You're In Control: A Urinary User Interface

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Figure 1. A user interacts with the *You're In Control* system.

ABSTRACT
The *You're In Control* system uses computation to enhance the act of urination. Sensors in the back of a urinal detect the position of impact of a stream of urine, enabling the user to play interactive games on a screen mounted above the urinal.

Keywords
Urinal, Augmented Reality, Entertainment

INTRODUCTION
While urination fulfills a basic bodily function, it is also an activity rich with social significance. Along with the refreshing release it provides, the act of micturition satisfies a primal urge to mark our territory. For women who visit the bathroom in groups and chat in neighboring stalls, urination can be a bonding ritual. For men who write their names in the snow, extinguish cigarettes, or congregate around lampposts to urinate, urination can be a test of skill and way of asserting their masculinity.

The *You're In Control* project is an effort to enhance the act of urination using computational technology. We believe that adding interactivity to urination has valuable applications to recreation, sanitation, and education.

RELATED WORK
Japan is on the forefront of modern toilet technology, with toilets that clean themselves, play music to mask the noises of elimination, and measure urine sugar levels and body-fat ratios. Toilets with cleansing water jet sprays are now in nearly half of Japanese homes, a rate higher than that of personal computers [1].

Various designs for detecting a stream of urine have been proposed, but rather than focusing on interactivity, these designs are primarily intended to discourage the inadvertent or intentional diversion of urine outside the proper receptacle. For example, children's potty training devices use targets and spinning flywheels to teach proper aim [6], and small porcelain statues of insects mounted on the urinals at Amsterdam's Schiphol Airport are effective in improving the cleanliness of the restroom floors [3]. A patent filed in 1987 suggests simple entertainment applications, but the proposed design lacks the sensor resolution to design a rich interactive experience [2].

PRESENTATION
We mounted a urinal to a freestanding sheetrock partition, and affixed a flat-panel LCD screen to a frame above the urinal. Since the flush-valve was not functional, we routed sensor wires from the urinal basin through the chrome-plated plumbing fixtures to the circuit board and computer behind the wall.

Figure 2. *You're In Control* installation.

In order to allow both men and women to participate in the demonstration, we created a customized game controller, consisting of a nylon belt, a formed acrylic pelvic plate, water bottles, tubing, and a flexible garden hose nozzle. The controller is worn around the waist and the bottles are gripped and squeezed to pressurize a stream of water. To use the *You're In Control* system in standard restrooms, women would need to take advantage of a device such as Whizzy [4] or P-Mate [5] that allowed them to urinate while standing up.

HARDWARE
We built the *You're In Control* system with a grid of piezoelectric ceramic buzzers mounted to a flexible Mylar membrane. Foam tape mechanically isolates areas of the Mylar from one another, and local sensors measure deformations of the membrane in response to a liquid stream. When the sensor array was mounted to the

compound curved surface of the urinal, the membrane had uneven tension over its surface. This resulted in slightly uneven sensor outputs because tighter areas deformed less in response to the water stream. We addressed this inconsistency by custom-tuning the amplifying circuits to deliver uniform signals to the microcontroller.

The two-stage signal processing circuit uses an amplifier with a gain ranging from 10-100 and an envelope follower to curb the signal attenuation. A 16F877 PIC microcontroller receives the signals as digital inputs. The impact of a stream of liquid creates a signal that breaks the 2.5-Volt threshold necessary to send the microcontroller's digital inputs high. We chose to use digital inputs because they can be read more rapidly, and we found that the resolution provided by the digital inputs was sufficient for designing a compelling interactive activity.

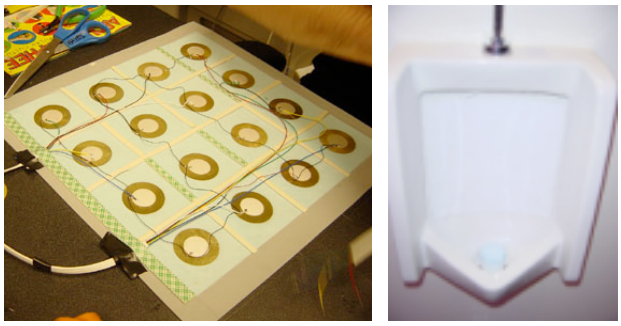

Figure 3. (a) Sensor array. **(b)** Sensor array mounted in urinal.

SOFTWARE

We programmed a custom interactive game in C++ on the Windows 2000 operating system. Our software reads the state of the sensor array from the microcontroller over a serial data link at a rate of 100 samples per second. The game we chose was a variant of *Whack-A-Mole*, a classic carnival game. Users aim at a series of jumping hamsters, with input position on the urinal corresponding to target position on the screen above. A successful hit turns a hamster yellow, makes it scream and spin out of control, and rewards the player with ten points. The parabolic trajectories of the hamsters conceal the grid-like arrangement of sensors, resulting in a fluid transition between input and output.

CONCLUSION

We believe that the *You're In Control* system offers many advantages over traditional bathroom fixtures:

Improved sanitation. Since our system motivates users to aim properly, it reduces splashing and spillage.

Hydration. By making urination more fun, the *You're In Control* system encourages proper hydration, and could result in increased beverage sales at restaurants and sporting events.

Potty training. *You're In Control* could also be used to teach children proper bathroom behavior at an early age.

Entertainment. While urinating outdoors is playful for many people, bathroom sanitation requires a serious focus and conformity. *You're In Control* encourages cleanliness while reintroducing play to the act of micturition.

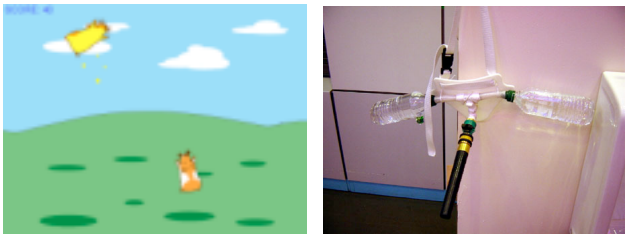

Figure 4. (a) Screen shot from our interactive game. **(b)** Custom input controller consisting of rubber nozzle with attached water reservoirs.

FUTURE WORK

While our design uses a grid of sixteen sensors, future designs could use only four sensors, reading analog values from the sensors and triangulating the position of the urine stream based on signal strength. This modification would reduce system cost and increase tracking resolution.

We envision a variety of additional software applications. For example, users could play a game in which they uncovered a hidden image with their urine. Another possibility is a cooperative networked game in which players attempt to maintain a steady aim at a common target as it moves around the screen, working together to achieve a shared goal. Users could even browse through news stories, advertisements, and stock quotes as they voided their bladders, in a new form of bathroom multitasking.

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