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 3rd 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

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.