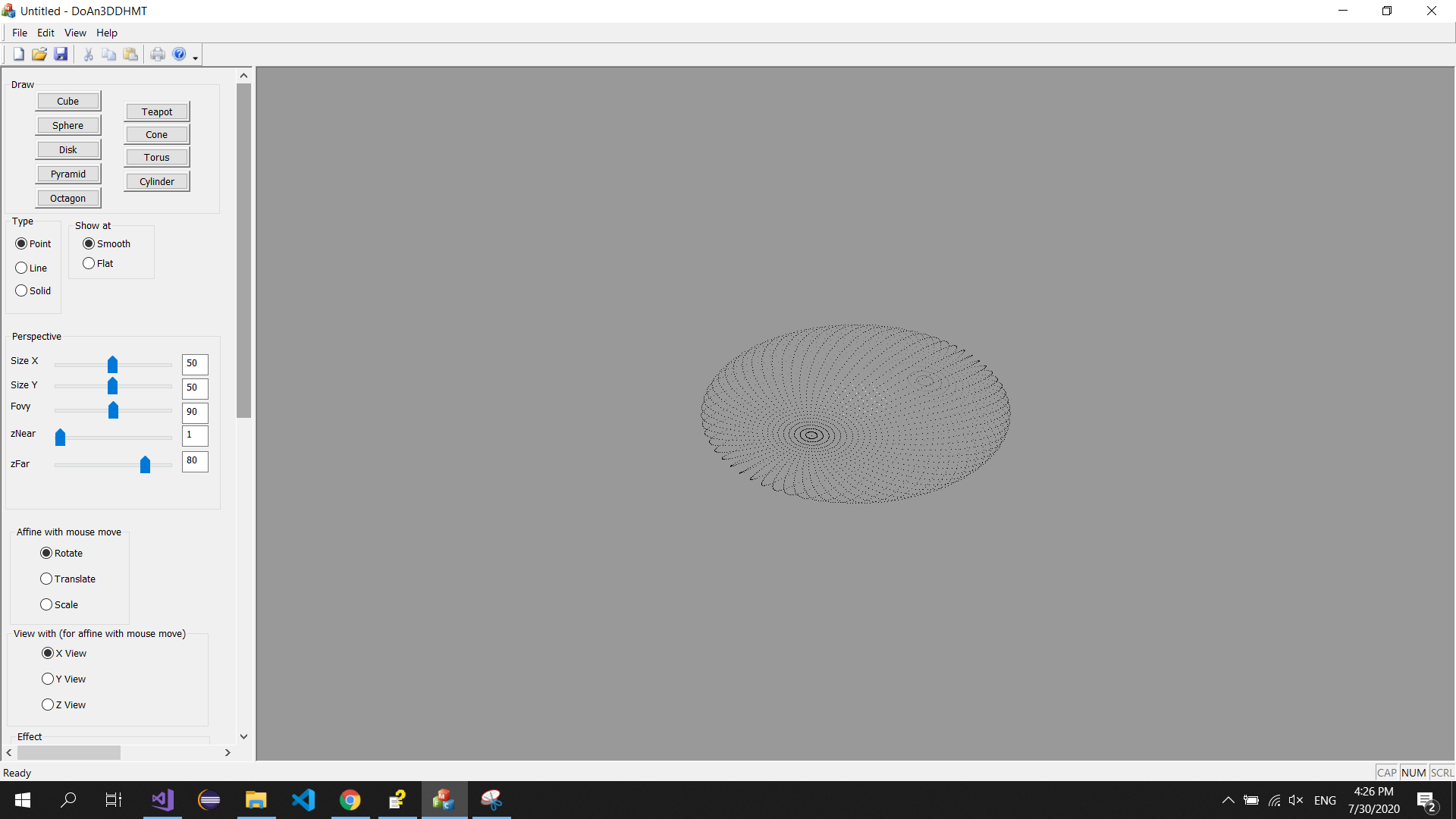
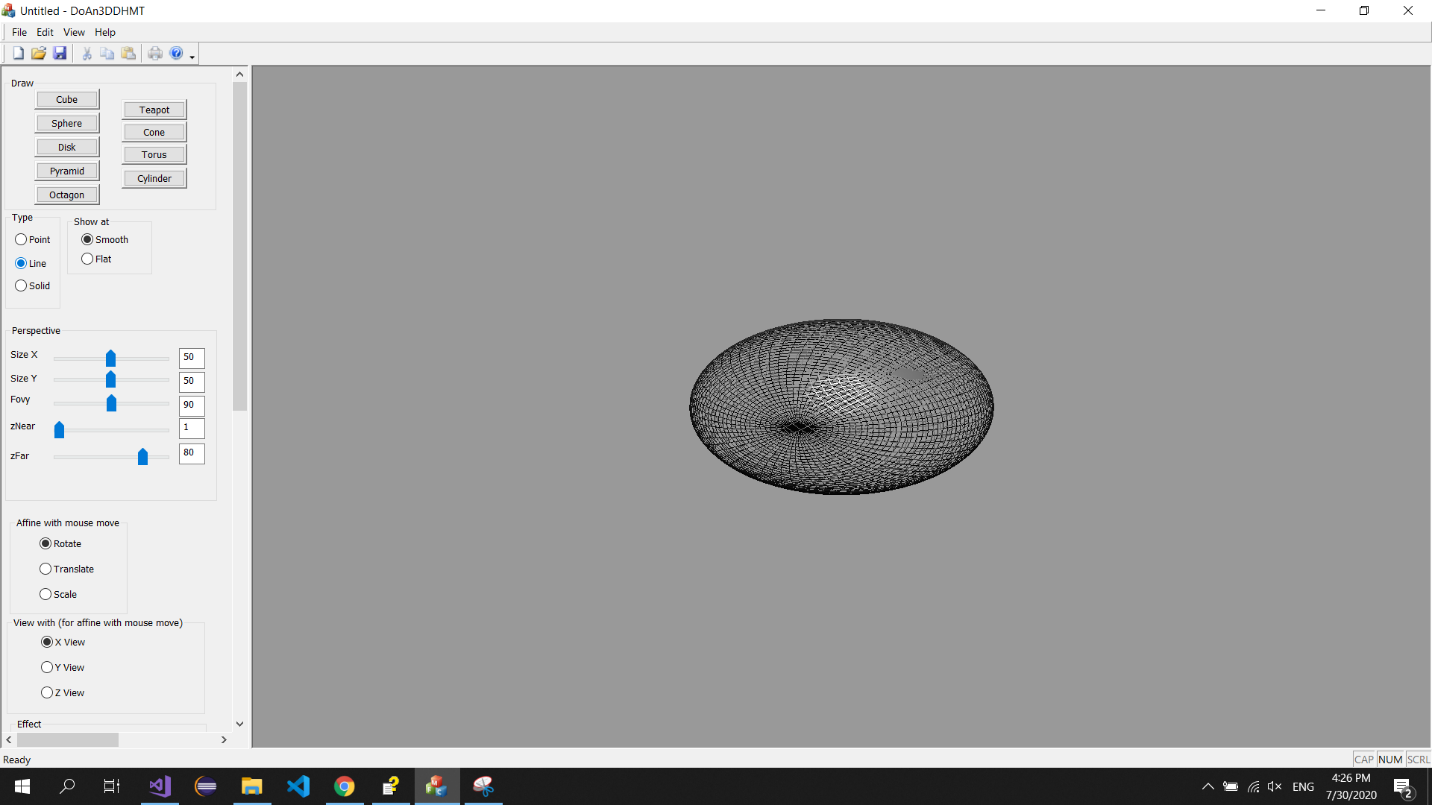
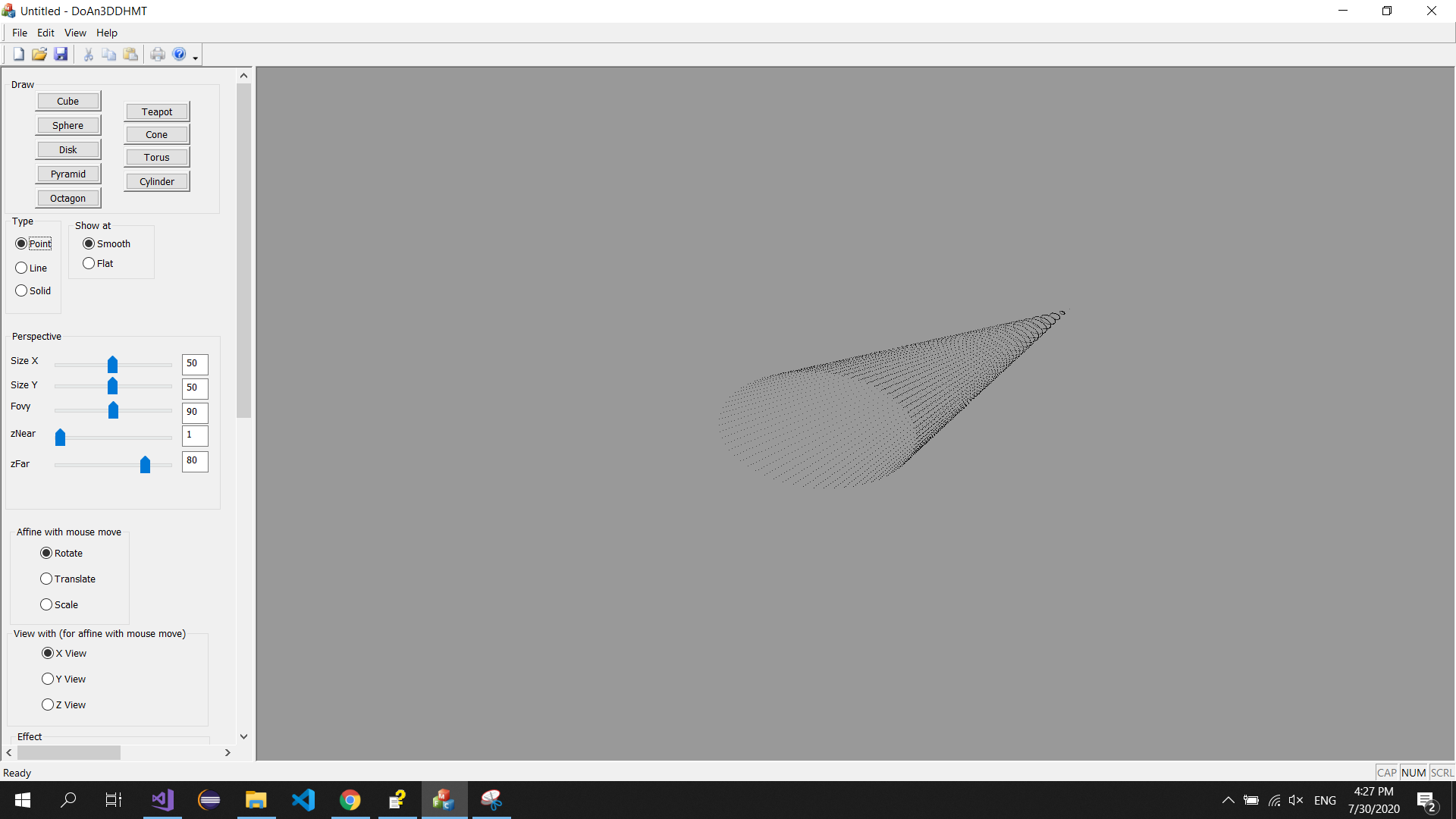
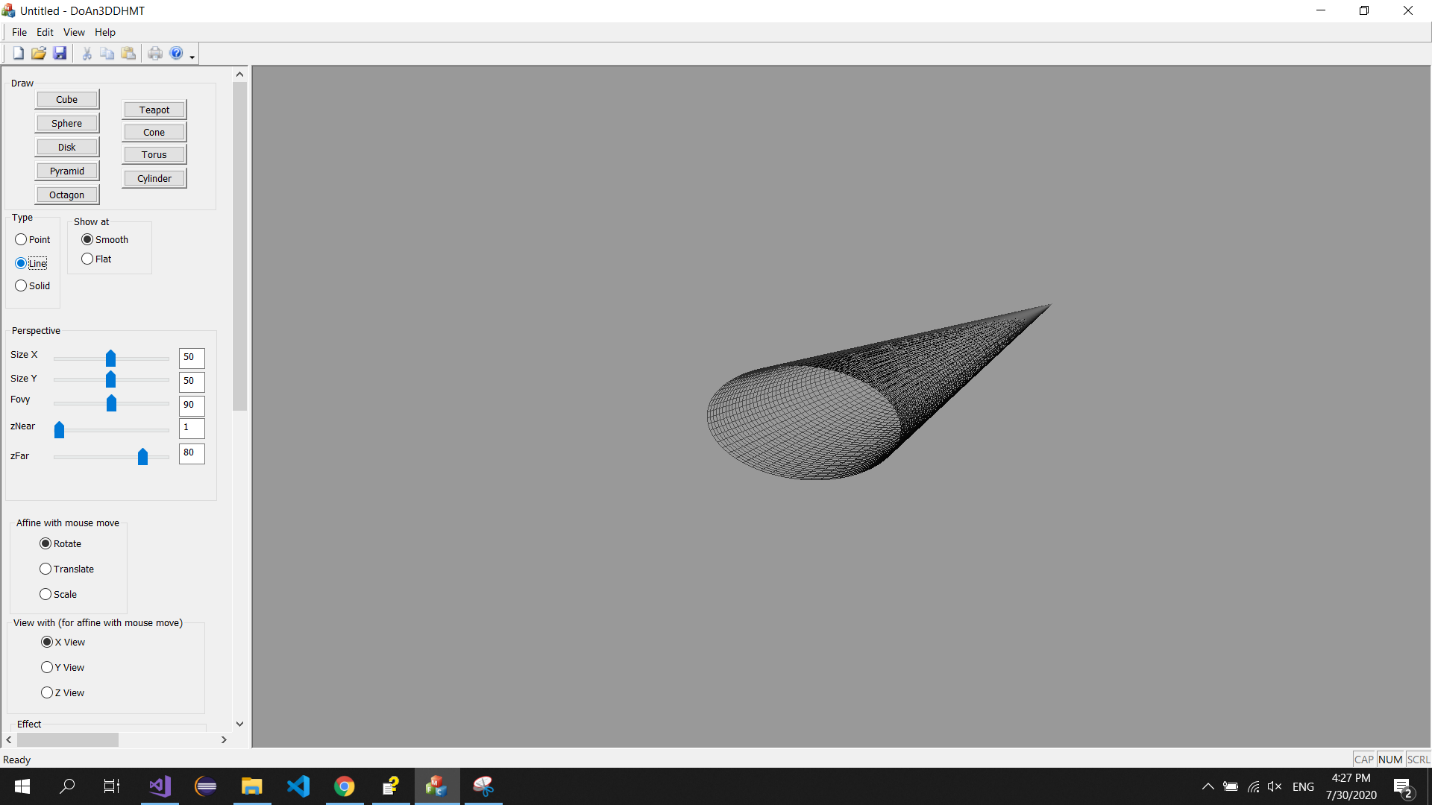
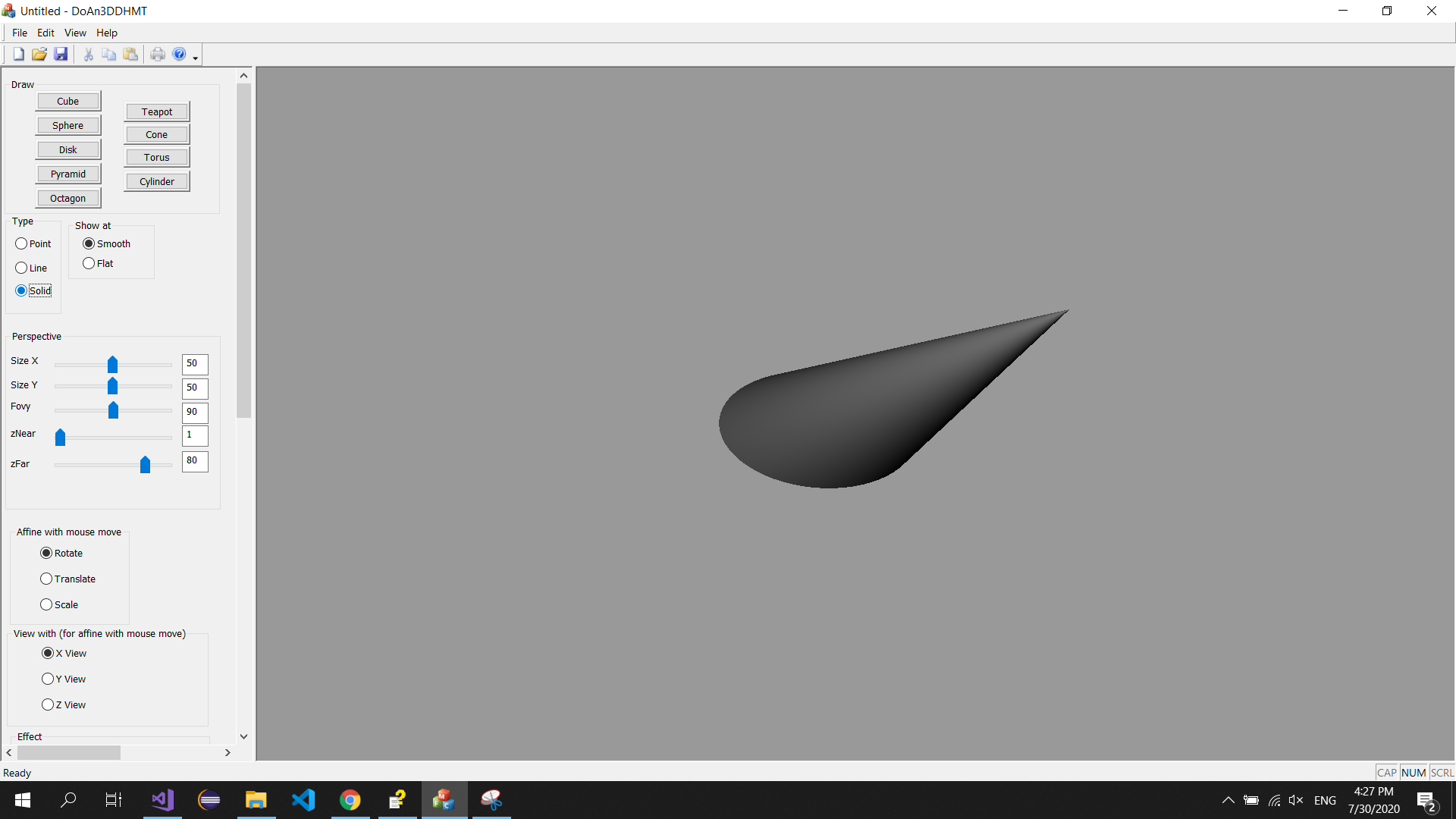
Sử dụng hàm glPolygonMode để hiển thị khối hình ở 3 chế độ này, với:

