Supporting meetings in Virtual Worlds with enhanced Communication features

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Abstract

With the rapid growth in the use of computer for addressing our day to day needs and the increased use of technology in our daily life, we cannot imagine a day without the use of the internet for our routine needs. Today, without any doubt in our mind we can say that technology has taken over human lives completely. A new era of computing has evolved where computers and the internet have a huge impact on everyone's life.

A lot of research has been done and is in process for generated tools and devices which will bring the world even closer. It started with telephone in the last century and since then till today there have been huge number of tools and devices that try to give the users who are geographically far away a sense of co-presence. The latest technology making rounds is the Virtual World technology. The popularity and impact of online virtual worlds is worth making a note of. It needs to be seen now, how does it really betters people lives. One such persistent virtual world is Second Life. The number of users and organizations associated with this world is impressive. It provides users with the right amount of collaborative content with a set of communication features. Second Life provides its users with unique meeting support which gives them a sense of co-presence achieved nowhere else.

This thesis focuses upon the kind of meeting support, collaborative content and the communication features provided by the virtual world that will allow its users to avoid the need for travel and long distance meetings can be achieved successfully in such an environment. This will help the travel time to be converted to productive office time as well as the costs involved in such meetings can also be reduced drastically. Such kind of meetings will also prove eco-friendly as they will save on fuel consumption and benefit from reduced pollution.

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1. Introduction

1.1 Preamble

Recent years have seen a tremendous increase in the use of Social Virtual Worlds. The users of these worlds have various motives of being a part of it. There is one such virtual world which has a huge impact on online collaboration and meeting support called Second Life. Users come to Second Life for fun, work, meet and collaborate. The fact that Second Life plays host to not only a certain amount of users but a number of public and private organizations, educations institutes and universities as well as some well know corporate firms. They have joined Second Life as well established their presence by buying land and developing better business opportunities by building replicas of their real world headquarters. These companies carry out various real life activities such as holding meetings, top level conferences and training activities as well.

Currently virtual worlds and real world are said to be parallel universes which do not communicate with each other [3]. Second Life virtual world is owned and maintained by Linden Labs. It was declared open for public in 2003 and since then they have never seen backwards. There is a significant amount of research going on in Second Life currently. What is it that makes Second Life so special? The answer is its support for collaboration along with its support for meetings held in customized conference room. Currently Second Life supports voice and text chat within world. There is also a support for uploading slides as images and playing them in these conference rooms.

The aim of this thesis is to study the current communication features as well as the collaborative content that the virtual world provides in order to go as close to the real world as possible, analyze it by conducting a study that would benefit the virtual world and suggest a prototype, INC.

1.2 Structure of thesis

Chapter 2 begins with an insight into Virtual Worlds and Second Life. It discusses the business content that the virtual world has managed to garner as well as the e-commerce and e-business opportunities within world. It also discusses the collaborative nature of Second Life and the support for meetings it provides in detail. The chapter comes to an end by discussing various communication features that Second Life currently provides.

Chapter 3 discusses the software that are used by professionals in order to carry out meetings in order to navigate away from Second Life virtual worlds.

Chapter 4 discusses the study conducted in order to obtain information on what the participants feel of the type of communication support and information sharing factor that Second Life currently provides its users to achieve collaboration and meeting support and suggest changes depending on what the results of the study were.

Chapter 5 proposes a software, INC with taking sections 2, 3 and 4 in to consideration and discusses its design and implementation along with the explanation of the features that it provides with corresponding system snapshots.

Chapter 6 will summarize the research work with some suggestions and future work.

2 Virtual Worlds

"Virtual Worlds (VW's) are immersive 3D environments that enable large number of users to interact with one another over the Internet" [2]. VWs have a variety of purposes, but can be divided into two main categories: the game based worlds which are Massively Multiplayer Online Role Playing Games (MMORPG's e.g. World of Warcraft) and the social worlds which are Massively Multiplayer Online Games (MMOG's e.g. Second Life). Users in VWs take form of an 'avatar' for in-world representation and projection of themselves and their actions [2]. Currently, virtual worlds and real world can be considered as parallel universes that do not share data [3]. A virtual world is not intended to replace your existing life but just give a platform to get yourself a second life," it brings you closer to some real experience without actually bringing you there" [11].

There has been a lot of research to link the 'avatar' or identity of user and offline real self. Avatar creation is a process which place in all the VWs with variation in their choices and controls made available for creation. For e.g. height and weight can be customized in Second Life while in World of Warcraft (WOW) a user can select from amongst different races; etc, but not much data is available which describes regarding user interaction and avatar generation tools opposed to technical aspects as to how to make virtual bodies look more realistic or gestures that an avatar can make.There has been a significantly quantitative research done regarding virtual environments so far. A simple SL screenshot is shown in figure 2.1. The figure 2.1 represents an avatar in a house. One such research was conducted by carrying out a study where three virtual environments were subjects categorized by their purpose. The three virtual environments studied: Second Life (SL) that is a social world, World of Warcraft (WoW) that is a gaming world and Maple Story (MS) that is a hybrid of both. Comparing gender distribution (male/female ratio), it was Second life which had the most balanced and almost 50/50 and that for World of Warcraft and Maple Story was approximately 70/30. Turning to participant's age Maple Story had players whose

mean age was 18.1 years, World of Warcraft had players with mean age 29.8 whereas the mean age for Second Life was a bit more older at 33. The study also included choice of users who choose an age different from actual, which was 1.3 years. It means that the age is slightly changed by the users [2].

Figure 2.1: Simple SL screenshot [23].

Virtual Worlds can thus be termed as a technology aimed at enabling interactions among users and a computer-generated environment or in better words as "such environments which tend to establish the concept of Simulated Reality where the virtual environment and reality are impossible to distinguish" [3]. The three virtual worlds in question thus differ in many ways. The basic differentiation is the motives of the users of each of them. The users in World of Warcraft and Maple Story have a clear motive of having a gaming experience. In case of Second life, the users have diverse objectives from having a fun based working experience to serious work. Let us discuss this Second Life in some more detail.

There are many advantages of a virtual world which can be seen from the above information. VWs are facing certain challenges despite them. These challenges can clearly be viewed from the table above.

2.1 Second Life

Second Life(SL) is termed as a game by many, it is said more so as its users participate because they can enjoy doing various activities there though there are no points to be won or battles to be played like World of Warcraft (WOW) or for that matter, any other MMOG's. It is intended as its name indicates, to provide its participants with a "second life". It provides its users with a social experience where users can interact with each other as they can see others. Users can have public and private meetings through various media applications such as instant messaging and voice-based communication system [11]. Second Life Grid Platform is created and owned by Linden Labs which hosts the Second Life Virtual world. SL boasts of about one million active "resident" users at any given time. Currently it is used by 15 million users and if reports are to be believed, the number might just cross 2.4 billion users by 2011. During the first quarter of the year 2009 the number of hours spent by the users inside the environment was 124 million [13]. Table 2.1 shown below suggests clearly that SL residents spend significant time per week if compared to the other MMOG's.

	WoW	**MS**	**SL**
Gaming experience (years)	2.1 (σ^2=1.2)	1.8 (σ^2=0.1)	1.7 (σ^2=1.0)
Hours played / day	4.4 (σ^2=2.3)	5.1 (σ^2=4.2)	4.5 (σ^2=3.6)
Days played / week	5.5 (σ^2=1.7)	5.6 (σ^2=1.9)	5.9 (σ^2=5.9)

Table 2.1: Comparison of time spent by users in various virtual worlds [2].

Users can create only one avatar per account. Multiple accounts need to be created in order to have multiple avatars for a single person. 90% users have at least one avatar

which resembles their real life self. In business context, most of the users who mean business and intend to have a clientele as in real world give their avatar as realistic a look as possible [2]. Second life has a complete economy based on its virtual world currency known as the Linden Dollar. The Linden Dollar denoted as 'L$' has an exchange rate of US$ dollar 1 equals to L$ 270. The rate is tried to be maintained at this price [9][11]. There are several countries that have their embassies inside SL. Maldives was the first country to have a Second Life embassy. Later on, Sweden, Estonia, Colombia, Serbia, Philippines and Albania established their embassies [14]. This reflects the impact of Second Life on real world. Let us now discuss some of the businesses and activities that are part of the Second Life virtual environment.

2.2 Business content of Second Life:

Second Life virtual world was developed with the intention of making it a business world since it was developed. The way Second Life progressed and developed itself into a business oriented world suggests that it was deliberately made for businesses to prosper and replicate elements in real world with the practical aspect in mind [22]. Whether a user comes across business oriented content in-world depends entirely on the fact where the user travels [1]. The day since SL was launched for public in 2003 there was no looking back for Linden Labs. It immediately scored the attention of media and real world businesses. The major reason behind such a stunning response was its acceptance for open source software, which gives the users a chance to display and appreciate their own creativity. This happens since users can create their own virtual goods and can retain the intellectual rights over them. They can sell these goods or say services in Linden dollars (currency for SL) as well as in real world currency [11].

Organizations and brands such as IBM, BP, STA Travel, NASA, Starwood Hotels, MIT, Harvard Law School have maintained their existence. This kind of an environment provides them benefits in business context.

Projects	Examples of entities involved
Meet and greet customers, host employee meetings, and conduct global interaction and collaboration.	IBM, BP
Conduct marketing and e-commerce in a virtual showroom.	Sears, BP
Provide product information and updates.	STA Travel
Provide a virtual campus and online collaborative learning.	Harvard Law School
Communicate vision and build relationships with the public and customers.	NASA, IBM
Host a virtual museum for brand recognition and e-commerce.	International Spaceflight Museum
Provide a 3D hospital with free online consultation on resources for medical conditions or issues.	Health Info Island
Conduct market research and test hotel designs.	Starwood Hotels
Interview, recruit, and hire employees.	OgilvyInteractive, TMP Worldwide Advertising & Communications
Provide training simulators and learning programs.	MIT, IBM, Nike, EMC, Discovery Education, BP

Figure 2.2: Various projects of organizations in Second Life [21].

Figure 2.2 shows the organizations and the type of projects they handle within SL. Organizations own the island or buy a part of it. For instance, IBM owns 20 islands, SciLands is another community of islands which is totally dedicated to science and technology, which hosts organizations such as US National Space Society, US national Library and the Tech Museum of Space Innovation [21]. Another advantage of second life is that users can make real money out of sold virtual stuff. There are hundreds of brands inside Second Life such as Nissan and Toyota which sell virtual cars. Toyota has a eight storey virtual vending machine in SL and they offer cars at as low prices as L$300 or as we calculate its real amount that is approximately one US dollar [9][23]. Users can buy the car, customize it, and provide feedback to the company. This will give Toyota a chance to test their design and the feedback would mean a lot in such cases [23]. As for the business organizations, there is a large presence of educational institutes and colleges inside SL. Many of them even conduct degree, diploma and certificate courses online. This type of learning is often referred to as collaborative learning. Collaborative learning brings in better results and provides good understanding of concept. It helps in building some amount of self-esteem and motivation for continuing the task, generates a will-power to handle tougher questions. Consider an event as different as ‘simulation of planning for a wedding’ which is otherwise not possible for other online worlds can be effectively managed in SL. Thus, SL is effective at simulating real world events in ‘as real’ way as possible [11].

SL can also be used for banking purposes. Banks in real life can open virtual branches in SL. Using these branches people will be able to deposit or borrow directly to and from the environment and the branches can provide users with services such as exchanging Linden dollars for real currency or vice-versa. The American apparel provides users a chance to buy their real-life clothing as well as virtual clothing. Virtual clothing is available for as small an amount as US$ 1. Some of the examples of second life projects are given in the table2 below. Second life currency which is Linden dollars is not actually money in actual context. It is a script which people exchange for virtual stuff [17].

Technology capabilities	Relevance to virtual teams and virtual-world project management
Various communication channels	Enables communication in team meetings, where team members can express themselves freely. Can eliminate geographic and cultural boundaries. Provides ability to communicate using nonverbal expression.
Rendering of people and the real world	Allows team members to express themselves through their appearance and to control their own behavior.
Real-time interaction	Provides an environment for real-time problem solving and discussion. Provides improved coordination and control by facilitating interaction between team members in the VW environment. Fosters mobility and the ability to change locations quickly and easily. Supports real-time immediacy of artifacts through creation and building of figures (3D models or images that can be left behind for others to interact with).
Team process tools and artifacts	Fosters team interaction and leadership. Allows for recording of meetings for subsequent viewing. Provides 3D brainstorming tools, voting tools, or visual problem solving, in which avatars "stand" on their vote (that is, move here for yes, and move there for no). Supports avatar training using software agents.

Figure 2.3: Technological capabilities provided by virtual worlds for collaborative work [21].

As shown in the above figure 2.3, the technological capabilities lead to certain advantages and disadvantages for a virtual business.

Some advantages that users see while investing in the virtual businesses may include:

- A chance for them to test their products in a virtual yet real environment.
- It is also a good way for marketing their newest designs or products at a minimal cost.
- A major motive of some large scale organizations is to achieve collaboration of ends.
- It allows users to create a world as they want by creating artifacts in-world.

- It allows working on a single artifact by multiple users addressing their remote nature i.e. it allows multiple people to handle a single object removing any boundaries caused by location [21].

Disadvantages that organizations see while investing in virtual businesses:

- Numerous server issues such as causing lag due to network overload leading to abnormal environment behavior.
- Synchronization issues on the client side causes inconsistencies.
- Nodes having lower speed and configuration could not see the avatar. Instead they could simply see a small white cloud.

2.3 E-commerce and E-business opportunities in Second Life:

Second Life is a SVW which is home to millions of virtual lives who exist in real. They consider SVW as a single globalized platform which gives them a common environment to explore their skills and talents. Residents of these SVWs consider it as a shared space where they can meet, create, share and co-ordinate with ease and grace. Such a shared space removes all the drawbacks of the real world in form of cultural barriers and geographic distances to help people collaborate. Residents use the tasks in Second Life such as creating simulations, walking, flying, getting teleported to specific locations or interaction with people who are geographically very far in a common space so as to give a feel such as being in the same shared space. The SVWs provide a way of collaborating which is not possible with any other technologies [21][24]. They help collaboration in teams or we may term them virtual teams by providing them an opportunity to be and share the same space, be in front, talk and move around with each other which is not offered by other technologies [25].

A number of technologies that support socializing and common space for people including Facebook, Twitter and YouTube which use the Web 2.0 technologies are present but they have a limited scope for activities such as collaboration and

coordination. Second life is majorly appreciated for its huge media richness characteristics wherein people get feedbacks and response instantaneously leading to quicker decision making. It is also very easy when it comes to sharing of information as they share virtual space [25]. Second Life is be said to offer their users a unique "sense of presence" which goes beyond the services offered by text and images that is provided by websites. It is observed that many of the real world organizations, companies and stores have created virtual replicas which are look-alikes of the real world ones. They have also created replicas of the merchandise that they offer rather than helping customers with their shopping experience [23].

Huge amount of business has flourished inside the Second Life virtual world. A large amount of trade takes place in-world. Organizations and companies from various fields are part of this world. The concept of e-learning has witnessed a lot of development due to the existence of virtual worlds in the first place [22]. Trade is in the DNA of humans dating way back from the days where our ancestors exchanged spears for some fruits. This type of trade is better known as bartering and the system where this trade is carried out as barter system. Since then the term trade is evolved to a meaning which can be closely referred to as business. The type of business which involves computer system or in narrow terms, internet to trade is called as e-business.

Advantages provided by SL virtual world in providing e-commerce support are:

- The opportunities tend to increase with technological improvements that take place inside the environment.
- The characteristic that puts users at different locations in contact through a common platform giving them a sense of sharing virtual space attracts people who want to do business towards joining the environment who would have not joined if this advantage was not there.
- The aspects of trade when linked with user participation forms a cycle which can be called as a virtual environment business cycle where the graph plots to an exponential growth [22].

Second Life is used as a platform to perform collaborative work by organizations. The main reason behind this is the shared physical space that is given to the users to perform activities which they cannot perform elsewhere. There has been significant amount of research to prove the cost effective way that virtual world such as Second Life provides its users. It happened in many organizations that due to the recession period, cost cutting had become a major issue. The first to get affected by cost cutting was the training schedules of companies for the new recruits as well as for the existing employees. It was observed that some organizations took to online training in Second Life virtual world as they thought "if there is a situation where we have to select from no training or online training then we would opt for the latter" [22]. In such situations virtual worlds are the best option. Various kinds of collaborative work take place in Second Life. The users are able to touch and handle objects in a common space. They also get a chance to alter the properties of the object and share it with other users i.e. work in groups, understand and solve problems mutually or create a product as a team. Virtual worlds allow some of the companies to leave their application and enter another application by providing links in-world using which users can navigate directly to some other seller website forcing the interested user to leave their domain.

These are some of the reasons that Second Life has been taken seriously in business context. The number of successful companies and business firms establishing their presence in a subjective manner are on a rise. They are exploring the environment to all extents in order to enhance their business processes. There is a difference between e-commerce and e-business. It is this difference that makes e-commerce the heart of virtual worlds. Second Life virtual world was developed with e-commerce and e-business in foresight. E-commerce is using Web and Internet to sell or buy goods. On the contrary e-business deals with carrying out business with the use of Internet. Thus, e-commerce can be considered just another subset of e-business [22].

