Team B1

SHTTR

Sustainable Hi-Traffic Toilet Redesign

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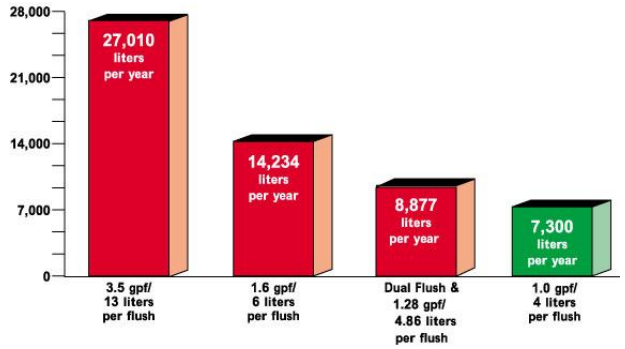
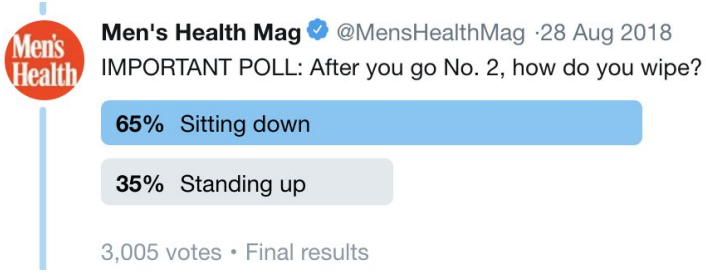
Introduction & Problem Statement

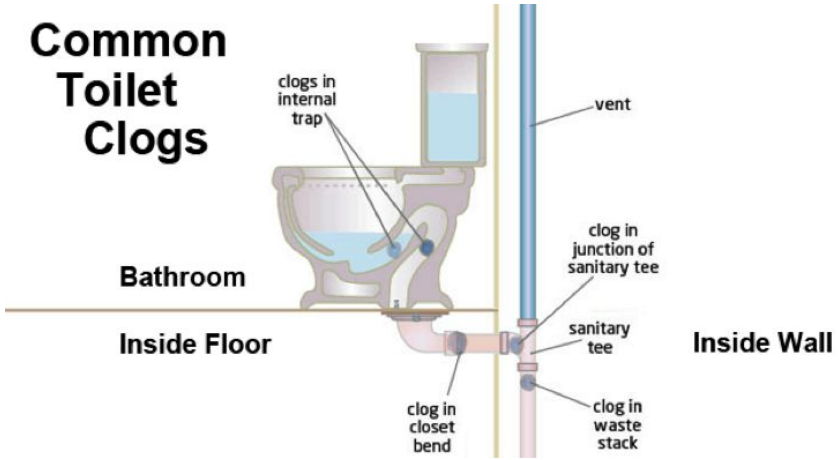
- The average person uses a toilet 2500 times a year
- Commercial automatic flush toilets are convenient, but they pose a problem with wastewater usage
- They often misfire, wasting gallons per-flush
- Most automatic toilets do not implement dual-flushing
- Bathroom usage is not standardized



