A Transelevator Moving Inside of an Automatic Warehouse in Virtual Reality

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Abstract. In this research, it is simulated the computed movements of a transelevator inside of a warehouse in virtual reality. This transelevator can be used to move some load from the floor to the deposit, and from the deposit to the floor, or can be used move the load from one place of the deposit to another one. The virtual reality is simulated using the graphic designer Quest3D. It is presented the simulation of the system.

1 Introduction

The automatic warehouse are elements used to make easy the works of moving loads from one side to another place in an automatic way. In the market, it is necessary to provide some tools to help to interact many systems. One of the tools used in the some complex applications is the virtual reality because in the virtual reality the designer can make many proofs in a simulator avoiding the necessity to prove it in the real system.

In the recent years, there are some researches related with the virtual reality as are [1], [2], [3], [4], [5], [6], [7], [8], [9].

In [2], they presented the projection based on a virtual reality and the use of a cave. In [3], they comment that the training on patients has raised concern among the profession and the public about how physicians will acquire sufficient skill to safely perform new, potentially righ-risk, endovascular procedures such as carotid stenting. In [4], the authors present the virtual reality of a surgery applied to a patient. In [6], VR exposure (VRE) is proposed as an alternative to typical imaginal exposure treatment for Vietnam combat veterans with posttraumatic stress disorder (PTSD). In [5] and [7], they determine the relative efficacy of exposure to a virtual airplane and standard exposure to an actual airplane at the airport compared with wait list control in the treatment of fear of flying. In [8], they present a virtual reality for a electromagnetism laboratory. In [9], they discuss two experimental studies to assess the impact on presence of this method in comparison to the usual hand-pointing method of navigation in virtual reality, their studies sauteed that subjective rating of presence is enhanced by the walking method provided that participants associate subjectively with the virtual body provided in the environment. This authors presented the virtual

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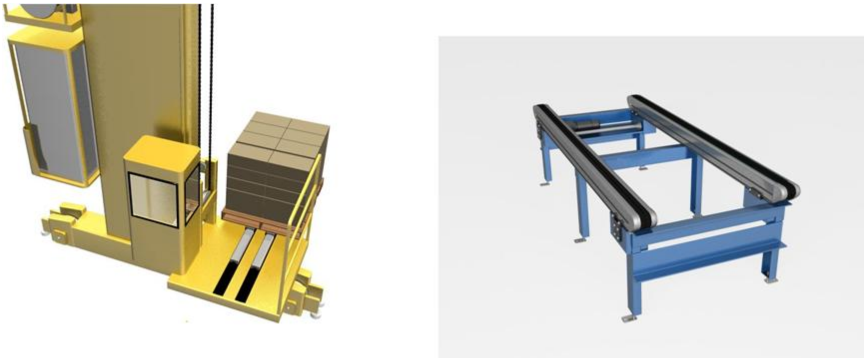


Fig. 1. Some 3D objects used in the simulation

reality applied to the medicine, but none of them applied the virtual reality for arm robots. In [1], they present the main characteristics of a virtual laboratory and some practices used to teach students the robotic.

In this paper it is presented the process for the build of an virtual reality in real time for an evaluation of an automatic warehouse (AS/RS) using the graphic designer Quest3D which is commonly used for the design of video games, but now is used for applications used in factories. In this case are presented the movements of a transelevator, this program is capable to interact with its environment which in this case is an automatic warehouse. Some of the characteristics of this system are: it can analyze the behavior of the warehouse, it can reduce the time used to develop the real application, it can make easy to see the department store in 3D. It is given a simulation of the system.

2 Building of the Physical Model of the Department Store

The elements considered in the warehouse are made in the Autodesk 3DStudio Max. It is important that was used the method called "lowpoly" to show in the screen the least number of polygons, and was used the method called "Texture Baker" to map the 3D object with only one map of bits, and including shadows and channels "alpha" (cut of a 3D object with an image). In Fig. 1 are given some 3D objects used in the simulation.

3 Building of the Logical Model

The logical model is used to compute the time employed by the works made for the transelevator, the simple and the combined works are considered. For the transelevator moving in the department store considers some assumptions, it produces some data wrotten as mathematical equations. For a simple cycle of work are considered the assumptions given in the Fig. 2.

