ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

MODELING AND SIMULATION OF TRANSPORT SYSTEM (CONVEYOR) OF FLEXIBLE MANUFACTURING SYSTEM USING VIRTUAL REALITY MODELING LANGUAGE(VRML)

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ABSTRACT

The Virtual Reality Modeling Language (VRML) enables the integration of interactive 3D graphics into the web. Specialized and expensive hard- or software is not needed, any web browser with a VRML viewer is able to run the program which makes the application independent from any underlying hardware platform. Together with Java and VRML's External Authoring Interface (EAI) the simulation can also be used for visualizing and telemanipulating real world objects such as Machine Tools, Robots, Humanoids etc. This paper deals with the modeling and simulation of Transport System (Conveyor) of Flexible Manufacturing System using Virtual Reality Modeling Language(VRML).

KEYWORDS: VRML, EAI, FMS, Robot

INTRODUCTION

Virtual reality provides an environment for immersing users in the environment as well as the ability to interact with the objects in the environment. The virtual environment provides support for using 3D graphics. The above features make VR an ideal environment for use in a simulation environment to synthesize object interaction[1].The simulation can be defined as the mathematical representation of the interaction of real-world objects. Virtually any objects with known characteristics can be modeled and simulated[2]. All the components / elements of FMS are converted into the mathematical models and then by giving them inputs their outputs are seen in the form of simulation[3]. The following are the methods used for simulation:

1. Using Software packages such as 3DMax, Pro E ngineer, Ideas, Maya, Catia, Unigraphics & many more)
2. Using programming languages such as VB, VC etc
3. HTML – Hypertext Markup Language (Layout of 2D Spaces)
4. Using VRML (Virtual Reality Modeling Language) for 3D Spaces

A flexible manufacturing system (FMS) is an arrangement of machines, interconnected by a transport system. The transporter carries work to the machines on pallets or other interface units so that work-machine registration is accurate, rapid and automatic. A central computer controls both machines and transport system [4]. The Virtual Reality Modeling Language (VRML) is a file format for describing interactive 3D objects and worlds. Now it is defined as ISO standard ISO/IEC 14772-1;1997, VRML was developed in 1994, at the First International Conference on the World Wide Web in Geneva. This was developed by

1. Mark Pesce - conceptualized VRML,
2. Anthony Parisi and Gavin Bell - wrote the specification for the VRML[5,6].

Over the years various researchers are working towards the Virtual Reality methods and their applications to solve engineering problems.

Tom Meyer and D. Brookshire Conner [5] propose a general method that allows for the specification of new types of VRML nodes and for the description of their associated behavior. They also suggest some additional syntax and standard nodes for VRML 2.0. G. U. Carrao, M. Cortes, J. T. Edmark and J. R. Ensor [7] discuss bicycling simulation enabled by peloton. They also discusses the role of VRML in the system’s implementation, focussing on how its virtual worlds are generated from topological data, how cameras and third – person viewpoints are managed, and how unconventional input/output devices are incorporated. Dace A. Campbell, assoc. AIA [8] investigated the use of VRML in the production and communication of construction documents, the final phase of the architectural building design. Luca Chittaro and Demis Corvaglia

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[9] worked with the textile industry, for the development of techniques and methods for cloth simulation specifically aimed at the Web3D context.They also defined a cross-application data exchange format among the different CAD systems and applications used in the textile industry, including the additional information needed to support 3D simulations, and implemented a tool that complements traditional textile CAD systems (which are based on 2D graphics), allowing the user to automatically obtain VRML-based 3D previews of the garment (for evaluating garment designs and also easily publishing them on the Web). Masaaki Taniguchi [10] describes an event processing method that has implemented in VRML browser, which is designed to handle complicated route connections.

METHODOLOGY

The methodology involves the modelling of the transport System i.e. Conveyor and then this elements are arranged in a suitable FMS layout so that a scene graph is created. This scene graph is static in nature i.e. all the elements of FMS do no have any kind of movement. The elements of the scene graph are then provided a mechanism of communicating with each other, which results in a simulation of the various operations such as load, unload, process, move and store. The whole of the process of work is divided into the following steps:

Modelling of Transport System (Conveyor)

The Transport system consist of following parts: (i) Base Frame (ii) Rollers (iii) Surfcae This are modelled using the IDEAS software and then this are exported to VRML file, the VRML file is then opened in VRML browser/ Plug-in. The Figure 1 shows all this parts. Since all the parts are not modelled using VRML and are modelled in CAD software package IDEAS therefore there programs are not given here, but a VRML program of assembly of all the parts viz. Base Farme, Roller and Roller Surface is given below.

