Blocky Road

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Figure 1: The logo of the game

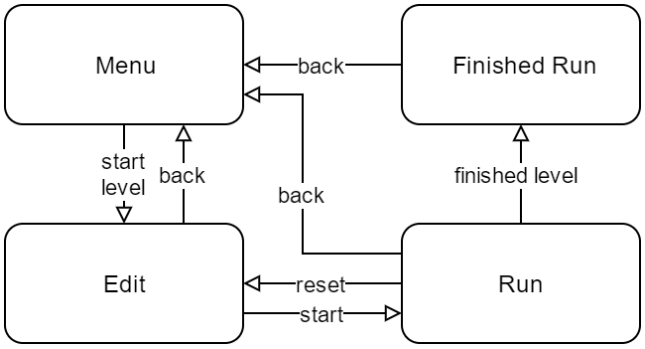

Figure 2: States of the game

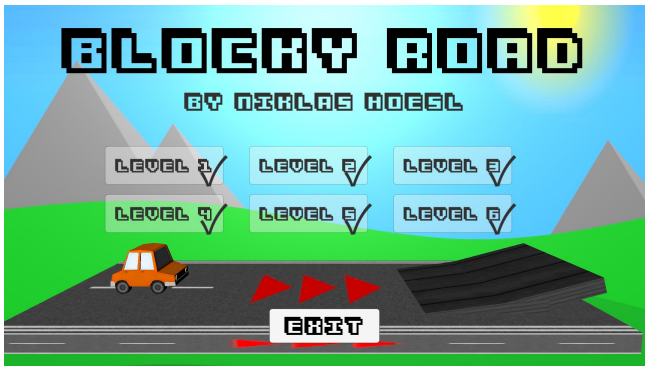

Figure 3: Menu and entry screen

1 About The game

Blocky Road is an Augmented Reality based construction game, where the player has to construct a road out of given blocks to let a car drive from the start to the finish block. When the player thinks the car may pass the finish line, he can start the race and see what happens. If it makes it to the finish block (the block with the two pylons) the level is completed. Otherwise the player can adapt constructed blocks and try the race again until he makes it to the finish line.
Due to Augmented Reality the player can watch the race and build the road from any direction, which makes it way easier to build a finishing road.
The game currently features 6 levels and the player will find out quickly that the blocks do not always have to be aligned in a perfect realistic way: They can also overlap or can be aligned to let the car crash into a block to change its direction. The player has to use all of his creativity to pass a level.

The game was created as a project during the lecture *Augmented Reality* by Christoph Anthes as part of the *Mobile Computing* master's degree program at the University of Applied Sciences Hagenberg, Austria during the semester 2016/17.

2 Requirements

The game requires minimum Android 2.3 and a device with a camera. For Augmented Reality purposes a printed version of the *Vuforia Chips* image is needed. It can downloaded here: `https://developer.vuforia.com/sites/default/files/sample-apps/targets/imagetargets_targets.pdf`

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3 States

The game mainly consists of four states. They and their transitions are visualized in figure 2. In the following section they will be described in detail:

3.1 Menu

Figure 3 shows the menu, which is the first screen that appears after starting the game. The player gets all levels displayed, where each level that is completed shows a check mark. The player can start any level or exit the game. By selecting a level the car on the bottom starts and the level will be loaded.
In every other state a *Back* button lets the player return to the menu.

3.2 Edit

The edit state (see figure 4) is the state where the player builds and adapts the blocks.
The Vuforia image marker needs to be placed in front of the camera, so that the static blocks will be displayed.
On the right part the blocks that can be built including the

Figure 4: Edit: The player tries to align the blocks in a way, so that the car can reach the finish line.

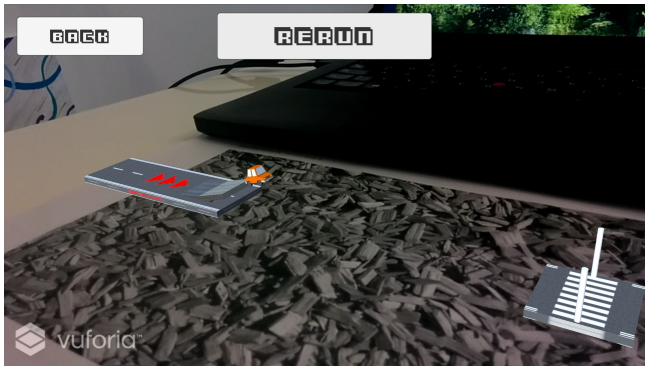

Figure 5: A run: The car is trying to get to the finish block

number of remaining blocks are displayed. By pressing on one of the remaining blocks it will be added to the road. The bottom part of the screen shows the possible actions that can be applied to the currently selected block. The player can move the block to the left (<), the right (>), up (+) or down (-). When a block is near to another block the player can snap the block to the end of the other block, to build a continuous road.
Tapping on an editable block will change the currently selected block, which applies all further actions to the tapped block.
If the player is not happy with a block he can choose to remove the block by selecting the *Remove Block* button. The next tapped block will then be removed.
Pressing the start button will hide all edit features and the game switches to the run mode.

