Report on the application of virtual reality in the construction industry

Design

Introduction

Virtual reality abbreviated as VR is a computer way of making imaginary things look like they are real. In this case, a simulation software is used which tends to make things look as if they are real even though they are not. Virtual reality involves the creation of animated and three dimensional objects which are then operated via a simulation software. Virtual reality can be applied in different fields of construction. It has several advantages and many firms are employing its use in their day to day activities in the firm. Several design works can be achieved through the use of virtual reality. (Howard 1992)

Virtual reality involves the use of computer for modeling which may enable a person to interact with an artificial environment. The artificial environment is computer generated. In virtual reality, only two human senses are involved and they include the vision and the hearing sense. (Nobert 1988)

The computer software for virtual reality must be kept up to date and try to imitate the real environment as much as possible. The main essence of virtual reality is to have an environment that resembles as much as possible the real environment. Failure to which the aspect of virtual reality will have not been realized. (Howard 1992)

History

Basically from the name, real time has been used to refer to systems which are fast. They are compared with a clock in their execution. A system can only be referred to as real time if they meet their time constraints. In real

time simulation, all the execution are meant to take place at the very time the process is being executed (Paul *et al, 1987*)

Background for real time simulation

Evolution

Real time simulation has evolved in the recent past step by step with the evolution of computing technologies. The computing technology has improved greatly thus the improvements and evolution of the real time technology and a result a decrease in the cost and an increase in performance. The systems which were used when virtual reality was first discovered has undergone a stream of changes and improvements are still being realized in the construction industry. (Howard 1992)

The construction industry has had several versions of virtual reality which include; different versions of AUTOCAD, coreldraw and other design software. The implementation of the virtual reality has had several advantages in the construction industry as it helps in saving costs and ensuring efficient representation of the prototypes. This also helps in decision making as the outcomes are first predicted before they are implemented. (Paul *et al, 1987*)

There are several aspects that have to work hand in hand in order to ensure a success of virtual reality. They include the hardware, software and the operator.

The operator

The operator also needs to understand that the environment is just being imitated and not that it is the real environment. He/she therefore need not to

expect perfection even though the system will try to perfect the situation but it is very hard to achieve. (Nobert 1988)

Hardware

Virtual reality is influenced with a variety of hardware which include the input devices and out put devices. The devices are designed in such a way that they tend to depict the sense of natural interaction. (Bennet 1987)

Software

The virtual reality software are designed so as to provide the actual operation of an environment so as to achieve its reality nature. The hardware cannot operate on their own but there must be some special kind of software which will be used in their operation. (Paul *et al, 1987*)

Background of virtual reality

Virtual reality has been existing since time immemorial. It is not a new subject in the computing or construction industry. The first person to introduce virtual reality was Ivan Sutherland who introduced some concepts about immersion in a simulated world. (Sutherland IV, 1965). The main challenge in the implementation of virtual reality is to make the world sound real and look real. (Howard 1992)

The main goal of virtual reality is to have the user fit in a loop of real time simulation. This is however not easily achievable. Some of the things that are required in order to realize this aspect include:

1. User input – These are the channels that allow for the interaction between humans and the environment. A person can feed information

into the computer system through the use of the user input and then wait for the response which in most cases should be real time.

2. Sensory feedback: Our senses are used to realize this. The senses involved here are our vision and the hearing sense which tend to grasp the imitation of the real environment with the simulating machine. (John 2000)

Benefits of real time simulation

1. It offers the ability to test equipments that would cause damage to equipment or personnel.

2. It offers the ability to test systems where there are no prototypes existing

3. There is overall reduction in costs especially in the later phases of development

4. It offers the ability to test systems at any time of the day without any form of hindrance. (Nobert 1988)

Applications of virtual reality in construction

1. Training personnel: Virtual reality can be used training personnel who are to work in dangerous environments. This is very useful especially in the construction industry where some environments may be considered risky. Training on safety precautions can be done using this method. It can also be used for simulating the training equipments especially when the equipment is expensive to acquire. There are some materials and training equipments which are expensive and not every firm can afford them. Having a simulator can help achieve the overall goal of training even without acquiring the real equipment.

Some examples of workers who can also be trained using virtual reality include pilots and medical practitioners for conducting new medical/ surgical procedures. (John 2000)

2. Prototype design for new products: The virtual reality can be used to carry out a market survey for a new product and predict the possible customer reaction before trying the new product in reality. (John 2000)

3. Entertainment: Virtual reality is used in designing gaming software so as to imitate the real gaming environment as much as possible. (John 2000)

Development of virtual reality environments can make a very significance impact on how projects can be successfully completed in a construction industry. The techniques of Virtual reality have proved to have the potentiality of enhancing efficiency and effectiveness of all the stages in a project. The virtual reality helps in laying down an organized process for the construction activity, these include: design, planning all the way to completion of the construction.