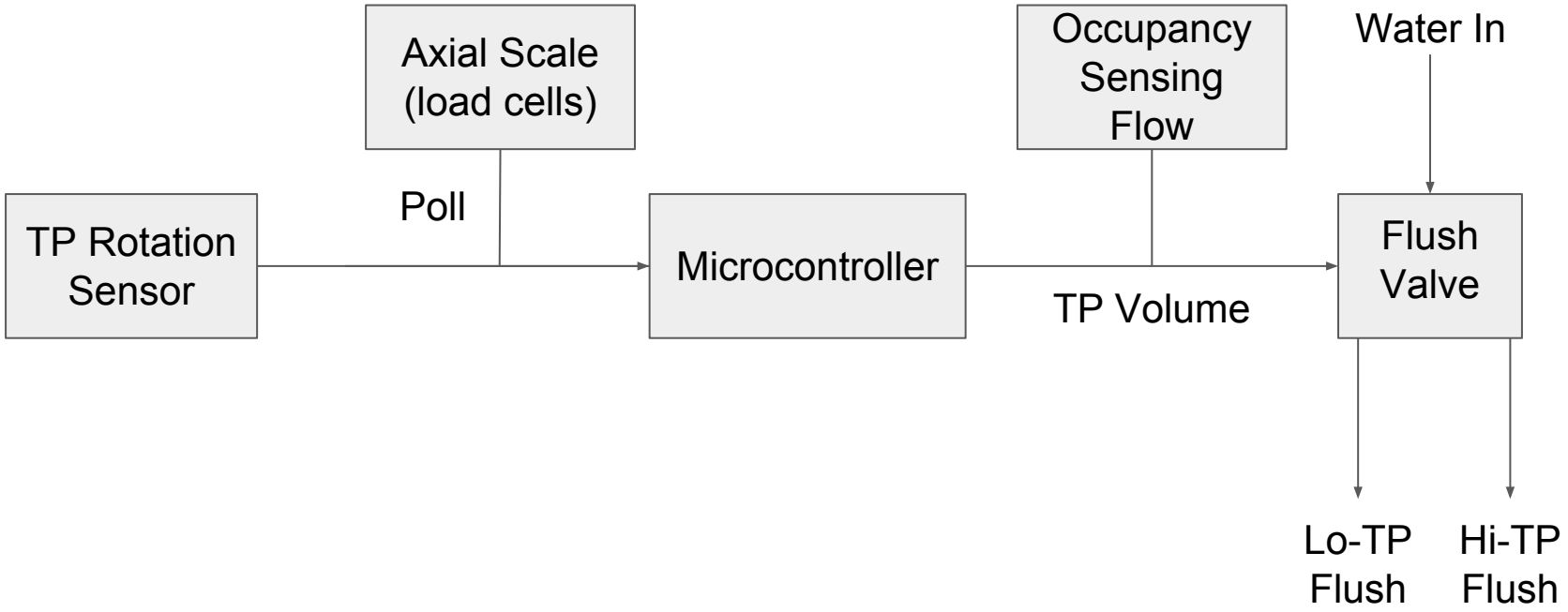


Proposed Solution

- Toilet paper sensing
  - Toilet paper is the most frequently clogging item in toilets
  - Detecting how much has been used would allow toilets to implement variable volume flushes, further conserving water
- Improved occupancy sensing
  - Reduces flush misfires
  - Better accounts for non-standard usage



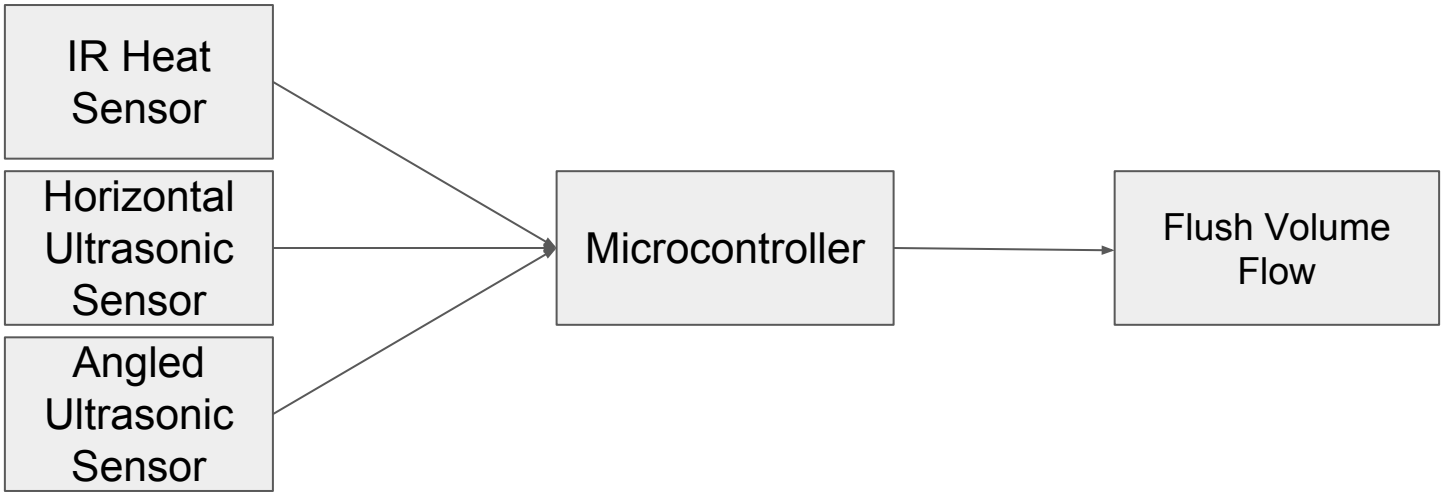
Solution Detail (Variable Flush)



