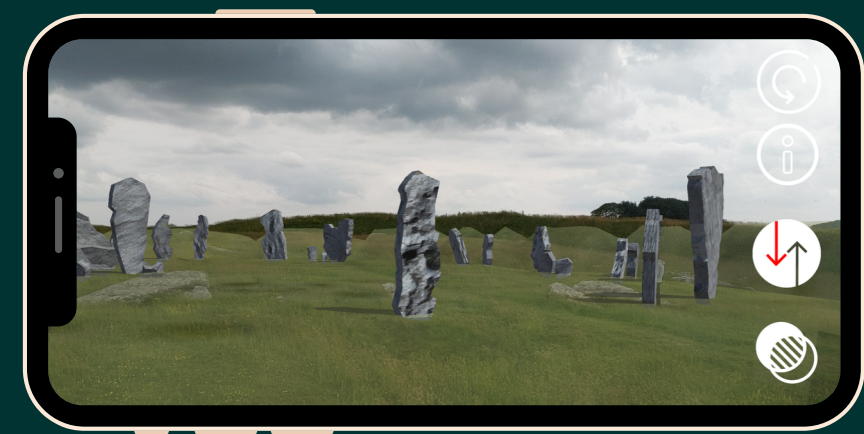# Arbor Low Neolithic henge monument in Augmented Reality

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Introduction

Arbor Low is a nationally-protected archaeological site and one of the most visited archaeological monuments in the Peak District, UK. It contains a stone circle with 50 limestone slabs, all now fallen [1].

Figure 1: Arbor Low stone circle [1]

Aim

The aim of this project was to use Augmented Reality (AR) so that the stones could be viewed standing and interacted with *in situ*.

Methodology

- A low-resolution 3D model of the stones and landscape enclosure was used for optimal rendering speed on a smartphone.
- The Unity real-time engine and ARFoundation were used for implementation so that the application could be deployed on both Android and Apple devices.

Normal Maps

Normal maps of the stones' textures were created and applied to each individual stone. This helped to give the impression of bumpy surfaces on the low-resolution 3D models [2].

Figure 3: Stone before and after applying normal maps

Textures

Photographs of individual stones at Arbor Low were taken. Rendering realism is enhanced by using those photographs to colour the models of the stones. A 3D Computer graphics program was used to apply the textures using the UV texture mapping technique [2].

Figure 2: Photograph taken on site and resulting model after applying textures

Graphical User Interface (GUI)

A graphical user interface allows the user to control which stones are standing or lying down in the AR view on the smartphone. Information 'hotspots' are virtually placed in different site locations to display educational information about the monument.

Restart the application

Toggle on/off the information points

Toggle the stones standing up/lying down

Toggle the stones' transparency

Figure 4: GUI icons and explanation

Results of on-site testing

Figure 5: Screenshots of the final application

Conclusions

- The resulting AR software to be used to support field trips for undergraduate students in the Department of Archaeology.
- After further testing the intention is that the software will be made available via online stores so that members of the public can use mobile devices to either display the site in their own homes or see the stones standing *in situ*.

References:

[1] English Heritage (https://www.english-heritage.org.uk/visit/places/arbor-low-stone-circle-and-gib-hill-barrow/)

[2] Tomas Akenine-Möller, Eric Haines, Naty Hoffman, Real-time rendering, A K Peters/CRC Press; 4th edition, 2018

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