* GL\_POINT: để vẽ Point cho khối hình
* GL\_LINE: để vẽ Line cho khối hình
* GL\_FILL: để vẽ Solid cho khối hình

Trên giao diện chương trình, để chọn kiểu vẽ, ta bấm vào các radio button trong mục Type



Sau đây là một số ví dụ một số khối hình có thể hiển thị ở cả 3 dạng POINT, LINE, SOLID dễ nhìn vì có một số khối hình hiển thị không rõ ở chế độ LINE

* Với hình cầu – Sphere
  + Vẽ theo Point
  + Vẽ theo Line
  + Vẽ theo Solid
* Với hình nón – Cone:
* Vẽ theo Point
* Vẽ theo Line
* Vẽ theo Solid

**5. Phép chiếu phối cảnh**

Trong đồ án này, nhóm thực hiện phép chiếu phối cảnh bằng cách sử dụng glPerspective.

Cấu trúc hàm glPerspective: glPerspective(fovy, aspect, zNear, zFar);

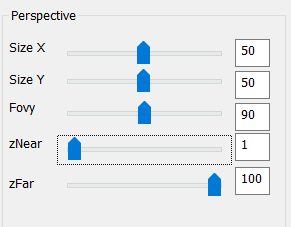
Trong đó:

* Fovy: góc chụp hiện lên màn hình. Fovy càng lớn thì ảnh chụp được càng lớn dẫn đến vật được hiển thị càng nhỏ.
* Aspect: tỉ lệ width/height biểu thị sự cân đối về mặt kích thước giữa dài và rộng của ảnh.
  + Aspect = 1 thì vật đó sẽ “cân đối”.
  + Aspect < 1 tức width < height thì ảnh trở nên “dài” hơn.
  + Aspect > 1 tức width > height thì ảnh sẽ bị “dẹp” lại.
  + Trong đồ án này, width là Size X, height là Size Y.
* zNear khoảng cách từ điểm chụp ảnh đến ảnh.
* zFar khoảng cách từ điểm chụp ảnh đến màn hứng ảnh.
* ![A picture containing game

  Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAeAB4AAD/4RDsRXhpZgAATU0AKgAAAAgABAE7AAIAAAALAAAISodpAAQAAAABAAAIVpydAAEAAAAWAAAQzuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAFFVQU5HIFRPQU4AAAAFkAMAAgAAABQAABCkkAQAAgAAABQAABC4kpEAAgAAAAM2OAAAkpIAAgAAAAM2OAAA6hwABwAACAwAAAiYAAAAABzqAAAACAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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càng gần zFar thì ảnh càng bị che nhiều

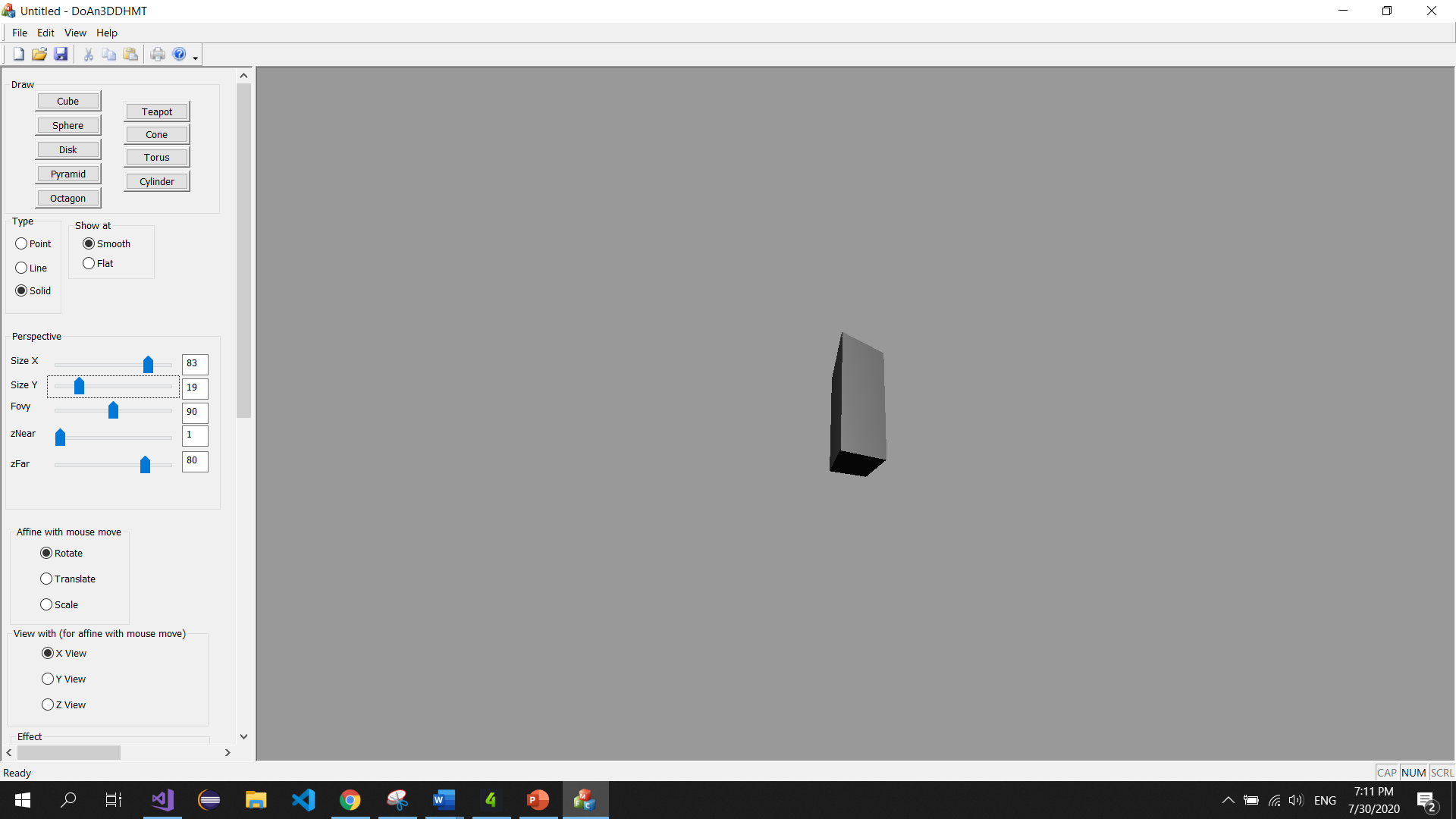
*Minh họa glPerspective*

Điều chỉnh các chỉ số Size X, Size Y, Fovy, zNear, zFar ở nhóm Perspective trong chương trình

