Development and Optimization of an IPC2581A Format Parser for KICAD: Streamlining PCB Design Data Exchange and Communication

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Abstract. Based on Kicad software platform, this study developed an IPC2581 file format parser for PCB layout. Through the parser, the circuit layout tool designed by any other third-party EDA design tool generated IPC software generated circuit board formatter file can be converted to KiCad format, to achieve the compatibility between different software. The parser has the characteristics of high efficiency and accuracy, which can quickly analyze large-scale complex circuit board designs and generate corresponding KiCaD file format. In the experiment, we have tested several circuit boards, and the results show that the analyzer has good stability and reliability. Through this research, we provide a convenient file format conversion tool for the field of circuit board design, which is helpful to improve the efficiency and quality of circuit board design

Keywords: Electronic Design Automation; Format Parser; IPC2581; KiCad; Printed
        Circuit Board

1. Introduction

In today's era of rapid development of electronic products, the design and manufacture of circuit boards has played a crucial role. To ensure that the design is accurate and efficient, design engineers need to use advanced circuit board design software. KiCad has become a widely used open-source circuit board design software in this field.

With the increasing complexity of electronic products and the continuous expansion of functions, circuit board design is facing higher requirements. As an industry standard, IPC2581 file protocol plays an important role in the field of

circuit board design and manufacturing. It provides a standardized file format for data exchange between different software and platforms. However, currently KiCad, an open-source software suite for Electronic Design Automation (EDA), does not support direct integration of the IPC2581 file protocol, which makes circuit board design engineers face some limitations when using KiCad.

In the field of electronic design automation (EDA), KiCad is a widely used open-source software for circuit design and PCB layout. However, while KiCad has many advantages in terms of functionality and user interface, there are still some issues in terms of data exchange with other EDA tools. One of the main issues is the compatibility and scalability of KiCad's PCB layout information storage format: KiCad_pcb file.

In this context, the purpose of this thesis is to study and analyze the feasibility and advantages of KiCad integrating with IPC2581 file protocol. The main goal is to develop and optimize the IPC2581A format parse based on KiCad to solve the problem of data exchange between KiCad and other EDA tools. Through the review of the existing literature and related technologies, the researcher will discuss how to integrate KiCad with IPC2581 file protocol completely to improve the efficiency and accuracy of circuit board design.

The researcher's main motivation for the study was to provide solutions to the problems currently encountered by KiCad users in data exchange. By addressing data compatibility and scalability issues between KiCad and other EDA tools, users' productivity and experience can be improved. In addition, by improving KiCad's overall performance and data exchange capabilities, it can enhance KiCad's competitiveness in the EDA field and promote its wide application in the industry.

2. Methodology

The study used a developmental research method. Developmental research is most used in studies that create or develop a technology to address one problem. Developmental research is defined as "the systematic study of designing, implementing, and assessing instructional programs, procedures, and products that must satisfy the requirement of internal consistency and effectiveness," as compared to basic instructional development (Richey et al., 2004). This method is applicable to the study because the expected output for the study is a system that can be used and utilized.

Journal of Multidisciplinary Research and Development

2.1. Sampling Procedure

Purposive sampling was used in selecting the respondents of this study. Purposive sampling is a non-probability sampling method in which the items of the sample are picked based on the researcher's judgment. Researchers frequently feel that by applying competent judgment, they may produce a representative sample and save time and money (Black, 2010). For this study, the purposive sampling technique allows the researcher to choose the respondents for the study based on his personal judgments that he thinks will give the appropriate evaluation for the study.

The respondents were purposively selected because they are the professionals who are aware of the concept and is expected to give their judgements that will benefit on the improvement of the proposed parser.

2.2. Respondents

The study targets professionals in the field of printed circuit board (PCB) design and manufacturing, including PCB designers, engineers, and technicians. These individuals often have expertise and extensive experience in PCB design and manufacturing and can provide valuable insights and recommendations. Their experience in using IPC2581A format parser and KiCad software in their work can also provide practical application scenarios and problems for the research, which contributes to the practicability and operability of the research.

The proponent gathered data from fifty (50) respondents: twenty (20) PCB Designers, ten (10) PCB Engineers and twenty (20) PCB Technicians served as the respondents of the study and evaluated the system based on the ISO 25010 Software Product Quality Standards and its level of effectiveness.

2.2.1 Research Site

Selecting Shenzhen, China as the locale for the study is justified due to its economic significance, diverse business landscape, and accessibility of data. Shenzhen's thriving economy with a wide array of industries provides an ideal setting to investigate the adoption and impact of big data analysis and business intelligence for gaining a competitive edge. Moreover, the region's strong government support for technological advancements and the presence of academic and industrial collaborations offers valuable insights for the research. Conducting the study in a culturally and linguistically relevant location further

enhances the research's quality, and potential generalization to other similar regions adds broader significance to the findings.

3. Results and Discussion

3.1. Challenges in Data Exchange and Communication in PCB Industry Using KiCad

Based on the responses gained from the questionnaire provided, challenges exist in the current process of data exchange and communication using KiCad in the PCB Industry. Most of the respondents agreed that there were problems or challenges in terms of Compatibility Issues, Component Libraries, File Format Standardization, Version Control and Collaboration, and Manufacturing Documentation.

3.2. Limitations and Shortcomings of the Existing IPC2581A Format Parsers for KiCad

Based on the responses gained from the questionnaire given, majority of the respondents agreed that there were limitations and shortcoming in the existing IPC2581A format parser for KiCad in terms of Compatibility, Parsing Accuracy, Lack of Standardization and Performance and Efficiency. This clearly indicated that there is a need to develop a new version of the parser that will address all the challenges and limitations.

3.3. Development of IPC2581A Format Parser using the Agile Development Phases

The IPC2581A Format Parser was successfully developed following the Agile Model Phases namely conception, inception, iteration, release, and maintenance.

3.4. Respondents' Evaluation on the Developed IPC2581A Format Parser Based on the Selected ISO/IEC 25010 Software Product Quality Standards

The evaluations given by the respondents indicated that the developed application highly exceeds the ISO 25010 Software Product Quality Standards on technical quality assurance. This indicates that the developed application is highly functional, highly efficient, highly compatible, highly usable, highly reliable, highly secured, highly maintainable, and highly portable.

3.5. Respondents' Evaluation on the Level of Acceptability of the Developed IPC2581A Format Parser

All respondents agreed that the developed format parser was Highly Acceptable in terms of Parsing Accuracy, Performance, Compatibility, Error Handling and Ease of Use. This indicates that the developed format parser provides the answer or the solution to the challenges and limitations experienced in the older version of the parser.

4. Conclusions

Based on the findings, the following conclusions are drawn:

1. Challenges are experienced in terms of data exchange and communication in PCB industry using the old KiCad format parser.
2. Limitations and Shortcoming are evident in the existing format parsers for KiCad based on different categories.
3. The IPC2581A format parser was developed following the Agile Development Phases.
4. The respondents evaluated the developed format parser as highly functional, highly efficient, highly compatible, highly usable, highly reliable, highly secured, highly maintainable and highly portable.
5. The developed format parser is evaluated as highly acceptable by the respondents in terms of various categories stated.

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