Implementation of an AI-Assisted CI/CD Pipeline for KiCad Library Quality Assurance

TECHNISCHE UNIVERSITÄT DARMSTADT

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Motivation

INTEGRATED ELECTRONIC SYSTEMS LAB
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Managing and maintaining high-quality electronic component libraries is a critical but often tedious task in hardware development. Inconsistencies, errors, or poorly documented components in a KiCad library can lead to significant design flaws and costly manufacturing mistakes. Manual verification of each component against its datasheet is time-consuming and prone to human error.

This project aims to solve this problem by creating an intelligent, automated workflow. We propose the development of a **Continuous Integration/Continuous Deployment (CI/CD) pipeline** that not only enforces a strict quality schema for all library components but also leverages the power of **Artificial Intelligence (AI)** to automatically verify schematic symbols against manufacturer datasheets.

The goal is to build a robust system where every library contribution is automatically checked, ensuring all components are correct, well-documented, and reliable before they are used in a project.

Your Tasks

Your primary responsibility will be to design and implement this entire verification pipeline. The work can be broken down into the following key tasks:

- **CI/CD Infrastructure Setup:** You will set up a CI/CD pipeline using a platform like **GitHub Actions** or **GitLab CI**. This pipeline will automatically trigger whenever changes are pushed to the KiCad library repository.
- **Library Schema & Linting:** Define a clear schema for KiCad symbols and footprints. This includes mandatory metadata fields (e.g., `Manufacturer Part Number`, `Datasheet Link`, `Description`), naming conventions, and style guidelines. You will then implement linter scripts (e.g., in Python) to enforce this schema automatically.
- **AI-Powered Datasheet Verification:** This is the core innovative task of the project. You will develop a module that:
  1. Parses the KiCad symbol file to extract its pin information (pin numbers, names, electrical types).
  2. Automatically fetches the component datasheet (PDF) from the provided link.
  3. Uses **AI/LLM tools** and potentially computer vision techniques to read and understand the datasheet, specifically extracting the pinout table or diagram.
  4. Compares the pin information from the KiCad symbol against the data extracted from the datasheet to identify any discrepancies.

- **Reporting & Integration:** Integrate all checks into a single, seamless pipeline. The pipeline should provide clear, actionable feedback to the designer, highlighting exactly which checks passed and which failed, with links to the relevant components.

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Your Profile

We are looking for a motivated student who is enthusiastic about bridging the gap between hardware design and modern software engineering practices.

- Strong programming skills, preferably in **Python**.
- Solid understanding of **Git** for version control.
- A keen interest in **AI, Large Language Models (LLMs), and automation**.
- Basic knowledge of electronics and the ability to read a component datasheet.
- Familiarity with CI/CD concepts (e.g., GitHub Actions, GitLab CI) is a big plus.
- Experience with **KiCad** is beneficial but not a requirement.

Interested?

If this project sounds exciting to you, please do not hesitate to get in touch!

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