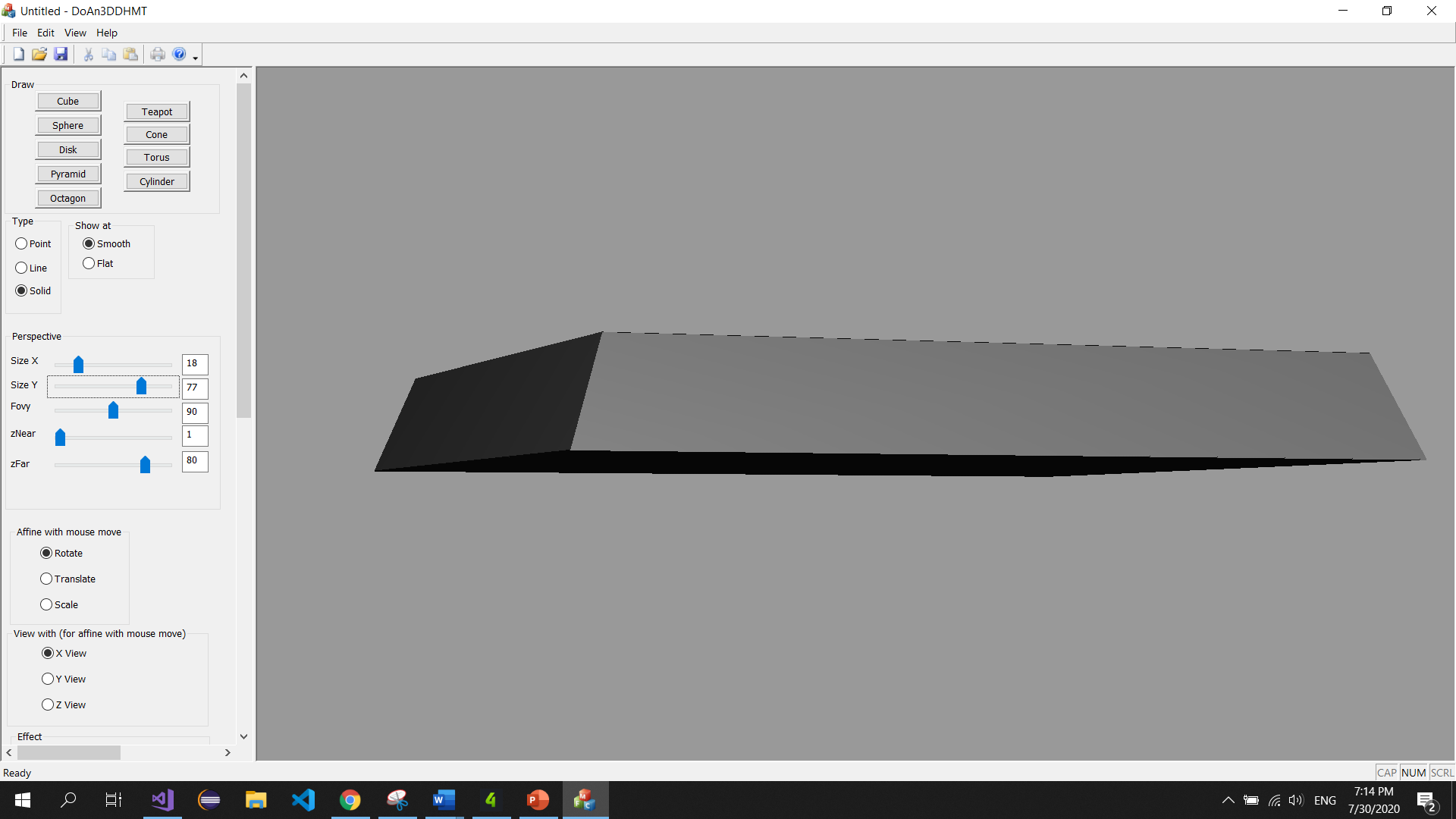


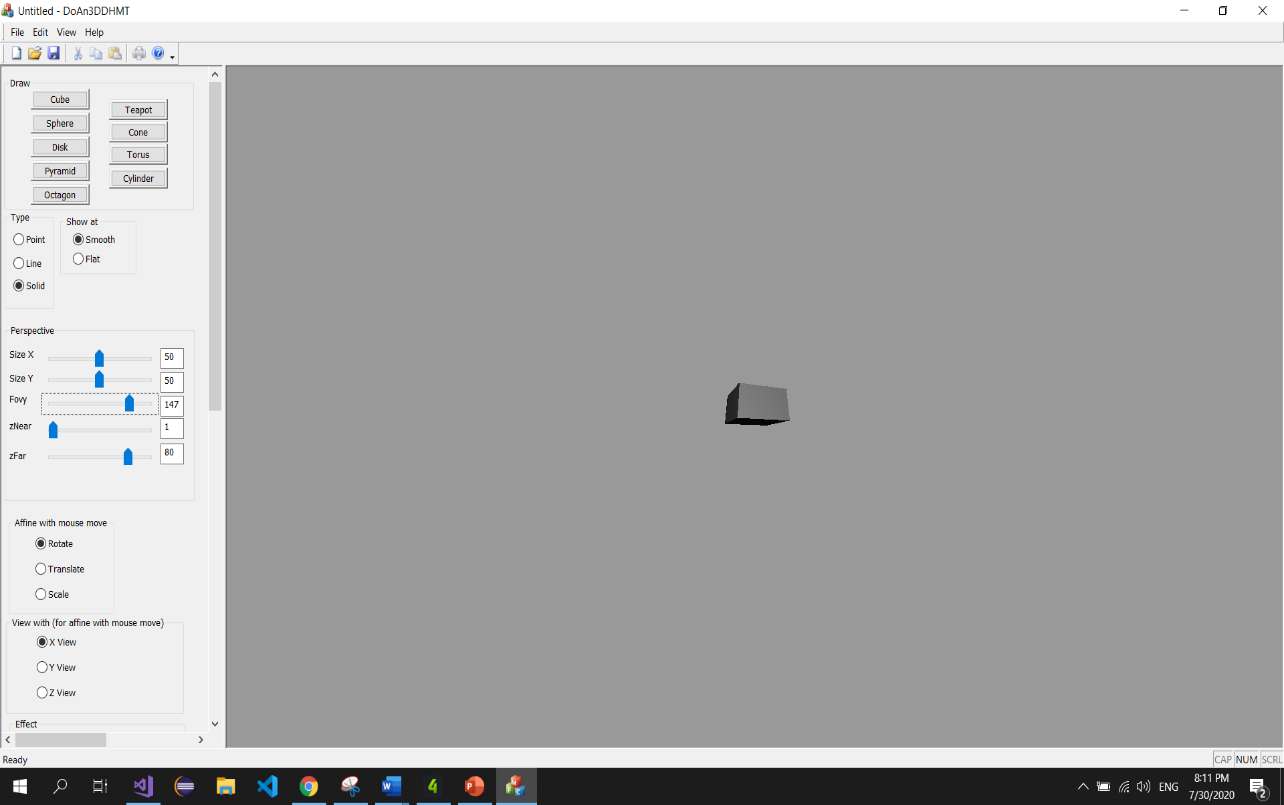
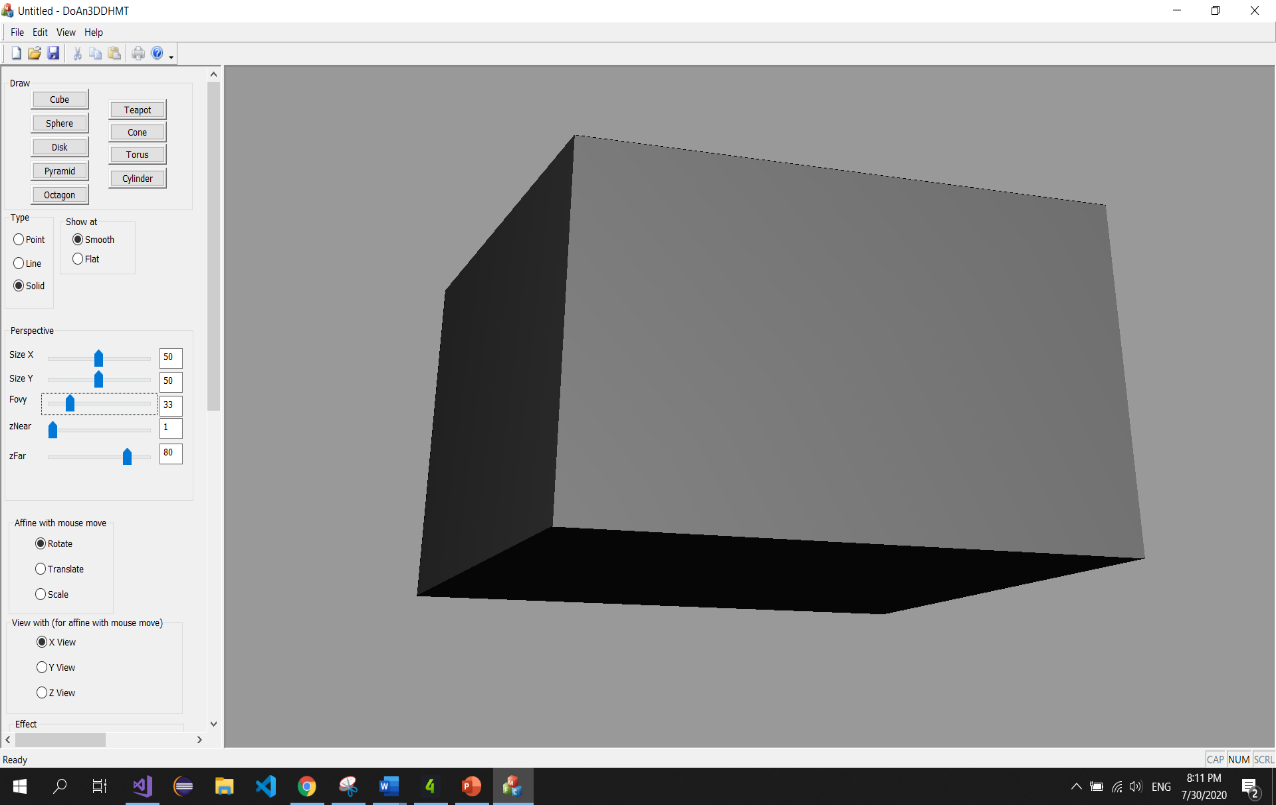
Một số hình ảnh demo của chương trình

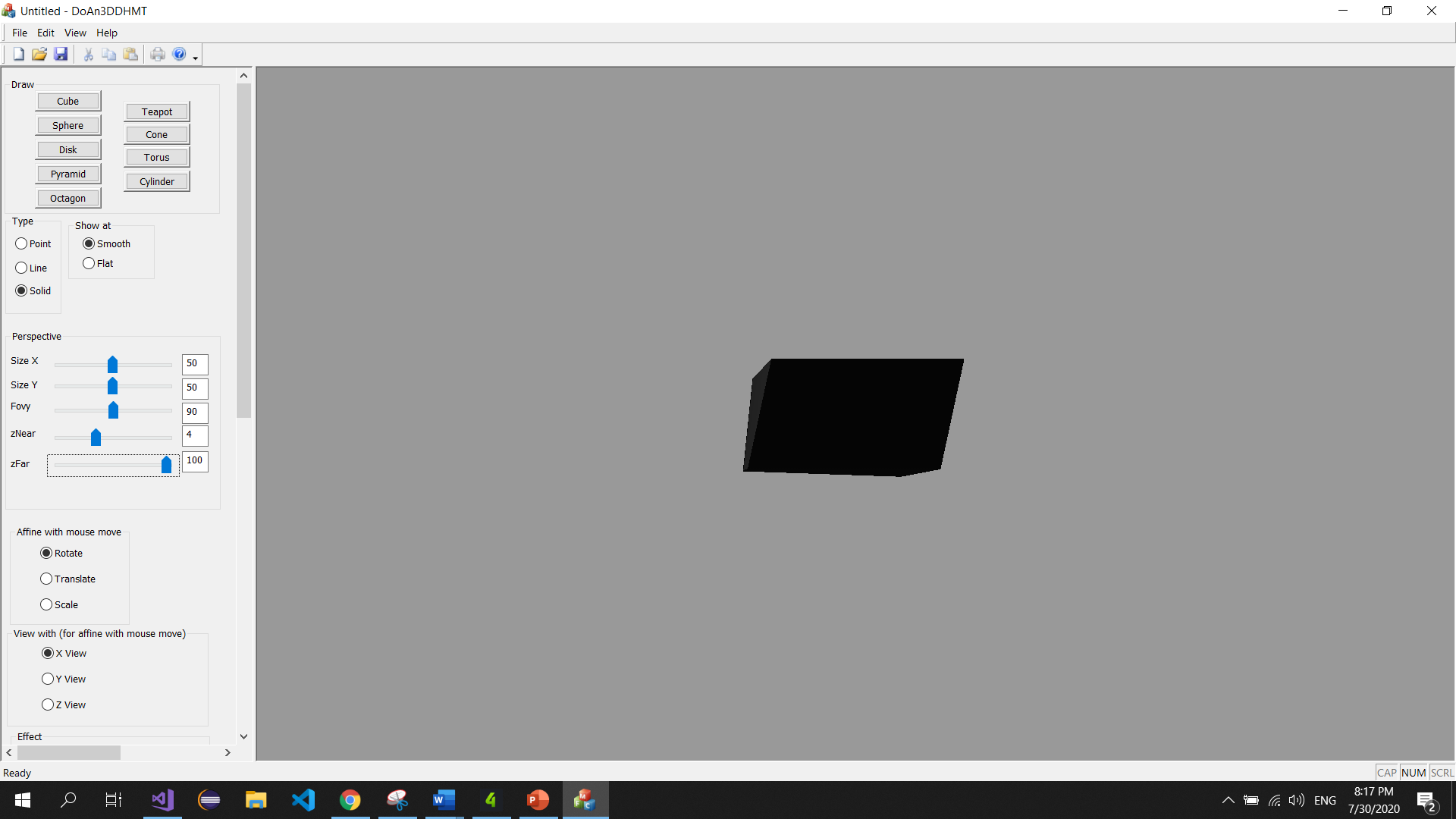
* Aspect > 1 với Size X, Size Y.



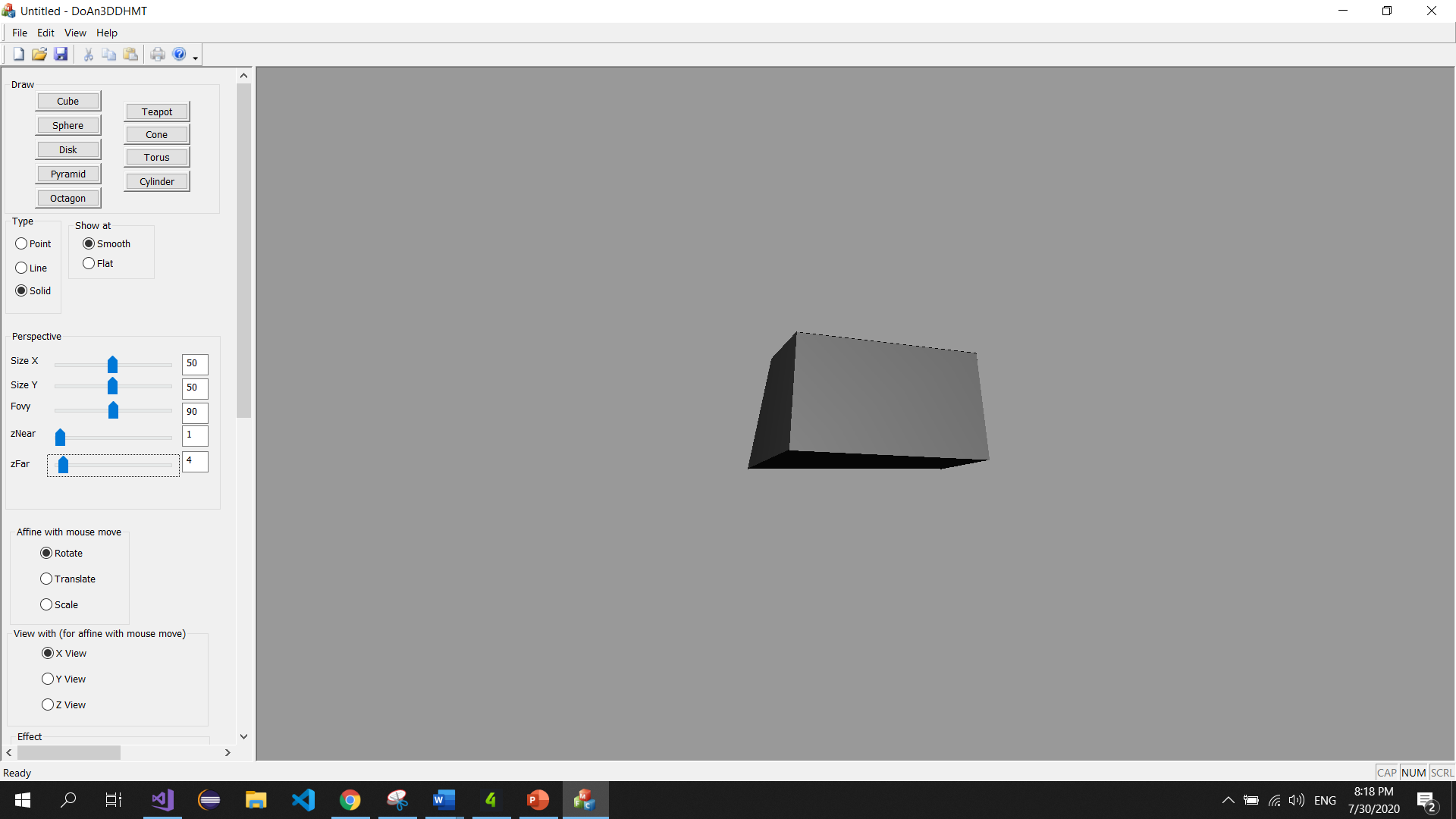
* Aspect < 1 với Size X, Size Y.



