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**Abbottabad, Pakistan**

**FurnishARt (An AR-Based Furniture Store)**

(Version 1.0)

***By***

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***Bachelor of Science in Computer Science (2021-2025)***

**The candidate confirms that the work submitted is their own and appropriate  
 credit has been given where reference has been made to the work of others**.

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**FurnishARt (An AR-Based Furniture Store)**

**A project presented to**

**COMSATS University Islamabad, Abbottabad**

**In partial fulfillment**

**of the requirement for the degree of**

***Bachelor of Science in Computer Science (2021-2025)***

***By***

**Muhammad Umer CIIT/SP21-BCS-016/ATD**

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**DECLARATION**

We hereby declare that no part of or all this software has been taken from any source. It is also stated that we created this software and associated report fully through our own efforts. If any component of this project turns out to have been copied from another source or to be an exact copy of others. We will not back down from the consequences. No part of the work presented has been submitted in support of any other degree or accreditation available at this or any other university or institute of research.

Muhammad Umer Muhammad Noman Hafiz Talha Nazir

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**CERTIFICATE OF APPROVAL**

It is to certify that the final year project of BS (CS (Computer Science)) “FurnishARt (An AR-Based Furniture Store)” was Developed by **Muhammad Umer (CIIT/SP21-BCS-016), Muhammad Noman (****CIIT/SP21-BCS-014)** and **Hafiz Talha Nazir (CIIT/SP21-BCS-007)** under the supervision of “**Ma’am Bushra Mushtaq**” and that in their opinion; it is fully sufficient, in the scope and quality for the degree of Bachelors of Science in Computer Science.

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**Ma’am Bushra Mushtaq**

**Supervisor**

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**Dr. Iftikhar Ali**

**Head of Department**

**(Department of Computer Science)**

**EXECUTIVE SUMMARY**

The shift toward digital shopping has created demand for innovative solutions that seamlessly blend online and offline experiences, particularly in the furniture sector, where customers benefit significantly from visualizing products in their real-world spaces before making a purchase. Traditional e-commerce platforms often fall short in providing this immersive experience, leading to uncertainty in purchasing decisions and increased return rates. To address these challenges, furnishARt introduces an Augmented Reality (AR)-based platform that enables customers to view and interact with 3D furniture models both on the web and through an AR-capable mobile application.

furnishARt provides users with the ability to preview interactive 3D models of furniture on a web application. For an immersive AR experience, users can select the "AR preview" option on the web, which will redirect them to the mobile app, allowing them to place and view models in their own environment through their device’s camera. This integrated flow offers customers a clear sense of furniture dimensions, style, and fit within their space, helping them make informed purchasing decisions without needing an in-store visit.

The furnishARt system features modules such as 3D model management, AR preview capabilities, user registration and authentication, furniture catalog management, customer reviews, and secure payment processing. An admin panel allows for efficient management of furniture listings and reviews, while users benefit from a secure and user-friendly shopping experience. The project is being developed using an Agile methodology to support iterative progress and rapid response to feedback, and object-oriented principles for modularity and maintainability.

With furnishARt, furniture retailers can offer a unique and engaging shopping experience, giving them a competitive edge while enabling customers to make confident, personalized choices directly from their own homes.

**ACKNOWLEDGEMENT**

All praise belongs to Almighty Allah, who enabled us to complete this difficult activity by giving us a tiny fraction of His limitless wisdom.

We are grateful to our project supervisor, "**Ma’am Bushra Mushtaq**". The accomplishment of this project would have been uncertain without their personal supervision, advice, and important guidance. We are grateful to them for their support and encouragement throughout this process.

We are also grateful to our parents and loved ones for their constant encouragement and for teaching us the values of honesty and respect.

Muhammad Umer Muhammad Noman Hafiz Talha Nazir

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**ABBREVIATIONS**

|  |  |
| --- | --- |
| **AR** | Augmented Reality |
|  |  |

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# Introduction

With the rapid advancement of augmented reality (AR) technology, the retail industry, especially e-commerce, has gained a powerful tool to elevate the online shopping experience. For furniture retail, AR brings a unique solution to a longstanding challenge—how to bridge the gap between online shopping and the in-person experience of seeing furniture in context.

furnishARt is designed to address this challenge by providing customers with an immersive AR shopping experience. Through the furnishARt web application, users can view interactive 3D models of furniture, exploring details and design from various angles. When ready for an AR preview, users can select the option to be redirected to the furnishARt mobile app, where they can view these models in their real environment, adjusting placement and angles to ensure the perfect fit.

