# Momentum

Group members: Bernhard Buss, Claudia Kuster, Jürgen Fornaro

This document describes the progress in our implementation of the game proposal, developments since our in-class demonstration of the software prototype as well as design revisions we made in response to game critiques. But first a summary of the game play is presented.

## 1. Summary of Game Play

Momentum is inspired by the original board game where you have to balance a wooden board in order to move a metal ball from one end of a labyrinth to another, avoiding the holes along the path.

The game provides two different game modes:

Classic game mode:

Only single player mode.

Simulates the original game play on the wooden board. The player controls the ball by balancing the board with the game pad. If the ball falls off the board, the game is lost.

Momentum game mode:

Single player or multi-player modes (up to 4 players, single screen).

The player directly controls his ball (a spherical cage containing a quantum particle) with the game pad, accelerating it in the desired direction (without balancing the board). The particle gains momentum if the player is able to navigate the ball smoothly through the labyrinth on the board, staying off the obstacles. The player can release the momentum of his quantum particle to perform special moves such as speed-ups, jumps or pushing an opponent off the board. The player that reaches the other end of the labyrinth, the so-called warp core matrix portal, wins.

An important feature of our game is general physics and rendering engines, enabling the construction of diverse game boards by simply importing a geometric model that was built using external software (e.g. Blender or Maya, in our case the software used for 3D content creation).

## 2. Design Revisions

At the in-class presentation of our software prototype, several suggestions to improve the game play were made. In response to this we have and will further investigate additional features that may enhance the experience of our game.

We focus our attention to multiplayer momentum mode. It combines the core game idea, the player's ball is a cage containing a quantum particle - storing momentum energy, with the interactive fun of a multiplayer game.

We have extended the original concept of a flat game board to a game board showing multiple levels (Figures 1 and 2). The multi-level design of a game board poses additional challenges to the players, enhances gameplay and makes the game visually more attractive. For example, a player's ball may fall off to a lower level of the game board, forcing him to play catch up on his opponents. On the other hand a player might take a shortcut to a higher level using his ball's momentum.

Play testing showed that the original idea of a dropped out player controlling the board leads to near impossible circumstances for the remaining players to win the game. Therefore we tried to find a better behaviour for dropped out balls. Once a ball drops out of the game board, it is placed on its starting position and the player can continue to play. The final player score will reflect a penalty for a drop out (-1 point). The first player to reach the finish of a board will receive five points. The player with the highest final score wins.

