Technical Datasheet
Low-Cost LED Analyser

Project: 42088 – Industrial Project
Customer: Altice Labs
Version: Prototype v1.0
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Description

Low-cost system for objective LED analysis, capable of measuring LED colour, luminous intensity, and estimated wavelength. The solution targets LED validation in network devices (routers/gateways), reducing dependence on subjective visual inspection and costly commercial equipment. The system uses RGB colour sensors, optical isolation with Plastic Optical Fibers (POFs), and processing on a Raspberry Pi.

Main Features

- Measurement of multiple LEDs in parallel
- Support for up to 8 sensor channels via I^2C multiplexing
- Optical isolation using POFs and a 3D-printed enclosure
- Modular software architecture with REST API and GUI

Optical Characteristics

- Number of sensors: 8 colour sensors
- Sensor type: VEML3328 colour sensors
- Measured parameters:
    - Red, Green, Blue (RGB)
    - Relative luminous intensity
    - Estimated dominant wavelength
- Optical coupling: Plastic Optical Fibres (POFs)
- External light isolation: Opaque 3D-printed optical enclosure

Electrical Characteristics

- Processing unit: Raspberry Pi 4
- Power supply: External power supply (3.3 V)
- Communication with sensors: I^2C via TCA9548A multiplexer

Interfaces and Connectivity

- Ethernet (via Raspberry Pi)
- Wi-Fi (via Raspberry Pi)
- Bluetooth (via Raspberry Pi)
- REST API for data access and system control

Software

- Embedded firmware for sensor control and data acquisition
- REST API for communication between control unit and user interface
- Graphical User Interface (GUI) for test execution and data visualisation
- Version control using GitHub

Mechanical Characteristics

- Custom 3D-printed enclosure
- Integrated support for PCB and Raspberry Pi
- Dedicated optical alignment structure for POF positioning
- Designed for repeatable and stable measurements

Operating Conditions

- Intended environment: Laboratory and development environments
- Operating temperature: Typical indoor laboratory conditions

Typical Applications

- Validation of router/gateway LED indicators

- Laboratory testing and quality control workflows

- Low-cost alternative for prototyping and light industrial testing
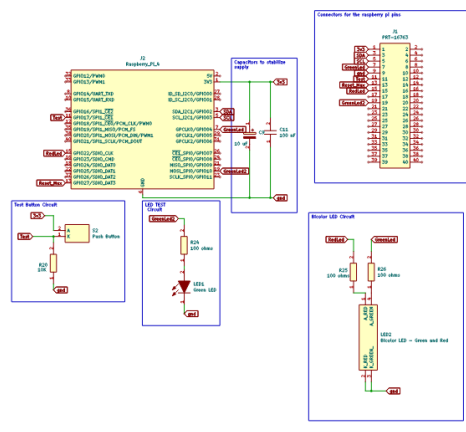
Operating Notes

- Best performance requires controlled optical coupling and ambient light isolation

- Calibration improves accuracy and consistency across devices and sessions

- Mechanical alignment of POF ports is critical for repeatability
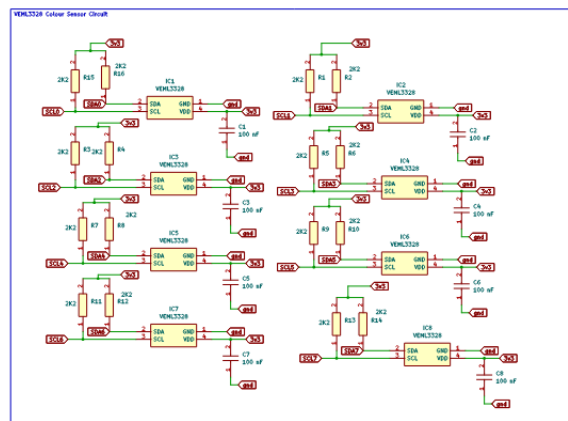
Performance and Notes

- **Repeatability:** To be quantified after calibration

- **Limitations:** Measurement accuracy depends on optical alignment and ambient light isolation

- **Future work:** Software extensible for additional metrics and calibration routines, final enclosure refinement, database integration for historical data logging
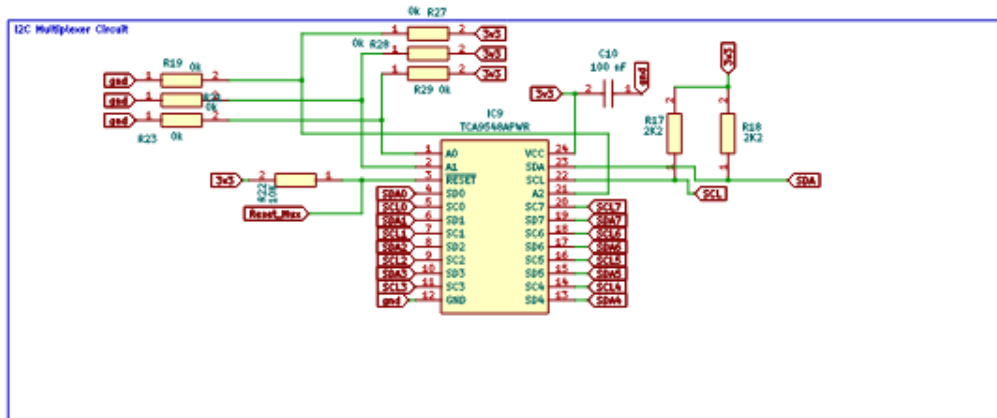
Schematics and PCB