There are four broad categories in which immersive business can be categorized according to its use of virtual world:

2.3.1 Prototyping: Second Life can be used to develop service models in order to receive feedback from customers leading to an improvement in design, product or building model whatever it may be. Let us consider examples that have utilized the power of SL and used the user feedbacks for the betterment of the process:

- Starwood Hotels is a hotel chain which operates worldwide. They used the SL platform to test their new concept hotels. The hotels which were supposed to be physically open by 2006 were tested in SL for its design. The SL version was opened in 2006 with a perspective of marketing the design and testing it. What best way to test a design in such a low cost. The popularity of SL helps them get feedback from all types of users. They wish to use the feedback from SL in the form of usability changes that need to be made. This is a look-alike of their hotel they are building in New York. Similarly, car designs, designs for clothes, etc. can be displayed in their respective virtual stores. This is a very innovative methodology which may help the companies know about their most popular designs [11].

2.3.2 Event Simulation: Another use of Second Life virtual environment is in simulating real life events. The virtual world such as this allows a real world event being simulated in a virtual environment in an as much realistic setup as possible. It provides the simulation to be custom built as per the user's requirements to make it more practical oriented. The idea behind such a simulation is not simply related for a showing but realizing the potential "do's and dont's" which may prove very essential and important over the time. Simulations relating to the method of dealing during disasters and other such events prove to be worthy behind investing real life money into it. Some of the examples are listed below :

- Homeland security department have developed a simulation in Second Life which may train their workers in an emergency setup.
- Davis medical centre is another example who has taken up to Second Life simulation to train their workers for a national crisis and the medical facilities may be required in emergency.

- This kind of simulation is also useful while building a house or interior decoration of a new house. Arranging a house in a virtual setup makes them realize some possible mistakes they have made which might prove fatal in the long term and costlier to reconstruct.
- A wedding simulation can also be accomplished by giving the would be newly-weds an opportunity to organize things beforehand and avoid any pressures that may come their way at the last minute [11].

2.3.3 Commerce: The kind of opportunity that Second Life economy provides gives the individual entrepreneurs and other business organizations a chance to deal in commerce related activities. There are different goals for different entities while dealing in this kind of environment. The motive may be to sell the goods directly or to just support commerce activity in real life by say marketing in virtual world setup such as this [11]. It is a matter of fact that that companies who are attracted towards this virtual market is interested in promoting their products or services via the advertisements. Companies bank upon the interaction features that these worlds provide them with. IBM has bought around 20 islands in Second Life and a huge number of its employees have a Second Life avatar. Before using their business and marketing strategies in the real world they first test it in Second Life. Many companies have actively started their recruitment process in Second Life and provide them with real world jobs as well as in-world jobs. These companies include some big names like Microsoft [24]. Some of the examples would be:

- Heaps of real life clothing brands have put their newest and best designs on display. Some of them have put them for sale at a price as low as US$ 1.
- There are a number of banks that allow users to buy and sell Linden dollars directly.
- Some of the product based companies will test their products and use the feedback gained effectively in this virtual yet real market [11].

2.3.4 Education: Many universities and institutes have opened up a new window in e-learning for its students. This is possible only due to the emergence of virtual world

such as Second Life. Even though online learning has not been able to replace courses that are conducted face-to-face, there has been a small increase in the number of people opting for them. It is in some way related to the ratio of cost/benefit. The courses where this ratio is less have been the most in demand. Online courses have been beneficial for the working student population. Socially, virtual worlds such as Second Life has proved its worth as the evolution of an e-learning process which have evolved to extents that universities now offer online degree courses with the replica of their original university is present. Students who come from rural backgrounds, or they who work full time get a chance to acquire knowledge. Physically challenged students who are unable to attend real world classes get an opportunity to enhance their skills of interest and better their personal lives by excelling professionally by educating themselves.

Despite of all the advantages mentioned above, e-learning fails to make a significant impact since it is not as natural as face-to-face learning. There is another reason for this, that it can be used only at those places where there is high speed internet connection available. It cannot be used where there is no internet access [22].

2.4 Collaborative working opportunities in Second Life:

The nature of Second Life VW allows its users to share space amongst them. Collaborative work is better accomplished when the users share space and objects. This allows users not only to see or touch the objects but to alter them as well. This helps them in achieving tasks which were not made possible by any technology so far. The Second Life VW was developed with business needs on their mind. This in turn led to more and more number of users making themselves a part of this Social Virtual world (SVW) which further led to the development of economy in the virtual world. In future as well, as the number of users that are part of this world increase the economy will in turn get a boost [22]. A question was often raised in the form of "Can actual work be accomplished in virtual worlds?"[22]. The question was very

well answered by many companies and organizations using this technology joining the list of Second Life VW users each day. These companies are exploring the opportunities in these worlds by not simply training their employees or recruiting new employees but by setting up their shop and making the virtual world as an epicenter of their work. Companies that have small budgets for simulations carry out these simulations here in SL to make the best use of the budget. They would not have been able to conduct any simulations if these virtual worlds were totally absent. Simulations such as training emergency staff in case of a fire in a factory would be quite impossible to demonstrate in reality have been made possible because of these worlds. The Second Life virtual world scores high on media richness features which allow some level of synchronous communication as well and also allows managers with some fast decision making [25]. Figure 2.4 below shows virtual teams working in collaboration.

Figure 2.4: Virtual team working in Second Life.

Possibility of collaborative work taking effectively in Second Life has been justified by the inflow of these brands who have found a new home in the form of a virtual world. They have established their brand's headquarters here. The future of

collaborative work taking place inside Second Life can only be justified by the benefit to cost ratio. For Second Life to improve on its technical aspects would need more amount of business inside the world in future. This again depends on how much beneficial it proves in comparison with the cost. For business to flourish further needs Second Life to offer more benefits and serve them and cover at least the cost entities invest [22]. The aspect of collaborative work can be achieved the best in the sense of people trying to mock up some parts together to get a mechanical thing working. This can be considered as a simulation as there is no manufacturing unit inside Second Life. This virtual world allows them to play audio and video recordings, play live music, teleport to other locations, simulations as said earlier or hold meetings, conferences. This world tends to support working in collaboration which is not supported by any other online worlds in existence [21].

2.4.1 Factors supporting collaboration:

- A 3D environment which gives a feel of real life conversation.
- Provides an immersive environment to its users which makes the interactions real (even though virtual in nature).
- The sense of creating things in real environment because of the ability to touch and feel the virtual objects created in same shared space.
- Due to the limited yet powerful communication features and the ability to work in a controlled environment [21].
- The characteristics which make feedback possible allows more and more information to be shared and the time factor involved in the decision making process is reduced [25].
- Single problem viewed by many users provides more approaches towards a solution [12].

2.4.2 Factors hampering the opportunities of collaborative work:

- People do not use emoticons in formal business meetings when they want to express their emotions. They do not like emoticons in such situations.

- The emotions that are visible when talking with a real person is not the same when we are using animated or virtual avatars for interaction and thus the information reflected by the gestures of these avatars are sometimes annoying as users are not able to convey the information completely as they are when confronted with real faces.
- Face to face working opportunities as well as the opportunities created by working in small groups is affected by the "less natural communication media" which is in turn a result of interface problems faced by these environments. Unless and until the interface problems are not addressed, more natural communication is not possible in these virtual environments [22].
- SL allows user to jump of its website by simply minimizing it as it runs on the browser and browse for other sites simultaneously. This allows users to leave SL and use other software that may provide some of the features that SL does not have. This in turn is a drawback on behalf of the virtual environment.
- Many users might just be a part because their senior has ordered them to do so which may simply add to their problems as they will be confused and question themselves "Where to begin?" [1]

2.5 Meeting support within Second Life:

Second Life is a social virtual world and people can interact with each other in an interactive environment. This environment offers them a chance to work in a collaborative setup. It allows users to come together and work in groups to attain a common goal. This world helps them understand the goal and the underlying methodology better. It betters the performance of individuals to solve problems in a team atmosphere. Working in a team gives them more angles to look at the same problem since each member of the team will be having his own way and solution to solve the particular problem. It will make the users think and adopt the best and most effective solution. It is also obvious that they will be compelled to indulge in more interactions and hence prosper team work. The end product obtained from this methodology will reflect the quality of collaboration involved [12].

IBM was forced to cut down on their travel costs during the economic slowdown last year. A big question that arose was “how will the meetings which require travel take place in such occurrence?”, and the answer was Second Life. Study interviews were conducted for those who attended virtual conferences such as IBM’s Academy of Technology General Meeting (AGM) and Software Technology Conference. A study was conducted for users who attended the meeting held on a global platform with remotely scattered attendees. Most of them were satisfied with the experience. The motive of the attendees was simple and pretty straight forward, they wanted to build business relationships and gain as much information as possible from the technical conversations they had. These meetings also gave an opportunity to talk to some people with whom they would not have initiated contact in case of a face to face meeting. They found some advantages as they did not have to recollect names of whom they were talking to as the name was displayed on their avatar. The first study was conducted for a software technology conference attended by 300 attendees. 123 participants took part in the study. Attendee-interviewees also had some observations in common which was the ambiguity of the real identity of the person they were talking to since it was their avatar who they were talking to [26]. The results of a study conducted on the users from software technology conference held within SL are shown below. Users were studied for various communication features which they used for collaboration during the conference. Their answers are based on the experiences they had while sharing information.

Information: Ability to Share Content				
	High	Medium	Low	“Satisfactory”
Face to Face Meeting	94.7% (54)	3.5% (2)	1.8% (1)	98.2%
Teleconference (audio only)	11.1% (6)	42.6% (23)	46.3% (25)	53.7%
Web Conference (telecon plus shared presentation)	55.6% (30)	40.7% (22)	3.7% (2)	96.3%
Desktop Video	40.0% (16)	52.5% (21)	7.5% (3)	92.5%
Virtual 3D Space Meeting	36.8% (21)	47.4% (27)	15.8% (9)	84.2%

Figure 2.5: Information sharing via various technologies at the Software Technology Conference [26].

The above results clearly show that web conference was the most successful among the other features which came closest to face to face meetings. The findings of the study suggested that users who had come to the virtual conference for information sharing rated web conference (audio) with shared presentation (96.3%) way above traditional audio teleconference (53.7%). The users had the same view for work oriented tasks where they rated web conference as most satisfactory after face to face interaction which is shown in Figure 2.6 below.

Work: Ability to Produce Results				
	High	Medium	Low	"Satisfactory"
Face to Face Meeting	96.3% (52)	1.9% (1)	1.9% (1)	98.2%
Teleconference (audio only)	5.8% (3)	69.2% (36)	25.0% (13)	75.0%
Web Conference (telecon plus shared presentation)	19.2% (10)	75.0% (39)	5.8% (3)	94.2%
Desktop Video	2.6% (1)	79.5% (31)	17.9% (7)	82.1%
Virtual 3D Space Meeting	10.9% (6)	67.3% (37)	21.8% (12)	78.2%

Figure 2.6: Technological effect on producing results while at work in software technology conference held in SL [26].

Similarly, users were interviewed during the AGM held in SL. Following figure 2.7 shows that web conferences were rated at par with face to face meetings for information sharing between users. They were able to share content in a better way when they could speak as well as give presentations simultaneously. Users who attended with work on their mind but driven by producing results rated web conference (94.2%) as the next best option to face to face meetings (98.2%) well above a simple audio teleconference (75.0%).

Information: Ability to Share Content				
	High	Medium	Low	"Satisfactory"
Face to Face Meeting	94.6% (331)	4.0% (14)	1.4% (5)	98.6%
Teleconference (audio only)	15.7% (54)	46.2% (159)	38.1% (131)	61.9%
Web Conference (telecon plus shared presentation)	50.9% (177)	47.1% (164)	2.0% (7)	98.0%
Desktop Video	58.0% (163)	35.2% (99)	6.8% (19)	93.2%
Virtual 3D Space Meeting	21.4% (70)	45.3% (148)	33.3% (109)	66.7%

Figure 2.7: Information Sharing for technologies in AGM held in SL [26].

Results for the same conference for obtaining results at work rated web conference next to the gold standard that is face to face meetings. Following figure 2.8 shows the percentage of users who rated web conference way ahead of teleconference. It is thus clear from the study results of the conference that teleconference is far less satisfactory as compared with Web conference. The difference between a web and teleconference is the ability to share presentations.

Work: Ability to Produce Results				
	High	Medium	Low	"Satisfactory"
Face to Face Meeting	90.5% (316)	8.6% (30)	0.9% (3)	99.1%
Teleconference (audio only)	13.3% (45)	60.4% (204)	26.3% (89)	73.7%
Web Conference (telecon plus shared presentation)	24.9% (86)	67.1% (232)	8.1% (28)	92.0%
Desktop Video	21.6% (61)	62.8% (177)	15.6% (44)	84.4%
Virtual 3D Space Meeting	9.5% (30)	41.6% (132)	48.9% (155)	51.1%

Figure 2.8: Technological effect on producing results while at work in AGM held in SL [26].

Second Life provides support for virtual world project management in a way which betters collaboration because of its rich interface and the ability to touch and alter objects created by other avatars. While meetings are being held inside the environment, avatars tend to interact by means of gestures, messaging and a display component. Now, in Second Life, the object used to display is a wall component. The display screen is wall component in Second Life where a presentation can be successfully made addressing everyone present [3].

The unique features that these worlds provide with respect to meeting support are:

- Ability to create new objects, touch and alter the properties of objects created by other avatars [8].
- The environment properties and look can be controlled by the users which allows them to give it an appearance which they wish to have depending on the purpose of use.
- Immediacy that these worlds provide with respect to the response time during communication leading to better coordination among team members [8].
- Tools which allow voting are very important when there are decisions to be made. This feature helps improve the collaboration process by creating a team environment [21].
- Permissions can be granted to other avatar users so that they can handle the objects created by moving, copying or editing [12].
- The choice for communication medium such as text and voice along with choice for expressing data in ways such as audio, video gives it the versatility leading to customized working environment [8].
- Avatar interaction leads to a 3 D conversation giving it a real life environment appeal. Avatar interaction is a result of avatar behavior which takes place in a user controlled environment [21].

Challenges	Description
Client software and hardware	Each user must download client software that requires memory and graphics. VW audio capabilities are not robust, and desktops must be high end.
Learning curve	Learning to operate within the environment to take full advantage of its capabilities can require considerable effort.
Balancing worlds	Project managers must recognize that a VW is not a complete substitute for first life; there could still be a need to meet in traditional surroundings at the same physical location.
Acceptance	Securing buy-in and support from managers and other employees for use of the technology is essential.
Distractions	People's avatars might be tempted to explore and drift away.
Norms of behavior	Some people might show less respect or restraint when using technology to convey their thoughts.
Uncertainty of behavior	The behavior of other people's avatars cannot be controlled.
Representation	Users might have to adjust to the idea of working as their virtual personas.
Security	Second Life is a public space with limited security features.

Figure 2.9: Challenges faced by SL with respect to meeting support [21].

Drawbacks of SL for meeting support:

- Avatars in a virtual environment tend to deviate from their motive due to certain distractions.
- The behavior of all the users cannot be controlled which may result in griefing.
- The data exchange that takes place during a meeting is held by SL which is a third party server (refer figure 2.9).
- Difficulty in identifying a user as the avatar looks different than the age and look in actual life.
- Technical problems may lead users to leave the virtual world [26].
- The second life window can be minimized during meetings and users can deviate from SL to use other software having better communication features [22].

2.6 Communication features within Second Life:

For real business to flourish and the concerned technology to have a practical appeal the benefits obtained from using it should outnumber the costs involved in investment and use by a larger margin. The case of virtual world technology is no different.
The possible benefits that a user of a virtual world gains include:

- Saving up on time by avoiding the need of travel where jobs that do not require the person to be physically present can be accomplished.
- The cost of travelling can be cut down wherein the budget allocated is just about sufficient or not in some cases.
- Ease of achieving collaborative work with virtual worlds such as Second Life is next best possible to real life collaborative work [22].

The possible costs involved in using such a technology in terms of investment and operational costs will include:

- The basic costs required for creating an existence setup and maintaining one inside the world.
- The interaction delays associated with the worlds which depend upon the system used and the capacity of the network in use.
- The communication ambiguity caused due to the reduced conversational fluency.
- The ambiguity increases further because of the awkward interfaces that these worlds offer [22].

Previous experience suggests that whenever a technology reaches out to more number of audience i.e. users in this case, the technology is there to stay longer and improve the services it provides in the long term. This will result in technological improvements and make it a more usable tool eventually leading to better collaboration prospects which will outweigh the overheads and costs involved during setup and while in use [22]. The best examples of such technologies are the world-wide-web (www) and e-mail which started off with being called "technologies having lower business appeal" to this day where there is hardly any job/work being carried out without the use of these technologies. In a virtual world such as Second Life users can communicate using text and voice chat. Though voice chat was introduced in SL only in 2007 its introduction caused some problems such as controversies and extended unto a level where certain users rejected it fearing that the purpose of being in a virtual world in itself would be hampered. The decision of introducing voice in SL was only taken by its developers after thorough research proving the benefits involved. The more a medium is technologically equipped, the more effective it is be the second best alternative to face-to-face meetings. Researchers have been constantly striving to give heavy impetus to representation in a virtual world compared to what we have in real world. For example: Linden Labs have tried to control avatar reactions in SL by using a Logitech camera. The Logitech camera captures user movements and reactions to a particular set of actions and translates them into the virtual actions of the avatar [6].

2.6.1 IM support:

Within the SL environment, communication can only be made using SL scripts. The scripts in SL communicate using e-mail, XML-RPC and HTTP mechanisms. The following table 2.2 describes the methods of communication in more detail.

While sending e-mails from and to SL, e-mail id includes the specific object ID. While using the Remote Procedure Call technique, scalability is a major issue as there is only one server present in SL which handles all the requests. But Linden Labs has declared that outside nodes can send HTTP requests to SL servers to establish a communication channel.

Method	Who initiates communication	Message length	Execution delay
E-Mail	Anyone (script/external system)	4096 chars	20 seconds
XML-RPC	External system	254 chars	3 seconds
HTTP request	LSL script	2048 chars	None

Table 2.2: Communication methods available within SL [5].

