

# 1 Introduction

This application has been designed and developed with augmented reality in mind. The application is a game in which the user has to first locate an augmented reality marker, where a cube will appear floating above the marker. On this cube there are five different puzzles, one for each face except the base. The user then has to rotate the tiles till a path is from the star tile, the green tiles, to all the end tiles, blue tiles, has been completed. Once each face puzzle is done the face disappears and the user has to move onto the next face. Once all faces on a cube has been completed the user has to find another marker, until all size markers have been found. As well as using the camera of the PS Vita for the augmented reality aspect of the game the application utilise the front touch screen panel for on screen buttons.

## 2 User Guide:

After starting the application either press the physical START button or press the on screen start button. Now face the PS Vita toward an AR marker, once the marker is seen move the left analogue stick left and right to select the right cube to solve. Next move the left analogue stick up and down to choose the desired face. Once the correct cube and face is selected use the left and right shoulder buttons will rotate the selected tile left and right respectively. To change the selected tile press the D-Pad and the selected tile will move in the same direction.

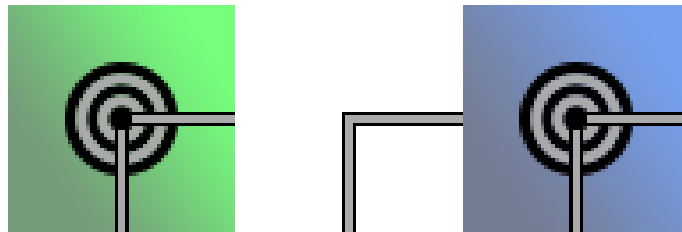


Figure 2.1: Puzzle Tiles: Left - Start, Centre - Normal, Right - End

To complete a puzzle rotate each of the tiles until there is a path from the start tile, as shown in Figure 2.1 as the tile with the green background, to all the end tiles, shown with a blue background. The centre tile are plain tiles that are used

as connectors. The tiles shown are just one variation of each of the three types of tiles. Once a puzzle is completed press either the on screen solve button or the SELECT button, this will check to see if there is a path between the start tile and all the end tiles. If there is then the face will disappear and the next face will be selected.

Once a cube is completed find another marker and select that cube to be solved. When every cube has been completed the game is over. The goal is to complete the game as quickly as possible whilst using the smallest number of solves possible. While playing the game pressing the on screen pause button or the START button will pause the game.

## 3 Design:

### 3.1 Technology:

When creating the application it was designed and built upon the main aspects of augmented reality applications, the use of a marker as an anchor in the 3D world. This application builds all the objects around a designated marker. Figure 3.1 shows the pseudo code that does this process.

```
for num of markers{
    if seen{
        set cube ar matrix();
    }else{
        clear ar matrix;
    }
}

set cube ar matrix(){
    for num of faces{
        set puzzle ar matrix();
    }
}

set puzzle ar matrix(){
    set ar matrix;
    build new world transform matrix;
}
```

Figure 3.1: Pseudo Code

In Figure 3.1 the augmented reality marker location matrix is sent to the main

cube object. From here there matrix is then passed to the faces of the cube to be used by the object as part of its own world matrix.

```
for each tile{
    //local rotation multiplied by local position for the puzzle
    build local martrix();
    //get the tile matrix and multiply by local matrix;
    tile matrix * local matrix;
    current matrix * ar matrix;
    set the world matrix of each tile to be the current matrix;
}
```

Figure 3.2: Matrix Pseudo Code

An example of how the world matrix is used by a tile in a puzzle can be seen in Figure 3.2. This code shows that each tile starts by first creating its own world matrix based upon its own rotation and position. Next this matrix is the multiplied by the matrix of the cube object it is relative to. This results in the position of the tile in the world being placed just above one of the faces of the cube. The next step is what sets the tile relative to the augmented reality marker, which is by multiplying the current matrix by the augmented reality matrix returned from the augmented reality marker.

As well as the application development working well with the exploits of augmented reality the gameplay of the application works well with how augmented reality works. As mentioned previously when playing the game the user has to solve the puzzle on each face. The best way to do this is by moving around the cube while changing the face needing to be solved at the time. This process allows the user to see each face of the cube without interrupting the gameplay to move the marker, which may not be possible if the marker is in a fixed location.

## 3.2 Software:

The application has been written as mentioned previously with the augmented reality technology in mind. Due to this the application has been built with object-oriented approach. This can be seen in how the objects are created. To start with there is a base game object which has variables and functions that are required by all objects in the application.

This class is then inherited from for the marker object which is designed around being relative to an augmented reality marker. This object has functions needed to do this such as setting an augmented reality matrix and building the world matrix based upon this new matrix. This is the type of the objects used to cover the augmented reality markers in the game.

## **4 Reflection:**

## References