

# Displaying curves and surfaces in Unity 3D system

## BACKGROUND

Students of **SCSE** are required to understand how mathematical equations can be visualized as **2D** and **3D** shapes using the coursework software **FVRML**.

**FVRML** has many drawbacks:

- It relies on 3<sup>rd</sup> party vendors to provide support
- It is a language extension without GUI
- It is single platform - Windows-based and requires IE and Firefox to use

## CHALLENGES

Design and make a new coursework software that can perform the same functions as the current software without the limitations of the old software.

New coursework software should be able to:

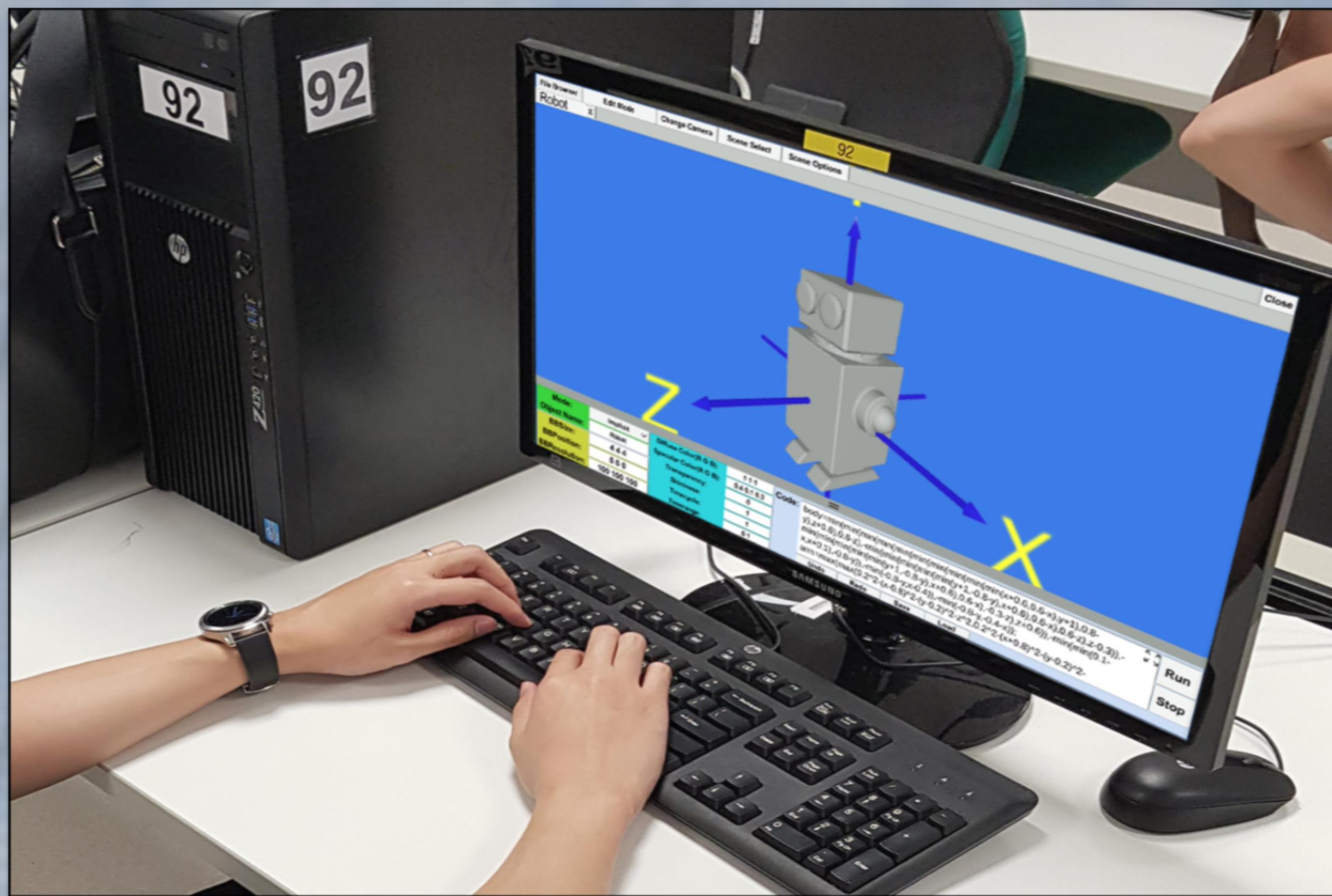
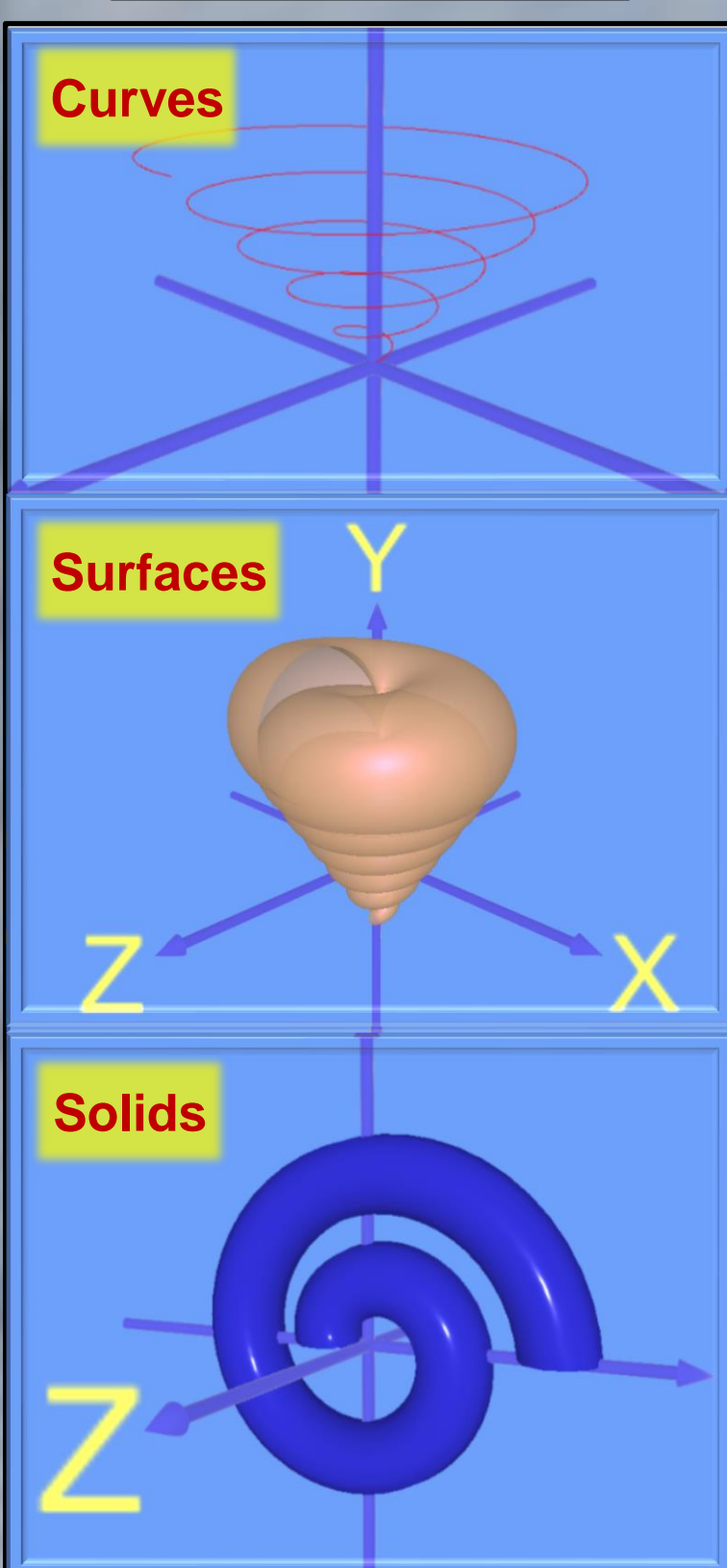
- Display curves, surfaces and solid objects using parametric and implicit functions
- Present an intuitive, easy to use GUI
- Run on multiple platforms - Windows, MacOS, iOS and Android

