

DES643 Practical Project.

Assignment 2 – Practical Project

Note: ALL STUDENTS TAKE THIS ASSIGNMENT. This work has to be done in a group with a minimum size of 5 and maximum size of 7. Exceptions to the maximum group size will be made only via special approval from the instructor based on a formal application with justification. The minimum group size needs to be adhered to. Every student has to submit a log book. The remaining deliverables, i.e. AR/VR project files with documentation, term paper and video need to be submitted ONLY one per group by the group leader ONLY. There will be two separate submission boxes for this assignment – one for the log book and the other for the remaining deliverables.

This will be an electronic submission on HelloITK. You may also submit a hard copy of your paper additionally, but that is optional.

URL for recording team details: <https://forms.gle/Q4JtaRptWxUR9xTs7>

Deadline: 15th April, 2024 at 23:59 hrs

Introduction.

For this course, your main assignment is designed to be a piece of work in the form of a practical project that allows you to demonstrate challenge & creativity in developing an AR/VR environment and validating it by obtaining user feedback. It is essentially an opportunity to develop elements of an industry-relevant or academic use relevant usable 3D environment. It may take the form of a project based around the Meta Quest 2 VR headset or a mobile VR environment. You will see that the marking scheme embodies a reflective aspect to help you develop more autonomy with the technologies we will expose you to.

Outcome expectations.

This will be your focused piece of formally assessed work for the course. The expectations I have as the module tutor are important and I have set them down below. The module has a set of learning outcomes and those that apply to this assessment are detailed below:

Learning Outcome	
1	Understand the fundamental principles of how AR and VR work
2	Learn to build a good AR/VR experience with digital and immersive authoring tools
3	Critique new and existing AR/VR experiences from an ethical standpoint
4	Create storyboards and physical prototypes of new AR/VR experiences
5	Infer technical requirements for implementing your AR/VR prototypes

This assignment is designed to deliver these objectives for the module.

Assignment briefing.

You are asked to approach the problem structures below. Your project must have the following characteristics:

- Use an appropriate mixture of the techniques and ideas we have looked at in the taught module to create an AR/VR environment based on ONLY one of the project descriptions outlined in the appendix of this brief
- Your work (actual AR/VR software prototype) should provide an important insight to the community by explaining how the authors built upon existing ideas and applied them to solve an interesting problem in a novel way. Each paper should include an evaluation of the success of the use of AR/VR/MR and/or 3DUI in the given application domain.
- Your term paper should include an evaluation of its contributions, such as user studies, benchmarking and/or comparison with existing systems/techniques/methods.

Marking Scheme:

Part	Deliverables	Marks possible.
1	Log book: Working notes on the problem, keep all sketches, notes, storyboards, software architecture, algorithms, etc and bind these into the working notes for your design, these must be scanned and submitted with the main assignment. This will show us the scale of the work you have undertaken because the deliverable, term paper and software prototype, does not generally include the work you do in preparing your final submission. Here we are awarding marks, against the relevant grade criteria, for this wider activity and you should include any thoughts you have related to progress you make as you make it. So as you work through your analysis try to spot these things in your work and highlight them as you find them. You will then be in a good position to report them in your evaluation.	10%
2	Actual solution material. Your AR/VR application including the project files together with a documentation of how to run the files on a different computer from scratch and the basic elements of your work as typically documented in software projects. It should be feasible to test your solution material by easily running a file such as an executable file and viewing and testing the 3D world that you have created.	30%
3	Self delivering presentation - a video or a self playing PowerPoint. A presentation, maximum 3 minutes, of your AR/VR solution product and your outcome prototype / model / Concept.	30%
4	Term paper. The term paper must follow the templates available at – https://tc.computer.org/vgtc/publications/conference/ It must typically meet the guidelines set out for IEEE AR/VR conferences, as mentioned below – https://ieeevr.org/2024/contribute/papers/ Your term paper should include an evaluation of its contributions, such as user studies, benchmarking and/or comparison with existing systems/techniques/methods. The term paper must be 4-9 pages long in IEEE format excluding references. Follow the structure used in past IEEE AR/VR conference papers so that your paper can potentially be considered for inclusion in such a conference in the future. Include your reflections on what you have achieved in terms of results and what you could do in the future to make the work better.	30%

Appendix: Project descriptions (Choose ONLY one: You must specify which description you are attempting in your project documentation)

Project Description 1

It is the year 2050 and robots have entered every aspect of human life. Teams of robots are engaged in working collaboratively with humans in hospitals, restaurants, food delivery, office spaces, homes, etc. Create a futuristic IIT Kanpur campus or a small scale smart city where such a thing is a reality. What will this futuristic campus/city look like? Use the current basic layout of the campus to envision a future campus with ultra-modern facilities. Envision how the robots may go to centralised charging stations and share tasks. Simulate disaster events such as a fire or an earthquake and illustrate how robotic teams may coordinate during such events. Consider the possibility of robots being lost during such events (either fully or partially damaged) and showcase how the remaining robots can re-plan the tasks during such disasters by reviving partially damaged robots, recovering fully damaged robots for recycling and still finishing the tasks required to overcome the disaster event.