Recently SL scripted objects having voice and SMS communications within and outside SL have been developed. Vodafone's InsideOut is one such technology which can SMS offline users as well. Calling InsideOut users outside SL on physical cell phones is also possible using the technology. The current technique used by most of the organizations inside SL is "drop box technique" which contains a notecard in SL which is nothing but a simple text document. It does not have that immediacy in communication.

Figure 2.10: Comparison between clients (SL, IM) for information desks [5]

A technology known as Information Desk System sends messages to actual cell phone of the staff member whose avatar was supposed to be present at the information desk. The SMS are sent to these cell phones using 2 GSM modems, one for sending and other for receiving. The communications are handled by the management server which is in turn handled by desk administrator who maintains a track of the staff members and designated information desks for them. The above figure 2.10 shows how multiple chat sessions can be used along with IM's [5].

2.6.2 Voice support:

Voice was integrated within the SL virtual world in 2007. It had garnered mixed reviews from users at the time of its introduction. Avatars within a distance range of 20 meters are able to hear the voice whereas the avatars must be in 100 meter range to listen to shout by other user. Private and group chat features offer flexibility to the users [25][27].

Voice demanded controversy while addition:

Controversies followed when the decision of imbibing voice was taken by Linden Labs. The matter of debate was "Whether the introduction of voice useful?" Many criticized it since introduction of voice would loosen the purpose of being in a virtual world in the first place. Concerns about information projection came to the fore. The value of anonymity which many users appreciated was no longer maintained. Voice tends to give away valuable information of the users such as their gender, age and ethnicity since playing the role of the opposite gender was a common thing. There were some studies carried out which explored some areas where users from varied backgrounds and motives were interviewed, some face-to-face, some using voice and some using text in an open ended fashion. There were extreme views on inclusion of voice, some said they hate voice in SL whereas others loved inclusion of voice. Advantages of using text chat during meetings were that the users were able to keep a log of what was said and when it was said. They were also able to refer it for later use. Another possible advantage was that during voice chat if you miss something it needs to be told and spoken again. But in text chat one can just view the other person's chat without having to ask him to repeat again [6].

When interviewed, a Linden Lab employee mentioned that: "People really love voice. Though some of them don't, many do like voice". The interviewees praised the use of voice to understand emotions, complex concepts and most importantly provision of a communication depth. Maximum number of users who expressed their concern over inclusion of voice mentioned that anonymity was their primary worry. A high number of users actually agreed to the fact that voice was the main mode of communication with text chat as a secondary mode of communication. An interviewee found voice useful while communicating with their customers and business partners since the identity of the person at the other end could be better known which makes you believe the person. The study results suggested that the online virtual world is formed by mostly two kinds of users, the first one being the recreational users and the other being business purpose users. While users who are part of the world for recreational purposes objected for the introduction of voice due to identity disclosure, users who

mean business were comparatively happy as voice gave a big boost to their business needs. Consider a case where live music and choir are to be played inside SL. It would not be possible for live music or choir to be played inside SL until it had voice support.

Users who want voice will stop using the environment if voice is banned and if someone using text refuses to use voice as the communication medium then maybe he is looked onto with suspicion. It is time that users now understand the cultural diversity caused due to the formation of these two groups and respect individual preferences [6].

Use of voice chat in Group meetings currently:

Voice chat during meetings is mostly used when the number of people in the conference is not much. Voice chat becomes less effective as the number of users logged into a single group increase. Ideally voice chat is the best way of meeting for one on one's. Users who are physically disabled find it difficult to use text chat and voice chat is like god to them. In real life we can control the distance range where voice reach can be controlled. This is not the case in SL, where a user cannot control the distance to which the sound reaches by maintaining certain volume levels. Voice chat tends to keep user's hands free and they may engage themselves in some other work while still in a conversation.

According to a study, when asked a participant who organized art galleries for the audiovisual art presentations in virtual worlds reported that some people from the audience ruined the silent listening experience of others [6]. It is basically a conflict between two sections of audience. The first section comprises of users who mean business and want to extend their real life self. These users wish a virtual world which will be technologically advanced and would never mind to any technological improvements happen. The second section comprises of users who have dominated the early days of virtual worlds. These users include all those who have joined the virtual world for simple fun who wish to keep their virtual identities totally isolated from their real life selves. Now that virtual worlds need to bring in real money for its

future growth, the only option that the owners of virtual worlds such as Second Life had was to accommodate the needs of the first section of users. Real business can evolve in VW's only after the environment is technically improved. The main concern of most of the second section of users being that their ethnicity, age, gender will be disclosed if they take to voice as primary communication medium inside SL. Possible solutions to which might be kind of a voice mask which will alter the properties of voice so as to make it entirely different than the original [6].

Advantages of having voice in virtual worlds:

- Voice chat offers the users to communicate complex conceptual thoughts rather easily.
- The depth of communication is better when one prefers voice over text.
- The amount of media richness that these worlds provide is a huge leap towards communicating user's emotions.
- Business meetings using voice in virtual worlds enable users on both sides to get a better idea of whom they were actually talking to.
- Voice chat enables users to keep their hands engaged in some simultaneous possible work [6][26].

Disadvantages of having voice in virtual worlds:

- Noise transmission is a major issue as it is sent along with user's voice.
- Users who are in a virtual world just for fun or to do some recreational activities often dislike voice as it exposes their real self which opposes the motive with which they joined the virtual world.
- Difficulty of keeping logs for voice chat is a major issue as users might want to go back and check history of their conversation.
- Users who feel shy or may lack confidence find it tough to express them whereas the extroverts take over completely.
- Large meetings in SL lose effectiveness since users at different locations have different audible levels. The sound of speakers is not constant throughout and

SL does not have any megaphone which can cover a huge amount of area with similar voice levels [6][26].

- Users have to be geographically close to each other inside the environment [25].

2.6.3 Video support:

Playing video inside Second Life virtual environment needs the user to own land on which he intends to play the video. It corresponds to the fact that the user informs SL that he is playing the particular video on the land. It needs a single prim to be used. The prim is a wall component in SL which will be used to display. The texture is then set for the prim and is also given a shape of a television screen. Texture is the part of the object that will be used by the user for display purpose. It allows users to customize size and shape the object displays [23]. The video will be displayed on all the locations where the texture will be applied. Uploading a video inside the environment could prove to be quite a task for new users. The file must open in quicktime format for it to get uploaded. The quicktime software being used shall also be a latest version else unauthorized users might crawl through and get access to some vital bit of information [15].

Conveying emotions during data transfer is achieved by facial expressions (65%) and verbal communication (35%). The current scenario in virtual worlds is not suitable for this type of a communication as video conference is not directly supported by any world. The most equipped world for meeting support in this fashion could be Second Life, but even SL is not up to the standard that can replace face to face communication. Though the users share virtual space along with possible voice communication, the opportunity of physical expression is considerably small and lack of it is a major technical limitation. Voice communication in any form (virtual or real) needs to be in synchronization with the facial expressions of the avatar. This does not happen in SL currently which negates the experience of the user [25].

Second Life runs in the browser window and users have an option to minimize the SL window and use other alternatives for video conferencing. Since, the video support

provided by current virtual worlds is negligible, users are forced to leave the environment and look for better options which help them pass on vital emotional information. Almost no video support, unsecured voice support and interaction delays result in users leaving the environment and using Skpye 3D like interfaces [22].

Creating machinima inside SL:

Machinima is creating a video recording of 3D animated interaction in real time. The word machinima is a combination of words “machine cinema”. Machinima within SL is a relatively easy task when it comes to creating a user’s view. It can get complicated as we demand further such as creating a live video of avatars involved in role-play where it can be recorded as an animated movie. Machinima is very demanding when it comes to hard disk’s space usage [17].

Creating a movie within SL is a big and demanding task. It is not as easy as capturing a screen. There are many experts who can be hired inside SL to faster and better the production process. Right from technical glitches to avatar representations everything can be handled for a movie production within SL by professionals [SL official guide book].

Why video conference inside SL?

(Bailenson and collaborators) pointed out in [24] that “A videoconference image is the most effectual way to produce high realism in mediated communications”. Researchers have been focusing on the improvements that can be made to current virtual environments since long now. Users find virtual worlds effective despite certain drawbacks. Most of them see virtual worlds as the heart of online meeting venue in future. Currently the users are categorically identified by the differed use they intend. Most of the users land here because of the interest and fun this environment provides. But, users who come here for business are the ones who have been responsible for giving it an image of more than ‘just a game’. The technical aspects need to be improved on with this user base in mind since these are the ones who have been instrumental in improving the economy of the virtual world as well as the development of business based processes. Failure to improvement in the technical

aspects may lead to users giving up on the technology somewhere in the near future which can be avoided by taking small but evolutionary steps as we move forward [26].

Figure 2.11(a): Filtered image [27]

Figure 2.11(b): Virtual image [27]

Evaluation of the current technology according to practical needs is very important. Evaluation is a must in a world which is growing faster than the real world. These worlds have their own improved needs which need to be addressed. [11] point outs that ”When tasks entail processing highly equivocal information, as is required for example in collective bargaining, then the medium that supports communications and information processing must be rich and therefore, face-to-face meetings between participants may be necessary” (p. 5). MRT (Media Richness Theory) has been in place considering the preferences of communication media in order of the richness content that it provides. Face-to-face meetings are ranked highest followed by voice chat and text (includes e-mail conversations and instant messaging) [11]. (Clemons, 2008) points out in [25] that “behavior of same person in virtual world is different than real world”. This can prove extremely difficult to tackle if used in business context. Negotiations being a vital part of businesses, it will be difficult to carry out negotiation talks when a person behaves in a way different to what he actually is. The importance of face to face business meetings is visible here. Referring figure 2.11 we can comment that even though the virtual meetings are not real, they can be supported by better audio-visual technical capabilities so as to reflect the emotions and behavior. These capabilities will enable the best possible interactions and give an

experience as close as face to face interaction [25]. Inside SL, the option of whether a user wants to use text, voice or video as their communication medium shall be left to them. They may reject all the mentioned ones and might go with simple emoticons or gestures [21].

Shy people tend to feel shyer when asked to use videoconferencing software. This happens since they are not comfortable with their voice and video being broadcast. This can be addressed by using filters which can degrade video images by edge-detector filtered (figure 2.11) video. The edges and facial expressions are mapped real time creating a degraded effect of the original. In similar way, voice modulation was performed and degraded effect was generated so that no one can even guarantee if it's a male or female behind the avatar [27].

Advantages of video conference inside SL:

- Improved co-ordination among team members.
- Better sense of co-presence.
- Immediate communication response (feedback) from other users.
- Trusted conversation due to multiple communication channels
- Create and alter content created by other users resulting in improved performance.

Disadvantages of video conference inside SL:

- Security issues may be a concern due to minimization in ambiguity of personal entity.
- Users who might not be comfortable using video may be looked upon with some doubt.
- Users with lack of self confidence may feel shyer affecting their meeting performance.
- Avatar representations may tend to lose their impact.

2.6.4 Information and Knowledge sharing:

Second Life was launched for public in 2003 and since then there have been many eras inside this virtual world. These eras reflect the stepwise progress that this persistent world has made. The latest of these eras then (2007) was the seventh era which was an era of globalization and conflict as there was a conflict about the applicability of real world rules in the virtual world. Globalization refers to the version of Second Life where it is now open-sourced and Linden Lab's SL viewer's software code was publicized which can be used by users to access Second Life in a number of ways different to which existed earlier [17].

(Bainbridge, 2007) pointed out in [20] that "So far it is unclear what enhancements are needed to make a CVE a really good environment for serious distributed collaborations". The SL world is persistent in nature which can be accessed using the SL viewer software from any part of the world whenever wished. Now, the most important aspects such as sharing and transfer of data within the world are used by all the teams vying for better collaboration achievement. In most situations the method and use of collaboration is same. This can be generated as a pattern within the world to avoid repetition of content. Patterns are mostly used by software developers to attain optimal content and save on time and space [20].

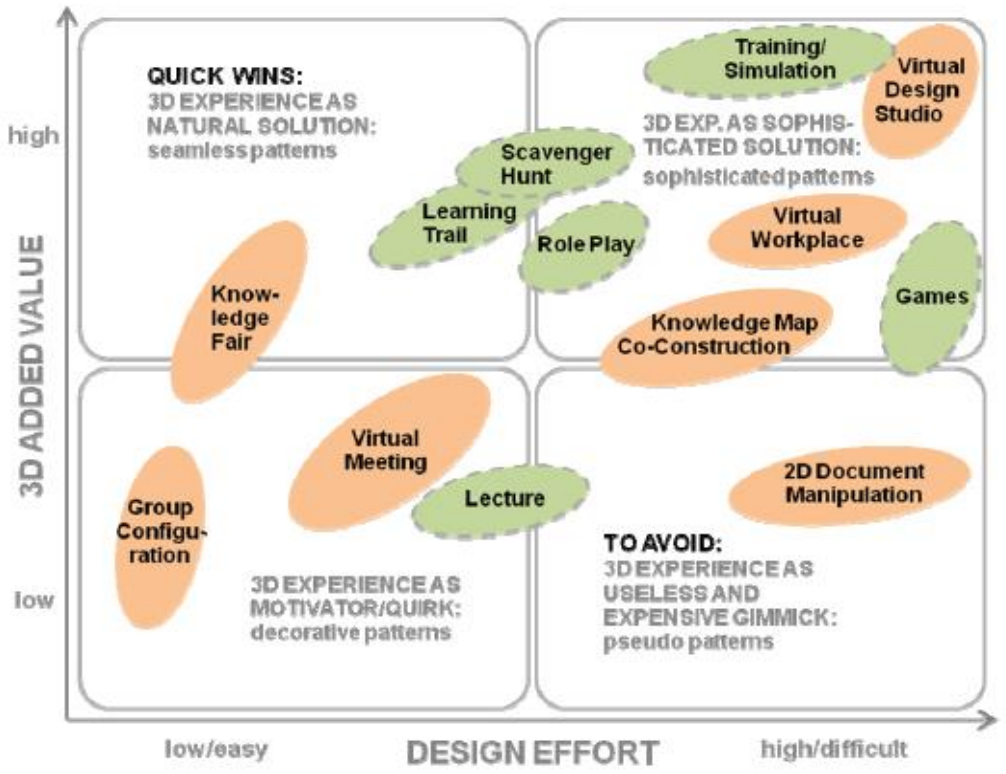

Figure 2.12: Design effort vs 3D value [20]

The above figure 2.12 represents the amount of design effort involved as the 3D content of the use increases. Currently the virtual meetings take place in low design effort with minimum 3D added value. As shown in Figure 2.12, the meeting environment need to be upgraded to a somewhere around virtual workplace or a virtual design studio to achieve a higher 3D value.

Ability for presentation is another thing that can be achieved in SL for better collaboration and understanding amongst virtual team members. Presentations in PowerPoint are not supported within SL. But SL supports images to be uploaded in JPEG format. The PowerPoint slides have to be converted to JPEG format to upload it within SL at L$ 10 per image.

The following steps will be carried out in order to give a presentation within SL:

1. PowerPoint slides are not directly supported by SL but PowerPoint allows its slides to be imported to JPEG format (supported by SL).

2. The PowerPoint slides are imported to JPEG format which are now ready to be uploaded into SL as textures
3. The textures are uploaded into the user's inventory.
4. The prim where the presentation is to be played is then selected, sized in ratio 4:3.
5. The inventory of the prim is then loaded with images that are currently in user's inventory in the order to be played.
6. A new script is then generated and the code is replaced by the code needed to run the script with the items in the prim's inventory.
7. The prim is now ready to play the presentation [16].

2.7 Summary

The above section discusses virtual worlds with impetus being on Second Life (SL) virtual world. The section helped understand the underlying business content within SL. It discussed the various opportunities that SL provides in real life business context. The aim was to discuss demonstrations in virtual time to a real life situation by means of prototyping or simulating real life events. Second Life is used by educators on a large scale so as to provide a natural learning environment wherein students can demonstrate various solutions for a single problem and obtain the best solution. In work context, it was observed that collaborations on a large scale can be handled by virtual teams to create a prototype. Virtual meetings aspect was focused on by comparing results obtained from technology conferences that were successfully

handled within SL virtual environment. Virtual worlds established a standard going as close to the gold standard of face to face meetings was immensely appreciated. The factors that supported and hampered collaboration in a virtual setup were discussed. It was observed that the current virtual meeting support was satisfactory despite the lack of technologically advanced communication features such as video conferencing software which leads to users deviating from environment and using advanced features which support better communication features such as Skype. It is possible more so because SL runs in a browser which can be easily minimized to use

other options. There are certain factors which decide whether or not the innovation is essential. These factors decide whether imbibing the current practical need is possible [11].

	Meeting needs achieved	Collaborative appeal	Practical Feasibility	Social Awareness
Teleconferencing (Audio only)	Moderately	Moderate	Achieved	Slight concerns
Web conference (Data sharing + Audio)	Well	High	Achievable	Slight security concerns
Video Conferencing (degraded video)	Completely	Very High	Achievable	Privacy and security concerns

Fig 2.13: Evaluating existing and future technologies against possibilities of it being accepted. [11][26].

The factors deciding the utility of the innovation:

1. Meeting needs: Will the innovation serve the purpose which an existing real world service does not?

   For e.g. A user wants to carry out a business meeting in a one-to-one professional setup. Users at both the ends are geographically distributed. The best way to achieve it would be to bring them closest to a face-to-face interaction which can best be provided by a video conference. The users want to demonstrate interior designing project with a combined effect which can best be achieved by a virtual world such as Second Life. Now, if the users use SL to demonstrate the combined effect then they will have to jump out of SL and use

other traditional software such as Skype to make their conversation as realistic as possible.