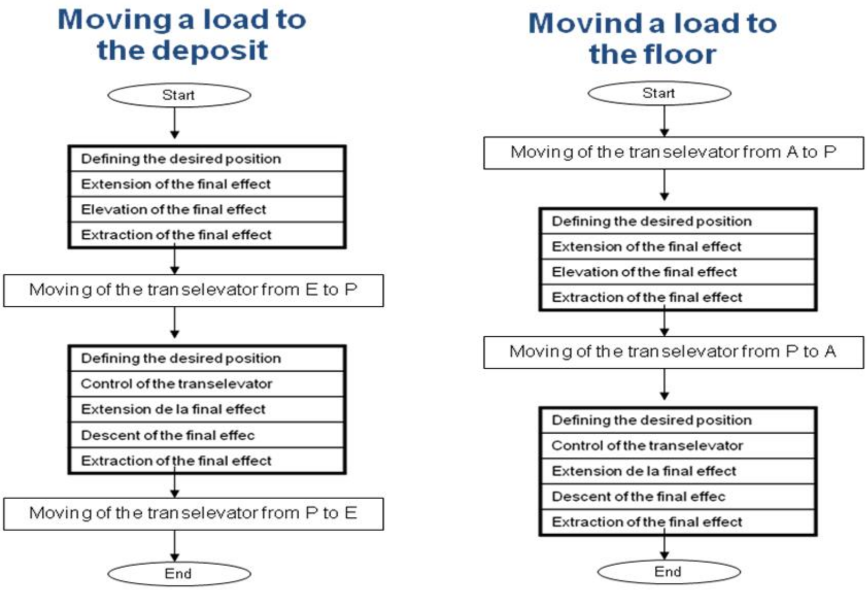


Fig. 2. Assumptions considered for asimple cycle of work

The most frequent works are:

- Case 1: Putting the load and taking from one inferior place.
- Case 2 : Putting the load at the start of the deposit and taking the load at the final of it.
- Case 3 : Putting and taking in the elevation.
- Case 4 : Putting and taking considering the moving in the X direction.
- Case 5 : Putting in an bottom place and taking from a top place.
- Case 6 : Putting in at the top place with the taking in a bottom place.

The reference points (desired points) of putting and taking are defined P_1 and P_2 as:

$$\begin{aligned} P_1 &= (\tfrac{1}{5}L, \tfrac{2}{3}H) \\ P_2 &= (\tfrac{2}{3}L, \tfrac{1}{5}H) \end{aligned} \tag{1}$$

Considering points P_1 and P_2 will be built the model to obtain the time employed in the simple cycles using the cases of before.

3.1 Case1: Putting the Load and Taking from One Inferior Place

The time used to the movement to one point will be the maximum of the vertical and the horizontal because when the transelevator moves in a longitudinal way, it moves in a vertical way, too. At this way, to compete the move to the two points proposed by the norm of P_1 and P_2

3.2 Case 2: Putting from the Point of Angle E. Taking from the Point of Angle A

It will be the same as the Case1, i.e., it will be computed the movement until P_1 and the time for the movement until P_2, then will be considered the average. At this value will be added twice the transfer time and it will be the average of time of one cycle of putting.

3.3 Case 3: Putting and Taking in Elevation from One Point

To compute the time employed for a simple cycle will be the same as in the Case 1, but takin in count that in this case the points A and E are points with coordinates different of $(0, 0)$.

3.4 Case 4: Putting and Taking Considering Movements in X Direction, E=A

To compute the time employed for a simple cycle will be the same as in the Case 1, but takin in count that in this case the points A and E are points with coordinates different of $(0, 0)$.

3.5 Case 5: Putting from a Point of Angle E. Taking the Load in Elevation in de Y Direction

It will be same as the Case1, i.e., it will be computed the movement until P_1 and the time for the movement until P_2, then will be considered the average. At this value will be added twice the transfer time and it will be the average of time of one cycle of putting.

3.6 Case 6: Putting the Load in Elevation in Y Direction. Taking the Load from One Point of Angle A

To compute the time employed for a simple cycle will be the same as in the Case 1, but takin in count that in this case the points A is a point with coordinates different of $(0, 0)$.

