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INFO3333 GROUP ASSIGNMENT

Group 61 (Prac 13 Tue 3pm CC)

Hao Chen[1], Zeyuan Ding[1], Dean Li[1], Harry Lockyer[1] & Louck Xu[1]

[1] The University of Sydney, Sydney, AU

Project Charter

Project Title: Classroom AR Integration

Project Start Date: 20 May 2023

Project Finish Date: 20 May 2025

Key Schedule Milestones:

- All hardware purchased by EOM May 2024
- All software developed by EOM November 2024
- Hardware installed in classrooms by EOM March 2025
- All testing finalised by EOM April 2025
- Project launched 20 May 2025

Budget Information:

Total $ 1,000,000. $240,000 for workspace rent (24 months). $100,000 for hardware devices (computers, servers, testing equipment). $5,000 for software (IDE, Github). $500,000 for salaries. $160,000 for all indirect and intangible costs (employee incentives, company culture, reputation)

Project Manager:

Harry Lockyer, hloc8611@uni.sydney.edu.au

Project Objectives:

Add AR integration into select classrooms in the Abercrombie Building of the University of Sydney to allow for projections of off-campus students in the classroom via AR headset, allowing for smoother, more involved learning. Allow off campus students to experience the classroom via VR.

Main Project Success Criteria:

The software must be developed and tested, the hardware must be purchased and installed and the classrooms must be ready for use in Semester 2 2025. The project must come in at budget.

Approach:

- Determine possible systems to utilise for headsets
- Develop software to be used on campus and off campus
- Install devices in classrooms and brief classes that will use system

Roles and Responsibilities

Name	Role	Responsibility
Harry Lockyer	CEO	Project sponsor, monitor project
Chuanzhi Xu	CFO	responsible for managing the financial operations of this project.
Dean Li	Director of Purchasing	Assist in purchasing hardware and software
Zeyuan Ding	CTO	Responsible for developing and implementing a company's technology strategy while overseeing its infrastructure, innovation, and cybersecurity
Hao Chen	Human Resources	Provide staff, issue memo to all employees about the project.

Comments:

Scope Statement

Project Name: Classroom AR Integration

Date Submitted: 28/03/2023

Project Description: The project will utilize existing hardware and in house developed software to provide an AR learning experience for on campus students and VR learning for students off campus participating in classes in the Abercrombie Build of the University of Sydney. The project will be limited to 3 classrooms and will have minimal impact on the capabilities to teach and learn the subjects being studied.

Project Deliverables

Deliverable No.	Description
1	New software developed to use AR/VR within the classroom
2	Software manual for IT Admin staff to aid with system use
3	Troubleshooting guide for students and teachers to help fix possible issues that may arise

Acceptance Criteria

Task No.	Description
1	The project functions without major bugs, glitches, or crashes.
2	The project provides seamless interactions between on and off-campus students.
3	The headset is comfortable enough for students to wear for most of the hour-long classes
4	The software is easy to use and has simple troubleshooting options.

Out of Scope

This project **will NOT accomplish or include** the following:	1. No changes to physical classroom environment 2. No changes to curriculum due to project 3. No hardware will be developed, only software

Project Assumptions

No.	Assumption
1	Adequate cooperation and support from faculty, staff, and students
2	Availability of necessary resources and funding
3	AR/VR technology remains relevant and continues to advance throughout the project duration
4	All hardware will be available for purchase when necessary

Project Constraints

Project Start Date	20 May 2023
Launch/Go Live Date	
Project End Date	20 May 2025
Hard deadlines	Project Completion: 20 May 2025
Other deadlines/milestones	● All hardware purchased by EOM May 2024 ● All software developed by EOM November 2024 ● Hardware installed in classrooms by EOM March 2025 ● All testing finalised by EOM April 2025 ● Project launched 20 May 2025
Budget Constraints	$1,000,000
Quality or Performance Constraints	Network bandwidth and latency: To provide a smooth AR experience, the system will require a stable and high-speed internet connection. Latency issues could lead to a less immersive experience for remote students, so it's crucial to address potential network bottlenecks. Software optimization: The AR application must be optimized for performance and responsiveness, ensuring that the digital content is rendered accurately and in real-time. The application should also be compatible with various AR headsets and devices. User experience and ergonomics: AR headsets should be comfortable to wear for extended periods, with a user-friendly interface for both remote and in-person students. The AR content should be presented in a way that minimizes
Equipment/Personnel Constraints	Equipment availability: Depending on your budget and the scale of your project, acquiring the necessary AR headsets and other supporting hardware for all students

	and faculty might be challenging. Determine the number of devices needed and procurement plan, considering factors like cost, compatibility, and functionality. Technical infrastructure: Your project may require updates or improvements to the existing network infrastructure to support the high-speed connectivity needed for AR experiences. This might include upgraded routers, switches, or even a dedicated network for AR traffic. Training and support staff: Implementing AR technology in the classroom requires trained personnel to manage the system, provide technical support, and assist with troubleshooting. This could involve hiring new staff or training existing staff members to meet the project's needs.
Regulatory Constraints	General Data Protection Regulation (GDPR) in the EU, or the Australian Privacy Act, is crucial. You should ensure that the AR system and any associated software adhere to these regulations when handling and storing personal information, such as student names, images, or other data. Accessibility: Your AR integration project must comply with accessibility regulations, such as the Americans with Disabilities Act (ADA) in the United States or the Disability Discrimination Act (DDA) in Australia. These laws require that educational institutions provide equal access and opportunities for students with disabilities, so your AR system should be designed with these requirements in mind. Copyright and intellectual property: The AR system may involve using copyrighted material, such as textbooks, images, or videos. Ensure that you have the appropriate permissions and licenses for using such content, and follow copyright and intellectual property laws.