This approach allows customers to make well-informed purchasing decisions, blending online convenience with a tactile sense of the product's presence in their homes. By incorporating an intuitive AR flow and easy-to-navigate 3D previews, furnishARt aims to revolutionize online furniture shopping, giving retailers a competitive edge and creating a more satisfying, user-centered shopping experience.

## Brief

furnishARt is an innovative AR-based online furniture store that allows customers to visualize furniture pieces in their physical space. Through an interactive web application and an AR-enabled mobile app, furnishARt empowers users to view 3D furniture models online and seamlessly transition to augmented reality for a true-to-life preview. By combining the convenience of online shopping with the immersive potential of AR, furnishARt enhances customer confidence in purchasing furniture online, reducing uncertainties and improving satisfaction.

## Relevance to Course Module

This system is built upon the foundation set up by many of the course modules we studied throughout the four-year program of BSCS. The courses modules that served as the building blocks for the project are:

**Software Engineering Concept**: We kept in mind the concepts we learned in software engineering Concept about how the project lifecycle progresses, which process model is used for what kind of project etc.

**Human Computer Interaction:** We kept in mind the major principles of HCI so that the interface is more user friendly and understandable by the end user.

**Software Project Management:** in this course we studied how to manage time, resources effectively and efficiently. How to make schedule for your project. Planning is also important we studied how to plan the development process and make the best use of available resources. Through this course we learn how to use the available tools for the planning like making Gantt chart on project plan.

**Web Technologies:** This project integrates essential web development principles by leveraging React.js, Next.js, and Three.js for creating interactive and responsive user interfaces that display 3D models online. RESTful APIs facilitate seamless data flow between the frontend and backend, aligning with the Web Technologies course focus on building dynamic, user-centric applications.

**Database Systems I:** With SQL database integration, this project applies core concepts from Database Systems I, including relational database design, data integrity, and transaction security. SQL stores and manages essential data such as user profiles, furniture details, and transactions, emphasizing efficient data retrieval and reliable storage. This supports high-volume operations typical in e-commerce platforms, directly tying into course topics on data management and security.

## Project Background

As online shopping grows, the need for enhanced customer experience is critical, especially in sectors like furniture retail where visualizing products in physical spaces plays a significant role in purchase decisions. Traditional e-commerce methods often fall short, offering only static images and leaving customers unsure of product fit and style within their own homes.

To address these limitations, augmented reality (AR) has emerged as a solution, allowing customers to view virtual furniture models in real-world environments. Leveraging AR, this project combines interactive 3D model viewing on a web platform with the option to preview furniture in AR via a mobile app, providing customers a highly immersive and realistic shopping experience. By enhancing the online shopping process with AR technology, this approach aims to bridge the gap between online and in-person shopping, ultimately leading to more informed purchasing decisions and customer satisfaction.

## Literature Review

**Table 1. 1: Literature Review**

|  |  |  |
| --- | --- | --- |
| **Application Name** | **Weakness** | **Proposed Project Solution** |
| VSurface | It lacks AR previews for furniture items, restricting its functionality to rugs only. | This system provides AR previews for a broader range of furniture items. |
| IKEA Place | The app's interface is complex or difficult to the end user – and IKEA is not available in Pakistan. | Our system will provide user friendly interface and this system will be launching in Pakistan. |
| Wayfair Spaces | Their Website is overwhelming and cluttered at times, with vast variety of products, categories, and subcategories to choose from. The website can be slow and laggy at times and Wayfair is not available in Pakistan. | We propose simplifying product categorization, optimizing the website for faster loading times, and refining subcategory structures. |

## Analysis from Literature Review

The literature review highlights the limitations and gaps in existing AR-based furniture and decor applications, particularly in usability, accessibility, and product range:

1. **Limited AR Functionality**

Applications like VSurface offer AR previews only for specific products, such as rugs, limiting their overall utility. Our platform will address this by providing a full range of AR-enabled furniture items, expanding the shopping experience.