2. Collaborative appeal: The innovation must use the features inside SL which support collaborative activity.

   The collaborative techniques work towards giving the user a chance to share space. This factor simply evaluates the innovation with respect to the collaborative content that it can provide. For e.g. If a text message to voice converter is to be developed inside SL, this factor keeps a check if this innovation supports and makes use of current collaborative features the environment provides.

3. Practical Feasibility: What is the practical feasibility and the problems faced to achieve the innovation intended?

   This factor determines the possibility of achievement of such an innovation inside SL successfully. In order to bring up the innovation into reality, the technical challenges and resource availability need to be checked. For e.g. If a text to voice converter is to be implemented in SL, then how much of this can actually (practically) be implemented depends upon the development features the environment supports and provides.

4. Social awareness: Is the innovation developed with the social aspect on mind?

   This factor considers if the application has really been developed with user privacy, legality and security in mind [11]. For e.g. for a software to be active inside SL some privacy issues need to be addressed. Does it harm the user by disturbing his/her privacy or security is of high concern. This factor is of high regard whenever usability concerns are voiced.

It is quite clear from the above figure 2.13 that data sharing is the need of the hour and should be incorporated inside a virtual environment such as Second Life. The only concerns voiced can be regarding the security of the data since the sharing of data will not take place on the servers owned by the customer organization. The entire data will be at the Second Life servers which may be a security concern with extremely confidential data in question [11][26].

The best video conferencing product in present situation is HP's Halo. It provides a collaborative meeting support environment amongst small groups in the most effective manner possible. HP's Halo collaborative meeting room is a step ahead of the rest. The participants in the room get a chance to establish direct natural eye contact by giving a feel as of sitting in the same room across the table. The sound and video quality that it provides makes the technology sit out amongst all its competitors. Such advancement inside SL will certainly eradicate the difference between a
virtual team and its face to face counterpart thereby removing communication boundaries and enhancing the sense of co-presence [21].

3. Software used outside Second Life

A number of software are being used by virtual collaboration teams for conducting meeting sessions. Popular virtual environments such as Second Life are used for conducting collaborative work on a large scale. The main reason of them being used is the shared space it provides. These virtual worlds have a drawback where users can easily minimize the browser in use for the world and use other meeting software for one to one or group meetings. It is high time that virtual worlds are upgraded with similar type of user-friendly software.

This section demonstrates such software that can be used inside a world such as Second Life which is immensely popular as well known for the business content. An important part of any business is meetings. The support for meetings in Second Life Virtual world is limited to instant messaging, voice chat for small group meetings and amphitheatre presentations and avatar interactive sessions for group meetings with larger audience. Video conferencing is the technology of future which is already being used by companies. Eye-contact is very essential for remote business meetings to be successful in order to convey emotions in a better manner. Companies such as Cisco and HP have already come to the party by their products such as TelePresence and Halo respectively [28].

Figure 3.1: Three examples of current video conference use.

These technological advancements are far more equipped to provide a sense of togetherness in comparison with Second Life's avatar representation during peer-to-peer or small group conferences. The advantage that Second Life has over others is

that it provides a chance to work in a shared environment, share artifacts created by other users and involve in better team building activities. Telepresence is termed by (Witmer and Singer, 2000) in [29] as "the subjective experience of being in one place or environment even when one is physically situated in another". Shared virtual reality is the concept which utilizes video conferencing technique to convince the user of being in a shared environment and interacting across the table as shown in Figure 3.1. Various views of shared virtual reality are dividing half close up screens from both the remote locations. This can be extended to the same number of half close up screens as the participants [29]. There are also some other software available free of cost which enable presentations to be given over VOIP while simultaneously providing a presentation view, they call it as a software effect combined of Skype + Vyew [10].

Let us consider applications that have been developed outside virtual environments but may prove effective in concern with the growing technological needs of the business world to provide as much a natural meeting environment as possible.

3.1 Coliseum immersive videoconferencing system

Coliseum is a multiuser teleconferencing system developed to provide users with a collaborative experience though of virtual nature. It betters a sense of co-presence by providing support for ten or more participants at a time. The gestures, emotions or expressions are mapped in real time and converted to avatar based representation as shown in figure 3.2. The effect of such a system depends upon the audio-visual quality that can be generated. Its ability to produce quality results on a single node depends upon the success of their analysis algorithms.

Figure 3.2: Mapping of real world users to avatar representation as seen by other users [30].

Coliseum provides acceptable frame rates for a good user experience. The main advantage of this system being that the video stream limits its size as the screen area is being maintained locally [30].

3.1.1 Coliseum system

The coliseum system is used at individual participant sites. It has five cameras to provide video as well as speakers or headphones and a microphone to provide audio. All the participants should be connected (either a LAN or Internet).

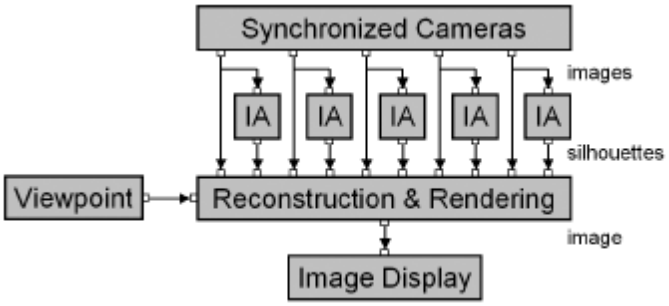

Figure 3.3: Procedure to generate the 2D image for display.

Image processing techniques are used since during mapping from real world images, the background pixels must be differentiated. The reconstruction of the captured images then takes place providing the image to be sent over the network.

3.1.2 Image generation:

1. All the five cameras acquire images as shown in figure 3.3.
2. 2D image analysis algorithm provides the endpoints cancelling out the background.
3. IBVH reconstruction technology is applied and a representation using currently captured video is generated.
4. Image rendering completes and the generated representation is sent over to remote sites wherever the participant node is connected.

Session is created when two participants log in for a conference. Whenever a new user logs in, he can either log in to an existing session or create a new session. The performance of such a system depends upon audio and video quality as well as the algorithmic efficiency [30].

3.2 SLMeeting system

The support for Second Life's virtual meeting capability has attracted users in the form of big names such as IBM, Intel and NASA. These virtual rooms enable avatars to carry out meetings and discussion. SLMeeting is a system which supports Computer Supported Collaborative Work (CSCW) in an environment which varies from chat rooms in its own ways. An object in SL is used to communicate with the outside world in the form of a website which stores all the details and information regarding the entire event.

There are several characters to hold such a meeting. The most important person is the facilitator who guides the meeting throughout its execution. Facilitator enters the meeting agenda and provides helpful guidelines to the users regarding it. Facilitator assigns speakers to various discussion points and allots specific timeline for each speaker. After the speaker the control of the meeting is again taken by the facilitator. The following figure 3.4 shows screens (a), (b), (c) and (d).

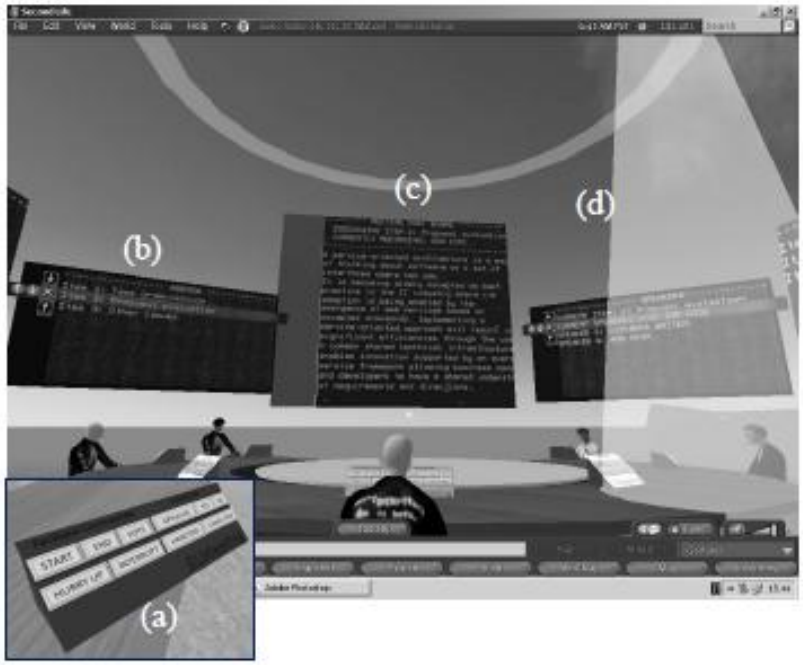

Figure 3.4: Boards used by facilitator to control meeting proceedings [19].

3.2.1 Interaction sequence

The meeting can be attended by the would be attendees by logging on to the website and then clicking the link provided over there or by teleporting to the meeting room inside SL. Meeting takes place on a round conference table and the interactions take place in the following order.

1. The facilitator initiates the meeting by pressing a start button as shown in fig (a).
2. The agenda as shown in fig (b) is checked where the title and the speaker are mentioned.
3. The next speakers are allowed to speak once the moderator clicks on the object.
4. The meeting chat board keeps record of the chat entered by the users as shown in fig (c) which is in turn saved on the website for future referral.
5. The booking list as shown in fig (d) mentions the current speaker and the agenda with the searchlight over him.
6. The facilitator has the option of changing the sequence of the items on agenda by using up and down arrows.
7. Once a speaker is done with their work, they are removed from the speaker list.
8. The hand raising option is available for the participants while making gestures.
9. A voting palette is also provided with options like favorable and contrary.
10. Timekeeping clock is usually green but turns red whenever the speakers will run out of time.

The SLMeeting system really offers control of meetings in cases where the number of users will be much more. It gives an idea on how a large meeting can be conducted in a controlled environment. Another advantage of this type of a meeting is that the conversations being saved automatically. This allows someone who has missed the meeting to go through the report. Participants who were present but want to refer can also use the web site for consultation [19].

3.3 Holoport based conferencing

Holoport is a device which makes use of technology enabled prototype to generate a 2D view of an object with sufficient information so as to build a 3D view. An application providing video conferencing along with data conferencing is desirable as it sets user's hands free for doing other work such as explaining their counterpart by drawing something on screen. It reduces the effort by being able to show their partner with the help of a mouse pointer. This setup involves a holo screen which is a very thin glass plate. The most important thing is the light that will be projected which needs to be at a particular angle and being projected from the rear end [7].

3.3.1 Hardware setup

- Holo screen or hologram which is a thin film of material such as glass.
- Camera having ability to take color images at 640 * 480 pixels resolution.
- Infrared Pen used for data conferencing and Infrared Receiver for capturing the IR light from the tip of the pen which will be sent to a photo diode.
- Network connectivity on a system with high configuration to route generated graphical signals.
- Projector for emitting light to be incident upon a mirror as shown in figure 3.5.
- Audio capability minus noise and echo for able video conferencing.
- Synchronization unit for the control signals of projector and camera.

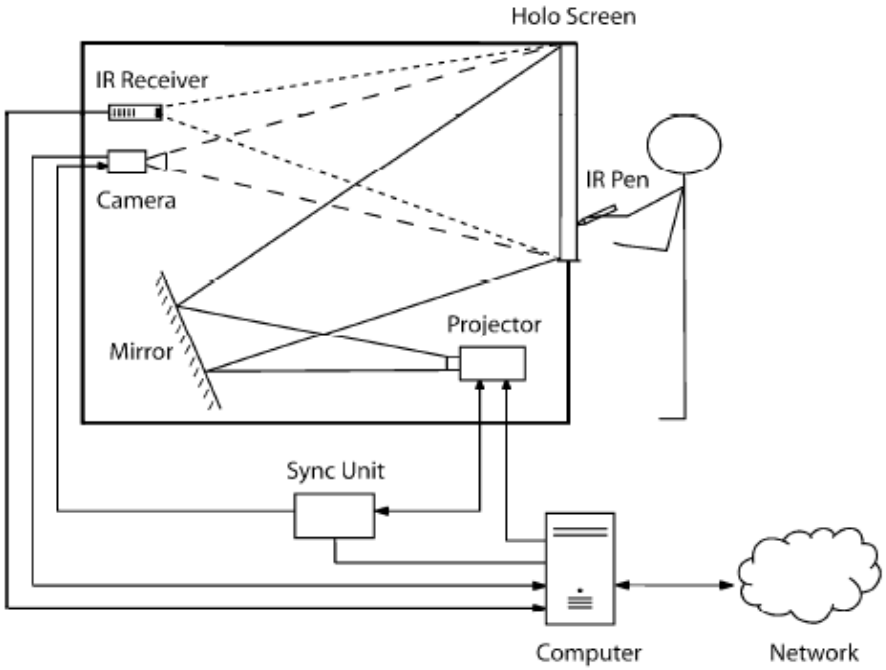

Figure 3.5: Holo Port setup describing the working principle [7].

3.3.2 Applications

The basic aim of HoloPort was to enable remote users establish a communication medium to be built amongst themselves where a video and data conference could thrive. This sort of a meeting environment resolves peer to peer information sharing issues by providing an ability to write, design or draw and explain their counterpart their point of view. Virtual group meetings are also possible and take place in a networked setup [7].

(a) Video and data Conferencing:

The video conferencing capability is similar to the effect of talking with a person through a transparent glass window. The data sharing takes place over this glass window as the users draw and write data atop the screen giving a feel as if it has been written over a glass window. The data representation over

the window is achieved using a IR Pen which takes place of a mouse pointer. This approach was very useful during sharing knowledge but was unsuccessful to a certain extent to provide a dependable eye-contact during conversations. It was also observed that the video feed was dimmed. In this context, we can term the video quality to be unsatisfactory [7].

(b) Virtual group meetings in networked environment:

A group meeting using a video conferencing technique enables participants situated remotely to establish a better eye-contact with their counterparts. The conference video is a full screen high quality video stream obtained from the other geographically spatial location. The locally situated group is seated in front of the HoloPort screen as if their table and the HoloPort device table are joined. This gives a feel of the discussion being carried on over a single table across the ends. The participants engaged in this type of a conference were content with the experience. The participants were satisfied with the feeling of a group meeting where one to one eye-contact was also commendable. The only concerns remain were the lag created by the live streaming and the compromised video quality [7].

3.4 Virtual body using Chroma-Keying:

Presence in a virtual world is influenced by the representation of the avatar in a virtual setup. The more the look of the avatar close to its real world look, better the sense of co-presence. A virtual body is obtained by tracking the movements of the user by using detection algorithm on a set of points. Cameras are attached over head mounted displays which captures these images [4].

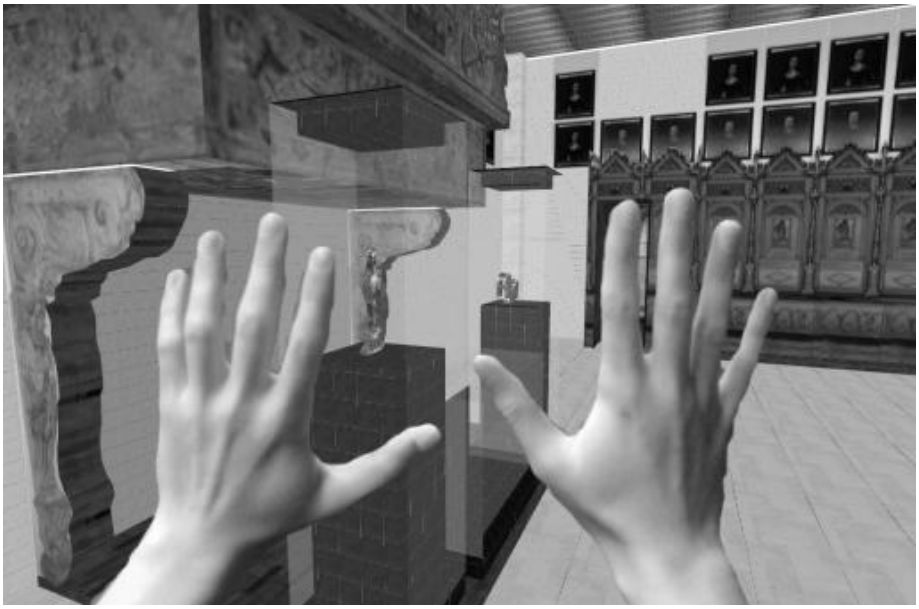

Figure 3.6: Immersive virtual hands within a virtual environment [4].

As seen in the figure 3.6 above, virtual hands are obtained by the use of the tracking devices. A virtual body can be seen as part of the view and being in a particular location within the environment giving it an immersive feel. This method demonstrates augmented reality such that a human image can be differentiated from the background pixels and mapped into a virtual environment [4]. Such a virtual body eventually gives the user a feel and sense of reality within the virtual environment and they are more attached with the avatar.

3.5 Summary:

In the above section we discussed some of the technologies which can be integrated within virtual worlds. The section first discussed Coliseum which is an immersive Videoconferencing system. Coliseum provided an immersive environment created by rendering images in real time and producing good quality effect essential for a meeting. The avatars generated using such a system is quite similar to the user in real life. This gives a better sense of co-presence simply making the experience better. The second system discussed was SLMeeting which was demonstrated within SL virtual environment. This system proposed a methodological approach towards managing a group meeting with better effectiveness. The meetings in such a setup are

better controlled and the system can be enhanced to be more scalable. SLMeeting system can be used to carry out meetings for up to 20 users at a time. Holoport was another such technology discussed where users can not only conference in real time but also share thoughts by writing them on the screen using Infrared technology. This system was more effective when used in a table-to-table virtual conference. The only disadvantage of such a system being the heavy hardware requirements needed at all the nodes where the technology will be used. The last one discussed was generation of Virtual Body (VB) using Chroma-Keying. Tracking devices are used after the cameras capture the real images of the user. Reconstruction is then performed on the captured images and the reconstructed image is immersed in a virtual environment. This is also called as augmentation of the virtual environment it is immersed into [4][19][30].