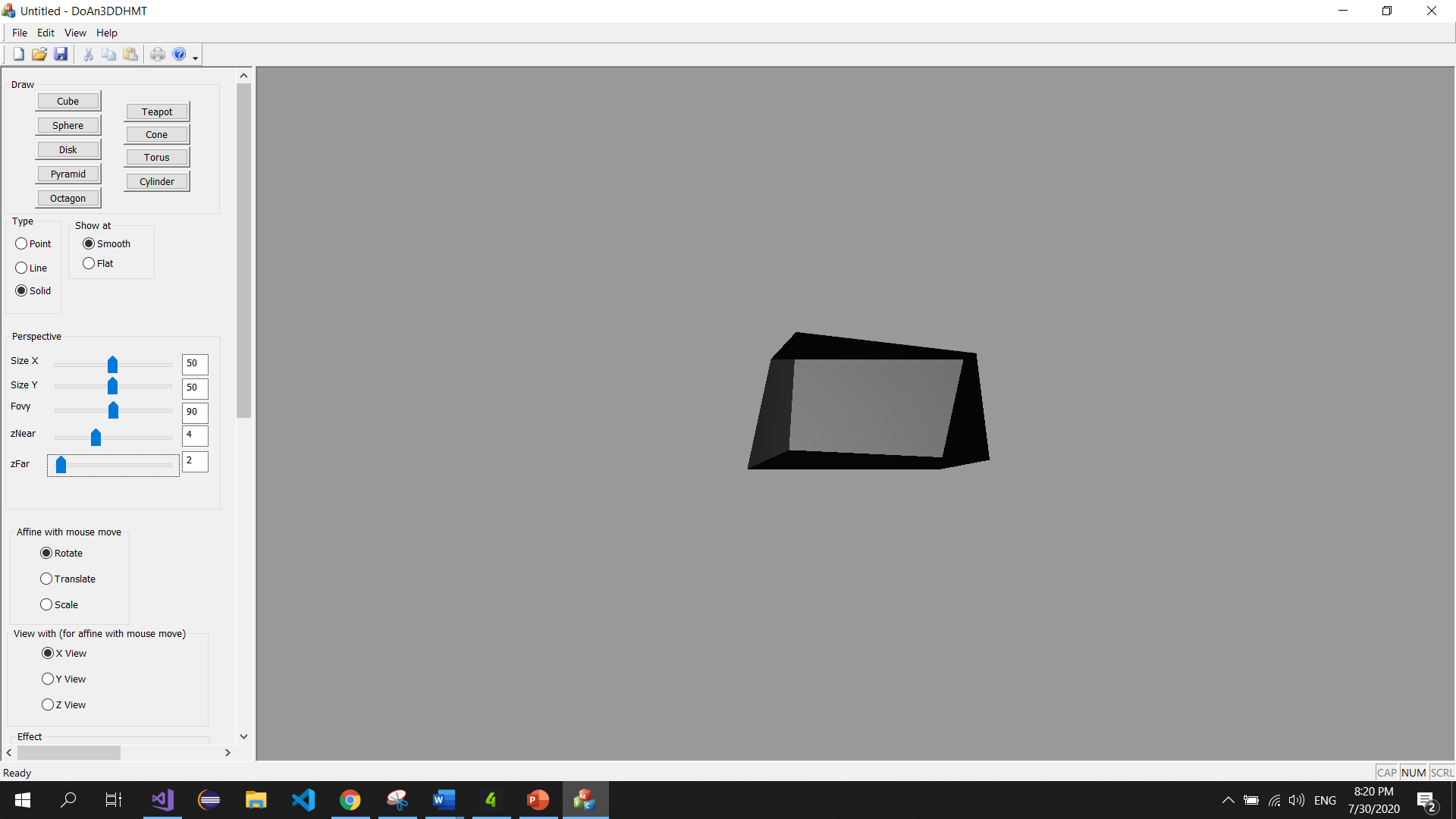
* Tăng Fovy
* Giảm Fovy
* Tăng zNear



* Giảm zFar



* Vừa tăng zNear vừa giảm zFar



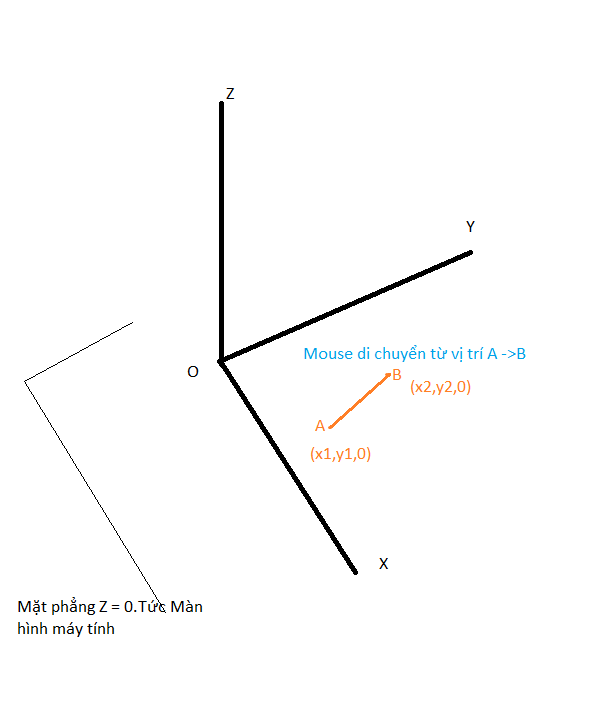
**6. Phép biến đổi Affine**

Trong đồ án này, nhóm sử dụng 3 phép biến đổi Affine cơ bản là:

* Rotate – tương ứng với hàm glRotatef trong Opengl
* Translate – tương ứng với hàm glTranslatef trong Opengl
* Scale – tương ứng với hàm glScalef trong Opengl

Với Rotation:

* Chuột nhấn ở vị trí A(x1,y1,0) kéo tới vị trí B(x2,y2,0)
* X\_Rotation -= distance(y2-y1)
* Y\_Rotation -= distance(x2-x1)
* glRotatef(X\_Rotation,1,0,0)
* glRotatef(Y\_Rotation,0,1,0)

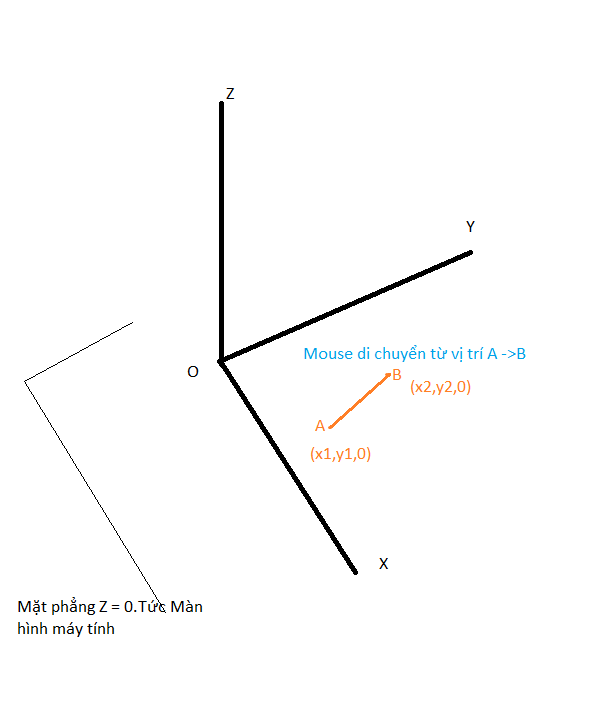


Với Translate:

* Chuột nhấn ở vị trí A(x1,y1,0) kéo tới vị trí B(x2,y2,0)
* X\_Translate += distance(x2-x1)
* Y\_Transslate += distance(y2-y1)
* Đối tượng sẽ di chuyển cùng pương,cùng chiều và cùng độ lớn.

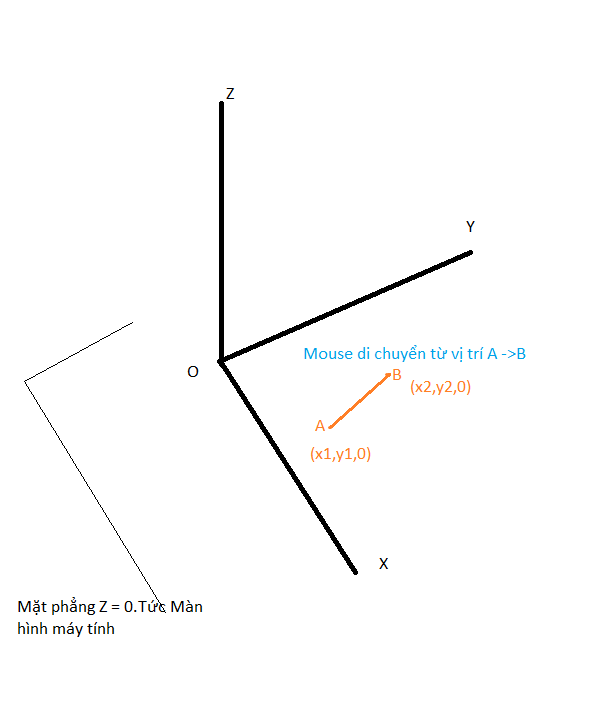
VD: Object S1(x,y,z) ------>S1(x +X\_Translate,y+Ytranslate,z)

* Sử dụng lệnh glTranslatef(X\_Translate , Y\_Translate ,0)



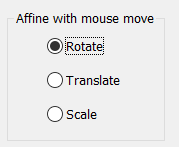
Với Scale:

* Chuột nhấn ở vị trí A(x1,y1,0) kéo tới vị trí B(x2,y2,0)
* X\_Scale += distance(x2-x1)
* Y\_Scale += distance(y2-y1)
* Sử dụng lệnh glScale(X\_Scale , Y\_Scale ,0) để biến đổi theo Scale.



Ở chức năng các phép biến đổi Affine này, ta sử dụng chuột trái để kéo thả khối hình ở các phép biến đổi. Và vì ứng dụng được vẽ lên màn hình nên các phép biến đổi sẽ được thực hiện theo trục X và Y.

Để có thể sử dụng các phép biến đổi Affine, ta chọn các tính năng trong mục Affine with mouse move

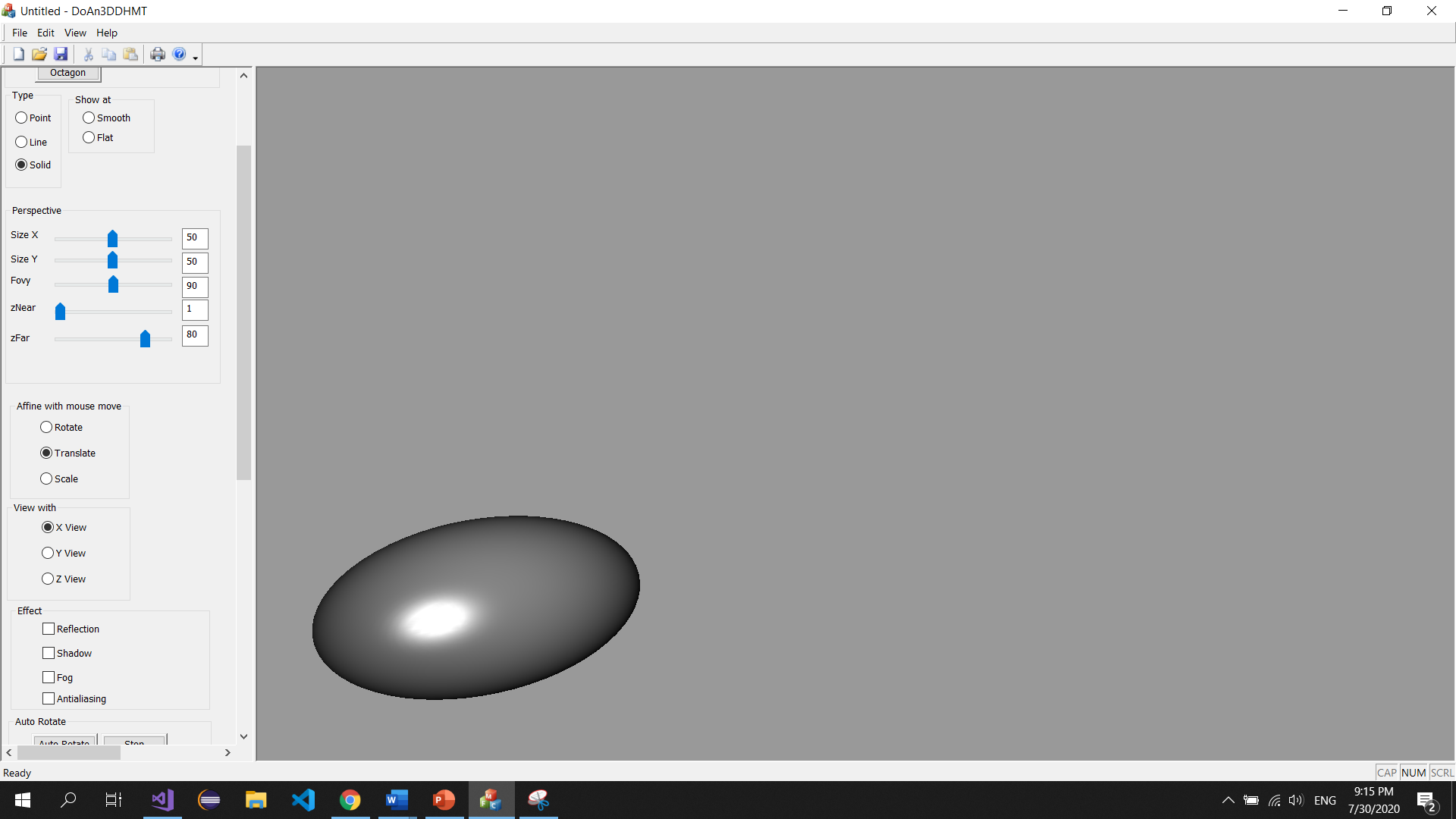


Mặc định khi khởi động chương trình là Rotate, có thể chọn cái tính năng khác khi sử dụng chương trình.