1. **User Interface Complexity**

The IKEA Place app has a complex interface that may overwhelm users, and the service is not available in Pakistan. By focusing on a user-friendly design and accessibility in Pakistan, our system will offer a streamlined experience for a broader audience.

1. **Website Performance and Navigation**

Wayfair Spaces, while comprehensive, faces challenges with cluttered categories, subcategories, and loading speeds. We aim to overcome these issues by optimizing the website for faster performance, simplifying product categories, and ensuring efficient navigation for a smoother user experience.

## Methodology and Software Life Cycle

For the development of the project, an Agile software development methodology has been selected due to its emphasis on iterative progress and flexibility. Agile allows teams to adapt to changes quickly, making it particularly suitable for projects involving emerging technologies like augmented reality (AR). The Agile approach promotes collaboration among cross-functional teams and enables continuous feedback from stakeholders, ensuring that the final product aligns with user expectations and business goals.

The software life cycle in this project will consist of several iterative cycles, including planning, designing, developing, testing, and deploying the application. Each cycle will focus on delivering incremental improvements and features, allowing for regular updates and adjustments based on user feedback and testing results. This iterative nature supports rapid prototyping and encourages experimentation, which is vital for integrating AR functionality effectively into the online furniture store.

### Rational behind Selected Methodology

The Agile methodology was chosen for several reasons:

1. **Flexibility:** Agile allows for adjustments throughout the development process, accommodating changes in user requirements or market conditions. This adaptability is crucial in the fast-evolving field of AR technology.
2. **Customer-Centric Focus:** By prioritizing customer feedback and involving users in the development process, Agile ensures that the final product delivers maximum value and meets the actual needs of users. This focus on customer satisfaction is vital in the competitive e-commerce landscape.
3. **Iterative Development:** The Agile framework promotes incremental progress through sprints, enabling the team to release functional components of the application regularly. This approach allows for early detection of issues and continuous improvement based on real user interactions.
4. **Enhanced Collaboration:** Agile encourages collaboration among developers, designers, and stakeholders, fostering a culture of communication and shared ownership of the project. This collaborative environment enhances creativity and innovation, essential for integrating AR features.

# Problem Definition

This chapter discusses the precise problem to be solved. It should extend to include the outcome.

3. 1. Problem Statement

Problem statement goes here.

* 1. Deliverables and Development Requirements

Deliverables and development requirements.

* 1. Current System (if applicable to your project)

A brief description of an existing system.

The following figure is a sample figure, Figure 2.1. You are required to follow the same style of numbering and caption for the whole report.

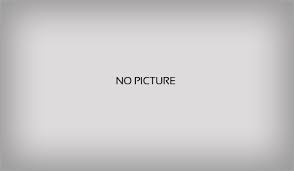


Figure 2.1: Sample picture

The following table (Table 2.1) is sample table; you are required to follow the same style of numbering and caption for the whole report.

Table 2.1: Sample Table

|  |  |  |
| --- | --- | --- |
| Header 1 | Header 2 | Header 3 |
| Text | Text | Text |
|  |  |  |

The following list style is the sample to consistently follow in the whole report.