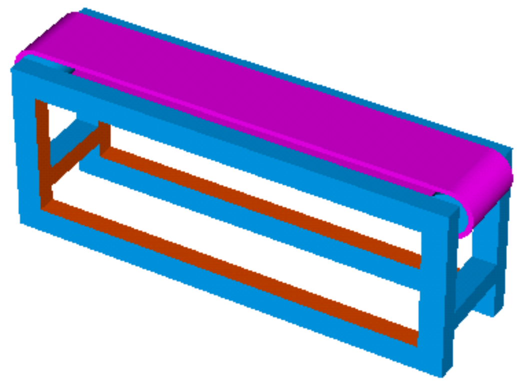

Figure 1: Conveyor

VRML program for assembly of parts of Conveyor

The Program uses Inline Node of VRML, which is used to call a separate VRML file into the assembly of lathe. There are different file for each part of a Conveyor. All files are called in the main file of assembly of Conveyor by the use of VRML node [11].

```
#VRML V2.0 utf8
Inline { url["Conveyor.wrl"]          }
Inline { url["Roller.wrl"] }
Inline { url["Roller_Surface.wrl"] }
```

Modelling of Work – Piece

The Modelling of work – piece is also done using the programming language VRML. Using the basic primitive cone of VRML does this. This is shown in the figure 2. The program for modelling of work – piece is given below.

```
#VRML V2.0 utf8
#Basic VRML
Shape {geometry Cylinder {height 0.1
                          radius 0.009        }
appearance Appearance {
material Material {diffuseColor 0 1 0  }}}
```

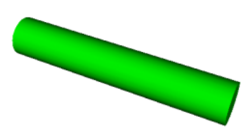

Figure 2: Work piece

SIMULATION OF CONVEYOR

Figure 3 & 4 shows the movement of work – piece over the conveyor. i.e the movement of the Surface of

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
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the Conveyor over the Rollers. In figure 3, the Work – Piece is shown at the loading end of the Conveyor and when user clicks on the Conveyor, the Conveyor takes the Work – Piece to the unloading end of the Conveyor from where it is picked up by the Robot and is carried to the Chuck of the lathe. The program of simulation of the Conveyor is given here.

VRML programme of Simulation of Conveyor

```
#VRML V2.0 utf8
#Basic VRML
DEF T Transform {
                    rotation 0 0 1 1.57
                    translation 0.335 0.223 -0.315
                    children [
                    Shape {
geometry Cylinder {
height 0.1
 radius 0.009 }
appearance Appearance {
material Material { diffuseColor 0 1 0  } } }
DEF Clicker TouchSensor { }
 # Run once for 15 sec.
DEF TimeSource TimeSensor
{ cycleInterval 15.0 }
DEF P PositionInterpolator{
          key       [ 0   0.5   1]
          keyValue[ 0.335 0.223 -0.315,   0.669 0.223
-0.315, 0.86 0.254 -0.46]   } ] }
ROUTE Clicker.touchTime TO
TimeSource.startTime
ROUTE TimeSource.fraction_changed TO
P.set_fraction
ROUTE P.value_changed TO T.set_translation
```

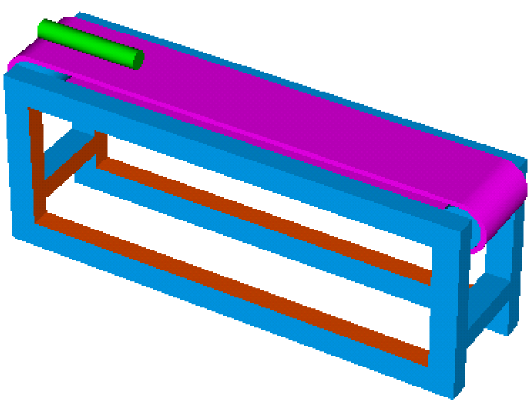

Figure 3: Simulation of Conveyor (Work piece at the start position)

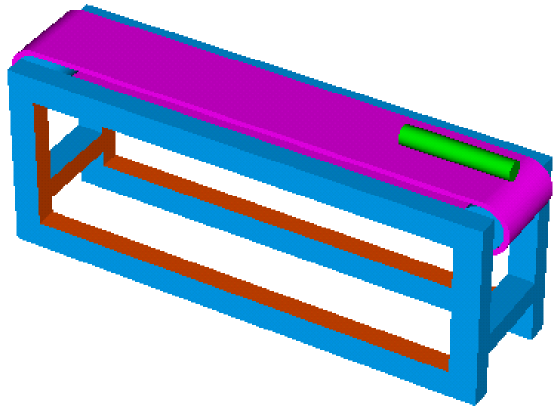

Figure 3: Simulation of Conveyor (Work piece at the end position)

CONCLUSION

The author has attempted to simulate the various components (Transport System - Conveyor) of the FMS System individually and then the simulation of the whole FMS System, This simulation is manual in nature i.e. the user has to touch the elements of FMS for input to the system. The goal of web based architecture is fulfilled but it requires to be improvements. The Modelling and simulation of CNC Milling machine, simulation of Robot and the synchronisation of all the simulation, and the issue of offline Planning and Control, Shop Floor Simulation, FMS Communication and Traffic Regulation, Development of GUI, Alarm Systems are left for the future work.

ACKNOWLEDGEMENTS

The author thanks to the Institute for providing the research facility to carry out the present work.

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ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
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