# Introduction

In this course, we worked with sensors and microcontrollers to observe hidden processes on our campus. For my project, I focused on a simple, everyday action: flushing a toilet. Normally, we don't think much about it. We press a button, water flows, and everything continues as usual. What happens next remains invisible.

With my project, I wanted to capture this small and unnoticed moment and translate it into something visible and physical in another place. I attached a reed switch sensor to a toilet flush and connected it to an ESP32 microcontroller. When the flush is activated, the signal is sent via Wi-Fi to another ESP32, which controls a small water pump and an LED ring. The pump runs for a few seconds and the light changes colour. The hidden infrastructure is transformed into a small reaction.

My project illustrates how everyday actions can trigger systems without us being aware of their effects. We usually use these systems and don't think about what happens after we press a button. By transforming the flush into a visible water and light reaction, the project creates a direct connection between action and reaction, making a normally invisible process visible and encouraging us to think about how we interact with systems in our daily lives.
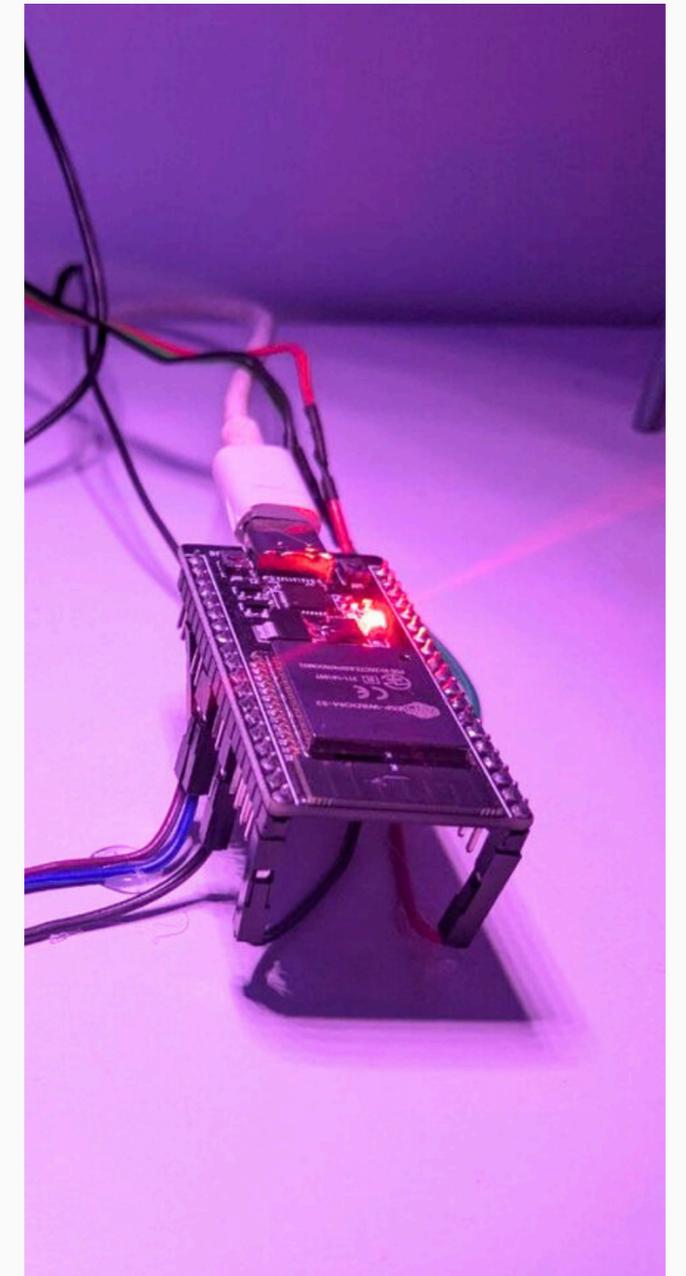
Design Process & Construction