3.3 Run

The car will be accelerated initially when the race is started. It will now move over the built blocks and tries to make its way to the finish line.
When the player sees that the car will not make it to the finish line he can press the *Reset* button to get back to the edit mode.

3.4 Finished Run

When the car enters the finish line the level is completed. In this state the player can't modify the built blocks anyone. It is still possible to restart the race to watch the car racing again (see figure 5). When going back to the menu the completed level will display a check mark.

4 Block types

These four different types of blocks are available:

Street A normal street block that lets the car drive over it. Is usually also used as the start block.

Speed Like the street block, but accelerates the car every time it drives over the block. This block is visualized by three red arrows.

Jump This block lets the car jump over an obstacle or the ground. It is indicated by a wooden jump on a street block.

Finish This block is indicated by a street block with a crosswalk and two pylons. When the car makes its way through the pylons (either on the ground or in the air) the level is finished. Usually this is only used as a static block.

5 Level Specification

All levels are mentioned in the *LevelsMeta.json* file, which has the following JSON structure:

```
{
  "levels": [
    {
      "id": 1,
      "name": "Level 1"
    }
  ]
}
```

Further the *Id* defines the file that represents the actual structure of the level:

```
{
  // Blocks that can be placed and edited
  "editorBlocks": [
    {
      "count": 2, // number of blocks of this
          type that can be built in this level
      "type": 3 // Speed Block
    },
    {
      "count": 1,
      "type": 2 // Jump Block
    },
    {
      "count": 1,
      "type": 1 // Street Block
    }
  ],
  // Blocks that are in the level from the
      beginning and can't be edited.
  "staticBlocks": [
    {
      "isStart": true, // Here the car should be
          placed
      "type": 1,
      "x": 6, // Horizontal position
      "y": 10 // Vertical position
```

```
    },
    {
      "type": 1,
      "x": -5,
      "y": 10,
      "rotation":90 // Static blocks can be
          rotated, e.g. to form a wall
    },
    {
      "type": 4, // Finish Block
      "x": -20,
      "y": 10
    }
  ]
}
```

6 Used Resources

The following tools and resources where used to develop the game. Special thanks to all the contributors!

- Unity: Game Development Platform
- Vuforia: Augmented Reality Platform
- Sounds:
  - Carstartgarage [1]: When starting a run or going over a speed-up block (edited)
  - Cheer [2]: When reaching the finish block.
  - Cool Game Theme Loop [3]: Background Music
- From Unity Asset Store:
  - Cartoon Car - Free [4]: The racing car
  - Simple Modular Street Kit [5]: Used for every street block
  - Dark Wood Texture [6]: Used for the jump

7 Technical difficulties

First the game was implemented without Augmented Reality as normal Unity game. After adding Vuforia the whole world was displayed way to big (166 times, to be precise). The solution was to scale the image target down to 0.006, which brought up further problems: Applied forces, the gravity, thresholds for snapping and delta values for moving a block also needed an adaption, which took a long time to figure out the actual reason.

Compound game objects (like the Jump block that consists of a street game object and two jump game objects) had a different scale than a single game object (e.g. street block) (1,1,1 vs 5,0.5,5) although they actually had the same size. The solution was a static block size.

A smaller image target was tried (a business card with a QR code), but due to the low resolution of the web cam of the developer machine it was often not recognized. Therefore the Vuforia chips image target is still used in the final version.

[1] https://www.freesoundeffects.com/free-track/carstartgarage-466329/
[2] https://www.freesoundeffects.com/free-track/cheer-426824/
[3] http://www.freesound.org/people/Mrthenoronha/sounds/371148/
[4] https://www.assetstore.unity3d.com/en/!#/content/38743
[5] https://www.assetstore.unity3d.com/en/#!/content/13811
[6] https://www.assetstore.unity3d.com/en/#!/content/11092