System Schematics

Microcontroller and processing unit schematic, including Raspberry Pi interface and control logic.
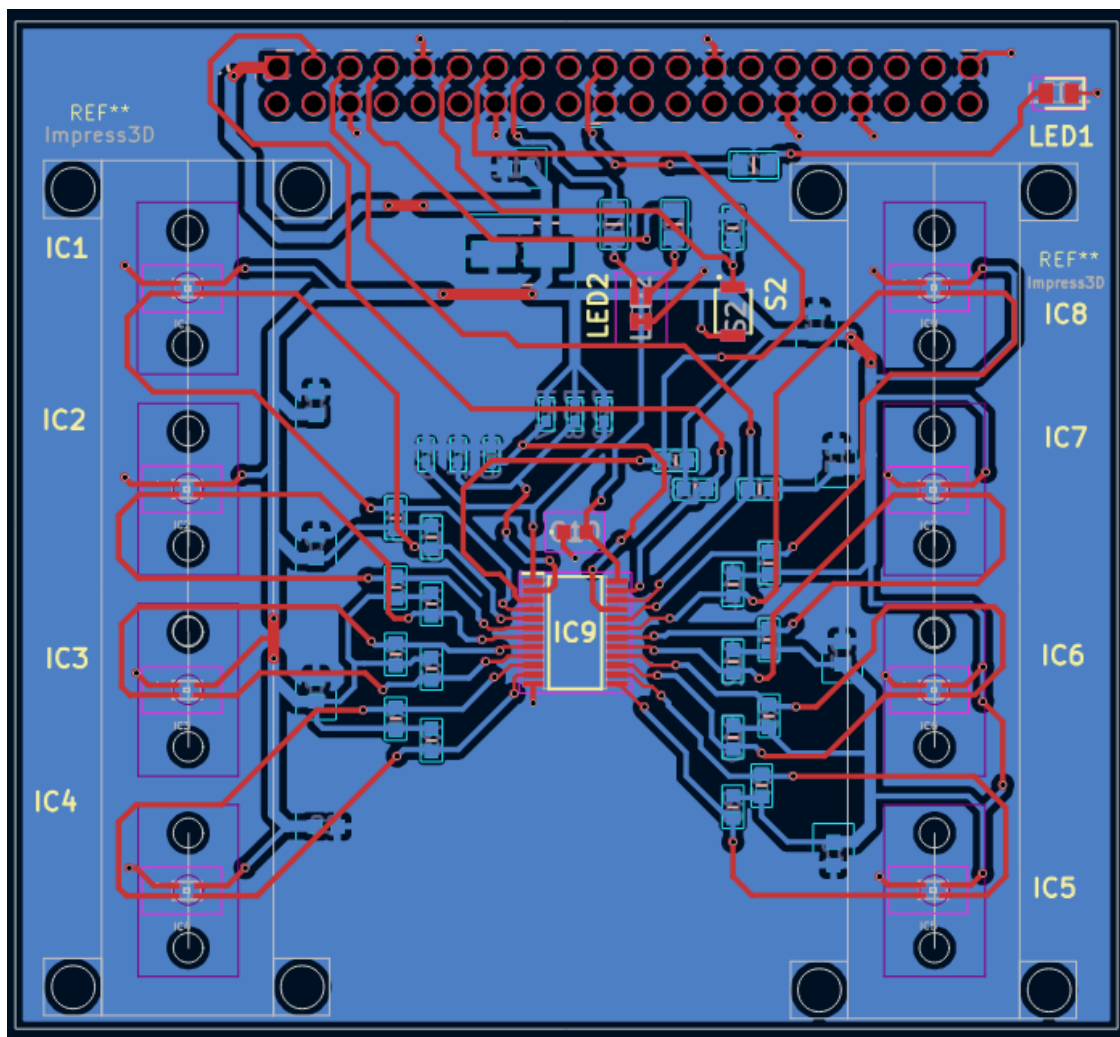

Colour sensor interface schematic showing VEML3328 RGB sensors and optical input connections.

I^2C multiplexing schematic using TCA9548A for multi-sensor communication.

Printed Circuit Board (PCB)

PCB layout of the LED analyser prototype, integrating sensor channels, power distribution, and processing interfaces.

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