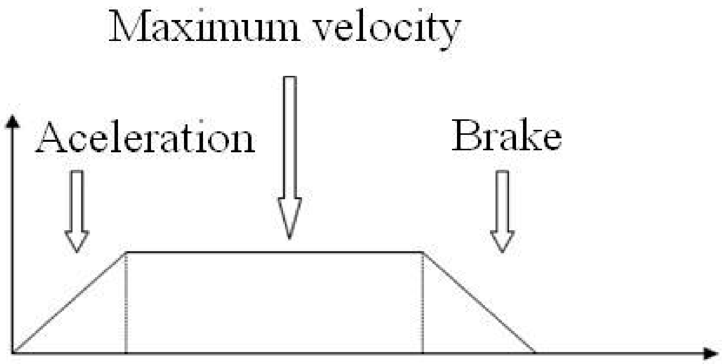
4 Example of a Case

Technical data:

$$\begin{array}{cc} L = 70m & H = 25m \\ Vx = 150m/\min & Vy = 60m/\min \\ Ax = 0.5m/s^2 & Ay = 0.5m/s^2 \end{array}$$

Reference Time= 10 sec.

1. Take the load in the input (E).
2. Time from E to P_1 with coordinates $(14, 16.67)$



To get the time employed to be at P1 will be considered the following: The time of aceleration denoted as $Tacel$, the movement with constant velocity denoted as $Tctelevel$, and the time to brake denoted as $Tbrake$.

In X:

$$T(E \to P_1) = Tacel + Tctelevel + Tbrake = 10.60\,\text{sec}$$

In Y:

$$T(E \to P_1) = Tacel + Tctelevel + Tbrake = 18.67\,\text{sec}$$

Then:

$$T(E \to P_1) = \max(18.67, 10.60) = 18.67\,\text{sec}$$

3. Putting the load in P_1
4. Time employed for the movement at the input (A)

$$T(P_1 \to A) = 18.67\,\text{sec}$$

After, the time employed for a simple cycle is:

$$Cs(P_1) = 10 + 18.67 * 2 + 10 = 57.34\,\text{sec}$$

5 Simulation

The program used to simulate the construction of the virtual reality of the transelevator and the warehouse is one variant of the DirectX called Quest3D.

Quest3D is the union of a graphic designer with a platform of develop, it is generally used for architecture, video games and for simulators. the CAD models are exported to Quest3D where are used for the simulation of 3D applications in real time.

One of the most important characteristics of the Quest3D is the method of programing. It is like Visual Basic, it uses blocks and some programing for this blocks. The programmer can change the program while it is running. There is not compilation in this program.

