A REPORT

ON

DESIGN OF A MIXED REAILTY SYSTEM FOR ARCHEOLOGY

BY

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DESIGN ORIENTED PROJECT

Under the guidance of

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ABSTRACT

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE PILANI (RAJASTHAN)

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Title of the Project: DESIGN OF A MIXED REAILTY SYSTEM FOR ARCHEOLOGY

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Discipline of the student: Computer Science

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Key Words: Computer Science, Archaeology, Mixed Reality, Computer Vision, 3d modelling, Unity, Reconstruction

Project Areas: Augmented/Virtual Reality

Abstract: Digitally reconstruct a damaged artifact/structure. Involves 3d modelling and augmented reality projection.

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DESCRIPTION

Restoration of ancient artifacts is an important step in the process of studying its history. In this world that's transitioning swiftly to a digital environment, we can make use of available technological tools to our benefit. Augmented Reality is one such field which can accomplish this task efficiently. Using AR, we can attempt to recreate history the way we want it to. Reconstructing structures, replaying scenarios, digitally repairing artifacts are some applications of AR in the field of archaeology.

This project focuses on using AR tools such as Unity, Vuphoria, OpenCV and 3d modelling applications like Blender, Meshroom, etc to make applications that can add 3d models to a real time element. In this project, we plan to achieve reconstruction and restoration of damaged artifacts, statues etc.

INTRODUCTION

The artistic or historical value of a structure, such as a monument, a mosaic, a painting or, generally speaking, an artifact arises from the novelty and the development it represents in a particular field and for a specific time of human activity. [1] The more faithfully the structure preserves its original status, the greater its artistic and historical value is. But preserving a structure cannot always be possible (for traumatic events as wars can occur). In such a frame, the current technology furnishes a fundamental help for reconstruction/restoration purposes to bring back a structure to its original historical value and condition.
The idea is to realize a virtual reconstruction/restoration before materially acting on the the structure itself, using 3D construction. A means of digitalizing the physical world, 3D reconstruction is often divided into two types, scene and object reconstructions, both of which are essential building blocks of various applications in robotics, self-driving vehicle-making and other forms of manufacturing, cultural-heritage preservation, digital museums, and mixed reality, among other fields. These reconstruction techniques have been developed with substantial effort and can be conducted by either traditional surveying or novel 3D modeling systems.

PROBLEM STATEMENT

Any monument, structure, or artifact can be reconstructed as its digital simulation, and the user can see it as if it was right there in front of him. Using a tracked video-see-through Head Worn Device (HWD) and dynamic modeling of the real and virtual world, it is possible to insert virtual characters into various buildings or sites and enact a real-time storytelling scenario. This would help the user experience the events related to the site as they happened and provide them with unique perspectives and feelings of presence and immersion.

MOTIVATION

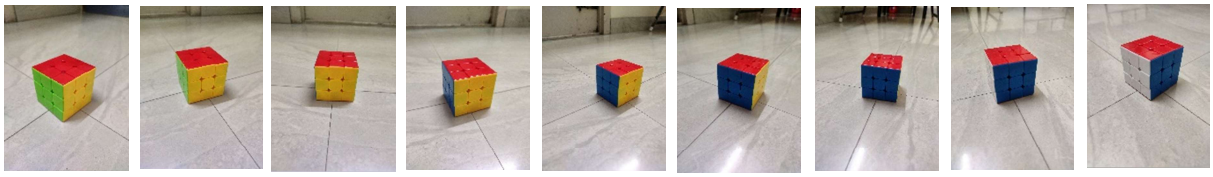
AR can be successfully used for restoration and reconstruction purposes, so it can play an *active role*, rather than be utilized for mere tutorial reasons, so to be confined in a *passive part*. [3]
This is for several reasons:

- restoration and/or reconstruction time can be reduced;
- the costs for restoration and/or reconstruction can be reduced: workforce and machinery are utilized only at the absolute final step, so even the energy consumption is saved;
- some potential breakages or risk of destruction of the archeological, often fragile but valuable, artifacts to be restored and/or reconstructed can be avoided;
- some potential abrasions/changes in colors of the artifacts can be avoided;
- it is possible to establish forms and dimensions of the parts which are eventually incomplete so to rebuild the relic exactly;
- it is possible to assemble the artifacts without damaging their remains and even cause damages in the excavation site where the artifact was found;
- it is possible to preview the possibilities of assembling more efficiently, reducing errors and the time spent in those tasks;
- the 3D scanning procedure is also helpful to create a database, for cataloging reasons, for tourism promotion aims, for comparison studies, etc.;
- in cases where the structural stability of a monument is not in danger, nonintrusive visual reconstructions should be preferred to physical reconstruction;

and so on.

