ReWire

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Remote Wiring System for Academic Laboratories: Real-Time Web-Controlled Multiplexing

Introduction

- Graduation project in Computer Engineering
- Focus: hardware + software integration
- Motivation: enable remote lab access for students

How We Came Up With the Idea

- Observed challenges in remote learning during labs
- Need for flexible circuit reconfiguration without being on-site
- Inspired by real lab wiring, re-imagined virtually

Why This Idea?

- Bridges the gap between theory and practical lab work
- Increases accessibility for students and researchers
- Reduces dependency on expensive lab infrastructure

Overview of Peripherals Used in this Demo

- Ultrasonic Sensor
- Servo Motor
- Water Pump

Key Features

- Compact circuit design
- Optimized hardware usage
- Low development and deployment cost
- High efficiency with minimal resources

A True Computer Engineering Project

- Emphasis on embedded systems + networking
- Integration of hardware with cloud/software
- System-level thinking, not just device mechanics
- We Have Used Real Concepts from Courses We've Taken.

Our Goal: Achieving a Virtual Wiring System

- Enable users to **perform real experiments remotely** through a web-controlled system.
- Provide a **flexible and scalable wiring solution** using nodes and demultiplexing.
- Create a platform that can be applied not only in **Computer Engineering**, but also in **Mechanical setups, Chemistry experiments, and beyond**.

The Need for Demultiplexing

- **Demultiplexers expand** one line into multiple outputs, enabling flexible routing.
- Without demuxes, **scalability and virtual rewiring** would not be possible.

Bidirectionality as a Core Requirement

- Real lab circuits require signals to **flow in both directions**.
- A node may act as an **input or output** depending on the experiment.
- **Bidirectional switching** gives users the same flexibility as physical wiring.

Technical Details

- **ESP32 acts as the I^2C master**, sending commands to 8 Arduino Pro Minis (slaves).
- Each Arduino controls **2 demultiplexers**, giving a total of 16 Type A nodes.
- The system also includes **16 Type B nodes**, together forming the virtual wiring network.

Turning the Concept into a Real Product

- Built a **working prototype** to prove the concept in practice.
- Design is **scalable** and can be expanded for larger lab systems.
- Potential to become an **educational tool or commercial EdTech product**.

Practical Usefulness and Applications

- Enables **remote access to labs**, saving time and resources.
- Allows **institutions and researchers** to share one system instead of multiple setups.
- Can be adapted for **Computer Engineering, Mechanical setups, Chemistry experiments, and more.**

Technical Details

- **ESP32 (Master)** communicates via I^2C with **8 Arduino Pro Minis (Slaves)**.
- Each Arduino controls **2 demultiplexers → 16 Type A nodes**.
- System also includes **16 Type B nodes**, forming the full virtual wiring network.

Future Work & Improvements

- Develop more advanced **bidirectional switching modules** for complex circuits.
- Improve the **web dashboard** with better usability and security.
- Expand support for **more nodes and peripherals** to cover a wider range of experiments.

Conclusion

- **ReWire** enables real lab experiments to be performed remotely.
- Combines **nodes, demultiplexing, and bidirectionality** into a scalable system.
- Flexible and **applicable across multiple fields**, not just Computer Engineering.

THANK YOU!