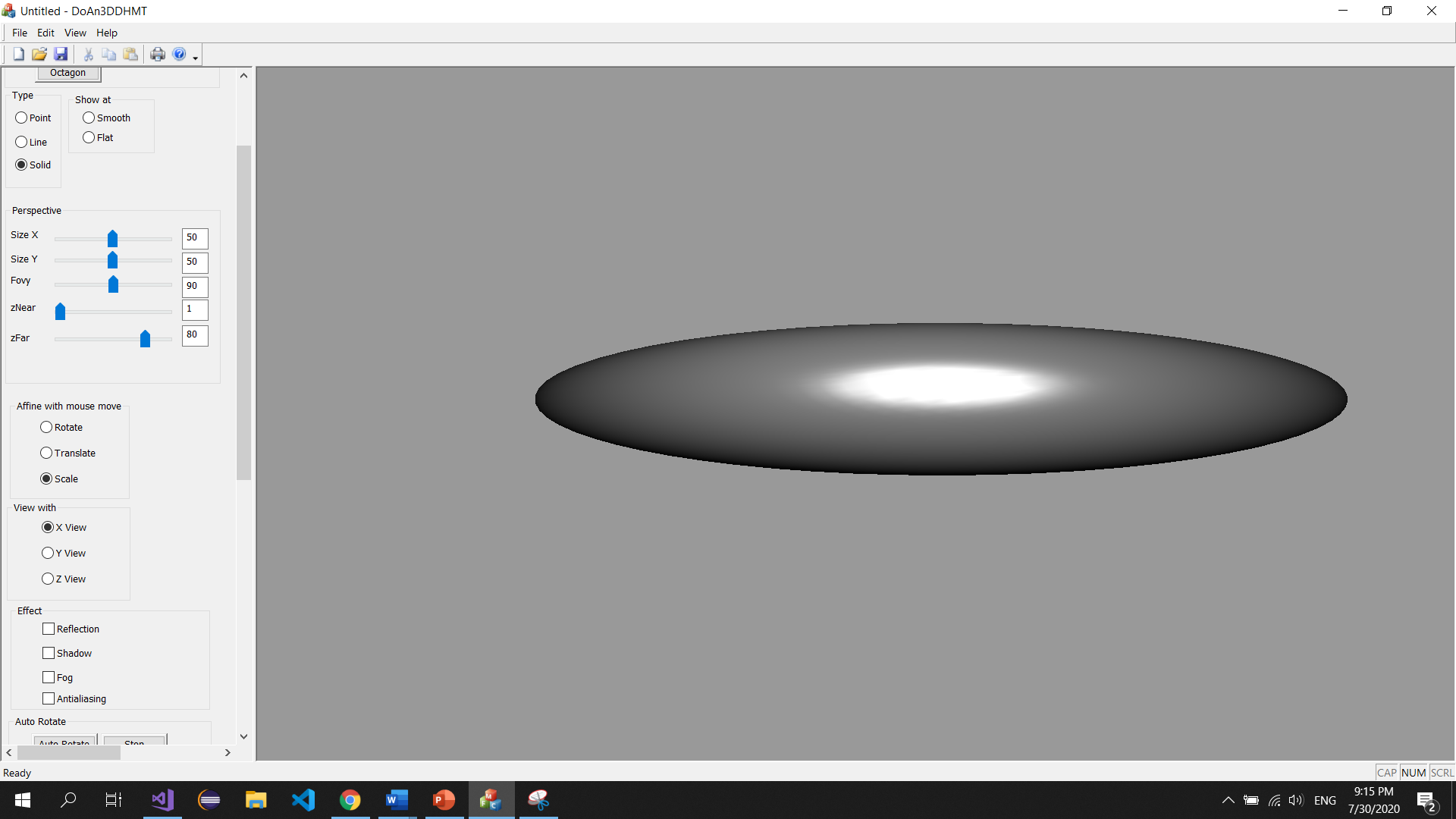
Với Rotate:

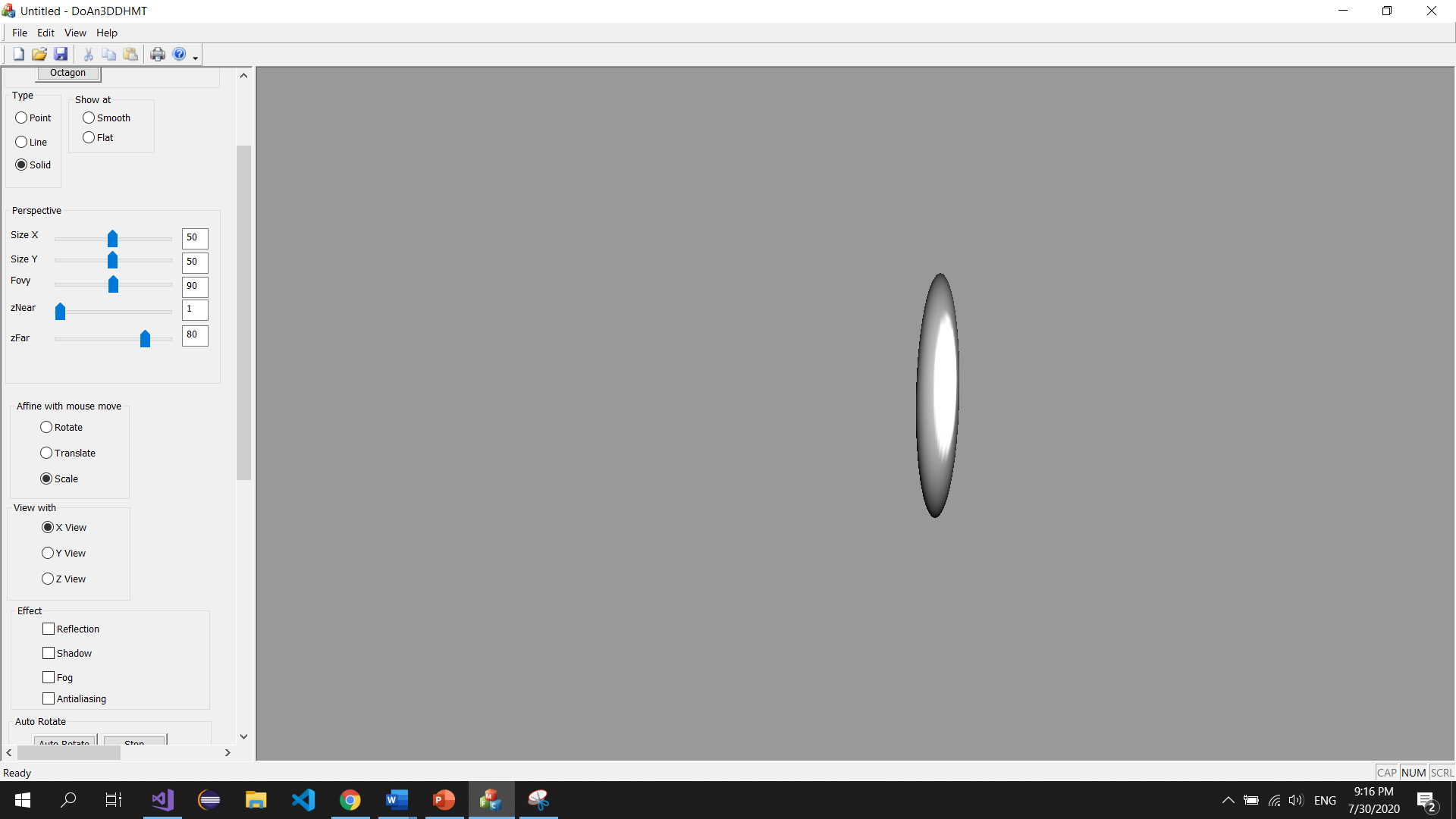


Với Translate:



Với Scale:





**7. Chiếu sáng**

Các thành phần chính của chiếu sáng bao gồm vị trí chiếu sáng và nguồn sáng. Vị trí chiếu sáng (light\_pos) là vị trí mà ánh sáng chiếu vào vật.

Nguồn sáng bao gồm 4 thành phần chính:

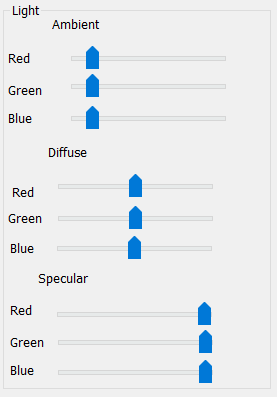
* Ambient – Chiếu sáng toàn phần cho đối tượng của vật
* Diffuse – Tạo ánh sáng khuếch cho đối tượng
* Specular – Tạo ánh sáng phản xạ cho đối tượng
* Shininess – Điều chỉnh cường độ điểm chiếu sáng phản xạ (Phần này nhóm đã tích hợp khi vẽ solid cho các khối hình)

Mỗi thành phần gồm 3 tông màu chính Red, Green, Blue.

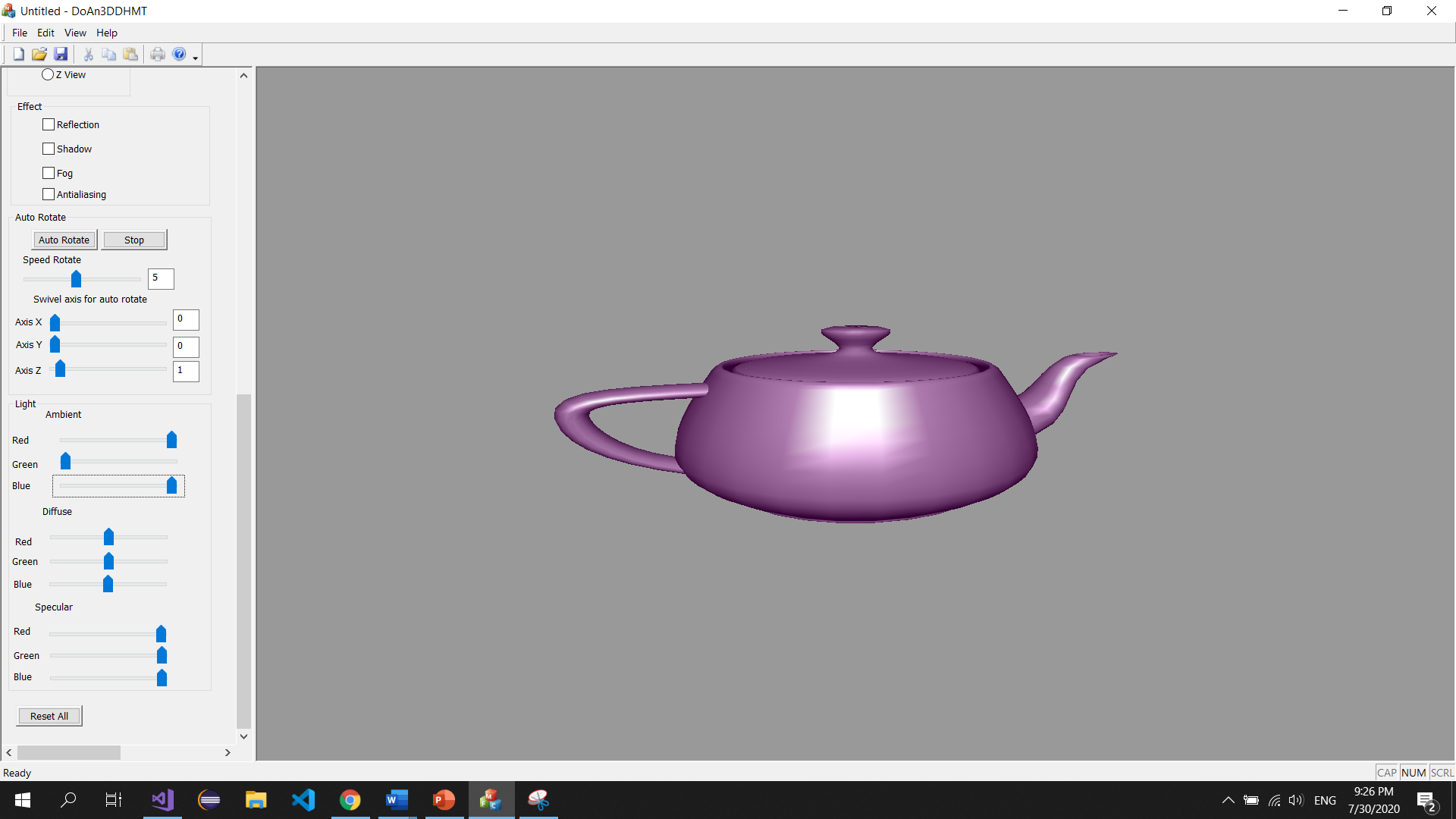
![A picture containing kitchenware, pot, lamp