Updated Estimates

Estimated hours required to complete the project	4900 rs

Literature Review

This literature review will analyse, examine, and confirm all the information included in the literature from 2013 to 2021 is recent, relevant, and correct.

Our project, classroom AR integration, aims to allow remote students to join the class through VR imaging and to project the remote students into the classroom as in-campus students through AR. The main objective is to enable two modes (online and on-campus) of teaching to work generally as conventional, allowing diverse and flexible learning styles.

1. Identifying Things to Know

Augmented Reality (AR) is leading a technical sensation. It integrates virtual digital information and images with the elements of the world you can see. In other words, it generates virtual objects in the same space as real-world objects that users can see through special visual equipment. In the 1990s, AR was initially introduced as an airline and Air Force training device. In recent years, AR has been popularly applied in educational fields. (Akçayır & Akçayır, 2017)

Virtual Reality (VR) is also one of the most popular and famous technologies in recent years. It works in an immersive style, immersing your senses into a surrounding differently from reality. (Intel, 2019)

2. Grouping Authors with Similar Conclusions

2.1 Supporting Ideas

2.1.1 The in-Campus Students' Positive Responses towards Augmented Reality (AR)-Supported

Since our Classroom AR Integration project aims to enhance the study experience for on-campus students, the previous research, which explained the AR benefits in the education area, is shown in the following research:

An experiment used students from two schools of similar size and teaching quantity as test participants. Some classes used AR interactive teaching, while others remained traditional teaching models. The experimental results showed that students with AR interactive learning have better learning effects and study results than students in classical teaching mode. (Cai et al., 2021)

One research taking 78 students as participants aimed to examine whether the learning motivation will be improved after using the augmented reality mobile application to study. The participants were required to finish questionnaires about their feelings before and after. The results showed that students' factors of attention, satisfaction, and confidence were increased. (Khan et al., 2019)

Another experiment found that AR can facilitate kinesthetic learning, promote student engagement, enhance interactivity, boost learning outcomes and satisfaction, and encourage collaborative learning. (Alzahrani, 2020)

Furthermore, using AR to provide virtual images/humans is also helpful for interpersonal communication. One experiment provided some first-hand empirical evidence that virtual humans in AR can influence social performance, adding to the literature on the social effects of AR agents. (Miller et al., 2019). Hence, it can help in-campus students communicate with off-campus students with a more effective social and academic communication experience.

"Some researchers reported specific AR-related learner outcomes such as 'decreases cognitive load' and 'enhances spatial ability.' These results require further exploration." (Miller et al., 2019) For example, Santos (2014) said, "Real world annotation improves perception. It juxtaposes real objects, and virtual text and other symbols. This reduces the cognitive load in the limited working memory so that a bigger fraction of the STM can be used for operating cognitive processes (e.g., storing in the LTM)." (Alzahrani, 2020)

Since the coronavirus outbreak in 2019, most professional activities have to work with remote collaboration. Moreover, AR has powerful features of visualisation and annotation by providing real-time descriptions in the virtual world. (Wang et al., 2022)

2.1.2 The remote Reliability of the VR Implementation for off-Campus Students

Similar VR tools are already applied in the remote laboratory for the remote student end devices. The existing Remote Lab is in physical control, connected to a central PLC(Programmable Logic Controller). (Trentsios et al., 2020) The central PLC build the connection with a desktop computer throw proprietary LabVIEW hardware. The software LabVIEW can control and monitor the equipment in the laboratory. (Trentsios et al., 2020) It can also distribute the laboratory data to open remote access to an iLab server. Users can access the iLab servers online and manage the Remote Lab in preferred time slots. (Trentsios et al., 2020)

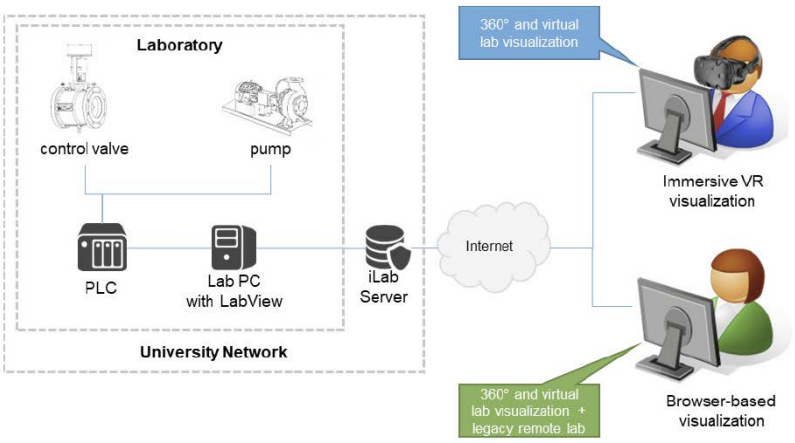


Fig. 1. Desired architecture of the complete Remote Lab.