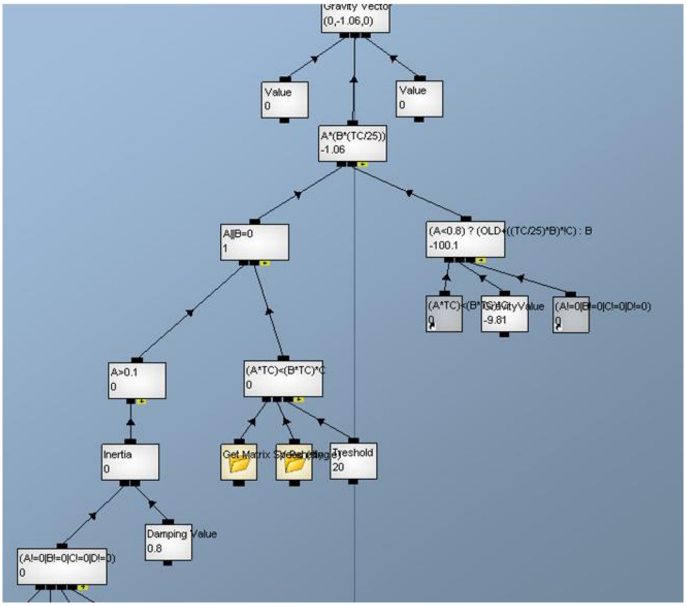


Fig. 3. Simulation of the gravity effect

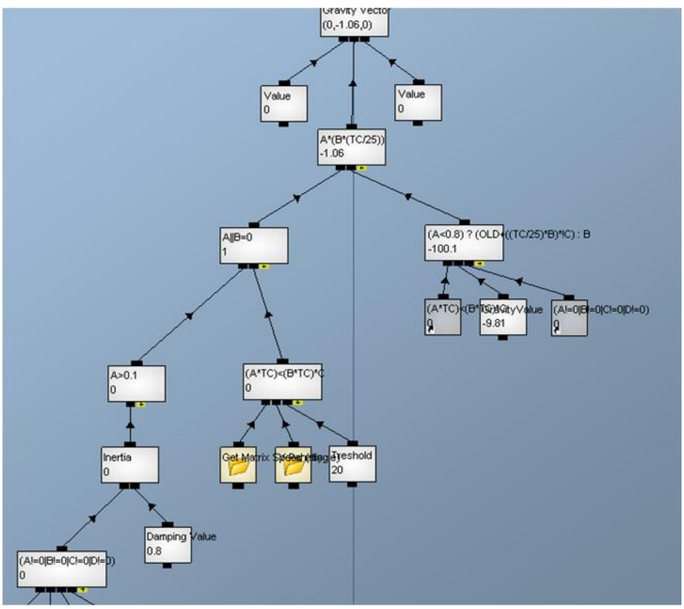


Fig. 4. Simulation of the transelevator

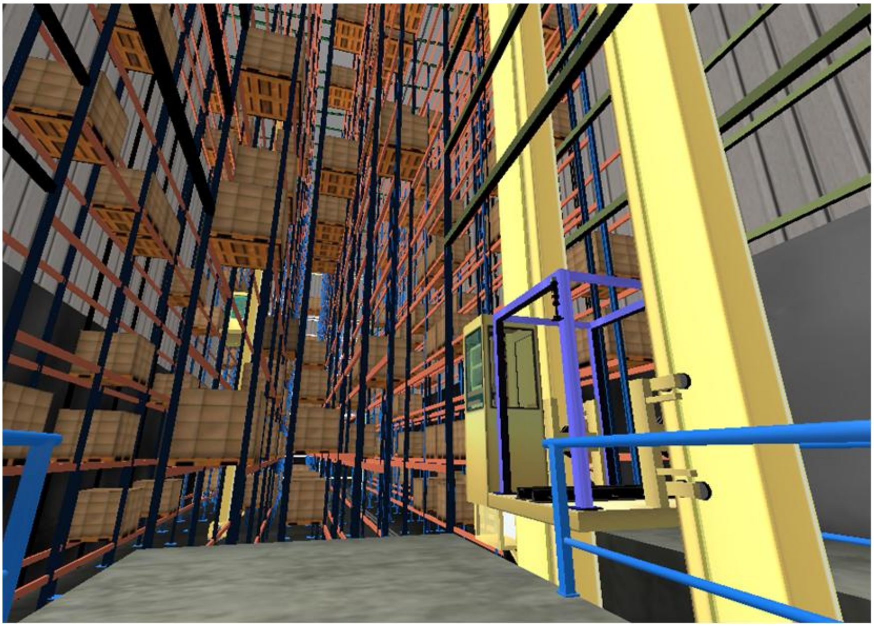


Fig. 5. A transelevator in the right side

Fig. 6. A transelevator taking a load

The application in Ques3D are made connecting functional components called channels. The channels form a structure of tree.

Fig. 3 shows the simulation of the gravity effect in the deposit.Fig 4 shows the simulation of the transelevator.Fig. 5 shows a transelevator in the right side, it moves from movements programed previously. It can be controlled in real time.Fig. 6 shows a transelevator taking a load.

6 Conclusion

In this research, it was simulated the computed movements of a transelevator inside of a warehouse in virtual reality. This transelevator can be used to move some load from the floor to the deposit, and from the deposit to the floor, or can be used move the load from one place of the deposit to another one. The virtual reality was simulated using the graphic designer Quest3D. In this paper the movements of the transelevator are programed previously. As a future research, the control of the transelevator will be considered.

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