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAeAB4AAD/4RDsRXhpZgAATU0AKgAAAAgABAE7AAIAAAALAAAISodpAAQAAAABAAAIVpydAAEAAAAWAAAQzuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAFFVQU5HIFRPQU4AAAAFkAMAAgAAABQAABCkkAQAAgAAABQAABC4kpEAAgAAAAM1MwAAkpIAAgAAAAM1MwAA6hwABwAACAwAAAiYAAAAABzqAAAACAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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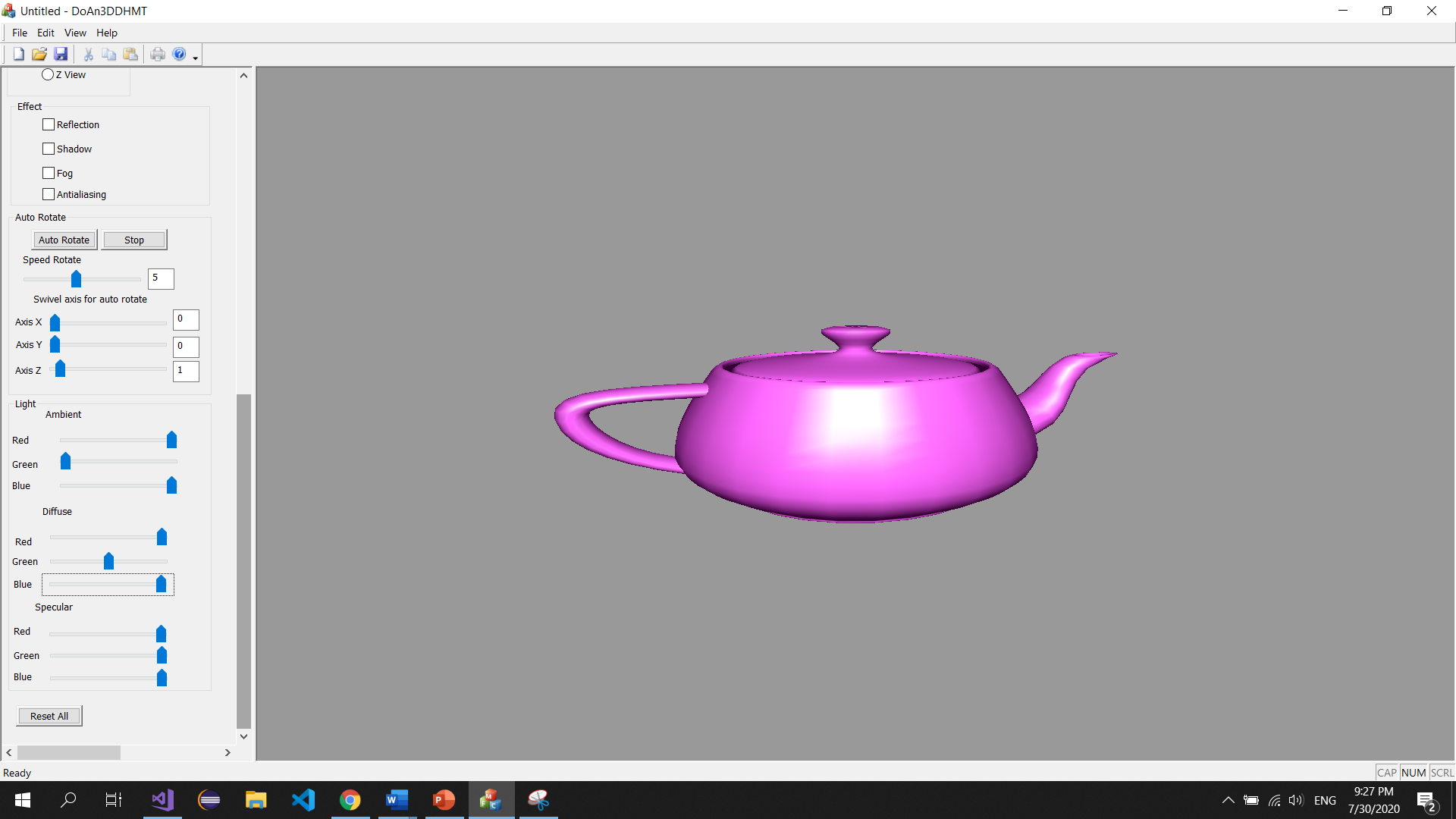
Để có thể điều chỉnh các thành phần chiếu sáng (trừ Shininess do nhóm đã tích hợp khi vẽ solid cho các khối hình), ta điều chỉnh các thanh tương ứng 3 màu Red, Green Blue của từng thành phần trong mục Light.



Một số ảnh demo:

Với Ambient: Demo tăng Red và Blue

Với Diffuse: Demo tăng Red và Blue



Với Specular: tắt Blue đi



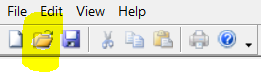
**8. Texture ảnh Bitmap**

Texture ảnh là quá trình chúng ta phủ vật liệu lên bề mặt của một đối tượng.

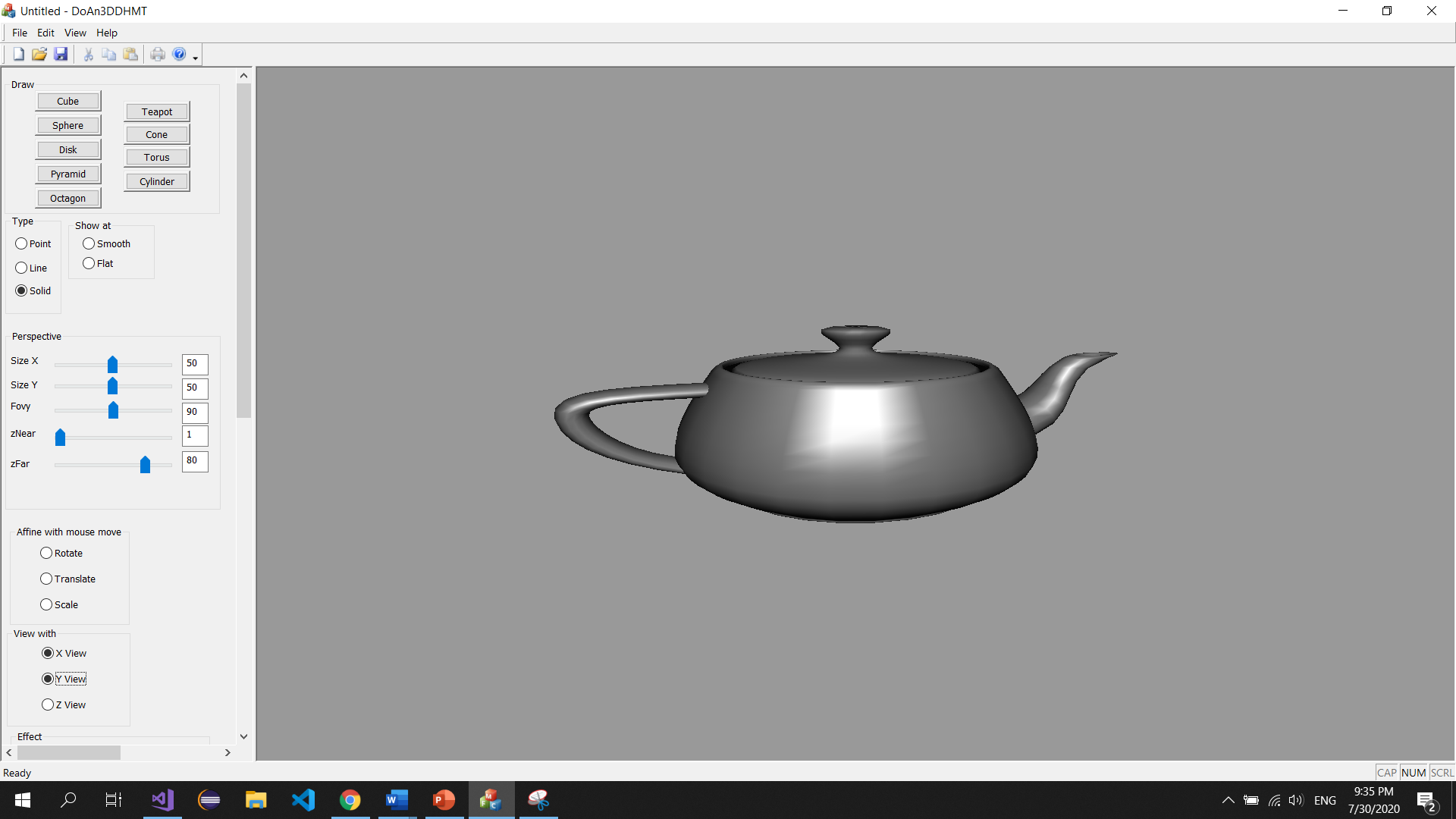
Texture gồm 2 quá trình chính:

* Load ảnh Bimap ( kích thước ảnh phải có chiều dài bằng chiều rộng và là kết quả của . Ảnh phải ở dạng bitmap và không nén,một số chương trình chuyển đổi ảnh trên internet sẽ nén bitmap khi chuyển đổi kiểu ảnh) với hàm auxDIBImageLoadA((LPCSTR)Filename).
* Texture ảnh
  + Gen texture với glGenTextures và glBindTexture.
  + Map dữ liệu bitmap vào texture.
* Nếu ảnh bitmap load vào không có kích thước phù hợp như trên thì ứng dụng sẽ tự động lấy kích thước gần nhất.

Để có thể load texture, ta click vào nút Open (như hình) hoặc nhấn tổ hợp phím Ctrl + O để load ảnh texture, sau đó chương trình sẽ tự động xử lý load Texture lên khối hình.



Demo Texture: Ban đầu và sau khi load Texture

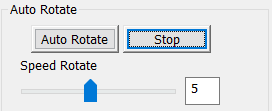




**CHƯƠNG 3: MỞ RỘNG**

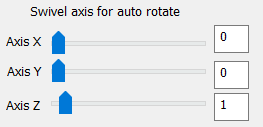
1. **Animation**

* Nhóm có thực hiện cho chương trình tự động thực hiện Rotate theo thời gian thực và có thể điều chỉnh tốc độ Rotate.