Figure 1. Desired Architecture of the Complete Remote Lab

https://www.sciencedirect.com/science/article/pii/S2351978920306818

2.2 Opposing Ideas

2.2.1 The in-Campus Students' Negative Responses towards Augmented Reality (AR)-Supported

Although students can benefit from using AR within the class, specific verification of the effectiveness is still required. Measuring its effectiveness can be crucial because the learners have great differences in attentiveness and competence in using AR. (Alzahrani, 2020)

It is hard for students to use AR-supported learning tools because they might be confused by the complex platform or too much information displayed. (Alzahrani, 2020)

2.2.2 The Remote Reliability Issue of the VR (Also AR) Implementation for off-Campus Students

As we plan to introduce VR into remote study, we will bring remote students to offline classrooms through AR technology.

In an e-learning environment, AR needs to combine digital information within physical and real-world

settings. The included elements use computer-generated sensory inputs such as video, sound, visualisations, graphics, and GPS data to be supplemented or augmented. (Khan et al., 2019) This situation will increase the requirements for hardware in teaching venues.

In addition, remote students also need certain network requirements to connect to teaching venues. There are three categories of collaborative VR networking issues - client-side, application-side, and server-side. Client-side indicates the network conditions and hardware capabilities of all clients. Application-side includes the protocol and design to synchronise data in the collaborative AR context. The Server-side is the corresponding server to handle the synchronisation. It is necessary for collaborative VR to utilise AI techniques for the prediction and optimisation of data synchronisation. (Chheang, 2022) It is challenging for our network optimisation in this project.

2.2.3 Not Suitable for all Learners and Teaching Situations

AR simulations are complicated and intensive for resources, which requires plenty of time and specialised knowledge in design, implementation, and evaluation. AR simulations may not adapt to all instructional environments or learners. (Dunleavy et al., 2008)

2.3 Technical Information

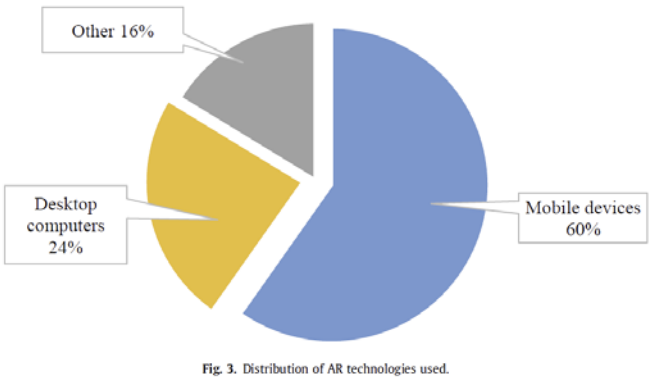


Fig. 3. Distribution of AR technologies used.

Figure 3. Distribution of AR Technologies Used

Technology plays a significant role in AR. Different technologies, like HMD or tablet PCs, can access AR. AR technologies have different characteristics in cost, usability, and accessibility of educational contexts. The research team found that mobile devices are the most popular delivery technology. (Akçayır & Akçayır, 2017)

3. Comparing, Commending, and Criticising Different Views

Positive	Negative

AR-supported on-campus learning	1. Producing more fruitful and meaningful results. (Cai et al., 2021) 2. Increasing attention, confidence, and satisfaction. (Khan et al., 2019) 3. Virtual humans in AR can improve the social effect. 4. Images/Icons can help to reduce cognitive load (Santos et al., 2014)	1. Not suitable for all learners and teaching situations. 2. Some learners will lose their attention and not be good at using technology. 3. The complexity of the AR platform 4. Requirements for hardware facilities. 5. Requirements for internet optimisation.
VR-supported off-campus learning	1. Remote VR collaboration has a usable example for the activities.	1. Requirements for hardware facilities. 2. Requirements for internet optimisation.

Commending and Criticising Summary:

- Positive: The number of test samples is relatively small compared to the market audience, and there is a lack of large-scale examples to support various advantages.
- Negative: Most of the shortcomings can be alleviated through software optimisation, which is the work we will do next in the project, while hardware issues gradually alleviate over time.

4. Market Research

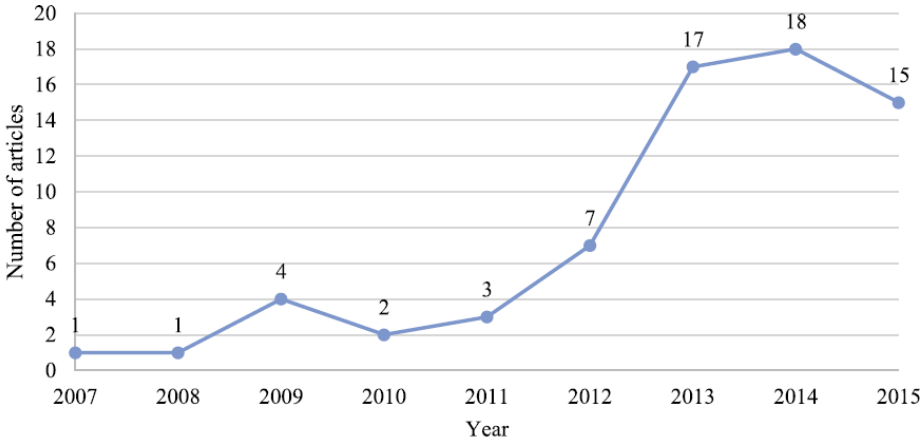
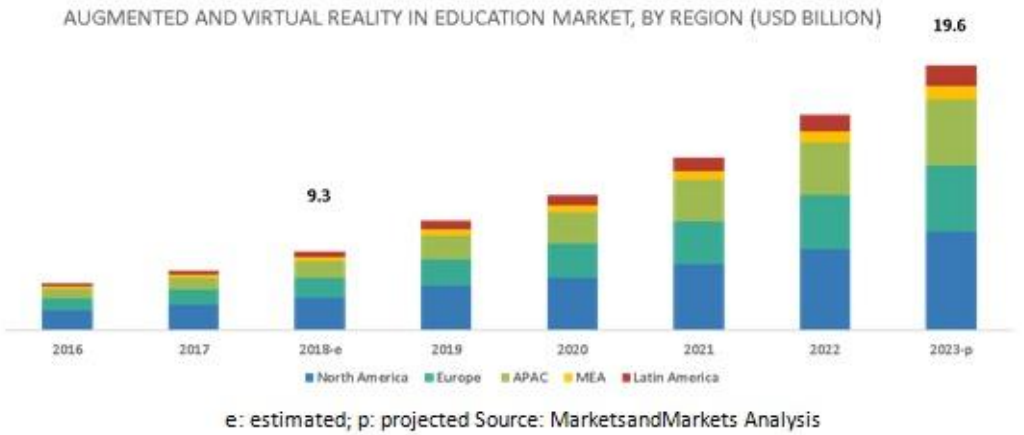