* List items 1
* List items 2

# Requirement Analysis

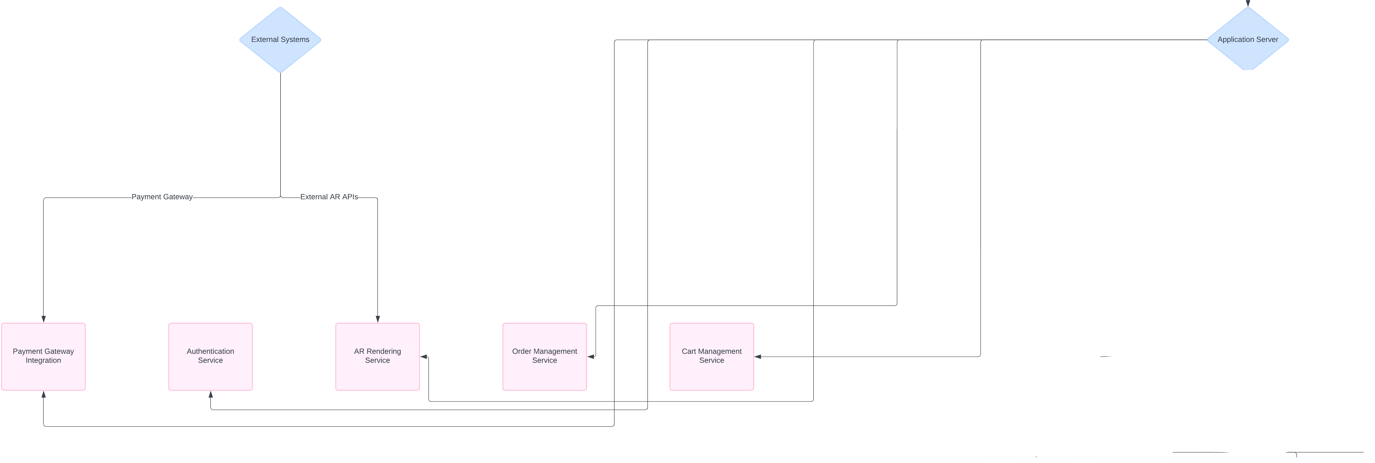
The following parts of Software Requirements Specification (SRS) report should be included in this chapter.

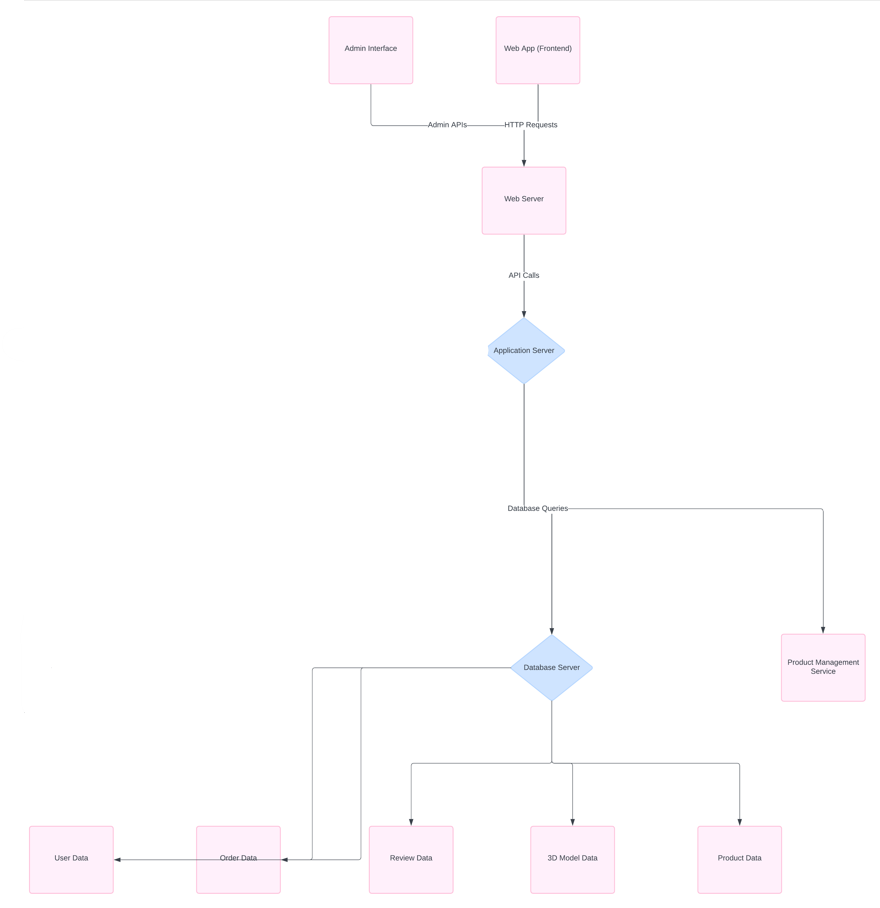
2. 1. Use Cases Diagram(s)
   2. Detailed Use Case
   3. Functional Requirements
   4. Non-Functional Requirements

# Design and Architecture

In this chapter, Design and Architecture of our system furnishARt (An AR-Based Furniture Store) is explained.