## PROPOSED SOLUTION

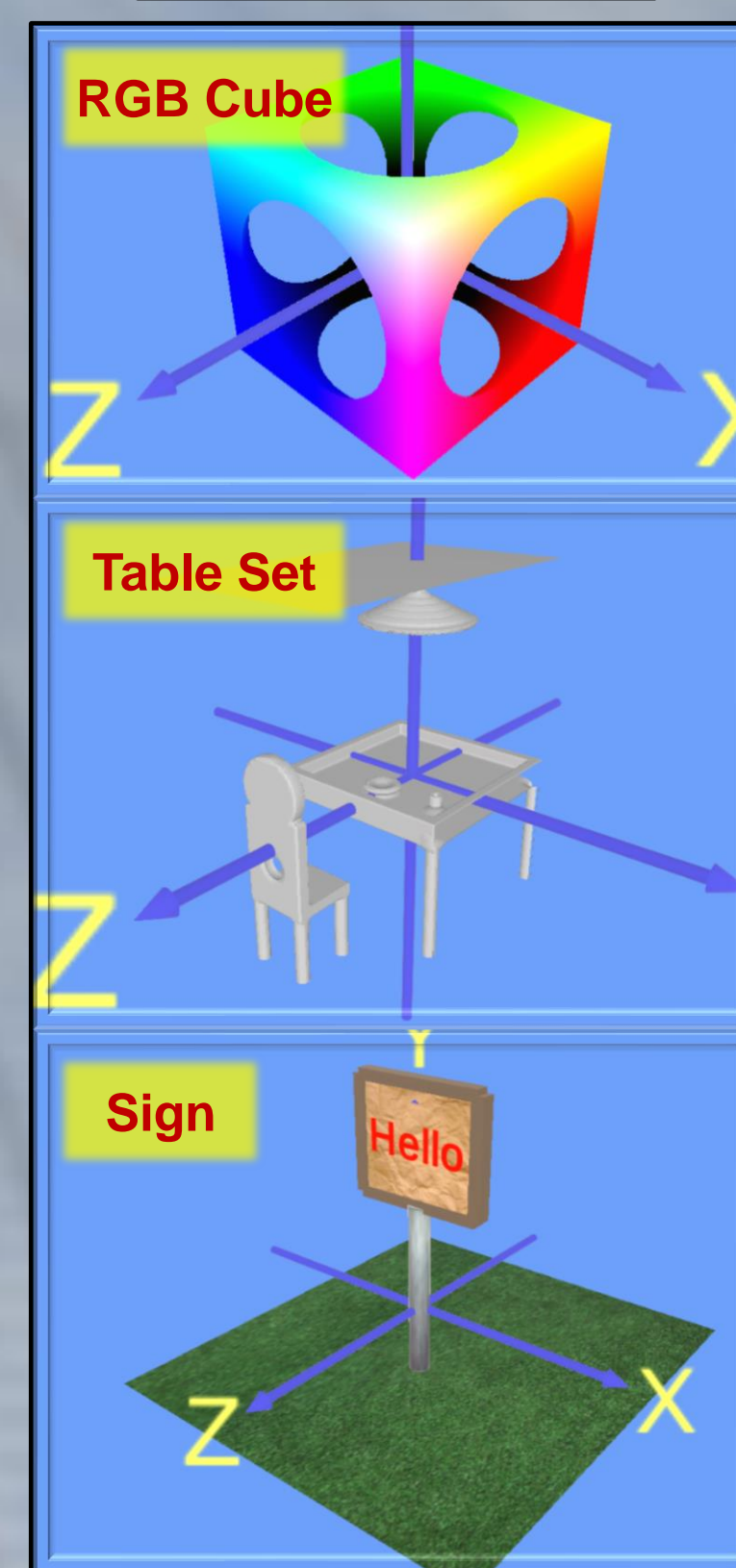
Use **Unity 3D** as a development platform to make the new coursework software.

- Have a GUI-level oriented to novice/student level of the user
- Have more advanced user level feature supported at the script level of the Unity 3D system

### Basic



### Advance



## INVESTIGATION

After 200 hours of investigation, Unity 3D is able to create a standalone software application to complete the challenges. The new software currently provides the following:

- Flexible GUI for editing of all the function scripts and their parameters with the ability to correct, undo, cancel and abort rendering
- Enlarge and Reduceable GUI
- Defining geometry of curves, surfaces and solids by parametric and implicit mathematical formulas within the GUI
- Defining visual appearance of these shapes by using mathematical functions
- Using time as another dimension/variable to animate shapes
- Saving and Loading
- Runs on Windows, Mac , iOS and Android devices

## ADVANCE FEATURE

Additional tests have shown that Unity 3D is capability and available for advance users.

- Physics, simulated gravity and wind can be applied to objects
- Multiple objects can be define in one scene
- Objects can collide and bounce off from each other
- Advance object appearance control using scripts and can be loaded from various online libraries.
- Generation of objects can be done on the GPU to increase generation speed.
- Scene can be introduce as an interactive or puzzle room as a gamification to the coursework to entice students.
- Objects can be saved and loaded into another 3D software.

## USER STUDY

A total of **58** participants was provided a demo software to try.

User feedback shows that:

- New software is **easier** to use compared to the old software because of the proposed GUI system.
- New software is more **convenient** to run on multiple systems without requiring internet browsers.
- New software is able to create shapes with similar speed and **greater visual quality** compared to the old software
- Participants expressed willingness **to see improvements** done on the new software.

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