Fig. 1. Number of articles published by year.

Starting from 2011, the number of academic publications on AR in education has steadily increased. As early as 2006, the Horizon Reports predicted that AR would be a promising technology in the long run and would gain significant attention and impact in the years to come, as Johnson, Laurence, and Smith stated in their report.



(Picture from Markets and Markets Analysis report)

Focused on the picture from the Marketsand Markets Analysis report, AR classroom technology has seen significant growth and adoption in various regional markets. The North American region has emerged as the largest market for AR in education, owing to the high penetration of technology and advanced infrastructure. Europe and Asia Pacific regions follow closely, with a growing interest in AR-based teaching and learning solutions. AR technology in classrooms has been seen as a transformative tool, allowing students to engage with the subject matter in new and exciting ways and providing educators with valuable tools for enhancing learning outcomes.

Undoubtedly, the development of augmented reality (AR) technology is driving the market forward. More and more schools and companies are adopting AR technology, enabling students to participate in learning actively. For example, AR-enabled textbooks have been used in classrooms to provide students with interactive learning experiences. AR-powered simulations have been used to train employees in various industries such as healthcare, manufacturing, and aerospace. This growing trend towards AR integration in education and training is expected to continue in the foreseeable future as the benefits of this technology become increasingly evident.

Currently, there are numerous technology companies actively participating in the AR education market, including major players such as Google Expeditions Pioneer Program. zSpace, Magic Leap, Alchemy VR, Unimersiv, GAMOOZ, Meta Company, DAQRI, InGage, Popar, Chromville, NEXT/NOW, VironIT, Groove Jones, HQSoftware, as well as smaller start-ups and niche providers.

4.1 Demonstration of Inexistence

Despite the growing number of AR classroom software available on the market, none have truly integrated AR and VR technology to facilitate online students' participation in offline classes. For example, AR classroom software such as Aurasma, Nearpod, and Classcraft have their own strengths and weaknesses. Aurasma provides a user-friendly platform with excellent AR creation tools but lacks the necessary tools to facilitate live classroom interactions. Nearpod offers a comprehensive package of interactive features, but its AR capabilities are limited. Classcraft provides an engaging gamification experience but does not focus on AR or VR.

On the other hand, our team's software offers a unique approach to integrating AR and VR into classroom settings, providing online students with a seamless and immersive learning experience. Our software bridges the gap between online and offline classrooms by leveraging cutting-edge technology, enabling students to engage with their peers and teachers in real time.

5. Criticizing Aspects of Methodology

After reading some articles on the field of AR or VR classrooms, we found that some research may have some possible aspects of the methodology that could be criticised:

Small sample size:

In some articles we read, we found that the sample size of some studies is small. For instance, the article by Radu (2014) on "Augmented Reality (AR) in Education: A Meta-Review and Cross-Meta-Analysis" only included 16 studies in the meta-review and cross-meta-analysis, which could limit the generalizability of the results. A larger sample size would provide a more representative view of the effectiveness of AR in education.

Also, for the article by Hsin-Yi Chen (2022), "The effectiveness of augmented reality in education: A meta-analysis", The study only searched two databases, Scopus and Web of Science, which may have limited the number of relevant studies that were included in the meta-analysis. There are other

databases and sources of information, such as grey literature or conference proceedings, that were not searched.

Heterogeneity of the studies:

The studies included in the article varied in terms of their design, methodology, and quality. Some studies had small sample sizes or did not have control groups. This heterogeneity could make it difficult to draw definitive conclusions about the effectiveness of AR in education.

The limited scope of the analysis:

The scope of some articles is very limited. For example, For instance, the article by Azuma and Akçayır (2017) on "Augmented Reality (AR) in Education: A Meta-Review and Cross-Meta-Analysis'' mainly focuses on the impact of AR on students' academic performance and does not examine classroom AR. Other important aspects of integration, such as teachers' attitudes toward AR or the impact of AR on student engagement and motivation. Limited focus may lead us to underappreciate the advantages or disadvantages of AR.

The short duration of study/experiment:

For The article by Radu (2014), "Augmented Reality: A Systematic Review of Its Benefits and Challenges in E-learning Contexts." The study only lasted for a single session, and the students were tested immediately after the session. This short duration may not be sufficient to determine the long-term impact of the AR system on student learning.