My final design consists of a sensor attached to a toilet flush that communicates wirelessly with a second device that controls a small water pump and an LED ring. When the flush is activated, the signal is transmitted via MQTT to another ESP32, which triggers a short flow of water and a change in light colour. The system translates a small physical action into a visible water and light reaction.
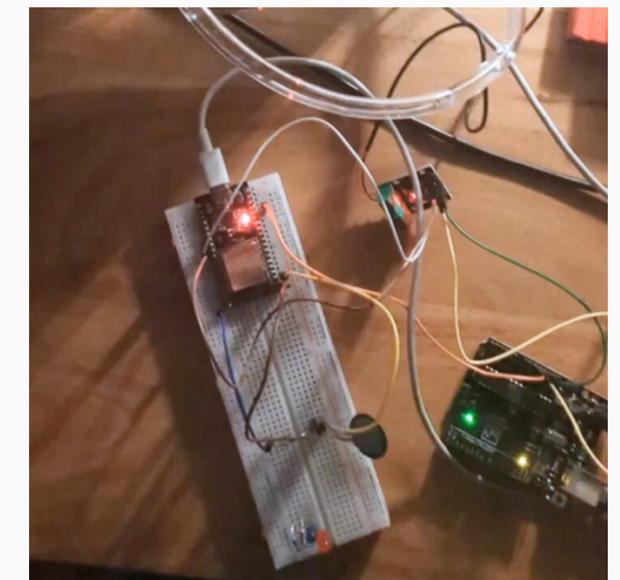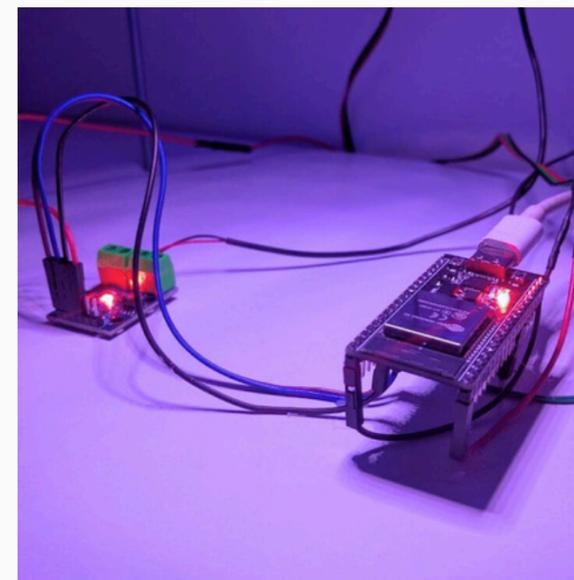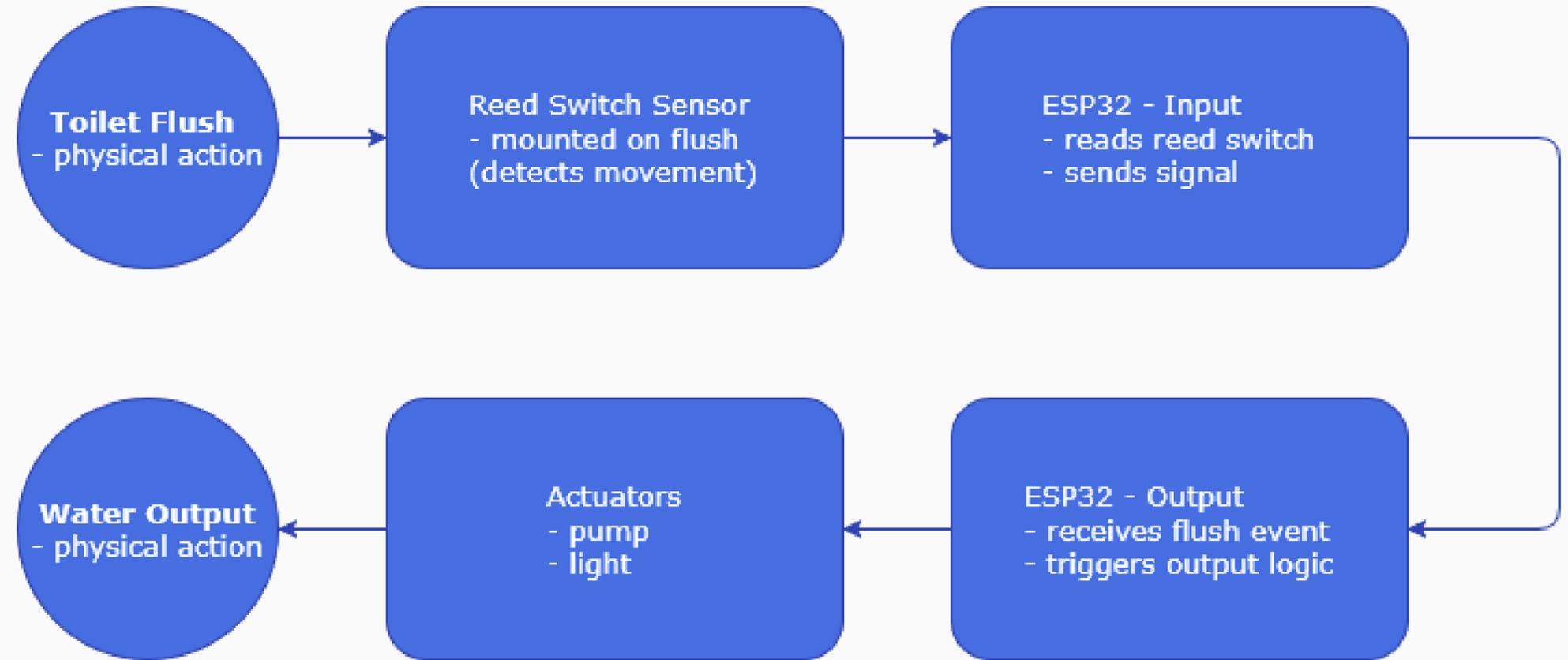
At the beginning, I had the idea of creating a kind of 'flush oracle'. The flush was supposed to trigger a speculative reaction. During the planning process, however, this idea seemed too abstract to me, and instead of creating a metaphorical interpretation, I shifted my focus to translating the action itself into a reactive system. This led to the idea of a fountain. Water became the central element, as it is directly related to the flush and the pipe system behind the wall. Instead of making predictions like an oracle, the final concept creates a direct cause-and-effect relationship between action and reaction.