## System Architecture

****



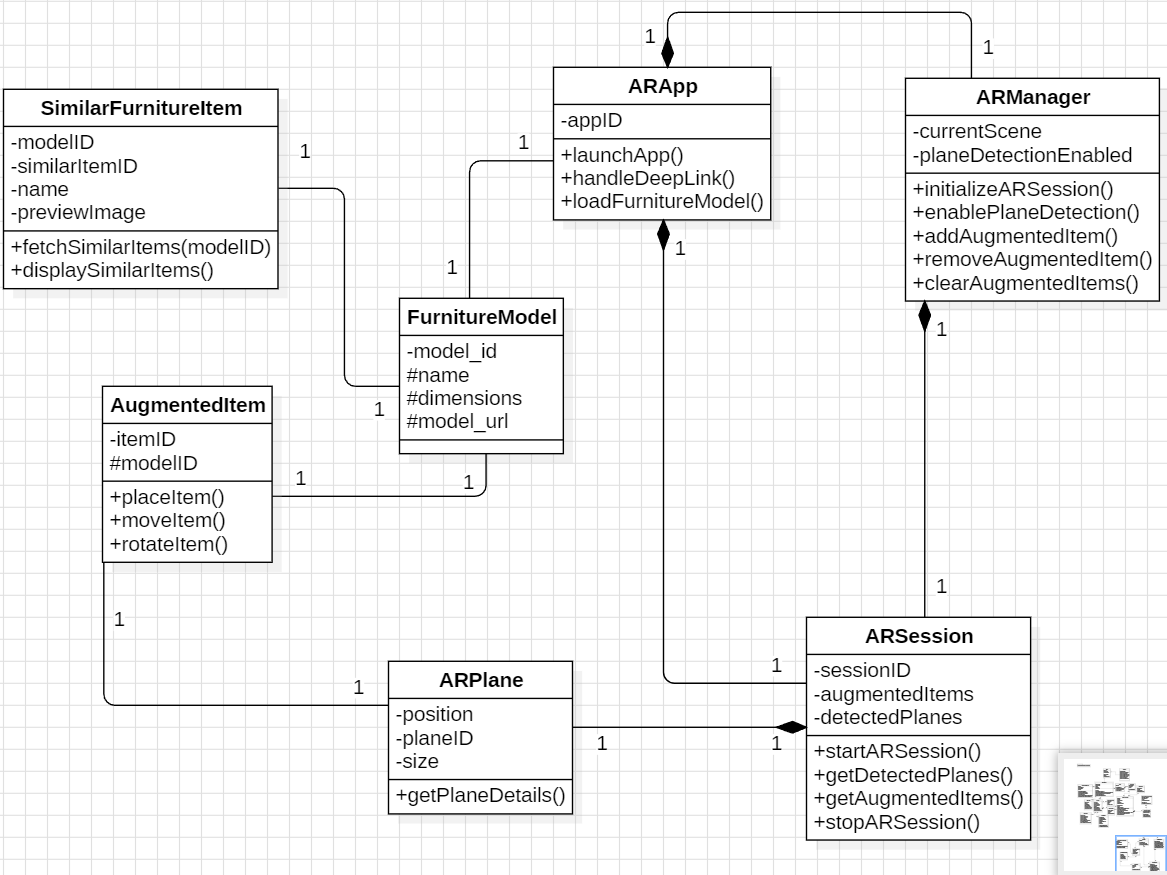
*Fig 4. 1: Architecture Diagram*

## Data Representation [Class Diagram]

### Website Application Class Diagram

*Fig 4. 2: Website Application Class Diagram*

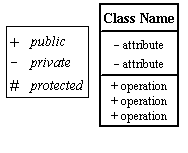
### AR App Class Diagram:

****

*Fig 4. 2: AR App Class Diagram*

**Legends**

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Description automatically generatedA black line on a white background

Description automatically generated

Composition

Association

## Process Flow/Representation

Process Flow are given as follow:

## Design Models [along with descriptions]

1. Implementation

This chapter will discuss implementation details supported by UML diagrams (if applicable). You will not put your source code here. Any of the following sections may be included based on your project.

1. 1. Algorithm

Mention the algorithm(s) used in your project to get the work done with regards to major modules. Provide a pseudocode **OR** a natural language explanation regarding the functioning of main features. Be sure to use the correct syntax and semantics for algorithm representations.

* 1. External APIs

Describe the APIs used in the table 5.1.

