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Harnessing Emerging Creative Technology for Knowledge Discovery of Multiwavelenght Datasets

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Abstract : Astronomy is one domain with a rise in data. Traditional tools for data management have been employed in the quest for knowledge discovery. However, these traditional tools become limited in the face of big. One means of maximizing knowledge discovery for big data is the use of scientific visualisation. The aim of the work is to explore the possibilities offered by emerging creative technologies of Virtual Reality (VR) systems and game engines to visualize multiwavelength datasets. Game Engines are primarily used for developing video games, however their advanced graphics could be exploited for scientific visualization which provides a means to graphically illustrate scientific data to ease human comprehension. Modern astronomy is now in the era of multiwavelength data where a single galaxy for example, is captured by the telescope several times and at different electromagnetic wavelength to have a more comprehensive picture of the physical characteristics of the galaxy. Visualising this in an immersive environment would be more intuitive and natural for an observer. This work presents a standalone VR application that accesses galaxy FITS files. The application was built using the Unity Game Engine for the graphics underpinning and the OpenXR API for the VR infrastructure. The work used a methodology known as Design Science Research (DSR) which entails the act of 'using design as a research method or technique'. The key stages of the galaxy modelling pipeline are FITS data preparation, Galaxy Modelling, Unity 3D Visualisation and VR Display. The FITS data format cannot be read by the Unity Game Engine directly. A DLL (CSHARPFITS) which provides a native support for reading and writing FITS files was used. The Galaxy modeller uses an approach that integrates cleaned FITS image pixels into the graphics pipeline of the Unity3d game Engine. The cleaned FITS images are then input to the galaxy modeller pipeline phase, which has a pre-processing script that extracts, pixel, galaxy world position, and colour maps the FITS image pixels. The user can visualise image galaxies in different light bands, control the blend of the image with similar images from different sources or fuse images for a holistic view. The framework will allow users to build tools to realise complex workflows for public outreach and possibly scientific work with increased scalability, near real time interactivity with ease of access. The application is presented in an immersive environment and can use all commercially available headset built on the OpenXR API. The user can select galaxies in the scene, teleport to the galaxy, pan, zoom in/out, and change colour gradients of the galaxy. The findings and design lessons learnt in the implementation of different use cases will contribute to the development and design of game-based visualisation tools in immersive environment by enabling informed decisions to be made.

Keywords : astronomy, visualisation, multiwavelenght dataset, virtual reality
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