The development process began with me considering how I could design the technology and which sensors I could use to reliably detect the flush. I quickly decided on a reed switch sensor, which is attached to the flushing mechanism to detect the movement of the button. I tested various time logics to ensure that only a real flush would trigger the system. The code basically works by responding to the moment when the magnet is removed, which resulted in a signal being transmitted to the receiver device.

The input side worked relatively fast, so I was able to turn my attention to developing the fountain. I connected a motor driver to a small water pump and added an LED ring to provide a visual response. Once the input and output were working from the technical side, I tested the code, which initially resulted in unstable MQTT connections. Therefore, the code was rewritten using a non-blocking method to ensure that the system could remain connected to the Wi-Fi. The pump runs for a defined time and the LED changes from pink (inactive) to orange (active), creating a clear visual output.

All components were first tested on a breadboard to check the wiring and logic. Once everything was working successfully, I soldered a few cables and connected the other connections directly to the ESP32.

I developed the aesthetic design of the fountain parallel to the technical system. I wanted the object to appear simple and almost neutral. I designed the shape of the fountain in Rhino and Grasshopper, with smooth curves and a controlled water outlet. The idea was to create a bowl-like shape from which the water could flow out. After the digital model was finalized, the design was 3D printed. I bought a glass bowl for the fountain on eBay Kleinanzeigen. The transparency of the glass allows the water and light reflections to remain visible. By combining the 3D printed shapes with the simple glass container, I tried to design a modern fountain with a minimalist appearance.

Toilet Flush
- physical action

Reed Switch Sensor
- mounted on flush
(detects movement)

ESP32 - Input
- reads reed switch
- sends signal

Water Output
- physical action

Actuators
- pump
- light

ESP32 - Output
- receives flush event
- triggers output logic

Final Reflection

During the semester, I learned how to work with ESP32 microcontrollers, sensors, motor drivers and LED rings. I improved my understanding of MQTT communication. Furthermore, thinking about how different elements interacted with each other was an important part of developing my system. This applied both to the technical components, which had to communicate reliably and to solving problems when something did not work as expected. It was also relevant on a conceptual level as I developed the idea of how to measure a process on campus and display its impact elsewhere as a visible response. Understanding these relationships helped me to view the project not just as individual parts, but as a connected system.

Overall, this project helped me to combine conceptual thinking with technical implementation. I gained confidence in building interactive systems and learned how small everyday actions can be transformed into physical experiences through technology.