Thus the above section discusses some systems with features for video conferencing which users tend to use by navigating away from Second Life. They also discuss the live immersive effect obtained from creating virtual bodies and render them in the virtual environment so as to give a feel of themselves being a part of that environment.

4. Usability Analysis for Communication features currently available within Second Life

4.1 Introduction

We have a set of participants who are ideally suited to be part of a study regarding a fast and ever changing world as Second Life. The participants who are mix of young students and professionals have the maximum chance of using a virtual world technology for long distance collaborative work or meetings. The study was intended to reveal the underlying communication barriers that the participants face while using the technology for collaborative purposes mostly related to work. The study was conducted with an exploratory approach which makes the study less formal. The study was largely interactive in nature making the participant comfortable improving their performance. The basic aim of the study was to obtain valuable opinions on the current communication features that Second Life virtual world provides and if possible suggest some changes that they would love to see to it so as to make it a better place to hold meetings and carry out collaborative work in future.

4.2 Aim of the study

The aim of this study was to analyze the communication and collaborative features for meeting support inherent in Second Life with respect to the users. The users selected for the study belong to the same age group which SL boasts of. The secondary aim was to know whether the participants are impressed with the features currently available within SL and would they recommend some additional features towards the betterment of the virtual world. The study is aimed to support a hypothesis put forward to benefit the Second Life virtual world by benefiting its vast user base.

4.3 Design of the study

The study was based on an exploratory approach. The study was designed in order to extract as much thoughts as possible from the participant's minds regarding the

features of Second Life virtual world, their take on the output of such worlds in order to achieve high-end collaboration, its supportive collaborative architecture as well as the communication features it provides to hold long distance meetings in the best way possible. To know the best possible meeting environment they use for long distance collaboration was also a major aspect of the design.

Since SL is not as easy to use as it looks at outset. Participants would face problems and difficulty in doing smallest of the tasks if they are entirely new to the environment. Design of the study took into consideration that the participants may be of a non-computer science background with average technical knowledge. The tasks were very easy which were not actually carried out within the Second Life virtual world. The users were actually shown two youtube videos in order that they understand better in comparatively lesser time. The design of the study made it last for an hour.

The main challenge while prototyping the design was that at any point of time the users should not give up on the study and neither should they dissociate from the study by losing the interest in doing it. They had been told that they can leave the study at any time or refuse to answer a particular question. The study was divided into three sessions. Sessions 1 and 2 comprised of questionnaires where participant was free to ask any questions regarding the study when needed. The 3rd session was an interactive discussion session where the participant and the researcher were free to ask any questions (related to the study) in an open ended fashion. The study then concluded with distribution of some sweets to the participant.

4.4 Tasks

The first session of the study was to obtain the basic information regarding participants. The participants were given part 1 and part 2 of the questionnaire which was demographic as well as general information about their knowhow of social networking sites. The participants were handed over an information sheet giving them

an overview regarding Second Life virtual world. The participants were made aware of the expectations the researcher had from them during the entire course of the study.

In the second session, the participants were shown two youtube videos giving them clear idea about the way meetings and gatherings are held within Second Life. The participants were expected to ask their queries regarding the videos and Second Life to allow them into a clear picture of the procedure. Part 3 and Part 4 of the questionnaire were then filled out by the participants leading them to the most comfortable session of the study, the discussion session.

The third session was an interactive discussion session which was open-ended in nature. The researcher asked the participants questions regarding the current support of communication features in Second Life and the content present within the world with collaboration as the underlying concern. The participants were also allowed to ask any questions to the researcher. This kind of discussion only allowed the researcher to get deeper into the participant's minds. This session was aimed to ease the participant's concern regarding the tougher questions that were posted by the researcher. The better the comfort level of the participants, better the output of the study.

4.5 Participant One

This participant seemed interested to be a part of the study right from the outset. They asked a few questions after they read out the information booklet regarding Second Life. Although this participant had never used Second Life they had heard about it. They particularly mentioned that such a virtual world could prove a lot of useful for companies who want to hold long distance meetings. They also went to state that this would be the best option for organizations during recession times when they are trying to cut down the major costs. It quite made sense to me since most of the organizations invested huge amounts towards the travel costs of their employees for long distance meetings and conferences. This participant was surprised by the number of users who are actually a part of this world on regular basis.

This participant was quite excited to know things about such a unique meeting environment which made them go through the study in a speedy manner. They particularly singled out that they would love to be a part of such a meeting environment because of its cost effective nature. This participant though suggested some improvements where one to one meetings or meetings of smaller groups was concerned. The improvements suggested included a software such as skype to be imbibed within the world so as to give a better idea of whom they were actually talking to since it is very important to know a person before doing any business with them. When asked if they would minimize Second Life browser window to use other conferencing software, the reply was yes. They went on to say that the interactions in such a virtual world would be very unreal and deceptive. They were of the opinion that for real business to flourish some real aspects need be reflected. They were satisfied with the support of the virtual world to share files or information. They were particularly impressed with the virtual world's capacity to project group meetings with small number of people which can be well analyzed by observing Figure 4.1. They liked the way information sharing can be done via presentations on slides during group meetings or small gatherings.

They certainly had some points to be made towards their concept of a better Second Life. They suggested changes such as betterment of group chat features and video-conferencing will attract more number of users which will in turn prove beneficial for them. This participant however commented that the current features provided are secured but not completely sufficient for the success of meetings and some features will have to be added with cyber security in mind to make it a better place. Figure 4.1 below describes their reactions better.

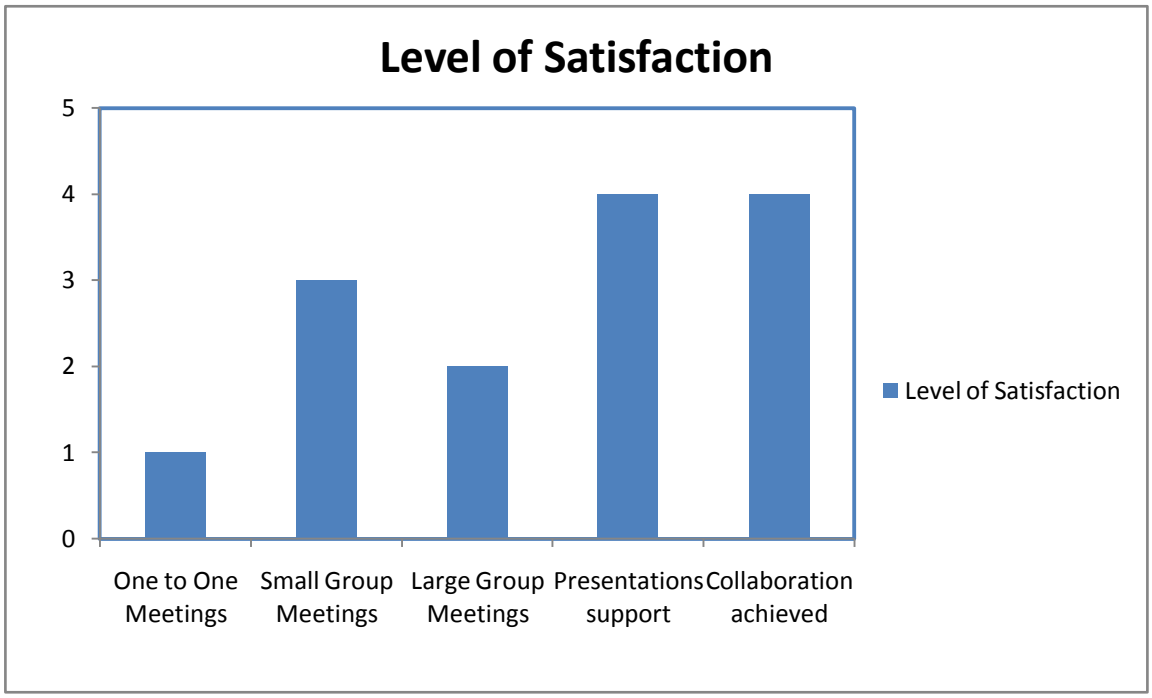

Figure 4.1: Satisfaction Analysis for Participant 1

4.6 Participant Two

This participant had never heard of Second Life before but mentioned that they were not very surprised by the presence of such a virtual world in an advanced technological world. They were not surprised by the kind of work carried on within Second Life as well as by the number of resident users that Second Life boasts of. They have been using the computer and the web for quite a long time now. They use it to socialize, work and hold meetings in a distributed environment. They mentioned that they mostly use either Skype or Gmail to chat and conference. They added that though they carry out meetings using these technologies they were aware of the drawbacks such as lack of support for presentations in them. They also mentioned the inability of such software when it comes to group voice and video conferences.

This participant was experienced when it came to holding meetings online but inexperienced when talking about Second Life and virtual worlds in general. They suddenly became cautious after they were shown youtube videos dealing with the

way gatherings and meetings are held within Second Life. They were impressed with what they had seen. They felt that the customizable rooms in Second Life was very interesting and they themselves would like to hold a meeting in a room within a virtual world with the design and feel of their own workplace creating a visual and making themselves more comfortable as if the meeting is there in their own office. This participant liked the way avatars can teleport to any location instantly without having the need to travel by even smallest of the means. They were very positive about the kind of presentation support provided in the virtual world and pointed out the cost to benefit ratio to be low thus making it quite an affordable way and can be clearly reflected from figure 4.2.

This participant did mention some drawbacks that a virtual world may have. They were very concerned about the security that these worlds provide as the entire meeting does not take place at their site. They cross questioned the researcher about the possibility of someone intruding a top-level confidential meeting where the users might be discussing some important aspects of business which no one else should know. They went on to say that users with a disability such as inability to speak will be able to talk as well if there were a text to voice converter support within world. This converter can also be used by others who do not like their voice to be projected. They however rejected the prospect of live video of users during meeting largely due to the security concerns but liked the prospect of large group meetings in future should the technological advancements better the Second Life virtual world as it does for the real world. Figure 4.2 shown below reflects the view of the participant.

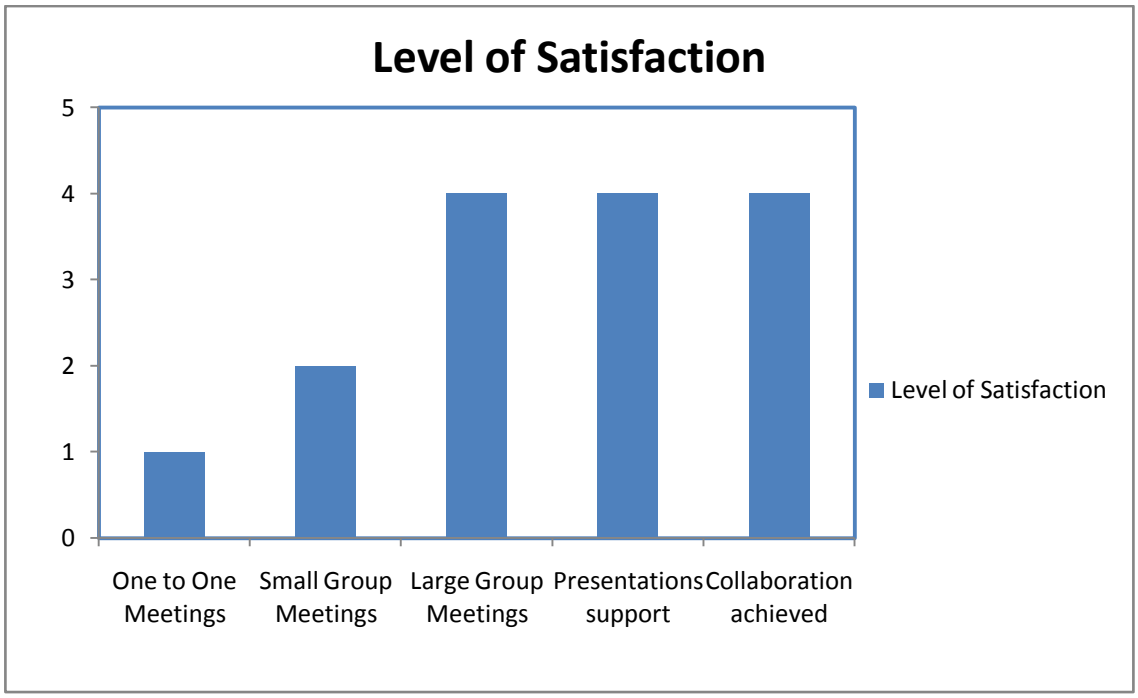

Figure 4.2: Satisfaction analysis for Participant 2.

4.7 Participant Three

Something different about this participant worth taking a note was that they had already used Second Life virtual world. This participant started the study in a very speedy manner. They looked very confident about the study. They hardly asked any questions or doubts regarding study. They mentioned that they often end up using conferencing software available online to hold meetings with their geographically distributed counterparts. They are quite satisfied with the software they use for distributed collaboration. They went on to say that they have used software available to better the meeting process.

This participant was very interested and the last session was extremely interactive. They liked the collaborative nature that Second Life provides but the communication features when small meeting groups are concerned are weak. They precisely mentioned the use of VOIP in business meetings. Second Life according to them quite gave the required comfort for gatherings and large group meetings but somewhere lacks on the one to one communication feature which will make them

navigate away from Second Life virtual world to use other software such as Nortel and Skype. They commended virtual worlds for their achieved user reach. They felt that because of the number of users who actually depend on the virtual world for meeting support, they should equip it with more technologically advanced software tools providing users a range of options for communication to choose from. They liked the aspect of file sharing by uploading in the world but suggested for a simpler and easier way to upload files. This participant would however be keen to be a part of such a meeting environment in future.

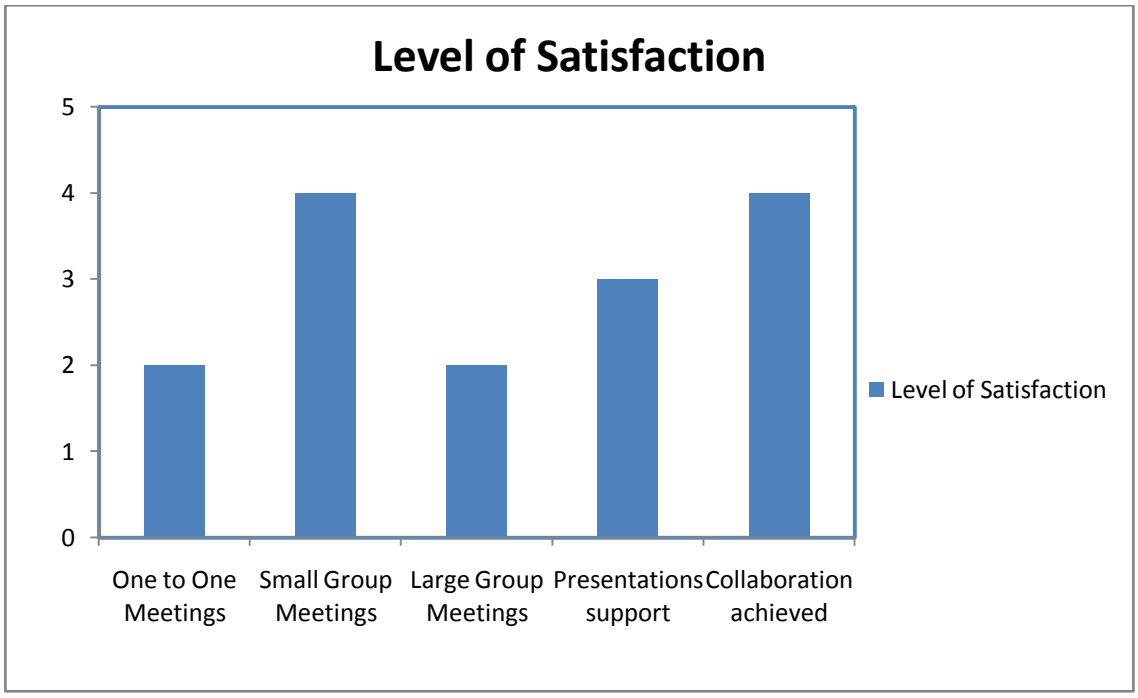

Figure 4.3: Satisfaction analysis for Participant 3.

They disliked seeing avatar interaction which they termed as not in synchronization with the audio and general lags lose the professional feel. The fact that one can attend a professional meeting with an animal avatar made them uncomfortable and they disliked it further. They felt that such an action can never lead to the development of good professional relationships. They went on to say that virtual world meetings can never replace face to face interaction but can only be best substitute given the technological improvements that need to be made with time. The above shown figure 4.3 summarizes the findings derived from participant information.

4.8 Participant Four

This participant was inexperienced in concern with virtual world technology. They had never really heard about virtual worlds. They had however been using other social networking sites and video conferencing technologies for quite some time. They were very cautious throughout the study. They looked confused at times and asked smallest of the doubts and questions. The study went on for more than an hour.

They however said that they had been using Skype since some time now to meet and be in touch with friends and family. They occasionally discuss some business issues over video conferencing and said that this gave them a better idea of where the communication was heading. They also said that Skype gives them a chance for an eye-contact which proves extremely helpful for transfer of emotions. They however went on to say that these software do not provide them with group voice and video chats which is a big disadvantage. They liked the concept on which Second Life actually thrives. They felt that a Second Life meeting can give a collaborative sense which is very necessary while working on common things. The sense of co-presence is enhanced due to the ability of sharing content. They were impressed by the range of activities that can be carried out within the world.