WORKFLOW

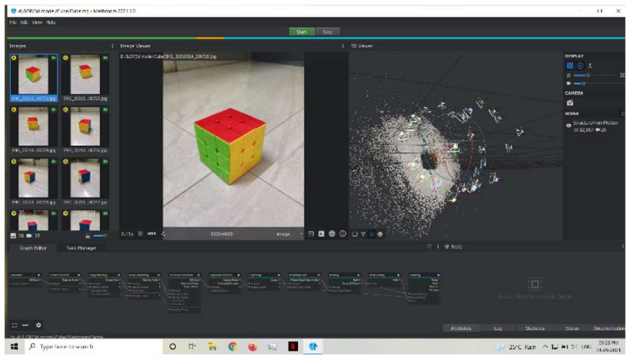
- The work is done in several steps. The first step involves identifying the structure to be reconstructed in the project and analysing it. We need to take several pictures of it from all angles and directions. An example of that is shown using this Rubik's cube.

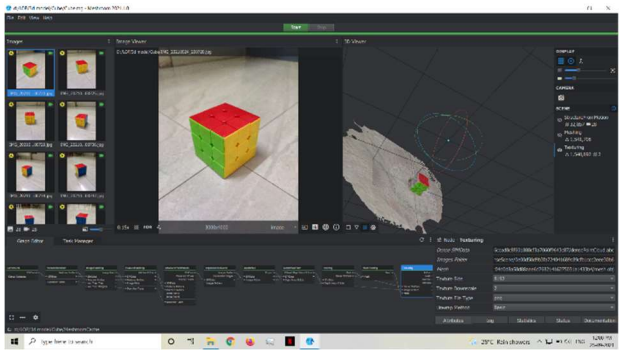


Here we see the cube from all sides and angles – top, front, side.

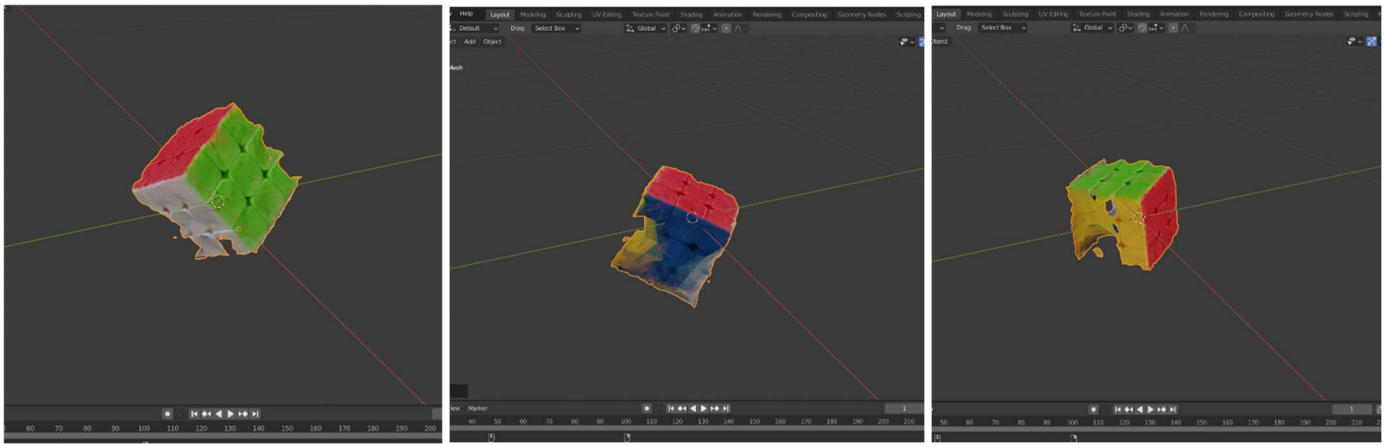
Next step involves processing these pictures in a software. We have presently used Meshroom which uses depth and mesh analysis to generate 3D models of general elements. It creates a mesh of pixels which acts as a base for the actual texture.

We input this collection of photos into meshroom and begin the process. This is what the processing looks like –





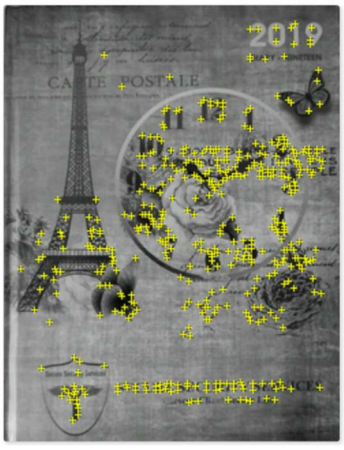
Once the processing is done, which itself is a time-consuming process we get an output mesh of the element. This mesh has to be then imported into Blender and further worked upon. Blender is a 3d modelling software with several formatting options to refine our model. Hence we use it to clean up our mesh and give a solid model of it. Once the refining in blender is complete, our model is almost ready –



This model is application-ready and can directly be exported to Unity for implementation.

- Another aspect of this project is application development. Here we use technologies like Unity and Vuphoria to develop AR-based applications. The 3d model obtained in the last process is used in Unity as an asset. It can be implemented into software applications like any other inbuilt asset.

