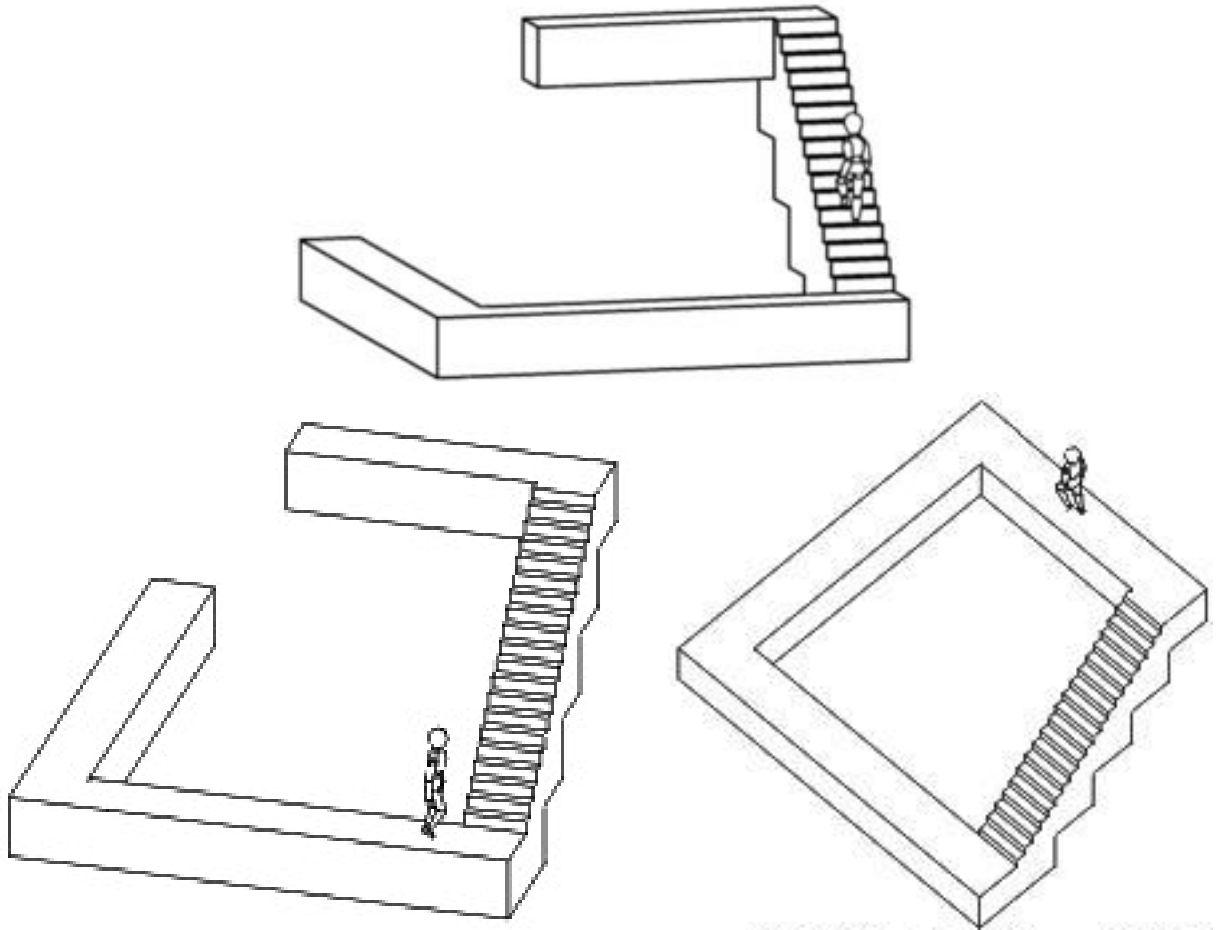


W4840 Project Proposal

Penrose World



Cong Zhu cz2311
Yao Luo yl3028
Yuanhui Luo yl3026

Overview

In this project, we plan to implement a 3D game, in which, a stickman can move in an incredible way by utilize the 3D space illusion feeling. The display of 3-D image involves large amount of point-to-point projection computation which possibly have no data correlation at all. Therefore it is very convenient to implement it by high speed parallel computation. Since the nature of software-based implementation is sequential execution, it is better to do these 3-D computation using hardware instead of software. With the FPGA source on this Sockit board, we can build such parallel computation hardware architecture easily and therefore increase the processing speed of 3-D image. In this game, players can change the angle of view to create a route, which doesn't exist in 3D world. In particular, it is based on the concept of "Penrose Stair". ("Penrose Stair" is a two-dimensional depiction of a staircase in which the stairs make four 90-degree turns as they ascend or descend yet form a continuous loop, so that a person could climb them forever and never get any higher.)

This project is similar to a PSP game "Echochrome". A video of that can be found on YouTube: <http://www.youtube.com/watch?v=QfICeBtVv8U>

Design Details

We intend to implement the project using Altera CycloneV SoCkit board, gamepad controller, and VGA display. Gamepad controller will be used to change the angle of view. Hardware acceleration will be implemented in image processing. There are many ways to do 3-D implementation such as Ray-Tracing and Ray-Casting. In this project we choose the Ray-Casting algorithm. First we will verify its validity on MATLAB and then implement it with FPGA. The voxel engine that is used to generate 3-D model may be used in this project and the model is then feed to the FPGA part of Sockit broad to compute the 2-D projection using algorithm mentioned before.

Milestone 1

- Configure gamepad and VGA interface.
- Implement the algorithm of ray-casting in software.

Milestone 2

- Implement the Ray-casting algorithm on FPGA.
- Display the 3D object on the screen.
- Using gamepad to change the angle of view.

Milestone 3

- Add stickman to complete the game.
- Try to generate some more complex models.
- Realize the light and shadow effect if the time permit.
- Test and improve the game, increase its robustness.

Reference

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