6. Identification of Knowledge Gaps and Creations

1) The literature we have found points out that AR technology positively impacts students in the classroom in various aspects, but there is also literature that points out that the AR platform may make teaching more cumbersome. However, it is unclear which AR platforms are being referred to in these studies or how they compare in terms of usability and effectiveness.

Although some studies have been conducted in some literature indicating that AR can improve attention, confidence, and satisfaction, it is still unclear how researchers measure these benefits and whether they are generalisable across different contexts.

2) The potential technical requirements for using AR in the classroom: As AR becomes increasingly common in educational settings, hardware compatibility of our project may become increasingly important.

3) The potential ethical and privacy implications of using AR in the classroom: It is still unclear whether the public accepts AR technology and how we can ensure the privacy of students' information during real-time remote interactions.

7. Summary

In conclusion, this literature review shows the compelling potential of AR and VR in education, but it also highlights the noticeable knowledge gaps and challenges in this project.

Our upcoming project will bring a substantial contribution by applying AR in projecting off-campus students into physical classrooms and applying VR to show the classroom to remote students. This innovative approach will enhance the inclusivity and engagement in remote education.

Some Significant challenges, such as technical requirements, user acceptance, and teaching adjustments, have been identified. This offers us critical areas to focus on and improve in the project.

Furthermore, this project targets to fill a knowledge gap by exploring AR and VR to create a more immersive and interactive learning experience for students remotely and on campus. This topic is currently under-represented in the existing literature and research.

Overall, the project has a good development prospect and uses value. After overcoming the knowledge gaps and challenges encountered in this project, it will be very successful.

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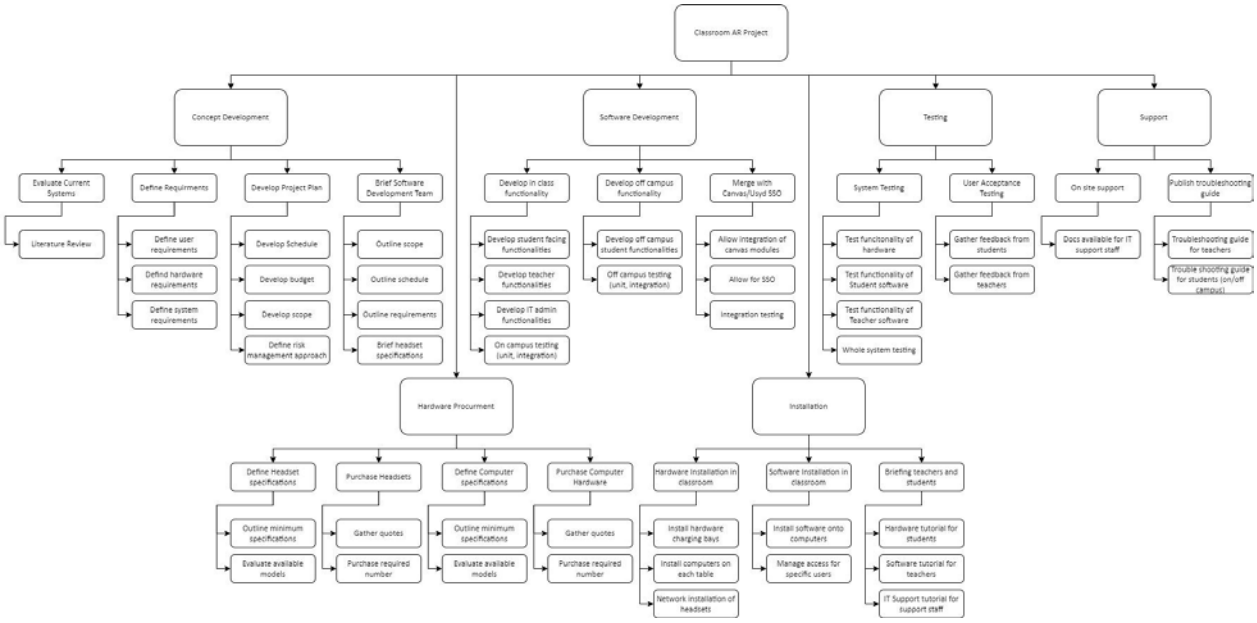
Work Breakdown Structure Diagram



Detailed List

1. Concept Development - Research and outline the requirements and needs of the Classroom AR System.

1.1. Evaluate Current Systems - Look at current alternatives available on the market.

1.1.1. Literature Review - Review literature to understand knowledge gaps.

1.2. Define Requirements - Define what the system is required to do and how it will perform.

1.2.1. Define user requirements - Define what the users of the system will expect from the system.

1.2.2. Define hardware requirements - Define the hardware requirements that the system will use.

1.2.3. Define system requirements - Define the requirements for the system, including the success criteria.

1.3. Develop Project Plan - Outline a plan for the entire project

1.3.1. Develop Schedule - Outline how long the project will take, breaking the work into smaller tasks with set timelines.

1.3.2. Develop budget - Work out how much each part of the project will cost and provide an estimate for ongoing costs after completion.

1.3.3. Develop scope - Outline what the project will entail and what will be excluded from the project.

1.3.4. Define risk management approach - Research what risks are involved in the project, how likely they are to occur and how they will be prevented, handled and mitigated throughout the project

1.4. Brief Software Development Team - Bring the developed requirements to the development team and facilitate input from the team.