Throughout the study they were a bit nervous about whether they were being able to answer questions to my expectations but once we got into the discussion session they felt very comfortable. This made them identify and express what they disliked about Second Life features. They had a myth that the text chat can only be public within Second Life. They were later told that we can have private one to one as well as private group chat. They were not satisfied with the uploading process of the slides during presentations. They felt that it should be easy to upload and free of cost. When asked “How can these troubles be overcome?” their response was that software can be imbibed within Second Life which will allow various options regarding voice, video chats and presentations. The results obtained from the study with this participant have been summarized in Figure 4.4.

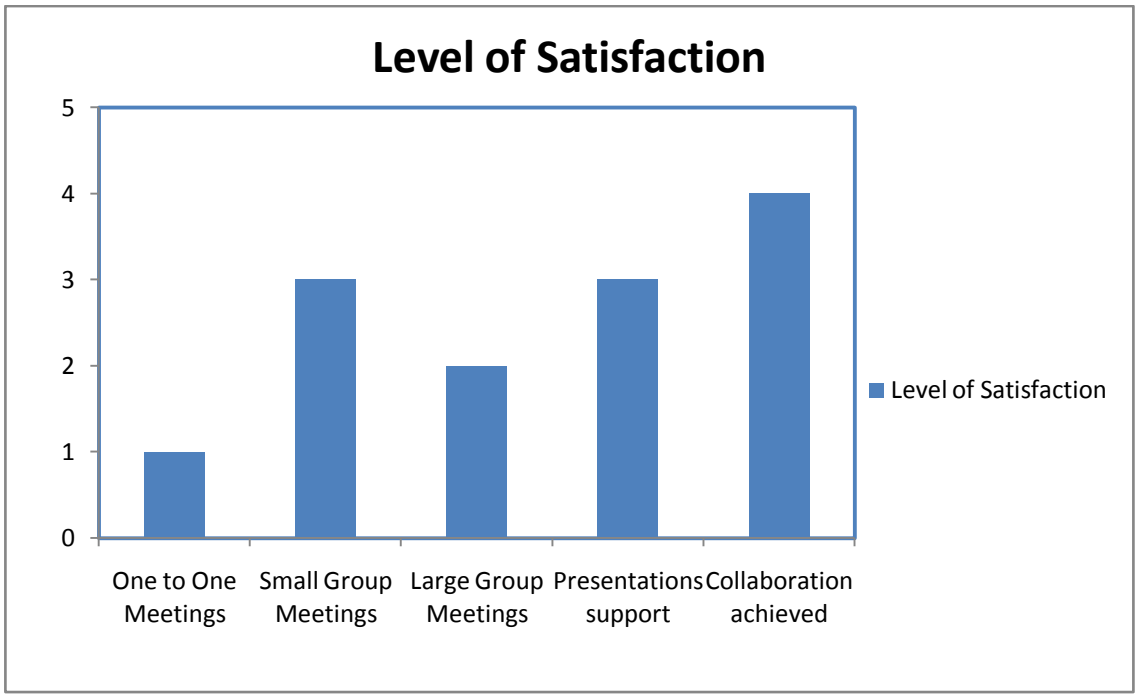

Figure 4.4: Satisfaction analysis for Participant 4.

4.9 Participant Five

Participant Five started off well and speedy enough to complete session one quickly. During the second session they had a few doubts regarding the legalities of this world's communication features. This participant was not much satisfied with what they had seen. They called it a multi-user game and went on to say that the world lacks the communication technology to go even close to face to face interactions. The only thing they liked was object building within a collaborative atmosphere where any user having the right to alter the contents of the object can alter them thus achieving team work.

This participant was not very satisfied with the virtual world's communication features. They mentioned that these meeting setups would be successful for bigger groups, groups with at least ten participants (refer figure 4.5). They liked the prospect of sharing files and giving online presentations to delegations but said that the process of uploading slides is somewhat not as easy. They felt that the avatars interacting with each other with some general lag involved makes them look out of

synchronization. They however mentioned that they would like to be a part of such a meeting and thought that such a meeting can be quite effective. They went on to credit Second Life for low cost to benefit ratio it provides for its users.

They suggested a better voice support for meetings and a separate messenger within the world to communicate which will include video support. They mentioned that if not live video feed then the avatar should be shown in the window so they get a clear idea of at least whom they are talking to. This participant had no doubt in their mind that they would navigate away from Second Life which runs in a browser and use some other messenger such as Yahoo or Skype since it gives them freedom to express themselves in the best possible way. This participant was more interested in the communication features that can be added and stated the existing ones to be low profile. Fig 4.5 summarizes the study results for this participant.

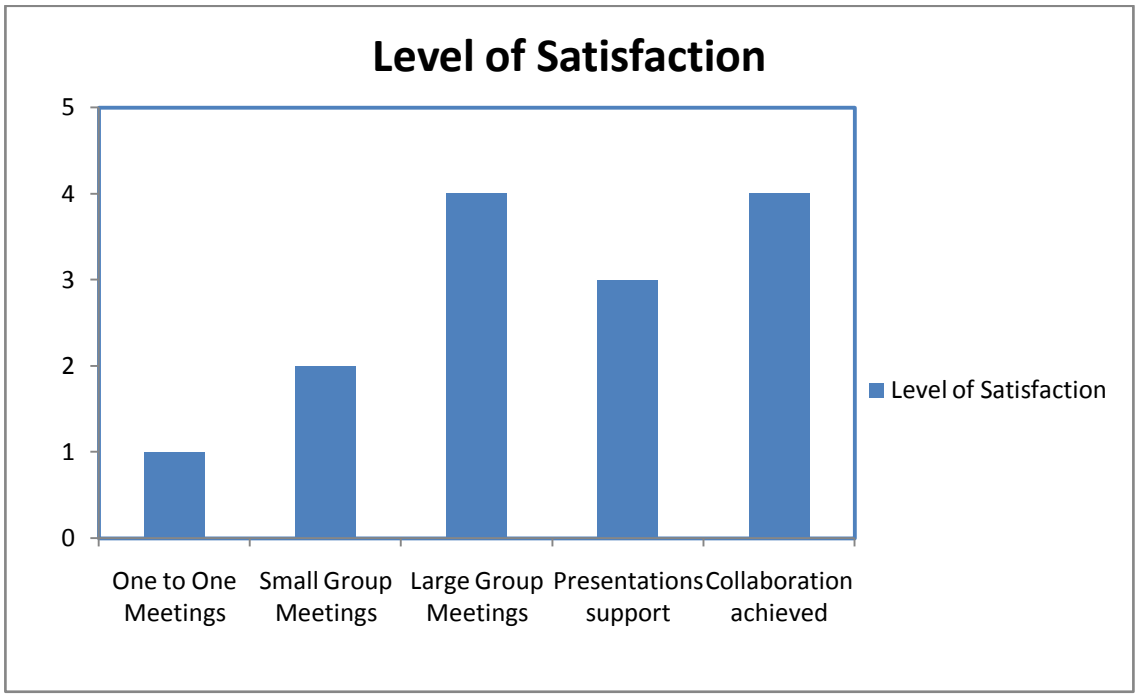

Figure 4.5: Satisfaction analysis for Participant 5.

4.10 Participant Six

This participant was extremely cautious from the outset. They thought for sometime before answering. They mentioned that they like some of the networking sites and are

the best way to be in contact with friends and family. This participant was also entirely new to virtual worlds. They had never actually heard of Second Life earlier. They said they use video-conferencing software to carry out their work related meetings when not available for face to face meeting and were extremely satisfied with it. The fact that the video conferencing software actually had no usage cost as well as it gave a live video feed which made them feel as a face to face meeting. They mentioned a thing or two such as the inability of the current software to send messages to actual phone. They were of the opinion that software which can be used for voice, video, SMS as well as e-mail would have been an ideal one to imbibe. When asked if they would like a software where a shared presentation can be given online, their answer was 'no'.

This participant mentioned that a virtual world is very useful in bringing people together who are geographically far away. They went on to say that it gives the users a sense of sharing the same space and build, alter things that they themselves or other users create. They felt that a virtual meeting would prove very effective and can be a substitute for real life meetings where the travel costs will be too high as compared to the benefit. They liked the fact that the cost to benefit ratio for a virtual meeting would be less. They said they would love to be a part of such a meeting environment. This participant had earlier mentioned that giving presentations would not be on their wish list if they were to select software for conferencing, but later they mentioned that such presentations can prove very handy while meeting conferences in shared spaces and were very happy the way Second Life provided it. They were content with the capability of virtual worlds with respect to meetings of smaller sized groups (refer figure 4.6) and went on to mention that large groups can also benefit if controlled voice access was provided.

This participant however was of the opinion that they would navigate away from Second Life to use video enabled software for one to one conference meetings. They felt that building relationships in a face to face professional setup is better and easier than in the virtual world. They suggested that messages and e-mails from Second Life to outside world and vice-versa should be made possible as well. They felt that this

environment was suitable for large gathering meetings of more than ten people if the avatars were controlled and everyone should be given their chance of making their point. They disliked the avatar interactions while speaking or discussing over an issue as they said it looked quite unreal in a professional setup. Figure 4.6 analyzes the summary of the participant's thoughts better.

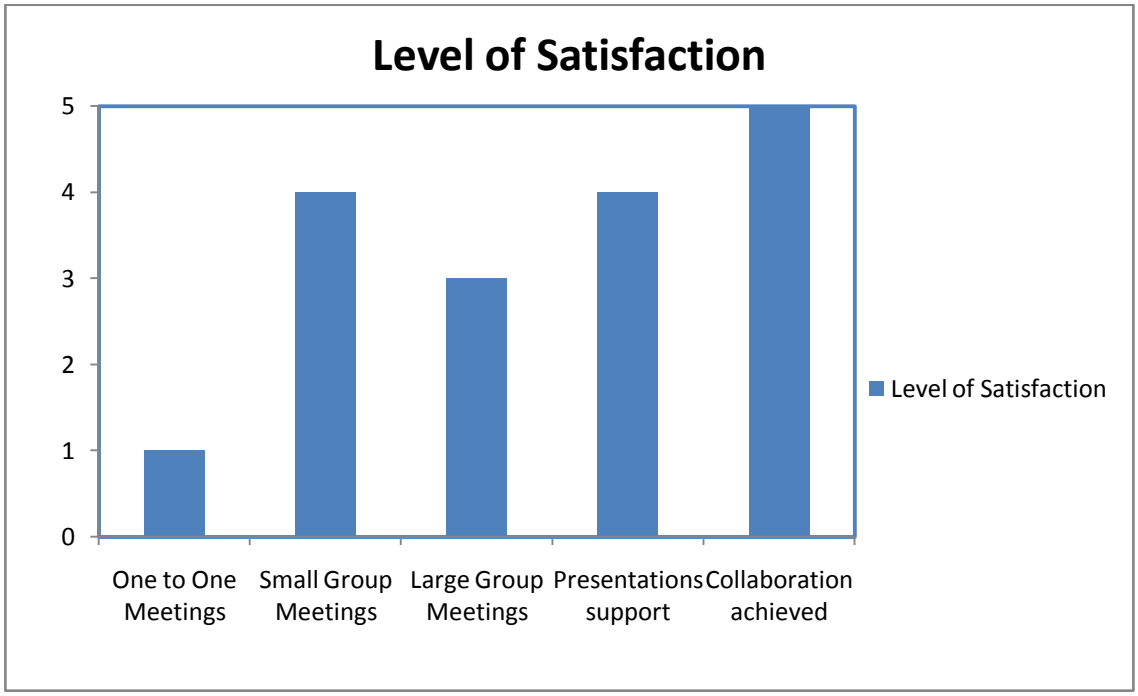

Figure 4.6: Satisfaction analysis for Participant 6.

4.11 Participant Seven

This participant was experienced with virtual worlds. They had used Second Life before. They sped up the entire study period but made a few comments worth noting before signing off. This participant is from the computer field and uses the internet always for socializing and working. They mentioned that the kind of investment that has been done within Second Life itself suggests the reach and potential of this world to provide the organizations with a suitable working and meeting environment. They liked the current features of the virtual world but went on to say that addition to the set of features is must with the technological advancements. This participant was very precise throughout the study.

This participant was very satisfied with what they had seen. They said they liked the voice communication feature in Second Life and maintained that the features will only get better with time. They were happy with the instant presentation ability provided in world and that they found it as the best attribute in having such an online meeting or conference. The kind of activities that can be supported within Second Life for team building process also impressed them. I did feel that the participant had a good idea of what and how Second Life actually works and understood the difficulties that may be faced while allowing live video streaming of users during a conference. They felt that they would like to be a part of such a meeting and personally felt that these worlds not only help save time and money but also reduce pollution by avoiding a need to travel and thus was eco-friendly. They however said that they would use Second Life for small group meetings and would also prefer for large group meetings if the voice access was controlled by a controller. They said this was also prove good to use if the number of speakers were limited (refer figure 4.7).

The participant then slowed down during the last session that is the discussion session. They were very interactive and answered the questions posed in a very professional way. They thought of the world being used by professionals and pointed out that the avatar interactions caused some lag leading to distraction when interacting professionally. They disliked the emoticons and the way avatar reacts for certain set of situations. This participant suggested that a simple avatar displaying the avatar in close-up screen be present while interacting via text or voice if not live video. They mentioned that they would navigate away from Second Life and use other available software only if they either want a one to one conversation. They however said that they would use Second Life for small and large group meetings where high speed access will cause least amount of lags. Figure 4.7 gives represents this participant better.

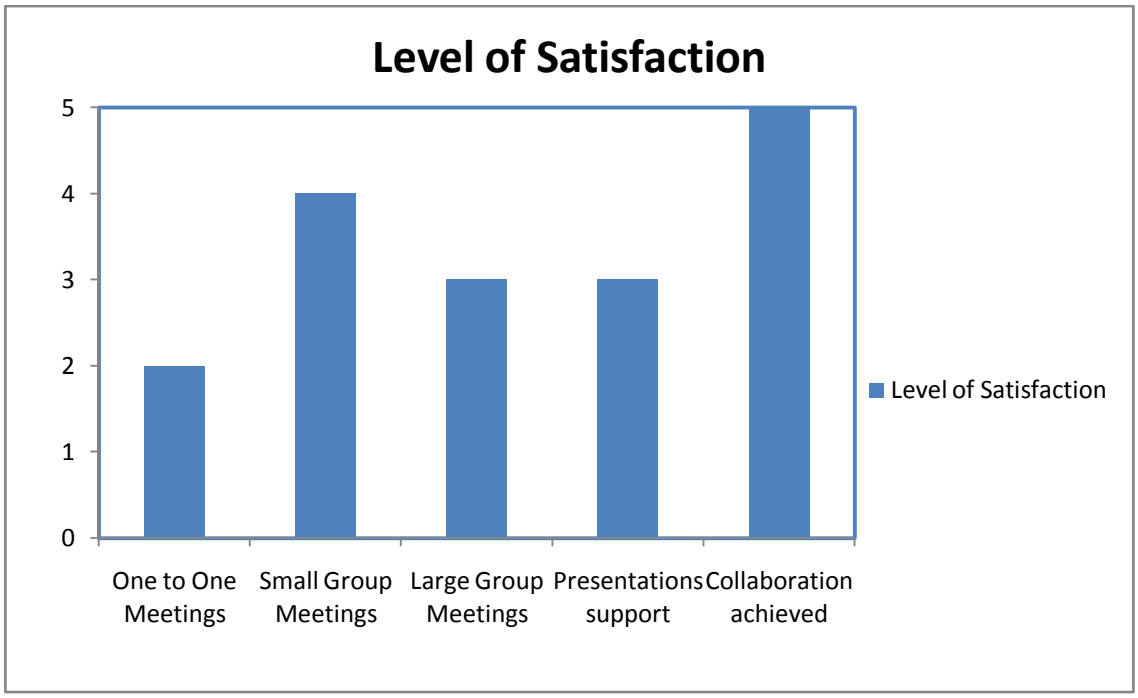

Figure 4.7: Satisfaction analysis for Participant 7.

4.12 Participant Eight

This participant was one of the few inexperienced ones and they did not know what Second Life virtual world exactly was. They had never been a part of a virtual world but were interested to know something new. They had some doubts and asked them each time they would feel they should know something more about that part. They initially mistook it for some multi user game but as the study progressed they felt that this was something very interesting that they should themselves give a try. This participant was impressed with Second Life overall and mentioned a few things that they thought might prove useful ultimately.

They were surprised by the kind of work that can be achieved here. Also, something that took them by surprise was the presence of top ranked organizations establishing a base within the world and holding recognized annual technical conferences, recruitment and training within Second Life. They liked the way meetings are held and the prospect of knowing and building relationships with people from the same profession excited them further. They said they would like to be a part of such a

meeting. They also found that during the recession hit period this would play as a best substitute for companies where they can cut costs on travel rather than cutting costs by lay-offs. They went on to commend Second Life for the collaborative nature it provides its users add to it the prospect of creating and sharing content and copyright the content they create (refer figure 4.8). This they say is unique and they would never navigate away from Second Life virtual world as they provide voice support for group meetings which can prove useful to hold small group meetings especially and large group meetings where the list of speakers would be limited. They rejected the idea of navigating away from Second Life and using other software but went on to mention that they actual relish the idea of seeing a person while talking with him.

This participant disliked the avatar interaction while meeting and greeting a person, they pointed out that "It just looks so unreal and manipulated and cannot fit into a professional outlook". They also did not relish the idea of meeting their manager who might bump into them with an animal avatar. They would have liked the immediacy of response to be better like where text messages can be sent from Second Life to real world and vice-versa. The following figure 4.8 summarizes the participant interaction.

