

## Prototyping Games with BIPED

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### Abstract

We demonstrate the use of BIPED, a system that explores a new approach to supporting the early stages of game design. Using BIPED, a game designer can leverage a single, concise game definition to get both a playable prototype and a formal rule system. In this way, BIPED's two legs give a designer access to insight: the first through feedback from human players (revealing player hesitation, engagement, or fun) and the second through automated analysis (revealing emergent properties, exploits, and puzzle solutions).

Our system focuses on board-game-like prototypes. On screen, human players manipulate individual tokens that are arranged on board spaces linked by paths. Using the mouse, they can trigger game events that interact with the designer-specified game mechanics. On the design side, designers have access to timers, allowing them to create interesting, real-time dynamics.

In addition to play testing with human subjects, we support a form of machine play testing. Using only the game definition, our analysis engine is capable of imagining complete play traces showing a log of game state and events over time. To drill down on interesting scenarios, the designer may specify additional constraints and ask the engine to show only (and possibly all) traces that fit these constraints. Examples include: defeat happens at time seven, no more than six monsters are slain, and the player character always picks up treasures.

### Introduction

Fullerton (2008, p. 248) calls play testing “the single most important activity a designer engages in”. Our system, BIPED, focuses on providing computational support for play testing early-stage game prototypes. Early-stage prototypes are often built out of physical elements such as cards, tokens, or dice, the same elements used in board games. BIPED provides a game-sketching language that a designer can use to quickly prototype a game idea using on-screen versions of these kinds of representational elements. A more complete overview is given in the accompanying full paper (Smith, Nelson, and Mateas 2009).

Game sketches created with BIPED support human play testing by producing computational prototypes. With these

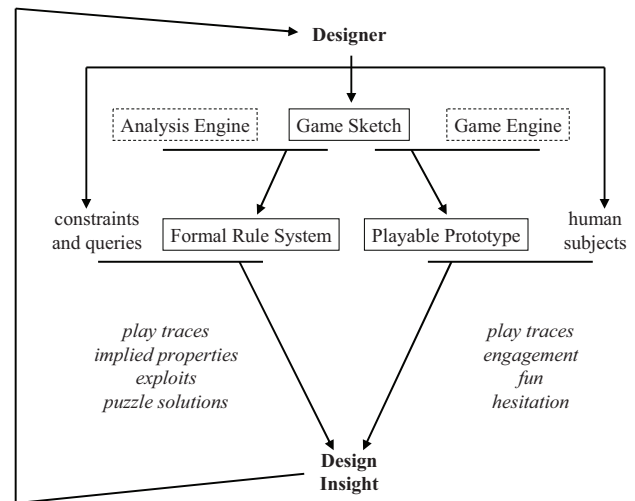


Figure 1: Architecture diagram for the BIPED system.

prototypes, the designer can carry out traditional play testing. Ideally, BIPED would be used after initial play testing with a physical prototype (which gives the designer experience with the game’s foundation using soft, negotiable rules), but before the implementation of a detailed computational prototype that may be more difficult to iterate on in response to feedback.

Unique to BIPED prototypes is the ability to carry out machine play testing using the same game-sketch definition that human players play. For us, machine play testing means extracting gameplay traces with interesting properties, using the analysis technique of Nelson and Mateas (2008). These traces can expose a difference between how the few human play testers played and what a dedicated player might achieve with practice or brute-force search. More importantly, these traces show how a game’s mechanics work immediately, without the need to rope in testers after each change.

The role of the designer and their game sketch, and this dual support for play testing, is outlined in Figure 1. Play testing is not only useful for the designer to improve their games; Niedenthal (2007) explains how prototypes can also

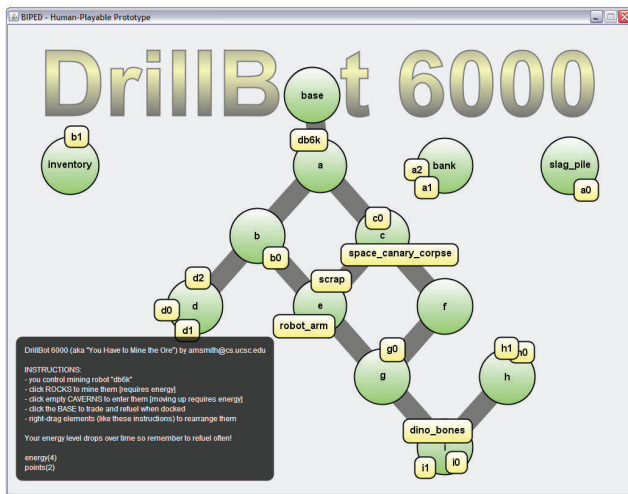


Figure 2: *DrillBot 6000*, a fast-paced mining game prototype, designed in the style of *Motherload*, powered by BIPED’s game engine.

be used to communicate and advertise design ideas, among other things. By virtue of BIPED’s architecture, designers can produce basic standalone games that can be shared with peers more easily than physical prototypes or computational prototypes with extensive dependencies. Even traces resulting from machine play testing can serve as a concise proof that the design supports the intended player experience.

### Example prototype

An example prototype in BIPED, *DrillBot 6000*, is shown in Figure 2. *DrillBot 6000* is a fast-paced mining game prototype based on the core mechanics of the popular Flash game *Motherload* from XGen Studios.<sup>1</sup> In this game, the player moves a mining robot through underground caverns, drilling out rocks of mixed value, while managing energy usage by periodically returning to the surface to refuel and trade items. This game was relatively easy to sketch, taking about 60 minutes of work to write 110 lines of game mechanics and 50 lines of UI bindings in our game-sketching language (not counting iterations after play testing).

### Play testing

We started play testing *DrillBot 6000* using self-testing, briefly playing the game ourselves to verify basic mechanics. Next, we tested with a few human subjects. All three testers claimed to enjoy the game, and could reach rocks at the deeper levels after some practice. Interestingly, no testers related to the game as a puzzle challenge, even when converted to a turn-based mode; all focused instead on the action aspect.

Figure 3 shows an example gameplay trace from *DrillBot 6000*, using the analysis engine, starting in the same scenario

```

happens( mine(a1), 0).
happens( drain, 1).
happens( drain, 2).
happens( trade, 3).
happens( refuel, 3).
happens( mine(a2), 4).
happens( mine(a0), 5).
happens( down_to(a), 6).
happens( mine(space_canary_corpse), 7).
happens( mine(c0), 8).
happens( down_to(c), 9).
happens( down_to(f), 10).
happens( up_to(c), 11).
happens( up_to(a), 12).
happens( down_to(c), 13).
happens( down_to(f), 14).

```

Figure 3: Example *DrillBot 6000* gameplay trace, generated by asking our analysis engine for a random 15-time-step trace with no constraints.

in which a human player would start, and putting no particular constraints on traces. From machine play testing, we learned that our human players were much more cautious than the game’s rules actually made necessary (frequently refueling their robot). Other experiments revealed that one seemingly radical level-design change did not affect either the maximum caverns reachable or the maximum number of valuable rocks brought back in a fixed amount of time.

In testing, we found alternating back and forth between human and machine play testing to be quite valuable, as insight from one mode prompts questions to ask in the other.

### Conclusion

BIPED is designed to give game designers the ability to take large creative leaps with their game ideas by providing rich feedback in the form of human and machine play testing applied to minimally specified formal game sketches.

### References

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<sup>1</sup><http://www.xgenstudios.com/play/motherload>