1.4.1. Outline scope - Brief the team on the scope of the project and what they are expected to create.

1.4.2. Outline schedule - Brief the team on how long they will have to complete each part of the project.

1.4.3. Outline requirements - Outline the requirements gathered earlier so the team understands what is expected.

1.4.4. Brief headset specifications - Outline the headset specifications that will be utilised in the project.

2. Hardware Procurement - Research and purchase all required hardware

2.1. Define Headset Specifications - Evaluate what headsets will be used

2.1.1. Outline minimum specifications - Define what the minimum headset requirements are for the system

2.1.2. Evaluate available models - Research available headsets that fall in the defined minimum specifications

2.2. Purchase Headsets - Procure the headset hardware for the project

2.2.1. Gather quotes - Get pricing quotes for the decided headset from various sources

2.2.2. Purchase required number - Evaluate quotes and purchase the required amount of headsets

2.3. Define Computer/Server Specifications - Discover the specifications for the computers and servers used in class

2.3.1. Outline minimum specifications - Define what the minimum specifications needed are

2.3.2. Evaluate available models - Research available computers that fall in the defined minimum specifications

2.4. Purchase Computer Hardware - Procure the computer hardware for the project

2.4.1. Gather Quotes - Get pricing quotes for the decided computers from various sources

2.4.2. Purchase required number - Evaluate quotes and purchase the required amount of computers

3. Software Development - Create the software needed for the students on and off campus and the teachers/tutors running the class

3.1. Develop in class functionalities - Create and test all software for those on campus

3.1.1. Develop student facing functionalities - Develop the software that on campus students will be using

3.1.2. Develop teacher facing functionalities - Develop the software that the teachers/tutors will be using

3.1.3. Develop IT Admin functionalities - Develop the software that an IT administrators will have access to

3.1.4. On campus testing (unit, integration) - Test the in class software that has been/is being developed

3.2. Develop off campus functionalities - Create and test the software for students in home

3.2.1. Develop off campus student functionalities - Develop the software that students at home will access

3.2.2. Off campus testing (unit, integration) - Test the off campus software that has been/is being developed

3.3. Merge with Canvas/USyd SSO - Merge the developed software with University systems

3.3.1. Allow integration of canvas modules - Integrate learning modules from USyd Canvas

3.3.2. Allow for SSO - Integrate USyd Single Sign On for verification

3.3.3. Integration testing - Ensure functionality by testing the integration of these systems

4. Installation - Install all hardware and software into the classrooms

4.1. Hardware Installation in classroom - Install the hardware required for in class use

4.1.1. Install hardware charging bays - Install bays to allow the headsets to charge when not in use

4.1.2. Install computers on each table - Install the computers to run the software on each table and configure headsets to computers

4.1.3. Network installation of headsets - Integrate the computers and headsets into the University network

4.2. Software Installation in classroom - Install the developed software on the computers in the classrooms

4.2.1. Install software on to computers - Install the student facing software onto the student's computers and the teacher facing software onto the teacher's computers

4.2.2. Manage access for specific users - Allow access for specific users to certain software systems

4.3. Brief teachers and students - Hold sessions to brief the students/teachers/IT staff that will be involved with the project once it is launched

4.3.1. Hardware tutorials for students - Hold a session on how to use the headsets and hardware with the students

4.3.2. Software tutorial for teachers - Hold a session on how to use the required parts of the software with the teaching staff

4.3.3. IT support tutorial for support staff - Brief the IT Administrators of the building on troubleshooting techniques and basics of operating headsets and software

5. Testing - Test all systems to ensure proper functionality

5.1. System Testing - Test the entire system as one entity

5.1.1. Test functionality of hardware - Ensure the hardware is performing properly

5.1.2. Test functionality of Student software - Ensure the student facing software is performing properly

5.1.3. Test functionality of Teacher software - Ensure the teaching software is performing properly

5.1.4. Whole system testing - Run test classes to test the whole system at once

5.2. User Acceptance Testing - Test how well the system is received by the users

5.2.1. Gather feedback from students - Collect feedback post-class from students who participate in the new system

5.2.2. Gather feedback from teachers - Collect feedback post-class from teaching staff who participate in the new system

6. Support - Provide supporting documents and help for those using the system

6.1. On Site support - Create an on site support resource using the current IT support staff

6.1.1. Docs available for IT support staff - Generate all necessary documentation for the IT administrators of the building

6.2. Publish troubleshooting guide - Publish brief troubleshooting guides for smaller common issues that may arise

6.2.1. Troubleshooting guide for teachers - Create a guide for the teachers to use if issues arise during class

6.2.2. Troubleshooting guide for students (on/off campus) - Create a guide that is available to both on and off campus student for common issues that could arise

Gantt ChartCost Modelling

Budget Table

WBS	Effort or Hours	Cost/hrs.	Type of Cost	Contingency	WBS Cost	% of Total
Workspace Rent	24 months	$10,000	Direct, Tangible	-	$240,000	24%
Hardware Devices	-	-	-	-	$100,000	10%
Computers	5 set	$3,000	Direct, Tangible	$1,000	$16,000	1.60%
Servers	1 set	$50,000	Direct, Tangible	$5,000	$55,000	5.50%
AR Headsets Devices	5 set	$4,000	Direct, Tangible	$4,000	$24,000	2.40%
Software	-	-	-	-	$5,000	0.50%
IDE	24 months	$50	Direct,	-	$1,200	0.12%