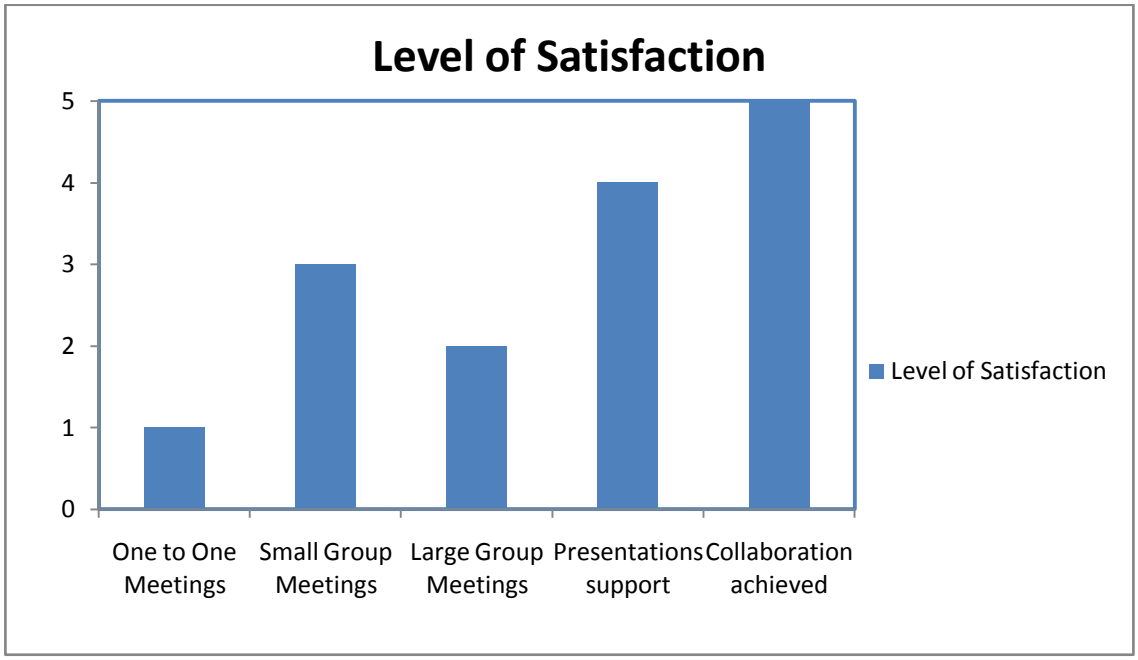

Figure 4.8: Satisfaction analysis for Participant 8.

4.13 Results

The study was not conducted with respect to any time constraints but the time for the entire study as well as individual sessions was recorded. The study was conducted for eight participants in all. On an average the participants took an hour to complete the study. Half of the participants slowed down towards the end of the study. The participants started the first session and most of them sped through it. They slowed down in the later part of the study as they had to go through some important data and videos.

It was observed that most of the participants had a liking for the collaborative content that Second Life provides with. They were very satisfied with the level of collaboration that can be achieved in the virtual world. They mentioned that they would have liked to have more immediacy of feedback than what was currently available within world. They would want to have ability of messages to be delivered from Second Life to real world and vice-versa due to the persistent nature of this world. When asked if they were satisfied with the collaborative content this world can provide, all the participants had consistently mentioned that they were either satisfied or very satisfied. When asked if they would love to be a part of a meeting held within Second Life, 75% responded positively. Also the support of uploading images and giving presentations was liked by 85% participants; they called the uploading task hectic. The participants were not satisfied with the possibility of one to one meetings as they felt that they would most other software outside of Second Life provide better features for communication and they would tend to navigate away from the Second Life world which runs in a browser by minimizing it. The participants were however liked the group communication features but said that the combination of collaborative nature with ability to video conference among small groups would have been close to the gold standard of face to face interactions. They mentioned that would invite a prospect of such software to be imbibed within the world. 80% of the participants agreed with the fact that some users might not be comfortable with their voice or

video being played on the Second Life server and mentioned that software can actually be imbibed in the virtual world which will present them with options for communication; even a text to voice converter can be used to hide the identity if it was male or female on the other end. However, the current features of this world will prove better for small group meetings than large group meetings because in large groups there will be confusion and lots of unwanted noise if a speaker list is not maintained. Following figure 4.9 shows the ratings within a certain range as the participants mentioned.

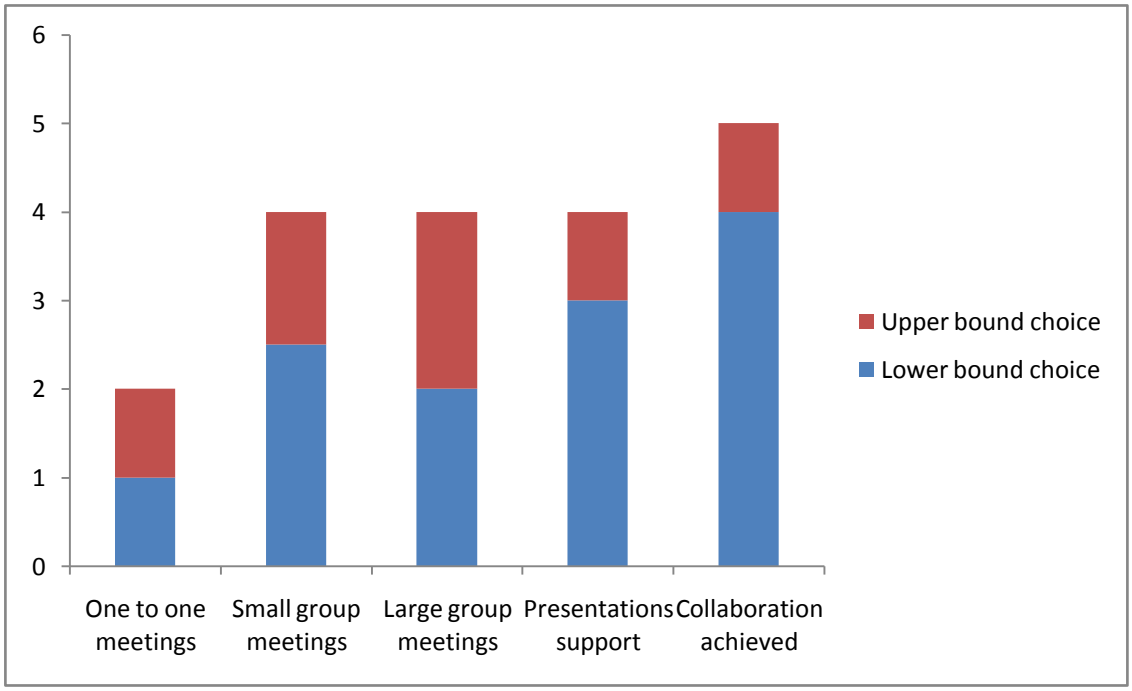

Figure 4.9: Comparative analysis of all participants.

It can be clearly seen from figure 4.9 that one to one meeting was not much preferred by the participants within the virtual world. The red part depicts the range of the ratings provided by the users for various features within Second Life. 100% of the participants were satisfied with the collaborative nature of the virtual world. When meetings were concerned most of them had the opinion that the due to lack of superior communication features that are available if they navigate away from the world, they rated the success rate of these meetings low. Almost 80% liked the shared

presentations but 85% of the participants rated the group meeting success as not very satisfactory. 100% of the participants said that given a chance they would add a few features which would keep up with the technological advancements in real world.

4.14 Demographic

The average age of the participants of this study was 35 years. The number of participants for the study was eight. The participants included 6 men and 2 women. The participants had different backgrounds, educational qualifications and computer skill level. They belonged to various fields from engineers, hoteliers, web developers, managers and students. Almost all the participants have been using computers for long now. The average number of years since they have been using computers is 6 to 10 years. Most of them used internet for socializing, e-mail and work. Almost 75% of the participants said that they often use internet for work related purposes. All the participants said that they were happy with the current software that they use for holding online work related meetings. Most of them used Skype, Gmail, Nortel, yahoo messenger services among others. 90% of the participants rated themselves good with their computer skills.

4.15 Conclusion

The aim to this study was to explore the current set of communication features and their support for a collaborative environment. This study also aimed at various avenues to find the advancements that can be made to the current set of communication features in order to make it more usable in future with collaborative work and long distance meetings in concern. The results of the study clearly show that users are satisfied with the amount of support this virtual world can provide when collaborative work is to be achieved. It shows that the users navigate away from Second Life only due to lack of few communication features that are provided by other software available. Software which will allow users to be in the same virtual world, carry out the collaborative work intended as well as communicate with their counterparts in a way they intend shall be imbibed. A video-conferencing software providing users with options for the level of transparency would be a better option. It

should also be able to send and receive messages from Second Life client to real life mobile phones without restricting the size of the message and support to send and receive e-mails so that users need not navigate away from the virtual world. The presentation support provided is very impressive but the process of uploading the images would prove to be a daunting task at times. To hide identity, a software can be imbibed which will have a text to voice converter which will not reveal if there is a man or woman at the other end and this will also be beneficial for users who do not have confidence to speak online.

Overall the study gave an insight on the status of the current communication features within Second Life and the needs users have while thinking of substituting such an environment for the gold standard that is face to face interactions. The next chapter discusses a software developed intending to solve the problems mentioned in this chapter.

5 INC (Intra Network Chat) Software

5.1 Introduction

The INC Software presents a very user friendly design using Java. This chapter discusses the technology used, design and analysis, user interaction sequence and screen shots of the implemented system to end with. It provides with the guided User interface description with screen shots of the underlying software. This software is built to produce an effect which can be imbibed in Second Life virtual world in time to come. This chapter demonstrates such a robust client-server system with unique feature set to support the need of the hour within existing virtual world technologies so as to make it more usable in future.

5.2 INC Basics and Implementation

INC software follows a client-server model where a client is a simple Java applet. An applet is a special kind of Java program designed to transmit itself over Internet and gets executed by a web browser having Java compatibility. The security and portability is very well addressed by Java without which it was impossible to use applets. Java is designed to meet the requirements of creating interactive and networked programs. This is supported using the concept of multithreading which allows to write programs which handle many things simultaneously. Similarly, a package java.util supports concurrent programming. The term socket refers to the relation between the client and server. It deals with the TCP/IP packets where IP is Internet Protocol and is a low-level routing protocol used to break data in the form of smaller packets which are then transferred over a network without the reliability of safe transfer. TCP (Transmission Control Protocol) on the hand is higher-level protocol which guarantees the safe transfer of data [18].

The Abstract Window Toolkit (AWT) contains a number of classes and methods which are used to create and manage windows. AWT is the foundation upon which Swing is built. The main purpose of AWT is to support applet windows. The AWT classes are contained in the java.awt package. Event handling is the most important thing when applet programming is concerned. Most of the events to which the applet will respond are generated by the user. Events are supported by the java.awt.event package which might be generated from mouse, keyboard and various other controls. Similarly imaging is supported by AWT's Image class and the java.awt.image package. Swing is an extension of AWT but not a replacement. Swing components extend AWT components [18].

Netbeans IDE has been used for the GUI development. Java users can download a single file and start using directly since all the modules required are obtained in a single file.

The Servlet Life Cycle:

- Servlets have some part which is static. They do not produce content by themselves. They perform some task on the part of the client.
- Servlet Container is a server which is responsible for executing the servlet.
- When the servlets are run it sends an HTTP request to the web server which in the case of INC is Apache Tomcat.
- The Web Server then sends a request to the web browser.
- The web browser then sends a HTTP response to the web server and the servlet are then active [18].

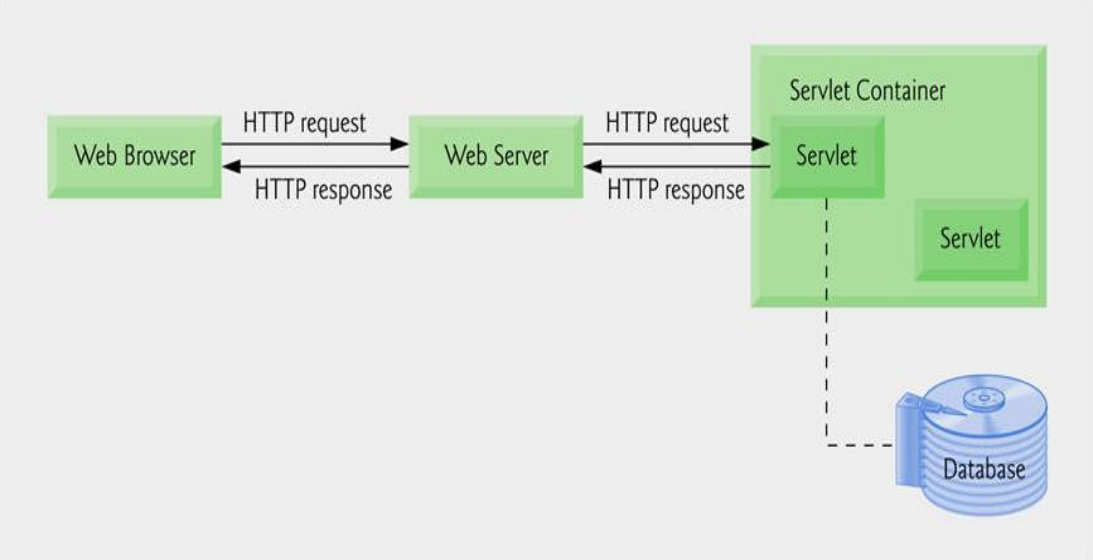

Figure 5.1: Servlet Life Cycle [18].

5.3 Analysis and Design

The class diagram is shown in figure 5.2 below. It shows the association of classes contained and the static structure of the INC system software. It gives an idea of the attributes and the kind of relation the classes have. To extend the design logically, classes are enclosed within different packages. The following figure shows briefly the structure of classes and their associations.

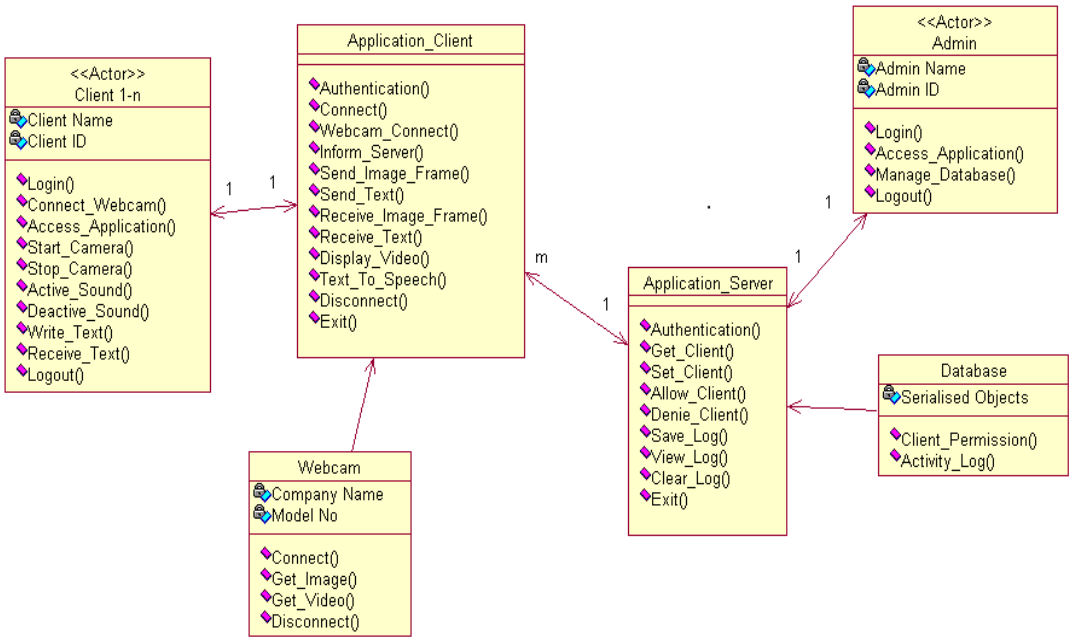

Figure 5.2: INC Class Diagram.

5.4 User Interaction in INC

Figure 5.1 briefly describes the system interaction when a request is made while servlet is run and active, the following section describes the interaction sequence:

1. The server node in the client-server model runs a servlet on their node and then the client.
2. The rest of the nodes directly run the client and provide with name of the server where they want to log in and connect into client-server architecture.
3. The users then sign in to the chat from their respective id's. Once they login they get several options to choose from including chat, video chat, send SMS, send e-mail amongst others.
4. They can select one of the options and will be able to see the number of users logged in.
5. The users then select an option if they want to allow or disallow video from that user.

6. Once they enter the chat window they can choose if they want to display their avatar, video or transmit video with text and converted voice.
7. They can actually create new profiles or update existing ones.
8. The above given user interaction sequence can be better realized with a sequence diagram showing the interaction sequence within the system with the order of the events being maintained. Figure 5.3 shows an interaction sequence diagram for the video chat event.