Variable Flush Methodology

- Load cell detects the start of TP usage
- Triggers the microcontroller to poll the rotation sensor
    - Conserves power by reducing polling rate
- Flush volume is determined by amount of rotation
- Once occupancy is no longer detected, rotational polling stops
- Volume is sent to variable valve to flush

Solution Detail (Improved Sensing)



Sensing Methodology

- Basic IR heat sensing to detect human presence
  - Issues arise from certain clothing, fallbacks are needed
- Horizontal ultrasonic sensor
  - Distance sensing to detect presence without the challenges of IR sensors
- Angled ultrasonic sensor
  - Used to compensate for shifting positions as well as standing wipers

Challenges

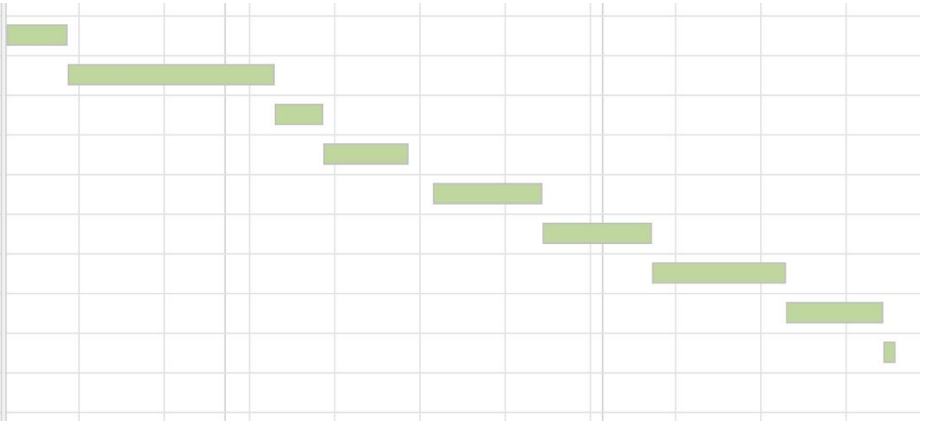
- Designing a rotation sensor that allows for TP roll replacement in an easy fashion
- Integrating a variable volume valve into a mechanism compatible with common systems.
- Tweaking the ultrasonic sensor angle to capture all relevant data
- Keeping the module small enough for commercial usage

Testing & Verification

- Testing Variable Volume Flush
  - Attach valve and TP sensor logic to test pipe
  - Measure flow rate
- Data logging for occupancy sensing testing
  - Integrate flush data logging into an off-the shelf flush sensor
  - Use a test chair to compare flush misfires between the two

Schedule

Research Stage	5d	02/11/19	02/15/19
Construct TP Sensor	12d	02/16/19	03/04/19
Construct prototype circuit (w/o occupancy)	4d	03/05/19	03/08/19
Spring Break LOL	6d	03/09/19	03/15/19
Prototype occupancy sensing	7d	03/18/19	03/26/19
Final prototype circuit, testing	7d	03/27/19	04/04/19
Design PCB	7d	04/05/19	04/15/19
Final Design, stretch goals	6d	04/16/19	04/23/19
In Lab Demo	1d	04/24/19	04/24/19



- David - Reverse Engineering/Valve Design, TP Sensor Design, and PCB Design
- Brian - Occupancy Sensing Logic and Occupancy Sensor Design
- James - TP Sensor Design and Housing Design
- All - Testing and Integration

MVP

- Semi-compact sensor unit
  - Basic TP volume sensing
  - Variable flush volume valve
  - Basic occupancy sensing
  - Manual override

Stretch Goals

- Near-perfect occupancy sensing to eliminate misfired flushes
- Small-form-factor commercially viable implementation
  - Professional quality housing & pcb
- Integration into a real working toilet