			Tangible			
Github Enterprise	24 months	$20	Direct, Tangible	-	$480	0.05%
Software development	-	-	Direct, Intangible	-	$3,320	0.33%
Salaries	-	-	Direct, Tangible	-	$500,000	50%
Reserves	-	-	Indirect, Tangible	$160,000	$160,000	16%
Grand Total	$1,000,000					

Cost Types

Tangible Costs:

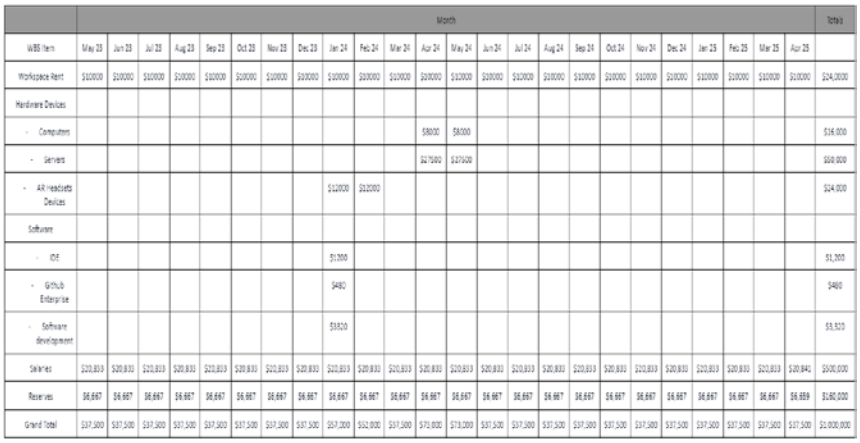
- Workspace Rent: The cost of renting a workspace to finish our software development and conduct business operations.
- Hardware Devices: The cost of purchasing the physical devices such as computers, servers, and AR headsets.
- Software: The cost of purchasing software licenses for various applications and analyzing tools for the software development and testing, such as integrated development environments (IDEs) and GitHub Enterprise service which is a version control and collaboration platform.
- Salaries: The cost of paying salaries and bonus to employees in our project.
- Reserves: The cost of setting aside funds for future expenses or unforeseen circumstances.

Intangible Costs:

- Software development: The time cost of developing for the software applications, which is an intangible cost as it is not a physical product or payment cost.

Direct Costs:

- Workspace Rent: This is a direct cost because it is directly related to the cost of renting our workspace for our software development and the business operations.
- Hardware Devices: This is a direct cost because it is directly related to the cost of purchasing the physical devices such as computers, servers, and AR headsets.



	Month																								Totals
WBS Item	May 23	Jun 23	Jul 23	Aug 23	Sep 23	Oct 23	Nov 23	Dec 23	Jan 24	Feb 24	Mar 24	Apr 24	May 24	Jun 24	Jul 24	Aug 24	Sep 24	Oct 24	Nov 24	Dec 24	Jan 25	Feb 25	Mar 25	Apr 25	
Workspace Rent	$10000	$10000	$10000	$10000	$10000	$10000	$10000	$10000	$10000	$10000	$10000	$10000	$10000	$10000	$10000	$10000	$10000	$10000	$10000	$10000	$10000	$10000	$10000	$10000	$240,000
Hardware Devices																									
- Computers												$8000	$8000												$16,000
- Servers												$47500	$27500												$68,000
- AR Headsets Devices									$12000	$12000															$24,000
Software																									
- IDE									$1,200																$1,200
- Github Enterprise									$480																$480
- Software development									$9,920																$9,920
Salaries	$20,833	$20,833	$20,833	$20,833	$20,833	$20,833	$20,833	$20,833	$20,833	$20,833	$20,833	$20,833	$20,833	$20,833	$20,833	$20,833	$20,833	$20,833	$20,833	$20,833	$20,833	$20,833	$20,833	$20,841	$500,000
Reserves	$6,667	$6,667	$6,667	$6,667	$6,667	$6,667	$6,667	$6,667	$6,667	$6,667	$6,667	$6,667	$6,667	$6,667	$6,667	$6,667	$6,667	$6,667	$6,667	$6,667	$6,667	$6,667	$6,667	$6,659	$160,000
Grand Total	$37,500	$37,500	$37,500	$37,500	$37,500	$37,500	$37,500	$37,500	$57,000	$52,000	$37,500	$72,000	$79,000	$37,500	$37,500	$37,500	$37,500	$37,500	$37,500	$37,500	$37,500	$37,500	$37,500	$37,500	$1,000,000

○ Computers: This is a direct cost because it is directly related to the cost of purchasing individual computer units for employees that are necessary for software development.

○ Servers: This is a direct cost because it is directly related to the cost of purchasing and maintaining servers for hosting the services for our project.

○ AR Headsets Devices: This is a direct cost because it is directly related to the cost of purchasing AR headsets for development and testing within the software development and testing steps.

● Software: This is a direct cost because it is directly related to the cost of purchasing software licenses for various applications and analyzing tools for the software development and testing, such as integrated development environments (IDEs) and GitHub Enterprise service which is a version control and collaboration platform.

○ IDE: This is a direct cost because it is directly related to the cost of purchasing and maintaining integrated development environments (IDEs) for software development.

○ Github Enterprise: This is a direct cost because it is directly related to the cost of using Github Enterprise as a version control and collaboration platform.

○ Software development: This is a direct cost because it is directly related to the time cost of the software developers building and maintaining software applications that work well in our project.

● Salaries: This is a direct cost because it is directly related to the cost of paying salaries to employees for their work.