Project Description 2

Create an immersive virtual reality-based mountain climbing system. One or more mountain scenes can be loaded based on user choice and the user must be able to experience climbing the mountain while being surrounded by other natural artefacts which are realistic. Take inspiration from detailed panoramic videos of great mountain climbers available on the web such as those of Ueli Steck climbing the north face of Eiger. You will probably need to carry out large-scale outdoor rock climbing scene modelling. Include aspects of dynamic balance of people during the climbing process and body weight transfer.

Project Description 3

The bell jar experiment is a common experiment used to demonstrate that sound needs a medium to travel. A bell jar is a laboratory equipment used for creating a vacuum. It is so named as its shape is similar to that of a bell. A bell jar is placed on a base which is vented to a hose fitting that can be connected via a hose to a vacuum pump. By pumping the air out of the bell jar, the air pressure inside the jar can be varied. The experiment is done by placing an electrical bell in the bell jar. As the air is pumped out of the sealed bell jar, the sound from the bell jar fades. At a particular vacuum, no more sound is heard from the bell, but we can see that the hammer continues hitting the gong and sound is produced. However, the sound is not audible to our ears because of the vacuum inside the jar. This demonstrates that the sound wave cannot travel through vacuum. That is, a sound wave needs a material medium for its propagation. Create an immersive visualization and 3D simulation environment of the “Bell Jar” experiment. The participants must be able to increase and decrease the vacuum inside the bell jar in steps and witness the effects of air pressure on sound using AR/VR technology.

Project Description 4

Create an immersive medical simulation game that helps to reinforce core medical skills in a fun and engaging environment. This game must have the ability to build and edit realistic virtual patient scenarios. Players are placed in real patient management situations and required to decide and implement medical therapies believed to positively affect the patient. The outcome of the case can be either positive or negative based on the way that the player treats their patient. The player is then scored based on the way they treat the patient in the case. At the end of the case the player is given written feedback as to how they did relative to how the patient case should have been. It is important to perform groundwork for this project to be able to include new patient management scenarios that commercial games do not already provide. This may require visiting a health centre or exploring TV series such as Grey’s Anatomy or 24 hours in A&E or documentaries or published work on such scenarios.

Project Description 5

Create a model of the solar system with as many basic details as possible such as the planets and the main moons around each planet. The user should be able to explore each planet and moon that you include in your prototype individually and learn about their basic characteristics. Specifically, for the earth, the user should be able to learn about the effect of the tilt of the earth’s axis on the prevalence of seasons on earth. The user may also be able to learn about the occurrence of solar and lunar eclipses. There are bonus marks for every additional physical phenomenon that you illustrate.

Project Description 6

Natural degradation, human development activities and overcrowding has meant that heritage preservation efforts are becoming more critical to ensure the sustainability of heritage sites. A list of UNESCO world heritage sites in India can be found at:

<https://whc.unesco.org/en/statesparties/in>

Using available video and image resources available on the world wide web or through a personal tour conducted by yourself or a friend/relative of one such site, create an immersive experience of a significant part or the entirety

of one such heritage site. The users must be able to walk around such a site and explore it as they would do in the real world.

Project Description 7

Create an interactive and immersive 3D game in an Indian rural setting that enables farmers to learn about sustainable practices that can enhance their livelihood. Examples include the use of biomass to create biogas, use of solar cell arrays to generate electricity, drip irrigation, rainwater harvesting, tree plantation, etc. This may need you to research and uncover a number of ways farmers can benefit from science and technology. You may get in touch with people on the ground from various government and non-government organisations such as renewable energy development agencies, banks such as co-operative banks, NABARD, etc. who are engaged in popularisation of such technologies and methods. The game can also include negative points for carrying out activities that damage the environment such as deforestation.

