From PhyDSL to Whack-a-Mole: Model-Driven Construction of Games

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ABOUT THE GAME

Whack-a-mole is a classic arcade game where a player hits moles that appear from holes. The player gains points by hitting a mole. In this version, moles pop up from 15 holes for 60 seconds.

Whack-a-mole types of games could potentially improve perceptual motor skills and cognitive functioning of patients with disabilities suffered after brain injuries. These types of games provide attractive storylines and reaction time gameplay designs that make rehabilitation therapy immersive and engaging.

THE CODE

The initial codebases of our games were generated using PhyDSL a code-generation environment developed in the Service Systems Research Group at the University of Alberta.

Using PhyDSL we can generate games, including, but not limited to, third-person shooters, puzzles, and strategy games like tower defense.

PhyDSL includes with a domain-specific language and a transformation engine that allows the specification of gameplay designs for 2D physics-based mobile games.

PhyDSL allows the automatic generation of executable code for Android devices.

OUR RESEARCH

Starting from an existing code base, we developed two extensions.

EXTENSION A	EXTENSION B
- Auditory feedback. - Haptic feedback for missing a mole. - Difficulty increase algorithms. - Bonus and penalty items randomly. - Score multipliers and display.	- Haptic feedback - Visual distractors and bonus items - Penalty moles - A combo bonus algorithm. - Timer and score displays

GAMEPLAY – EXTENSION A

SCORE: 220

MOLE | SQUIRREL | HOLE | COOL MOLE | SOUND | SCORE

MOLE — Tapping on a mole increases the total score (+10 points). After hitting 5 moles in a row, the game becomes more difficult as the speed of moles increases.

HOLE — Holes are where the moles randomly appear. Tapping on a hole without a mole resets the streak. A buzz and a vibration indicates the failed hit.
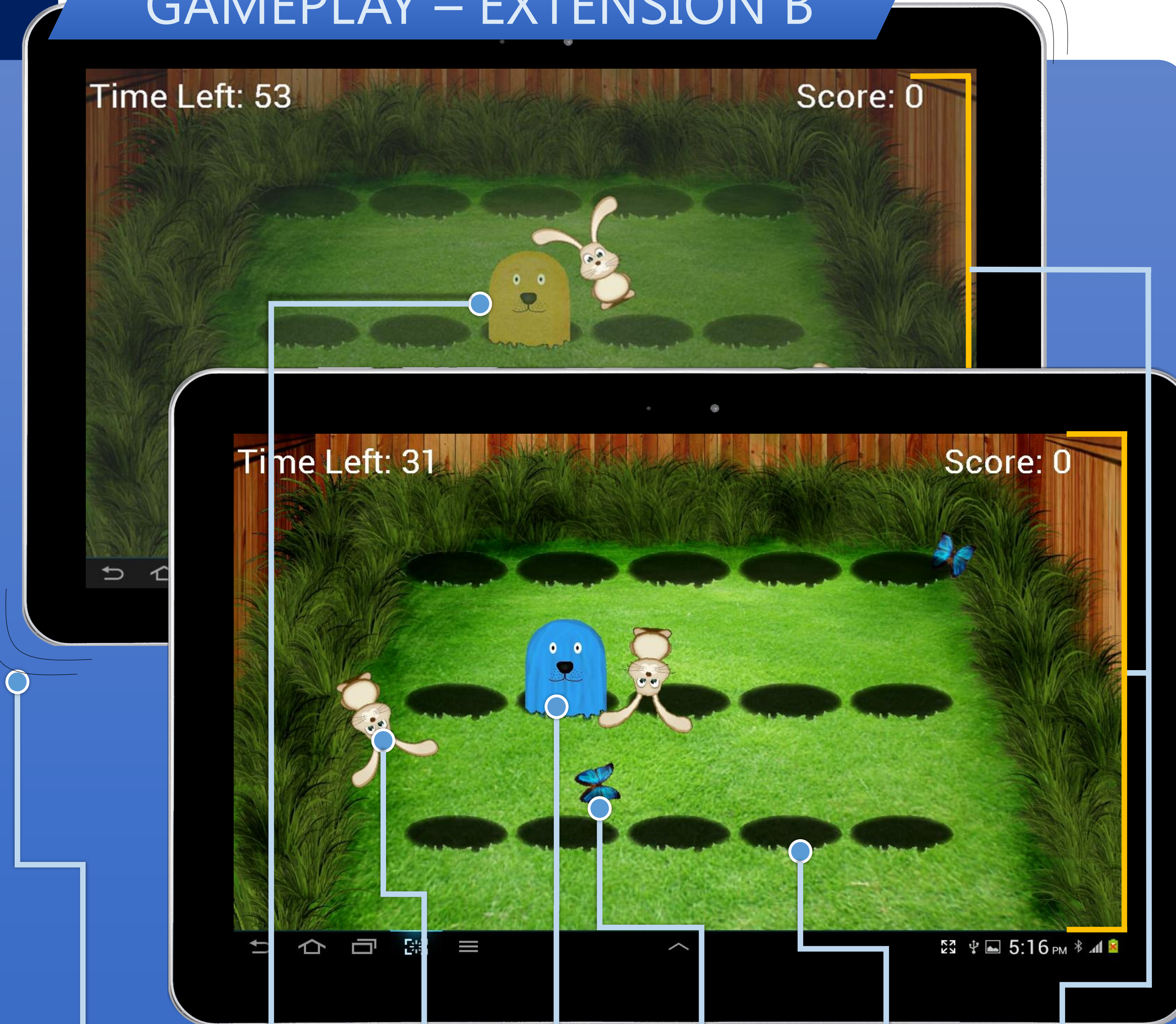
SQUIRREL — Squirrels are spawned randomly in the game. Hitting a squirrel deducts 50 points from the score.

COOL MOLE — These smarter moles figured a way out of their holes; they are randomly spawned and fly around in their fancy capsules. Hitting them is quite difficult and increases the score by 20 points.

SOUND — Sound effects are played every time the player interacts with the game, whether it's a tap, miss, or hit. This indicates player actions even if the player has visual disabilities.

SCORE — When the player whacks a mole multiple times in a row, a streak is created. Streaks increase the score even more as player hits more moles.

WHAT WE LEARNED

How to use version control systems (GitHub) to manage and share complex codebases.

How to use advanced Java programming techniques including threads for multitasking.

How to design high-quality software with high cohesion and low coupling.

How to use advanced Android functions, to setup activities, and views.

How to develop functionalities for physics-based gameplay design that use Euclidian geometry.

WHAT'S NEXT?

Conduct empirical studies to understand how the gameplay extensions improve the experience of rehabilitation patients.

Implement additional features including score leaderboards and multi-level gameplay designs.

Use PhyDSL to generate reaction games based on physics with different gameplay designs and visual themes, targeted at different player demographics.

GAMEPLAY – EXTENSION B

Time Left: 53 — Score: 0
Time Left: 31 — Score: 0

VIBRATION | MOLE | RABBIT | BUTTERFLY | HOLE | CONTRAST CHANGE | FREEZING MOLE

MOLE — Tapping on a mole increases the score (+10 points) and causes the tablet to vibrate. Tapping two moles in a row provides 5 bonus points.

HOLE — Moles appear out of holes and hitting an empty hole makes "Miss!" appear at that location.

RABBIT — Rabbits block taps to items beneath them and change the contrast when they hit the edge of the screen.

BUTTERFLY — A butterfly appears every ten seconds and is worth 20 points if you hit it.

FREEZING MOLE — Tapping on a freezing mole prevents you from hitting moles and butterflies for five seconds.