Real time simulation

This is an aspect of a computer property that makes it execute an action at the same time with a clock. It implies that there is no delay in the execution of the process. Once the process is complete then the computer program should also be in the position to have completed the execution. (John 2000)

Software tools available for real time simulation

There are several software tools which enable real time simulation and ensure that information is passed immediately a process is executed.

However, most of these software for achieving virtual reality are difficult to design.

Systems which support virtual reality can be subdivided into two:

Toolkits
These are in form of libraries with predetermined instructions. They provide a set of functions which are used to support the creation of a virtual reality application.

Authoring systems
These are programs which are complete with several interfaces for creating the virtual environment. They include scripting languages and other platforms which can enable the creation of the virtual environment.

There are no systems designed yet which has the capabilities of supporting the virtual reality environment alone. Several systems have to be joined together in order to provide the capabilities of the virtual environment.

Software tools available for real time simulation

Some of the software tools which are available for simulation include:

1. Screen capture

2. Electronic performance support

3. Assima

4. Datango

5. Install shieldcaptivate

6. View let viewer

7. Rapid builder (Nobert 1988)

There are several other software tools which are available in the simulation environment. Some of which have not been fully exploited.

Difference between real time simulations and other forms of visualization used in the construction industry include:

1. Its application is usually mission oriented
2. They are usually executed at the same time with the clock. Execution is done immediately.
3. In real time simulation, deadline must be met regardless of the load in the system.

Limitations of the simulation models

There are several limitations that are found in the simulation model. These are due to the fact that achieving a complete and a perfectly simulated environment is not easy to achieve. Some of the limitations include:

Lack of noisy data in the environment

Most of the sensors tend to pick unnecessary data from the environment which in turn affect the overall performance of the system. This makes it very difficult to train the system so as to understand what kind of data to pick and which ones not to pick. The environment has too much noise and it becomes hard for the system to filter only the useful data for its operation.

Incomplete and inaccurate Models

There are situations in the real world which are very hard to emulate. This poses a major problem of achieving a perfect system to emulate the environment and make the situation look real.

Lots of time for training a system

For a system to operate almost perfectly, several tests have to be done. The tests come with some predetermined conditions which are used to set the system. A lot of time is wasted in trying to train the system so as to react positively to the set conditions and give the desired results. (Paul *et al 1987*).

Case studies

Case 1: Airport Construction - San Francisco Airport

Virtual reality has been implemented in San Francisco Airport. The use of virtual reality made it possible for people to know the types of machines they were about to encounter and how to use them. The use of virtual reality also helped the constructors to put down the materials they would require before the commencement of the project. This also helped a great deal in ensuring that the project did not stop due to the absence of enough raw materials once the construction work had commenced.

Figure 1 Source: Bechtel Briefs, 2007

Figure 1 shows how the airport was to be constructed. It also shows the position and the lengths of the runways. Virtual reality helped in the implementation of the project and to determine whether the project was viable and whether the airport could operate as proposed.

Figure 2 Source: Bechtel Briefs, 2007

Figure 2 above shows the actual construction of the airport structures. It helps in determining the quantity of materials required and estimating the overall cost of the project.

Case 2: New School of Environmental Technology in FUTA - Akure

The Building was first designed using virtual reality. It gave the constructors and designers an opportunity to rehearse the construction of the facility in a 3 D interactive and immersive environment. This helps in increasing the conception of the design and improves the constructability of the project. We are going to base our research on a recent successful application of virtual reality in the Federal University of Technology Akure (FUTA) where virtual reality was implemented and gave very good results. This made it possible to represent a three dimensional space realistically (Burdea, 2003). In FUTA, virtual reality was used in the design of New School of environmental Technology. It helped in ensuring a timely construction and the materials required for the project was accurately estimated. this resulted into an overall reduction in costing.

Conclusion

Virtual reality has undergone a series of changes in its development. It has taken several years to reach the current stage that the aspect of virtual reality has reached. It is still undergoing some improvements in order to realize its perfection. The advantages that come along with virtual reality has made its use very significant especially in the construction industry. Changes are being made in the industry and exhausting the capabilities of virtual reality is far from being reached. As days progress many innovations in the

computer field are being realized which have a direct relationship with the improvements being realized in the construction industry in terms of efficiency and reduction in cost. (John 2000)

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