Here We try to implement 3d model of a statue bust in our application. The task of the application is to detect a target object and place the model upon it. The target used for this purpose is a diary –

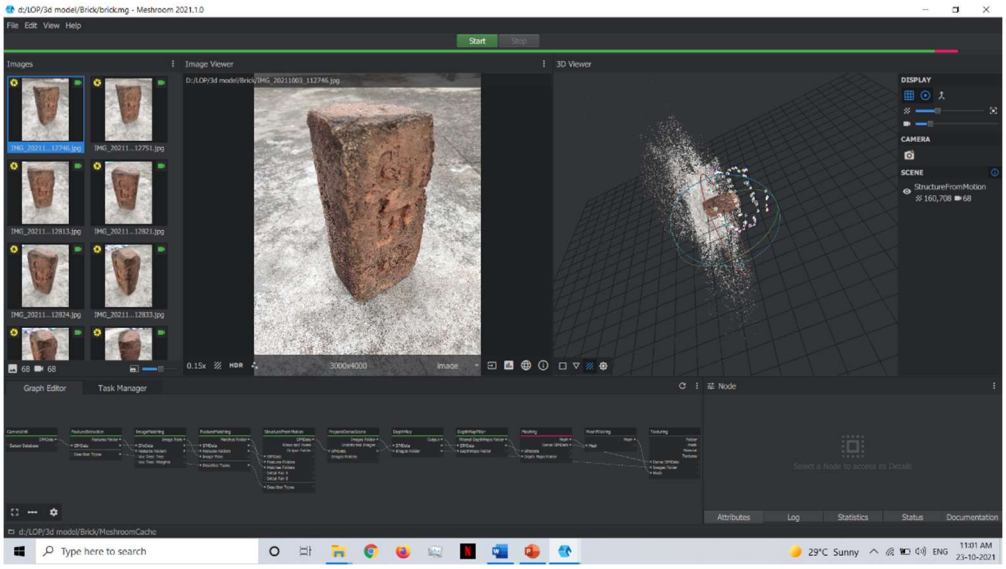


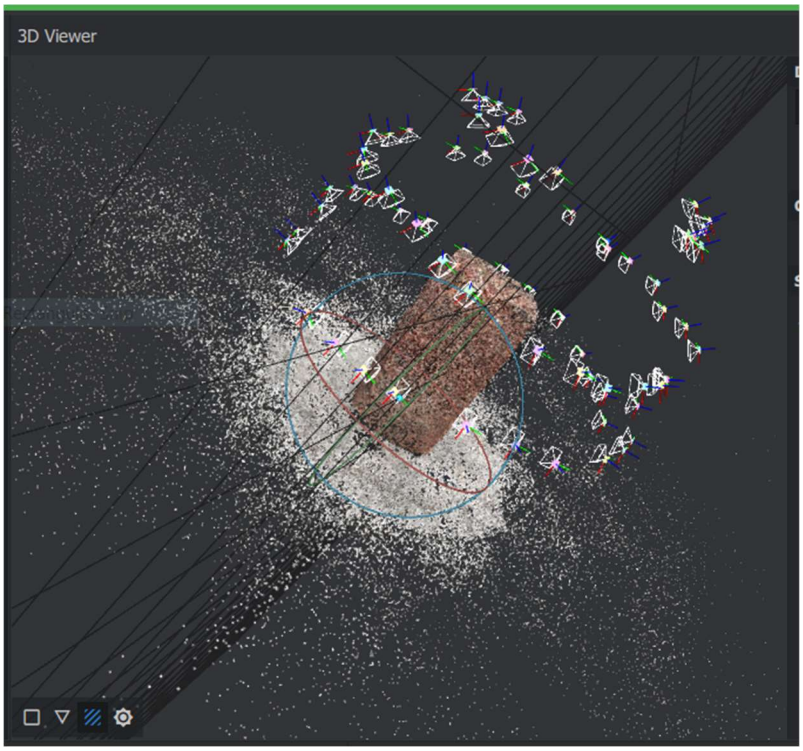
This target is added to the vuphoria database and Unity makes use of that. When the application detects the target, it places our model on top of it as shown below

NEXT OBJECTIVES

This implementation is a trial run of our main project. Construction of the Rubik's cube model will be replaced by construction of actual structure/artifact. Placement of statues bust model will be replaced by placement of this real model that will be generated.

We have started working on the actual artifact and it is being tested. We are using a red soil brick for implementation. Some instances of the progress include –





CONSLUSION

There have been several limitation and problems with the implementation of this project. The 3d model rendering takes a lot of time and sometimes needs to be reset as well. Also, surround lighting and high-quality pictures are currently difficult to achieve. But in spite of these limitations, the results of the project have been promising so far and we will surely come out with a good application in the end.

APPENDICES

[1] – https://core.ac.uk/download/pdf/53843688.pdf

[2] – https://www.vrvis.at/en/publications/pdfs/PB-VRVis-2007-006.pdf

[3] – https://www.sciencedirect.com/science/article/pii/S0926580512001690