Project Description 8

Winter in various parts of India, particularly at the higher latitudes of the north, can be particularly damaging to people in general and vulnerable people in particular. The combination of low levels of sunlight and human activities often lowers air quality levels, accompanied by hazardous smog that remains in the air for several days. In 2019, India's Supreme Court has said the world is "laughing at India" over its air pollution issues. Trains get delayed by several hours during this period inconveniencing people. At this time of year, farmers tend to burn crop stubble to clear their fields, contributing to the high pollution levels. In a news release, Prem Singh, head of the department of medicine in Kanpur's Ganesh Shankar Vidyarthi Memorial Medical College, said the number of patients the hospital receives with respiratory illnesses has more than tripled over the past five years to 600 a month, most of them children and people over 50 years old. "Every week a lung cancer patient walks in; earlier we would get one in three months," said Mr Singh. "Problems from air pollution are on the rise and leading to multiple diseases such as bronchial asthma, chronic obstructive pulmonary disease and pneumonia." Vehicle fumes, as well as construction and industrial emissions, also contribute to the smog. Burning of firewood, coal and plastic to get heat during the winter months is another leading cause of the poor air quality levels. Create a 3D game or simulation where the user can take an immersive journey into the effects of their daily activities that lead to the poor air quality levels and encourage them to change their habits so as to improve the air quality in the local environment and thereby have a positive effect on their health and that of other citizens in the city.

Project Description 9

CNC milling machines are one of the main machining equipment on a manufacturing shop floor. Even today, most new operators/technicians acquire their operating skills by observing, referring the operation manual and then operating under the guidance of an experienced operator. To make training safer, more economical and more effective, there is an increasing need to complete initial training away from the operating environment. A lengthy explanation or lecture to the trainees is usually time consuming and ineffective. The trainees may easily forget and a lot of time has to be spent by the helper. Besides, the new user may commit mistakes of operation when he or she operates the real machine in the initial stage. For example, initially, the user may get stuck with an incorrect operation procedure or holes may be drilled in the wrong place or, more seriously, he or she may destroy expensive machine or even harm himself or herself by mistakes. In addition, limited availability of training facilities and personnel can make it difficult to train large numbers of trainees for any given machine. Create an immersive and interactive training on a 3-axis CNC milling machine for at least 2 different types of work pieces, where different operating procedures may be required.

Project Description 10

The European robin (*Erithacus rubecula*), known simply as the robin or robin redbreast in Great Britain and Ireland, is a small insectivorous passerine bird that belongs to the chat subfamily of the Old World flycatcher family. It is found across Europe, east to Western Siberia and south to North Africa; it is sedentary in most of its range except the far north. It is about 12.5–14.0 cm (4.9–5.5 in) in length; the male and female are similar in colouration, with

an orange breast and face lined with grey, brown upper-parts and a whitish belly. It is a much-loved bird and in 2015, the robin was voted as Britain's national bird in a poll organised by birdwatcher David Lindo, taking 34% of the final vote. According to a web post, robins are born in the spring or summer and are mature birds and ready to breed in the following spring or summer. They do not mate for life. Pairs usually remain together during an entire breeding season, which can involve two or three nestings. However, in spring, sometimes a male and female who mated the previous year will both return to the same territory and end up together for another year. This happens most frequently when they were successful raising babies the previous year. Robins lay one egg per day, for a total of 5–6 eggs in a clutch. The eggs hatch about 12 - 14 days after the last egg was laid. Baby robins jump from their nest when they are about 13 days old, but the range is 9 - 16 days. After leaving the nest (fledging), it takes another 10-15 days for babies to become strong fliers and independent birds. The parents continue to feed their young during this period. Most robins die their first year. But the lifespan goes up dramatically for the ones that survive this critical time, because they've learned so many important life skills. Of those that survive their first year, most wild robins live to be about 5 or 6. Create an immersive storytelling journey in 3D exploring the lifecycle of a robin.

Project Description 11

Guided meditation sessions are becoming increasingly popular worldwide. In addition, many people prefer to meditate collectively in a group. However, this may necessitate travelling to a retreat or a yoga center. The Sahaja Yoga center mentions that collective meditation helps you obtain a stronger experience of vibrations, a quicker, easier shift into the state of thoughtless awareness, clearing out obstacles, deeper meditation, longer-term evolution of the self and complete harmony with yourself, the people around you, and the universe. You become a balanced and integrated personality with fewer conflicts pulling you in different directions. Create a virtual, immersive environment where a user can experience meditation either alone in a serene natural setting while being guided in their gestures required for the meditation or collectively in a group which mimics being in a yoga class with people around you and an instructor in the front.

Project Description 12

An ecosystem is a geographic area where plants, animals, and other organisms, as well as weather and landscape, work together to form a bubble of life. Ecosystems contain biotic or living, parts, as well as abiotic factors, or nonliving parts. Biotic factors include plants, animals, and other organisms. Create an immersive and interactive 3D visualization that depicts an ecosystem with a functional water cycle, nitrogen cycle, carbon cycle and oxygen cycle. Each of these cycles should be uniquely explorable by the user so that they can learn all about each cycle. Gamify the ecosystem so that users can learn about how ecosystems get disrupted by human activity and how that affects all life forms.