**PXL-Digital**

Elektronica-ict

**Project Katara -**

**An automatic plant care solution**

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# Introduction

Project Katara is an automated plant monitoring and care system designed to address the challenges of plant maintenance in busy lifestyles. Whether it’s watering your plants, ensuring they receive adequate light, or monitoring soil conditions, the system provides an electronic solution. The goal of this project was to develop a device that simplifies plant care, even during extended absences, by combining hardware, software, and connectivity.

The project began as a proof of concept to explore how microcontrollers, sensors, and mosfets could automate plant care. Over two years, it evolved into a fully integrated system with custom-designed PCBs, real-time monitoring capabilities, and an intuitive web interface.

With features like automated watering, customizable light spectrums via Neopixel LEDs, and a plant-specific data interface accessible through a website, the system aims to meet the needs of modern plant enthusiasts. While functional, the project also posed several challenges, including electrical design refinements, thermal management, and user interface optimization. This application note documents the journey, detailing each step of the design process, component selection, challenges faced, and the solutions implemented.

# Proof of concept

## Objectives

The primary goal of the initial design was to validate the feasibility of automating plant care using off-the-shelf components. This included controlling a water motor, monitoring soil moisture levels, and experimenting with light adjustments for plant growth. The focus was on creating a low-cost, modular system that could serve as a foundation for more advanced iterations.

## A green circuit board with black and white components Description automatically generatedDesign overview

The proof-of-concept system began with a simple relay module connected to an ESP32 development board. This initial setup tested the feasibility of controlling a water motor, laying the groundwork for more complex implementations. Once this basic concept was validated, the project quickly progressed to designing a custom PCB to enhance functionality and integration.

The first PCB iteration retained the ESP32 as a development module and introduced MOSFETs to replace the relay for motor control. The system consisted of:

Figure 1: First PCB prototype

* **Water Motor Control:** A MOSFET-driven circuit to manage a 12V water pump.
* **Soil Moisture Monitoring:** Basic capacitive soil moisture sensors for data collection.
* **Lighting:** Neopixel LED strips to provide a customizable light spectrum for plant growth.
* **Power Supply:** External adapters to provide 5V and 12V required by different components.

While the custom PCB marked a significant step forward, it also highlighted critical design flaws, particularly related to power distribution and MOSFET implementation.

## Key challenges

1. **MOSFET Troubles:** The MOSFETs used in the first PCB design failed to drive the water motor effectively, rendering the motor control system practically unusable. This issue underscored the need for careful MOSFET selection and gate driving considerations.
2. **Short Circuits:** A major short circuit occurred due to the placement of the 12V DC plug, exposing gaps in PCB layout knowledge.
3. **Power Management:** The 12V and 5V power supply design introduced thermal issues and unstable operation.
4. **PCB Layout:** Limited experience in PCB design led to several avoidable mistakes, such as poor trace routing and inadequate clearance around high-current components.

## Lessons learned

* **MOSFET Selection:** Choosing the correct MOSFETs and ensuring proper gate drive voltages are critical for reliable motor control.
* **PCB Layout Practices:** Proper placement of connectors, improved trace routing, and adherence to design rules are essential for preventing shorts and ensuring stable operation.
* **Iterative Improvement:** The first PCB, while flawed, provided invaluable insights that shaped the design of the final iteration.

The proof-of-concept phase was a crucial learning experience, highlighting both the potential and the challenges of automating plant care. These lessons informed the development of the second PCB, which addressed the limitations of the initial design while incorporating advanced features.

# Final PCB

## Objectives and improvements

## Electrical overview

## Component selection

# Design challenges

# Software and interface design

# Testing and validation

# Outcome

# Conclusion

# References

**There are no sources in the current document.**

# Appendix