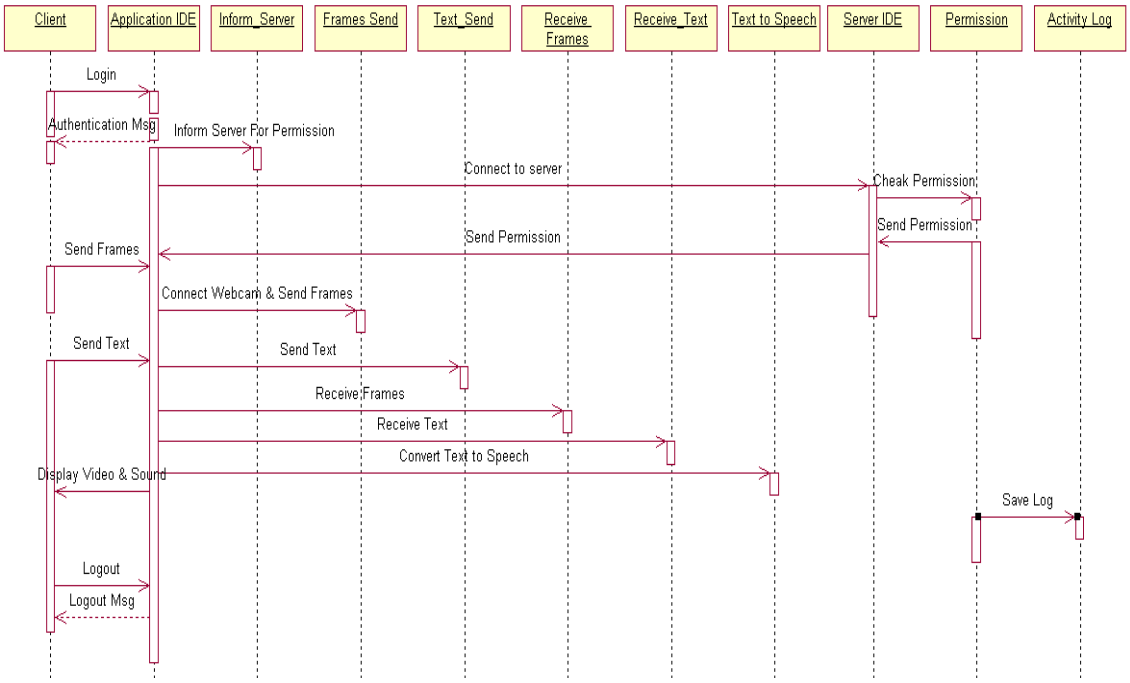

Figure 5.3: INC Sequence diagram for Video Chat.

5.5 INC Software Screen Shots

In this section, the snapshots of the implemented system are displayed. The developed product is not within a virtual world but it only demonstrates a possible prototype. The following section will only detail on the screen shots right from the log in screen. The screen shots are aimed to show the working prototype of this software. The avatar screen and the video ability are key aspects of this software. It will also demonstrate the working model of text chat and the SMS and e-mail ability

features. The group video chat software with avatar screen and with live video screen is the key aspects of this prototype. The voice chat feature with text to voice converter, SMS and e-mail being the other important aspects.

5.5.1 Log-in panel

The INC software user log in panel can be seen in figure 5.4. It creates a user profile when a user creates a new id. The reload gives the user id just created in the list of user-ids available. Once the user is logged in, a new session is created for the specific user profile.

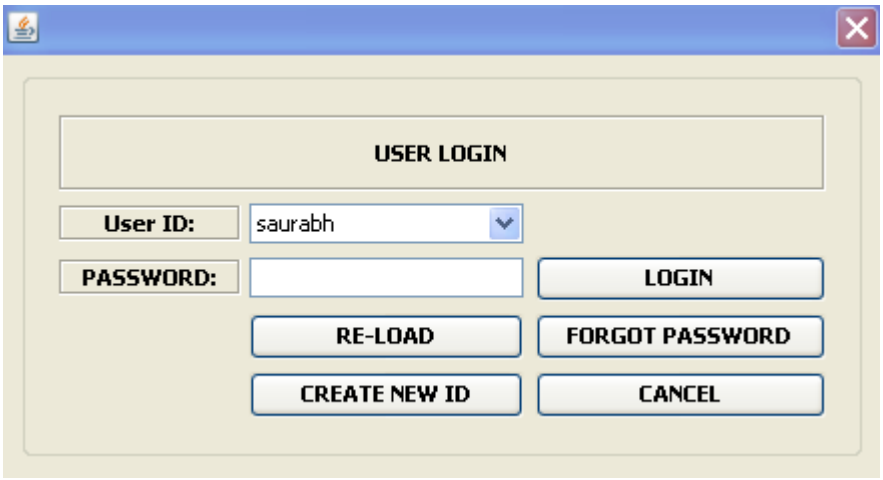

Figure 5.4: User Log-In panel.

5.5.2 Main menu

Once the user is logged in, the main menu screen will be displayed where the user will be selecting from the options such as chat or video chat. Figure 5.5 shows the main menu displayed to the user. Users can also edit their profile here. The settings can be changed and saved by clicking the update settings button. They can send SMS or e-mail to the outside world from within this software itself.

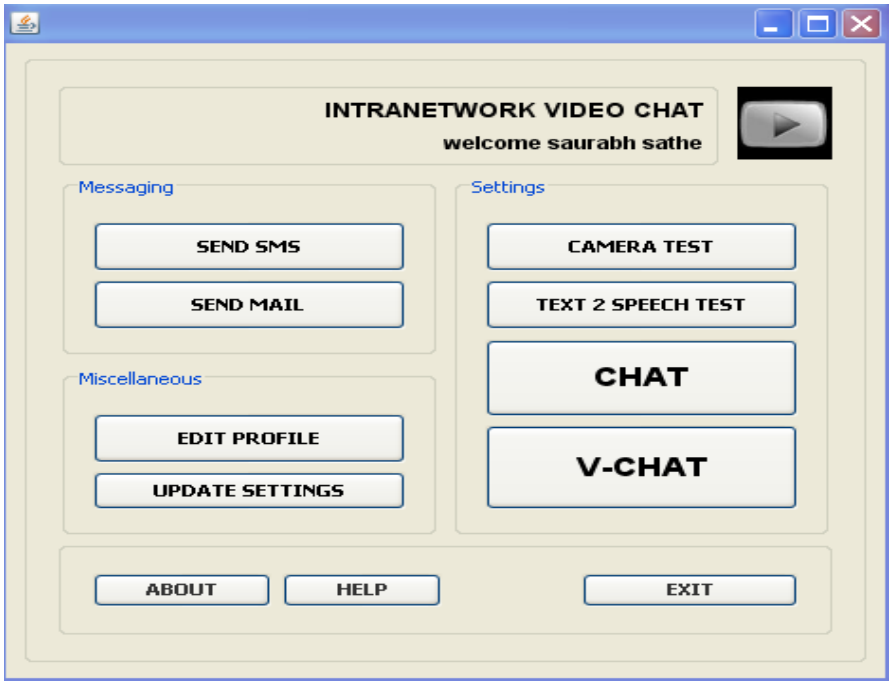

Figure 5.5: Screen shot for Main menu.

5.5.3 SMS and e-mail functionalities

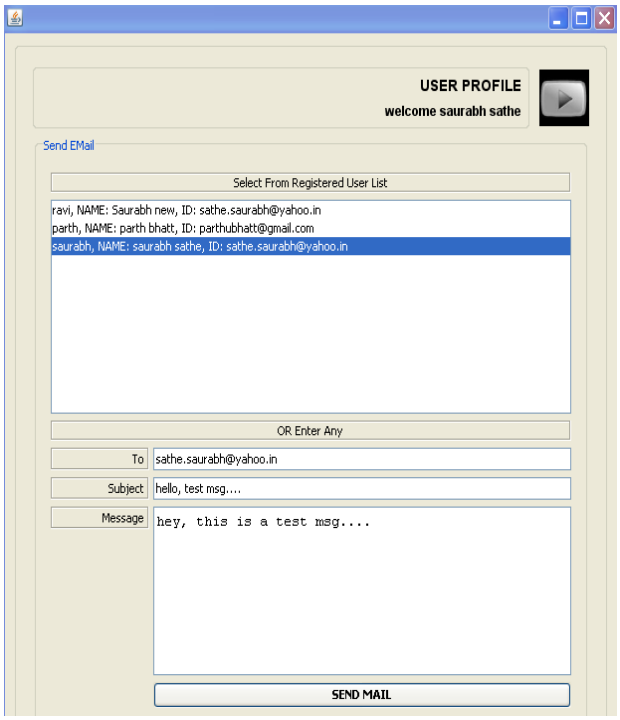

Figure 5.6: Sending e-mail.

SMS to real world mobile phones with no limit on the message size and e-mail messages can also be sent from the software without having to navigate away. Figure 5.6 above shows the way this can be done from INC software.

5.5.4 Chat functionality

The simple text chat functionality in Second Life allows voice to transferred over through a text to voice converter and the voice will thus not be the original one. This can prove useful who are not very comfortable with their own voice during a conference or someone who is shy and does not talk much. This functionality also allows a user to load their avatar close up screen image rather that empty or live video feed. Figure 5.7 is a screen shot of INC supporting avatar interaction.

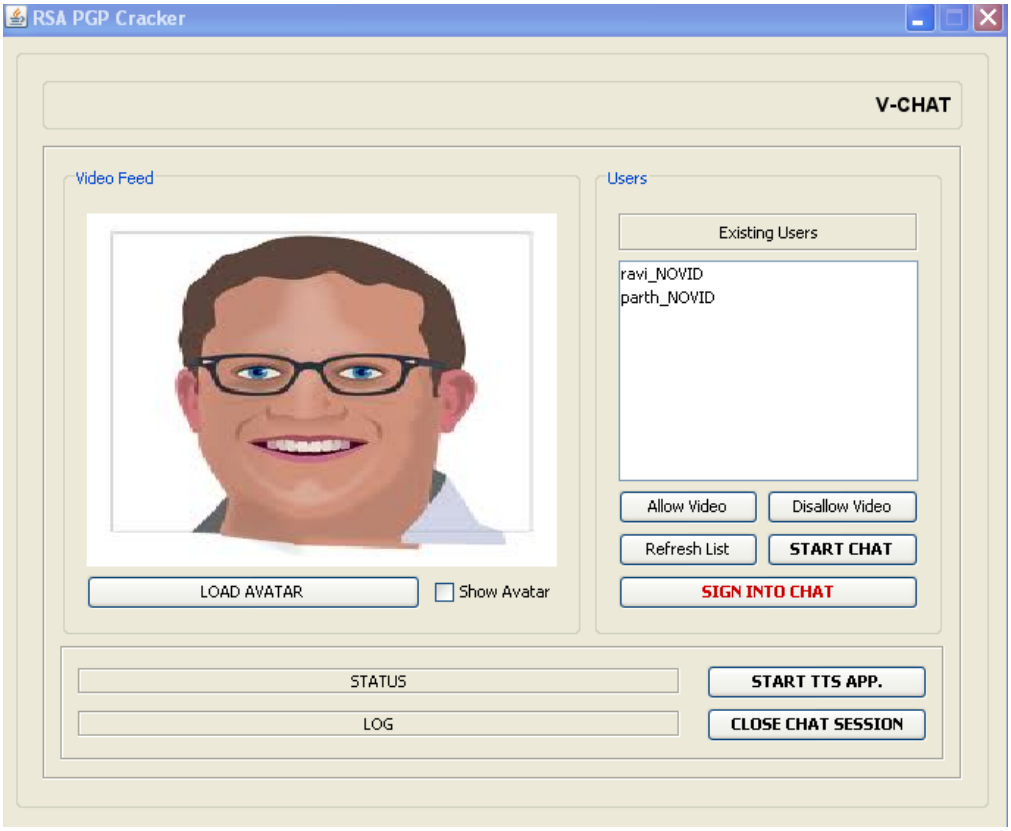

Figure 5.7: Voice chat functionality with avatar.

5.5.5 Video chat functionality

A video chat option offers the users with a live video of the person whom they are talking to. The user who initiates the chat has the option if they want to chat with the user with video or without video. They are also given the option of selecting or deselecting the 'enable feed' and 'transmit video' checkboxes. The users then need to select the user they wish to chat with and then sign into chat. Following figure 5.8 shows the video chat functionality in INC software.

Figure 5.8: Video chat functionality.

6 Research conclusion and Future Work

6.1 Conclusion

Virtual Worlds such as Second Life are used by many organizations, individuals and educational institutes. Users have found it beneficial since it puts users geographically far away into virtual contact with each other. During the course of this research, smallest of the things that Second Life supports with respect to collaboration and communication in order to prosper business, e-commerce in this world was discussed. It is known that Second Life is good at providing users with a collaborative sense giving them a sense of co-presence and make them feel as if they exist in the same physical space. Second Life provides its users with a limited set of communication features which includes one to one and group text chat, voice chat provided the users are within a specified virtual distance away when in world. This makes Second Life lose out on the edge they had over other communication software.

As the research progressed, the author conducted a participant study where most of the users opined that they would navigate away from Second Life for better communication features. Second Life runs in a browser and can be easily minimized to use other software for conferencing. The author's intention with this thesis was to integrate the benefits in the form of collaborative co-presence offered by Second Life currently and the advantages of better conferencing software. This triggered the motivation behind the development of a software to demonstrate its benefits if merged with the current Second Life setup and thus INC software was developed. This software addressed most of the problems alarmed by the study participants if it were ever integrated with the features provided by Second Life. Such a step would prosper the future of meeting support in Second Life and virtual worlds in general.

The ideas and implementation for betterment of meeting support within Second Life proposed in this thesis has certain issues that still need to be addressed. The following future work section discusses these issues.

6.2 Future Work

The author of this thesis had a few more things on his wish list but due to time and scope limitations remained in the 'wish' list. Some of them have been identified which can be addressed in the near future include:

- Presentation support for the users enabling them to give a presentation to their online counterparts without having to navigate from the system.

- Implementation of the underlying prototype using the native Linden Scripting Language in Second Life.

- Improve the frame transfer rate in order to achieve better video quality.

- Perform regular usability check to assure the validity of the prototype in this technologically advanced ever changing world.

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Appendix A

Usability analysis for communication features in Second Life

Session one:

The participants were given the following information sheet to let them know some basics about Second Life. They were also given some information as they asked for. This information sheet was a brief one since some participants may not understand what was going on and would lose interest in the study.

Second Life

Second Life(SL) is termed as a game by many, it is said more so as its users participate because they can enjoy doing various activities there though there are no points to be won or battles to be played. SL boasts of about one million active "resident" users at any given time.

Currently it is used by 15 million users and if reports are to be believed, the number might just cross 2.4 billion users by 2011. During the first quarter of the year 2009 the number of hours spent by the users inside the environment was 124 million. There are several countries that have their embassies inside SL. Maldives was the first country to have a Second Life embassy. Later on, Sweden, Estonia, Colombia, Serbia, Philippines and Albania established their embassies

It is often seen that Second Life is used as a platform to perform collaborative work by organizations. The main reason behind this is the shared physical space that is given to the users to perform activities which they cannot perform elsewhere.

Various kinds of collaborative work take place in Second Life. The users are able to touch and handle objects in a common space. They also get a chance to alter the

properties of the object and share it with other users i.e. work in groups, understand and solve problems mutually or create a product as a team.

The reduction in travel time may be converted to productive office time is the biggest advantage. Other advantages such as reduction in travel costs and collaborative work environment make virtual worlds the technology of future.

P.S. You will be shown some more informative youtube videos as you further your questionnaire.

Session Two:

The users were shown some informative video regarding the Meetings in Second Life and were given simple demographic questionnaire.

http://www.youtube.com/watch?v=L8v0cclQhUs

http://www.youtube.com/watch?v=6kM6WEh5iQk

http://www.youtube.com/watch?v=Kid11jfMLUA

http://www.youtube.com/watch?v=63kkEhyDQhk&feature=related

They were then asked some questions in an open ended session which they quite enjoyed. The study contained 4 parts as questionnaire. In parts 2, 3 and 4 they were asked simple question on their satisfaction with what they had seen.

Part 1: Initial Questionnaire

The initial questionnaire had the following questions in it:

What is your age group?

How long have you been using computers for?

For how many hours do you use computers in a typical day?

What are activities that you use the computer for?

How often do you use the internet to socialize/chat/work?

Part 2: Social Networking

Do you use social networking sites to meet or be in touch with others?

How many social networking sites you use regularly?

Rate the quality of satisfaction that these networking sites provide in terms of meeting people who are geographically far away.

Are you satisfied with the current video conferencing software available?

List the software you use for video conferencing?

Would you like to have some additional features such as sharing data files or giving online presentations?

Part 3: Second Life Virtual World Meeting Support

How effective do you think such a meeting can prove?

Would you like to be a part of such a meeting?

How expressive do you think an avatar is in a virtual environment such as this, so as to be the best substitute in place for face to face communication?

Would you like to use Second Life virtual world to hold gatherings or meetings, be it in work context or not?

How effective is presentation in Second Life according to you considering the cost/benefit ratio of uploading slides?

How easy would it be to talk and build relationships compared with a meeting in real life?

While meeting in Second Life, would you navigate away and use video conferencing software such as Skype, VOIP for meeting support?

Which out of the following meetings do you think can be better achieved in Second Life?

a. One to one meetings
b. Small group meetings (3-10 users)
c. Large group meetings (more than 10 users)
d. Large gathering meetings (more than 50 users)

Appendix B

System Requirements:

- Windows XP with a web camera facility.
- Internal memory: 256 MB.
- NetBeans IDE.
- Jdk 1.6
- Apache Tomcat Web Server.

Software installation:

1. While installing Netbeans you should have jdk already installed. Run the NetBeans exe and just before its installation deselect glassfish and select Apache Tomcat as the Web Server.
2. We need a text to speech (TTS) engine to make sure that the voice is enabled. To do this go on the Microsoft website and download SAPI installation files.
3. Also, make an acoount with timessms.com which will provide a unique GSM id to be able to send messages from INC.

Executing the system:

- For the INC to run, at least two systems must be in a network. For that just go to command promt and type "ipconfig /all" to get the IP address on all existing nodes. To authenticate a contact with the server, a client needs to run a command "ping 192.168.1.67"(put the IP address of the server, 192.168.1.67 is just shown as an example) the that node. Similarly the server needs to send a ping command with the client's IP address.
- Once all the installations have been done with, we must go to netbeans and select open new project. At the server end, browse the chat servlet module to start with and then open the chat client. While running from the server end,

run the chat servlets and then the chat clients where the PC name of the server will be provided.

- While on the client side simply run the chat client and enter the server PC name when asked.
- Now all the nodes are in a network and all they need to do is access the chat software with a valid username and password.