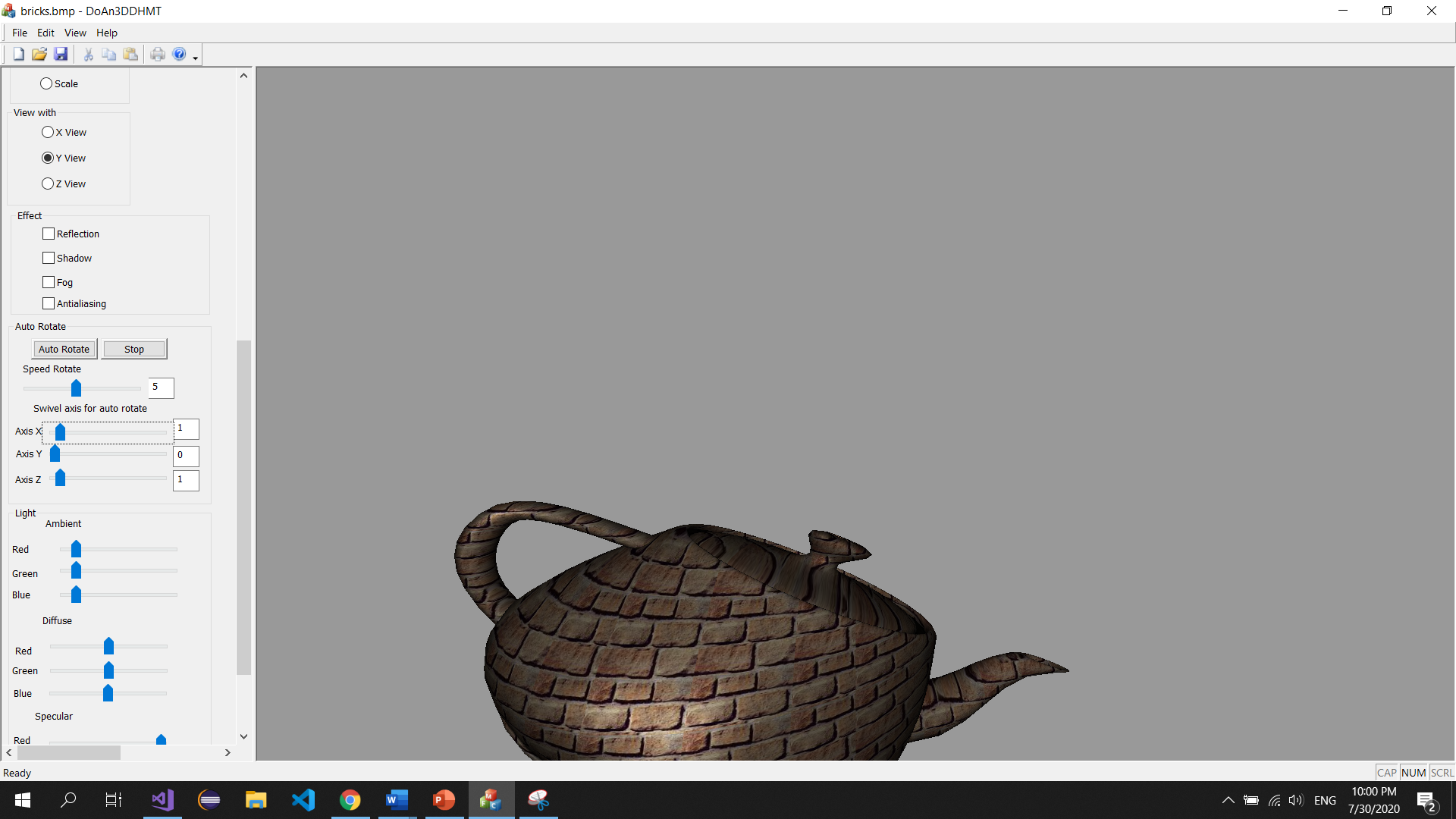




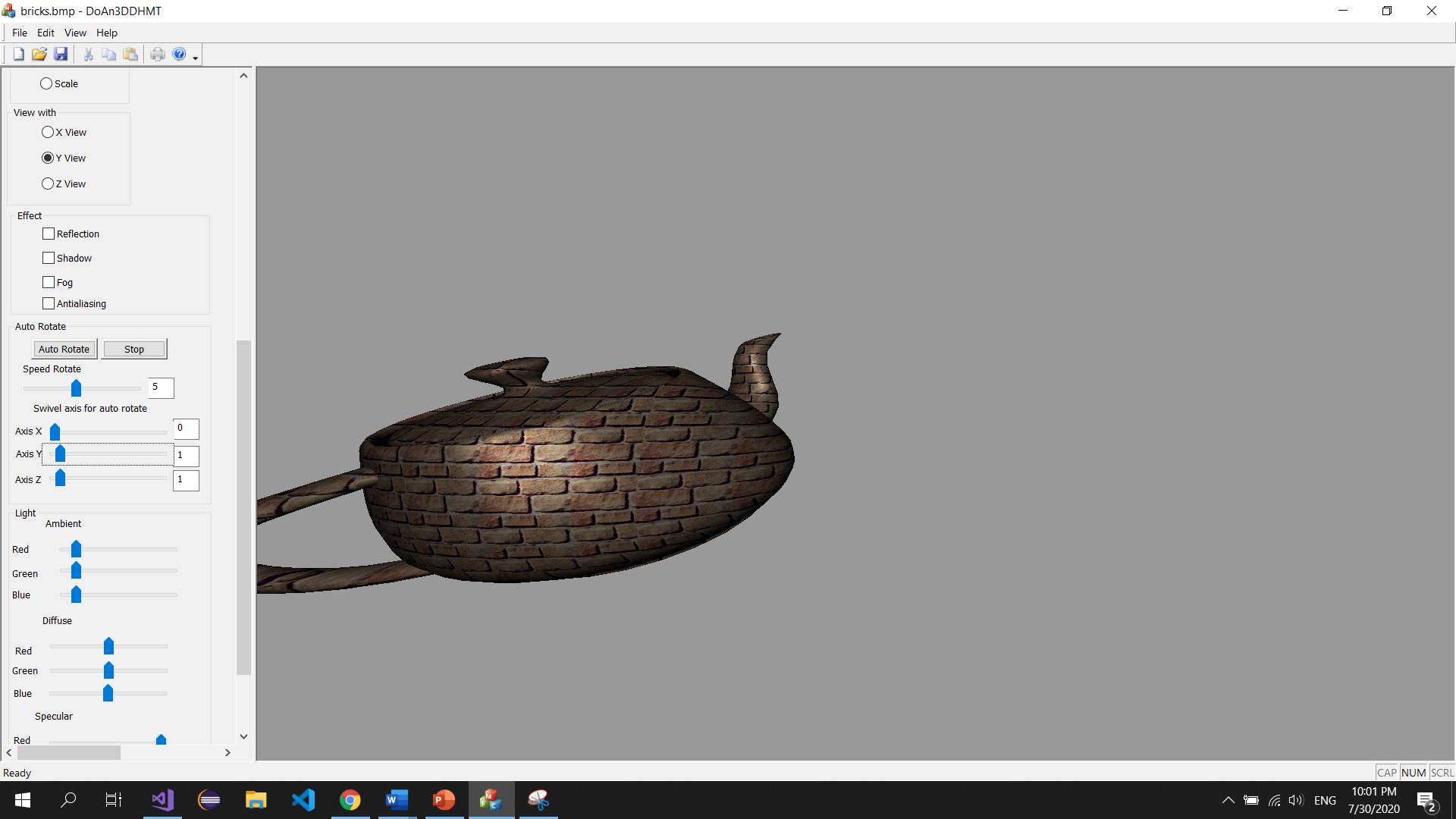
* Có thể thực hiện tự động xoay theo swivel axis



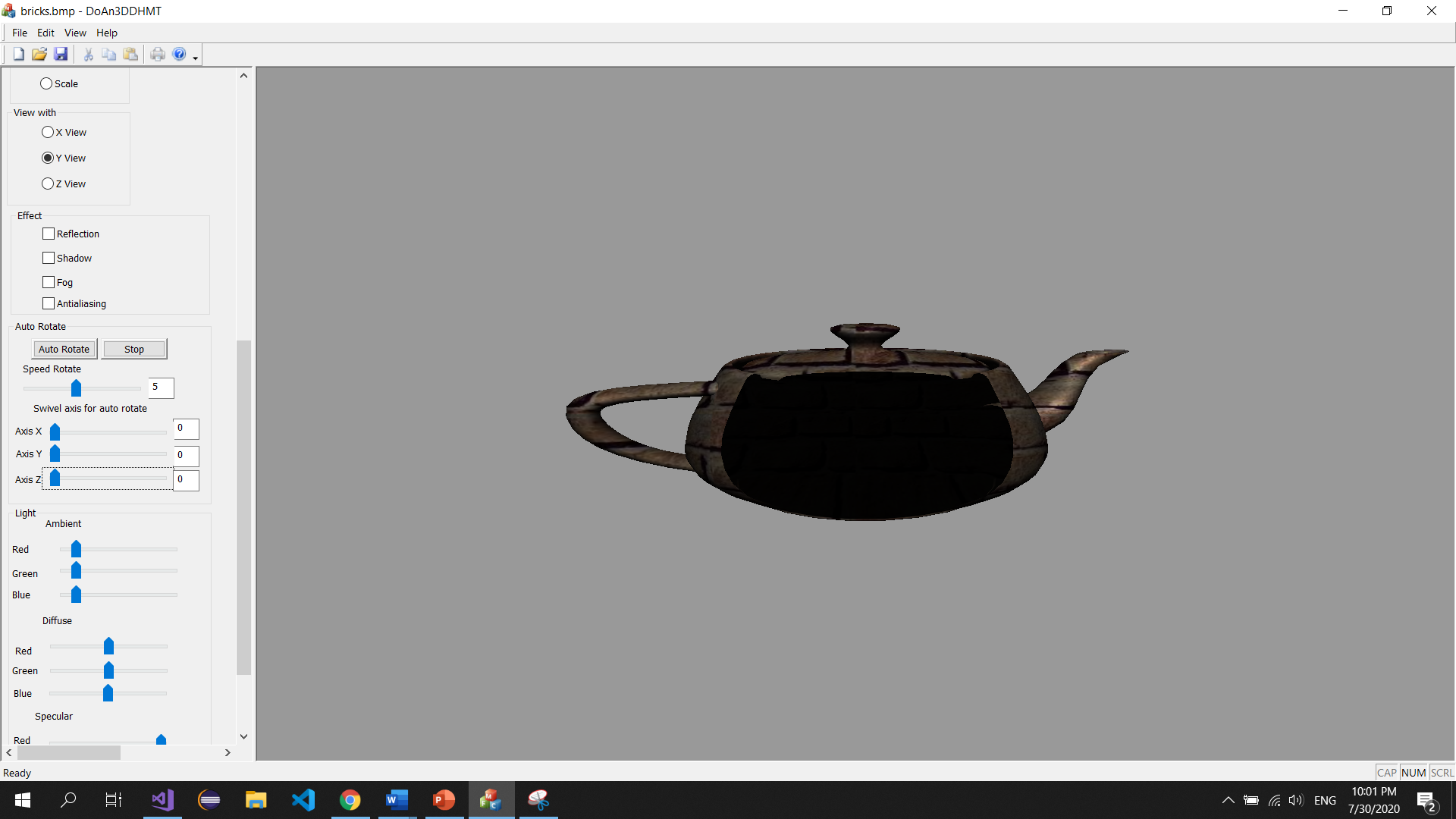
Xoay theo axis X



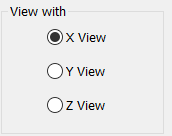
Xoay theo axis Y



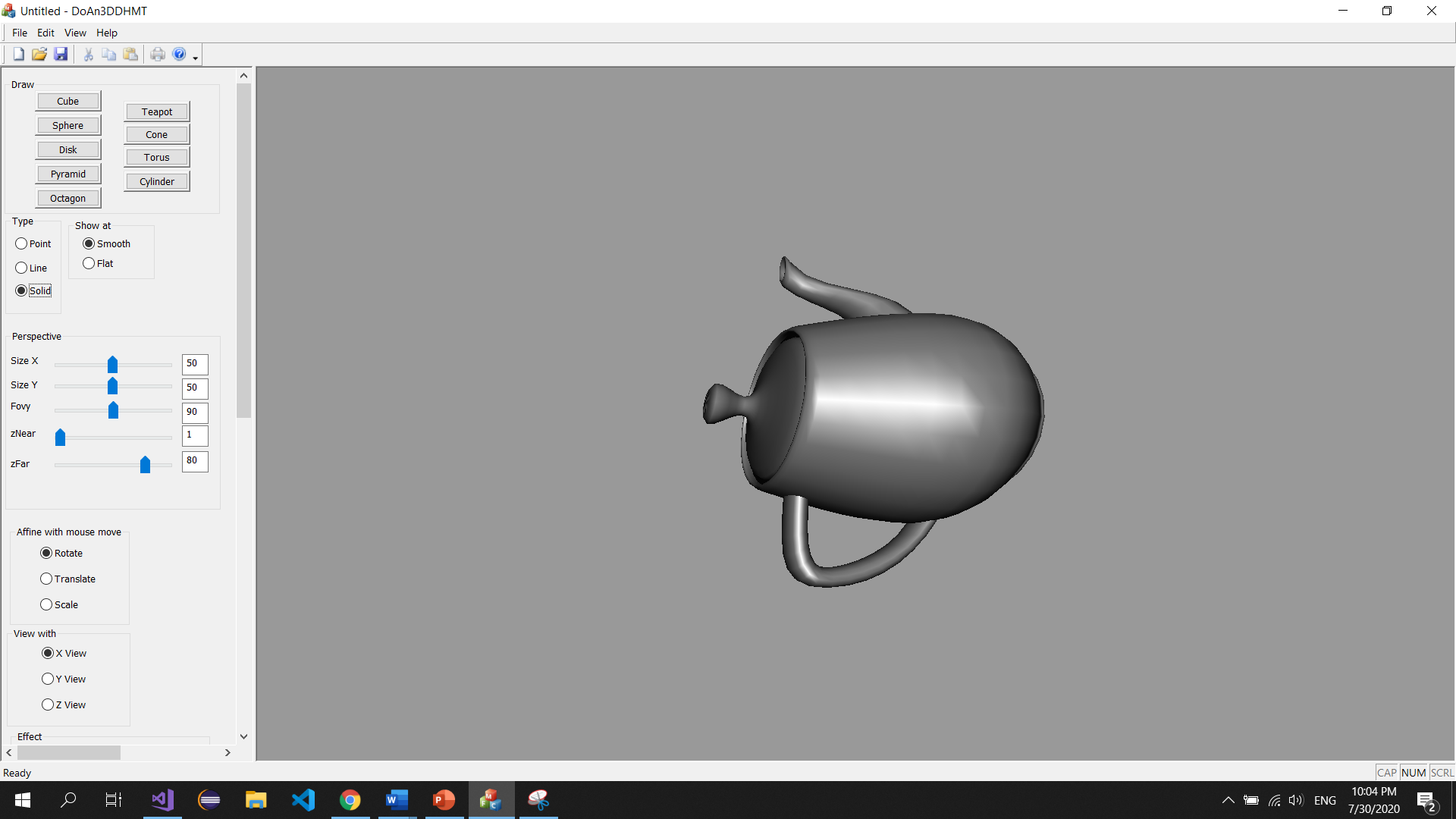
Xoay theo axis Z: khối hình sẽ chạy thẳng vào mắt người nhìn sau đó sẽ quay lại, như kiểu “thò ra” màn hình và “thụt lại” vào trong màn hình.



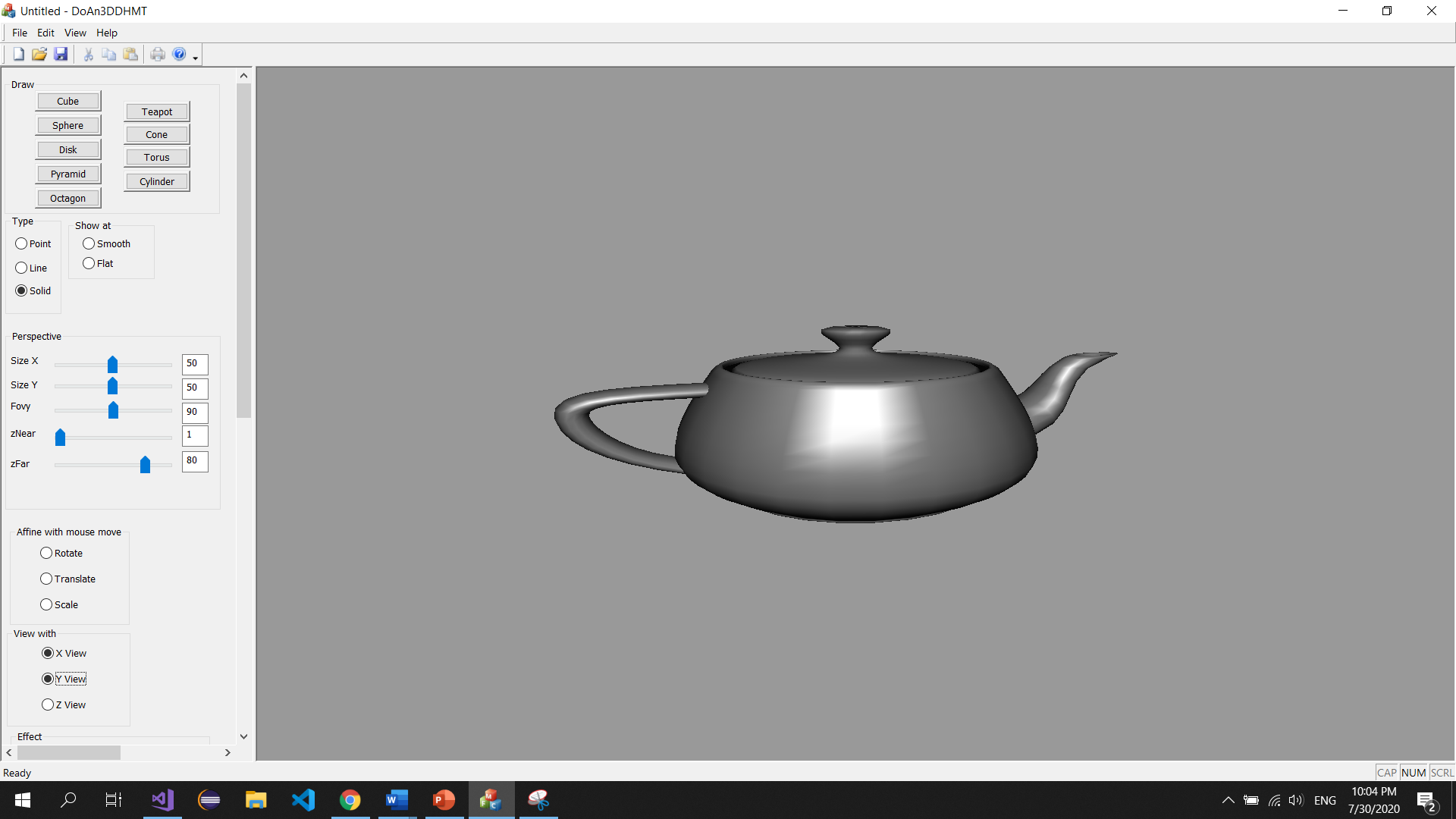
* Chỉnh góc nhìn của khối hình theo X, Y và Z