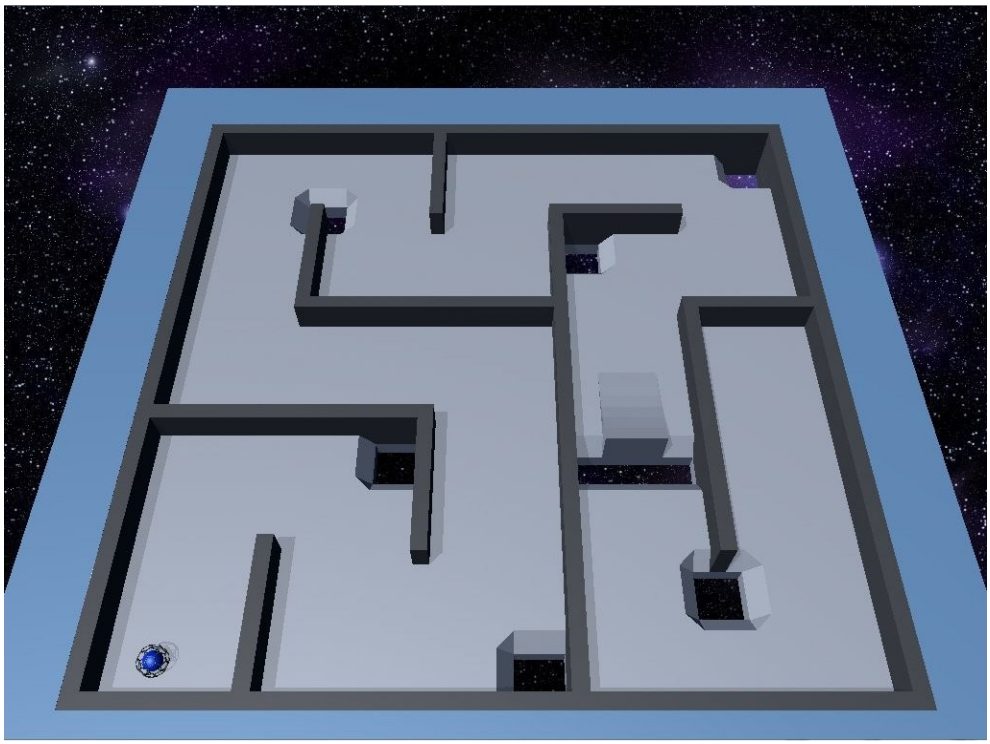

*Illustration 1: Single level game board in classic mode.*

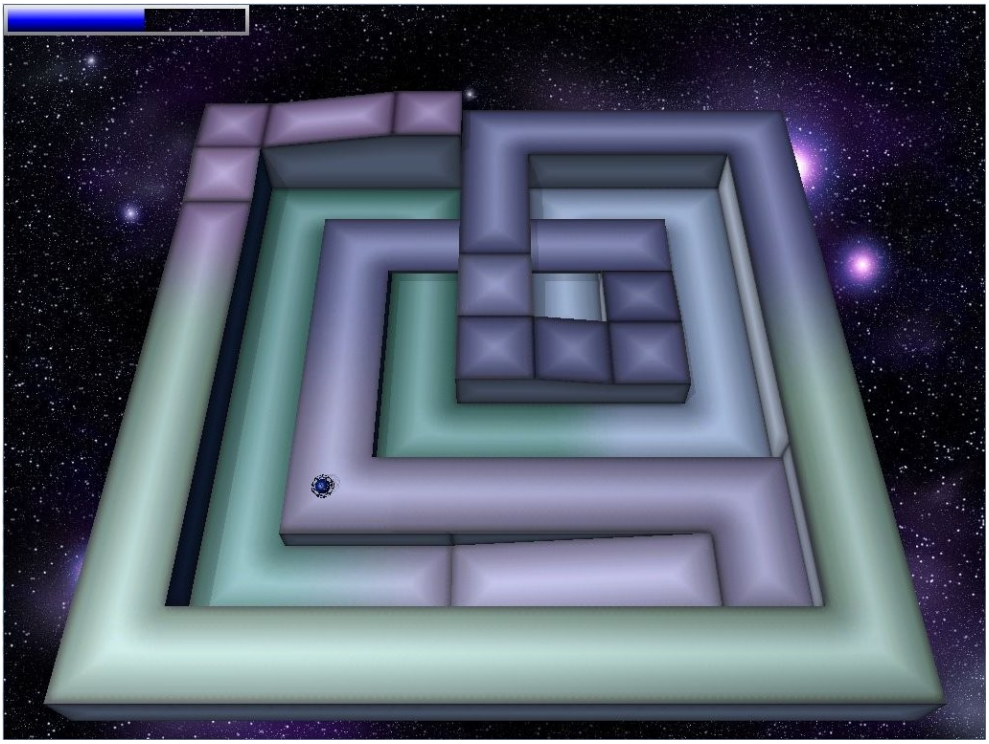

*Illustration 2: Multi-level game board in momentum mode.*

## 3. Progress of Implementation

We have finished implementation of the „Functional Minimum“ and the „Low Target“ of the development schedule and are currently starting to implement features of the „Desired Target“.

The following is an informal list of important features we have implemented so far.

**Game Boards:**

We have built several (so far 5) single- and multi-level game boards using Blender and Maya. We implemented a custom content pipeline in XNA to build a bounding volume hierarchy from the board's geometry and to read additional 'marker geometry' indicating starting locations and the position of the warp core matrix portal.

**Rendering:**

The elements that have to be rendered are the game board, currently containing only static elements, and the balls. We have added visually more appealing textures to some of the game boards. The ball is rendered as a hollow cage containing a particle (Figures 1 and 2). This particle currently is a static colored sphere but in a future version will be animated (using particle simulation) to display the amount of momentum energy. The animated particle will visually represent our main game idea. Currently the amount of

momentum energy of each particle is displayed only by progress bars in the corners of the screen (Figure 2).

Shadowing of the balls and the game board is currently done with projection shadows. We will explore other techniques to get better results for shadowing.

We implemented a camera with automatic adaptive positioning and zoom to achieve a visually more dynamic user experience.

**Collision Detection:**

We implemented efficient collision detection between balls and the game board. The geometry of the board can be queried in a binary bounding volume tree of spheres.

**Physics Engine:**

The movement of a ball is determined by the controllers input, gravity, momentum effects as well as restoring forces and friction computed from the output of the collision detection. The latter allows us to use more or less arbitrary game board geometries in our game. The balls movement leads to a corresponding visual rotation of the ball.

**Momentum Energy:**

The momentum energy of a ball is gathered by maneuvering the ball without colliding with the game board walls. Respectively a collision with obstacles of the game board will result in a loss of momentum. The momentum has an impact on collisions with other balls, allowing a ball with lots of momentum to easily push another ball with less off the board. In addition to that, two features are now usable with the momentum energy. Using button A of the controller, the acceleration of the ball is increased, allowing the player to catch up with his opponents or to climb a steep ramp easily. When pressing button B of the controller, a swift jump with the ball can be performed, in order to recover lost ground (when falling of a higher level) or to simply take a short-cut in the game board. The momentum features have already been play tested and adjusted but will need more fine tuning to assure proper game balance.

**Audio Engine:**

A basic audio engine currently allows to play one sound – collision of the balls with obstacles of the game board.

**Scoring:**

Player scores of the games are measured by levels won and number of drop outs for each player. A simple highscore list is presented after the set of levels has been completed.