Optimization of sensors in recirculating shower system using IR, impedance and ultrasound.

Most innovative technology today contain at least one sensor of some sort. Sensors can measure movement, temperature or position to name a few. Limited research has been found on sensors regarding instantaneous water quality detection. This work is somewhat unique in this field.

Ever since the first water system was constructed in ancient Rome over 2000 years ago, water has been used in the same way. Water is taken from a big reservoir, used for one single purpose and then directly disposed. In ancient Rome, aqueducts led water from large lakes. Nowadays, pipes lead water from water treatment plants. Access to water is taken for granted in many parts of the world, but this is about to change. The outdated system where water is disposed immediately after use together with increasing population and climate change results in water scarcity in many parts of the world. One of the most affected countries, South Africa, has been forced to hold numerous nationwide campaigns acknowledging water use and trying to make the population waste less water.

Orbital Systems is an up and coming water saving company based in Malmö. Their aim is to change the way society uses water and help create a sustainable planet. Almost 30\% of the total water consumed by a person each day is used as shower water. This is the first problem that Orbital Systems has tackled with their creation the recirculating Orbital shower. The shower analyses the water before it reaches the shower drain and if deemed safe to reuse, gets drizzled back down on the user.

The brain of the product is a systems that 20 times every second measures the water and decides whether or not to reuse the water. This work has researched and evaluated different sensor techniques in order to improve the sensitivity of detection and thus further optimize the use of water during a shower session. Practical tests, using different possible shower contaminants, were carried out for the three most promising techniques. These three were ultrasound, IR and impedance. Ultrasound is commonly associated with imaging fetuses, IR is frequently used in heat cameras or motion sensors and impedance sensors are commonly found in several industry applications.

Each technique had their advantages and limitations and it was easy to conclude that none of the three could detect all tested contaminates. A combination of techniques is required for optimal detection and a sensor system using IR and impedance seems like the most promising combination.