Table 5.1 shows that

Table 5.1: Details of APIs used in the project

|  |  |  |  |
| --- | --- | --- | --- |
| Name of API | Description of API | Purpose of usage | List down the function/class name in which it is used |
|  |  |  |  |
|  |  |  |  |

* 1. User Interface

Details about user interface with descriptions.

1. Testing and Evaluation

This chapter may include the following sections. (Students are required to perform the testing both manually and automatedly).

3. 1. Manual Testing

This is the sample text

1. * 1. System testing

Once the system has been successfully developed, testing has to be performed to ensure that the system working as intended. This is also to check that the system meets the requirements stated earlier. Besides that, system testing will help in finding the errors that may be hidden from the user. There are few types of testing which includes the unit testing, functional testing and integration testing. The testing must be completed before it is being deploy for user to use.

* + 1. Unit Testing

Once the system has been successfully developed

* **Unit Testing 1:** Login as FYP Committee as shown in Table 5.1

**Testing Objective:** To ensure the login form is working correctly

Table 5.1: Login Unit Testcase

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test case/Test script | Attribute and value | Expected result | Result |
| 1. | Verify user login after click on the ‘Login’ button on login form with correct input data | Username:  L001  Password:  1234 | Successfully log into the main page of the system as FYP Committee member. | Pass |
| 2. |  |  |  |  |

* Unit Testing 2: Edit Profile

**Testing Objective:** To ensure the edit profile form is working properly.

Table 5.2: Edit Profile Unit Testcase

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test case/Test script | Attribute and value | Expected result | Result |
| 1. |  |  |  |  |

* + 1. Functional Testing

The functional testing will take place after the unit testing. In this functional testing, the functionality of each of the module is tested. This is to ensure that the system produced meets the specifications and requirements.

* **Functional Testing 1:** Login with different roles as shown in Table 5.3

**Objective**: To ensure that the correct page with the correct navigation bar is loaded.

Table 5.3: Login Functional Testcase

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test case/Test script | Attribute and value | Expected result | Result |
| 1. | Login as a ‘FYP Committee’ member. | Username: L001  Password: 1234 | Main page for the FYP Committee member is loaded with the FYP Committee navigation bar | Pass |
| 2. |  |  |  |  |

* + 1. Integration Testing

Table 5.4 shows the integration testing

Table 5.4: Integration Testcase

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test case/Test script | Attribute and value | Expected result | Result |
| 1. | Login as “FYP Committee” member | Username: L001  Password: 1234 | Login successful and the FYP Committee page with its navigation bar is loaded and in the view profile page | Pass |
| 2. | Upload student record for Project 1 | - | File successfully uploaded and return to the upload page. Student records are updated. | Pass |
| 3. | View supervising student | - | The list of supervisees shown on the screen. | Pass |

* 1. Automated Testing:

This is the sample text

* + 1. Tools used:

Table 5.5 shows the

Table 5.5: Tools used

|  |  |  |  |
| --- | --- | --- | --- |
| Tool Name | Tool Description | Applied on [list of related test cases / FR / NFR] | Results |
|  |  |  |  |
|  |  |  |  |

1. Conclusion and Future Work

This chapter concludes the project and highlights future work.

1. 1. Conclusion
   2. Future Work
2. References

References to any book, journal paper or website should properly be acknowledged. Please consistently follow the style. The following are few examples of different resources i.e. journal article, book, and website.

* 1. Lyda M.S. Lau, Jayne Curson, Richard Drew, Peter Dew and Christine Leigh, (1999), Use Of VSP Resource Rooms to Support Group Work in a Learning Environment, ACM 99, pp-2. **(Journal paper example)**
  2. Hideyuki Nakanishi, Chikara Yoshida, Toshikazu Nishmora and TuruIshada, (1996), FreeWalk: Supporting Casual Meetings in a Network, pp 308-314 **(paper on web)** http://www.acm.org/pubs/articles/proceedings/cscw/240080/p308-nakanishi.pdf
  3. Ali Behforooz& Frederick J.Hudson, (1996), Software Engineering Fundamentals, Oxford University Press. Chapter 8, pp255-235. **(book reference example)**
  4. Page Author, Page Title, http://www.bt.com/bttj/archive.htm, Last date accessed**. (web site)**