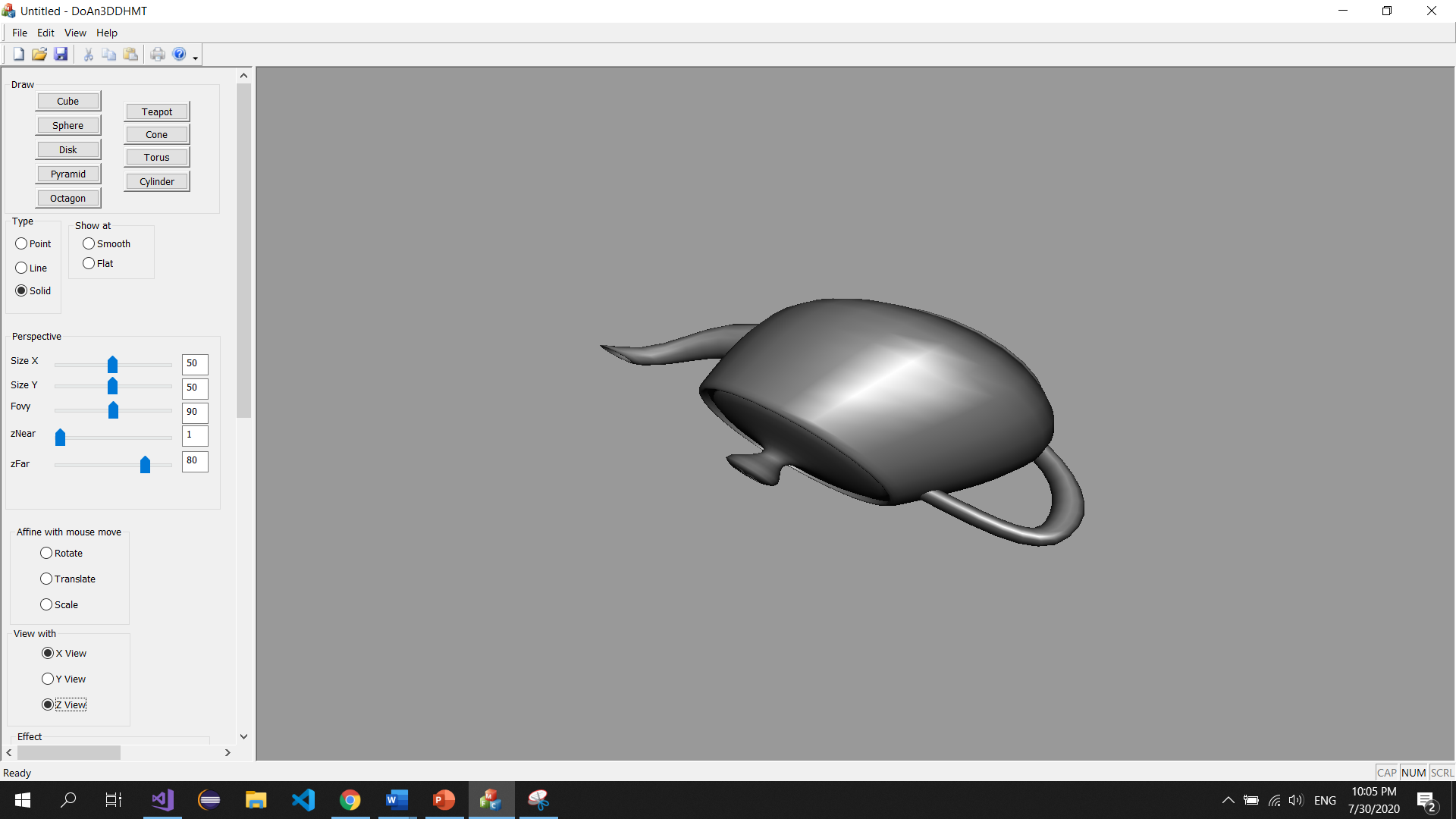
X View:



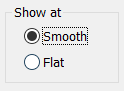
Y View:



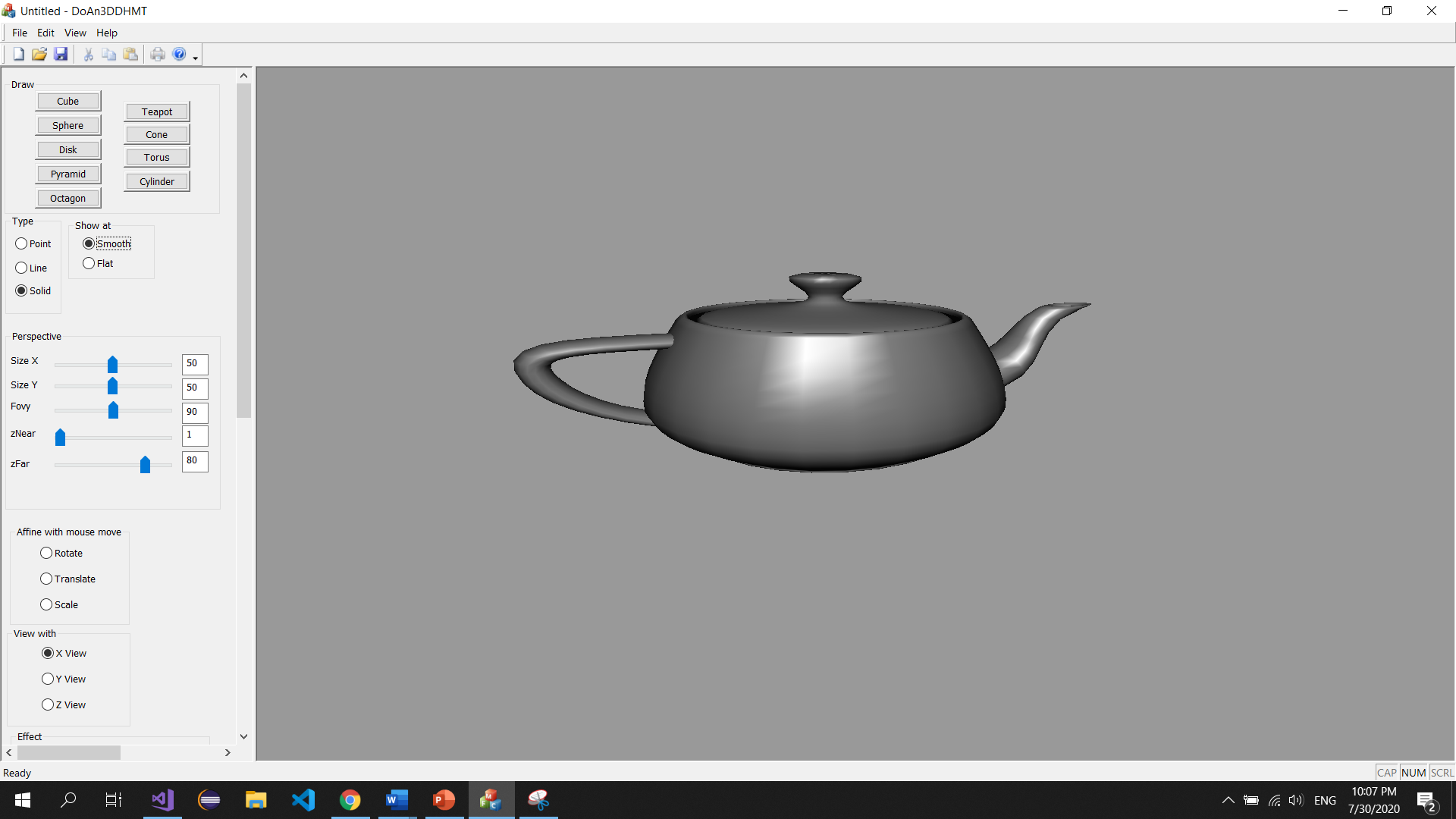
Z View:



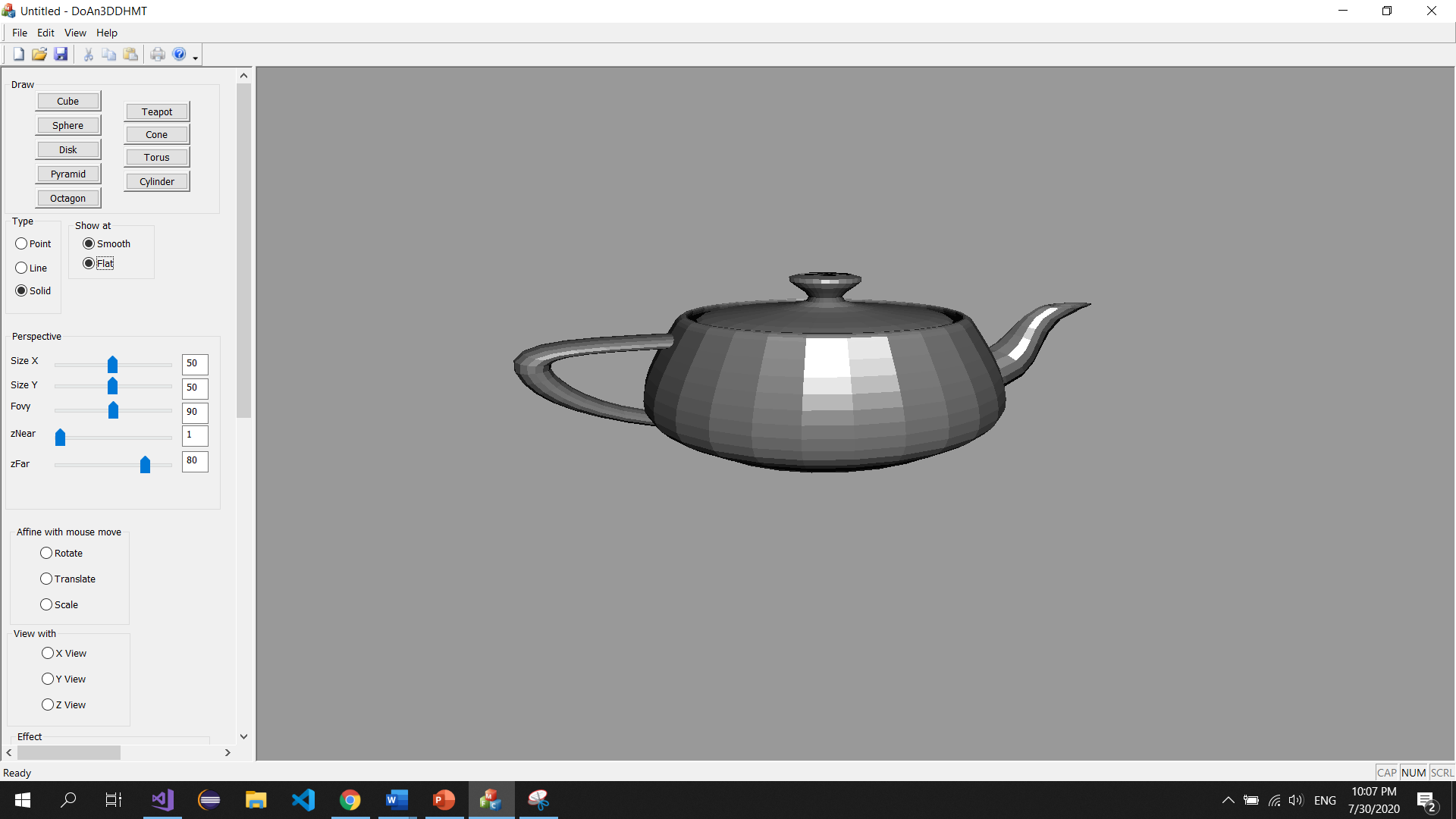
* Reset chương trình bằng nút Reset All. Khi đó mọi sự kiện sẽ được khôi phục về như lúc khởi động chương trình.
* Hiển thị các khối hình ở dạng Smooth hoặc Flat (thấy rõ khi vẽ các khối hình ở dạng Solid).



Ở dạng Smooth:



Ở dạng Flat:



1. **Các hiệu ứng**

Các hiệu ứng: Reflection, Shadow, Fog, Antialiasing



Vì khả năng sử dụng Opengl tích hợp MFC của nhóm chưa tốt nên phần này chưa được hoàn thiện.

**CHƯƠNG 4: HƯỚNG PHÁT TRIỂN**

Chương trình này có thể phát triển các tính năng: dựng mô hình 3d ngoài những mô hình trong Opengl, xây dựng môi trường như trong các môi trường game, xử lý đổ bóng, phản chiếu hình ảnh của đối tượng, tạo sương mù,…

Ngoài ra có thể tích hợp cài đặt với bàn phím để có thể thao tác với các đối tượng, khối hình, sự kiện trong chương trình bằng bàn phím.

**CHƯƠNG 5: KẾT LUẬN**

1. **Ưu điểm**

* Chương trình chạy khá ổn định, ít hay xảy ra lỗi, xung đột.
* Hoàn thành tương đối các yêu cầu cơ bản thầy đã giao.
* Có xử lý sự kiện với chuột ở các phép biến đổi Affine.
* Có thêm một số hiệu ứng, tính năng ngoài những yêu cầu của thầy.
* Có tự vẽ thêm 2 khối hình.

1. **Nhược điểm**

* Vẫn còn lỗi về load Texture.
* Lỗi về Rotate và Translate thi kéo thả chuột chưa như ý muốn.
* Khi Auto Rotate với Axis Z khi load texture một lúc sẽ bị tràn bộ nhớ làm chương trình không hoạt động bình thường nữa.
* Các hiệu ứng Reflection, Shadow, Fog, Antialiasing vẫn chưa được hoàn thiện.