Indirect Costs:

● Reserves: Although it will be a direct payment in the future, it should be considered an indirect cost since it is not directly related to any specific payment target. Part of it may be used to hold some activities as incentives to our employees.

Sunk Costs:

● NA.

Cost Baseline

Communication Plan

Type of Stakeholders	Level of Interest in Project	Description of Interest of Concerns	Document Name	Communication medium	Frequency of Communication	Communication Owner
CEO	High	Sponsor and monitor the project	Project Budget and Status Report	Email/Meeting	Daily	Project Manager
Marketing and Sales	High	Promote and sell products to customers	Project Introduction, Market Research Report, Sales Report	Email/Meeting	Weekly	Marketing Team Leader
CFO	High	Manage and report the revenue and cost	Project Revenue and Cost Report	Email/Meeting	Daily	Project Accounting Clerk
CTO	High	Develop the IT product	Project development progress report	Email/Meeting	Weekly	Developing Team Leader
Manufacturing Subcontractor	Low	Help to manufacture the product	Manufacturing order with the specification	Email/Mobile Phone	Weekly	Developing Team Leader
Procurement	Low	Buy the software and hardware the project needs	Purchasing List	Email/Meeting	Monthly	Developing Team Leader
Human Resources	High	Hire and pay the employee	Recruitment requirements and payroll	Email/Meeting	Weekly	Project Manager

Risk Management

Risk No.	Risk name	Risk Description	Risk Owner	Category	Mitigation Plan (what to do to avoid the risk occurring)	Impact level	Description of impact	Likelihood of occurrence	Contingency Plan (what to do if the risk occurs)
1	Hardware Unavailability	Difficulty in acquiring necessary hardware	Project Manager	Supply Chain	Establish multiple suppliers early procurement	High	Delay in project increased cost	Moderate	Rent or borrow hardware seek alternative suppliers
2	Inadequate Network Infrastructure	Insufficient network infrastructure to support AR	IT Manager	Technical	Assess current infrastructure plan upgrades	Medium	Poor AR performance connectivity issues	Low	Temporarily use alternative network solutions adjust project scope
3	Software Development Delays	Delays in developing the required software	Software Developer	Schedule	Allocate extra resources monitor progress	High	Delayed implementation increased cost	Moderate	Reallocate resources reduce scope or extend deadline

4	User Discomfort with AR Headsets	Users find the AR headsets uncomfortable to wear	UX Designer	Usability	Perform extensive user testing gather feedback	Medium	Reduced user adoption negative user experience	Low	Seek alternative headsets make design improvements
5	Non-compliance with Regulations	Failure to comply with relevant legal regulations	Legal Advisor	Legal	Perform thorough legal review obtain necessary permissions	High	Legal disputes financial penalties	Low	Engage legal counsel address compliance issues
6	Staff Training and Support	Insufficient training and support for staff	Project Manager	Human Resources	Develop training materials, conduct training sessions	Low	Staff unable to effectively use AR technology	Low	Provide additional training and hire additional support staff
7	AR Technology Obsolescence	AR technology becomes outdated during the project	Technical Lead	Technical	Keep up-to-date with AR advancements, conduct regular reviews	Medium	Increased costs and need for technology upgrades	Low	Reevaluate technology options plan for upgrades
8	Student Privacy Concerns	AR system infringes on student privacy	Legal Advisor	Legal	Implement privacy measures , conduct regular reviews	High	Legal disputes loss of trust	Low	Conduct privacy audits address concerns ensure compliance
9	Integration with Existing Systems	Difficulty integrating AR technology with existing systems	IT Manager	Technical	Perform thorough system analysis , collaborate with stakeholders	Medium	Delays cause additional costs	Low	Adjust integration strategy seek external expertise
10	Accessibility Compliance	AR system does not meet accessibility requirements	UX Designer	Usability	Design with accessibility in mind, consult accessibility guidelines	High	Legal disputes and exclusion of students with disabilities	Low	Revise design ensure compliance seek expert advice

Reflections

Member A:

B. He performed well as a leader to lead group mates to finish all the work and respond for many task

C. He demonstrates strong leadership skills by effectively coordinating team efforts and ensuring tasks are completed on time.

D. He has made many important decisions and is always the first to help with others' questions.

E. He demonstrates a strong sense of responsibility towards the project and guiding team members as a team leader.

Member B:

A. He worked hard to complete the assigned tasks and effectively communicated any issues or advice they had.

C. He consistently delivers exceptional results and provides valuable advice to the team.

D. He completes his assigned tasks timely and seeks official answers to questions actively.

E. He is able to provide suggestions for the results after starting the task.

Member C:

A. He put his hand up to do any parts of the project that needed quick work done and completed it quickly.

B. He always keep in touch and give the effective feedback to team mates in the work and finished the task quickly

D. He volunteered to do a large part of the work, arriving early, and holding meetings.

E. He is able to make plans for team members before starting the task.

Member D:

A. He continuously reviewed much of the work as it was updated and provided feedback on what could be improved to ensure clarity and consistency of work.

B. He treats work seriously and always give the positive and helpful feedback in time for the finished work

C. He shows great attention to detail and consistently produces high-quality work.

E. He actively helps team members solve problems while completing tasks.

Member E:

A. He worked hard to complete all assigned tasks and collaborated well with all team members to do so.

B. He provides lots of help when we need him. He never make us upset

C. He is a reliable team member who actively collaborates with others and supports the team's goals.

D. He provided a lot of constructive advice and completed the work with high quality.