BOM Wire Tracer Project

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PACCAR TECHNICAL CENTER

02

Motivation

- Harness modifications desired by customers are submitted to PACCAR for safety testing and approval before full implementation in a vehicle. Current verification of these harnesses consumes as many as 26 weeks due to manual tracing of wires through splices and multiple harnesses, necessitating a redesign upon discovery of any unsafe circuit characteristics.
- This project seeks to halve that time by creating a software program that automates the tracing process and reports potentially dangerous circuits, greatly accelerating the redesign stage by providing early identification of faulty harness design, reducing the need to manually search through an entire wiring harness for potential faults before final testing.

Objective

- Based on the bill of material files and the fuse rating files, the software would trace through the entire circuit and report on wires that are potentially threatening based on PACCAR's established standards and tolerances.
- Maintain the efficiency of the code while conducting accurate and comprehensive analysis on the circuit.
- Takes less than 5 minutes on its analysis.

Requirement

- Create an easy to use and user-friendly interface with standard Python libraries
- Able to read/write csv files from Python
- Able to process data in the form of dataframe and adapt to non-conforming or incomplete input data

Implementation

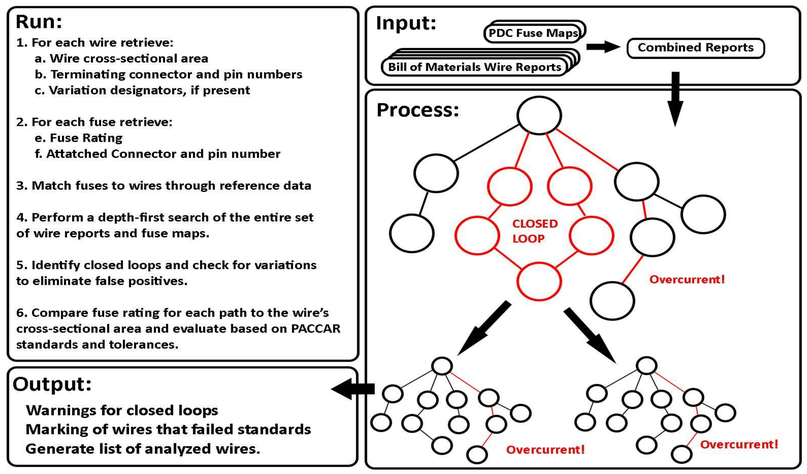

Figure 1. High-Level Diagram of the Auto Wire Tracer

Algorithm:

The risk analysis uses the Depth-First Search algorithm to traverse through the fuse rating report, where all wires that are connected directly to the power distribution center are listed. Then, it checks the BOM report through finding finds all the matching rows by comparing from component and from pin. It compares the fuse rating of the BOM report to the fuse rating to the reference table provided by PACCAR.
All circuits visited are stored in a dataframe to detect closed loops in wire paths. If a loop is detected, the algorithm compares the circuit variation designators. If designators are identical, a closed loop has been detected and this problem reported. Non-matching variations are separate circuits, and these loops ignored.

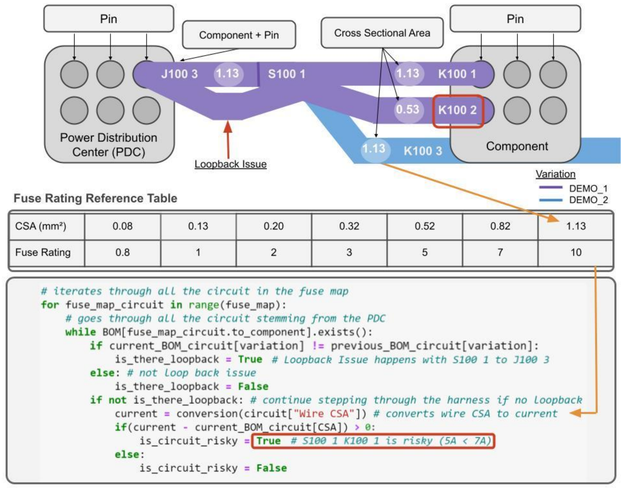

Figure 2. Risk Analysis Algorithm Diagram

Result

From Com	From Pin/	To Compo	To Pin/Ca	Wire CSA	Harness	Variation
A	1	B	1	1	xxxx	xxxxx
A	1	D	1	1	xxxx	xxxxx
A	1	E	1	3	xxxx	xxxxx
E	1	F	1	0.3	xxxx	xxxxx
F	1	Z	1	2	xxxx	xxxxx
G	1	H	1	3	xxxx	xxxxx

Fuse Conn	Fuse Pin	Fuse Rating
A	1	15
G	1	35

From Com	From Pin/	To Compo	To Pin/Ca	Wire CSA	Harness	UserFunct	Fuse Ratin	Problem F	Problem F	Problem CS	Problematic Circuits
A	1	B	1	1	xxxx	xxxxx	15				
A	1	D	1	1	xxxx	xxxxx	15				
F	1	Z	1	2	xxxx	xxxxx	15	E	1	0.3	['E 1 to F 1']
E	1	F	1	0.3	xxxx	xxxxx	15	E	1	0.3	['E 1 to F 1']
A	1	E	1	3	xxxx	xxxxx	15				
G	1	H	1	3	xxxx	xxxxx	35	G	1	3	['G 1 to H 1']

Figure 3. Output of a Small Demo Circuit

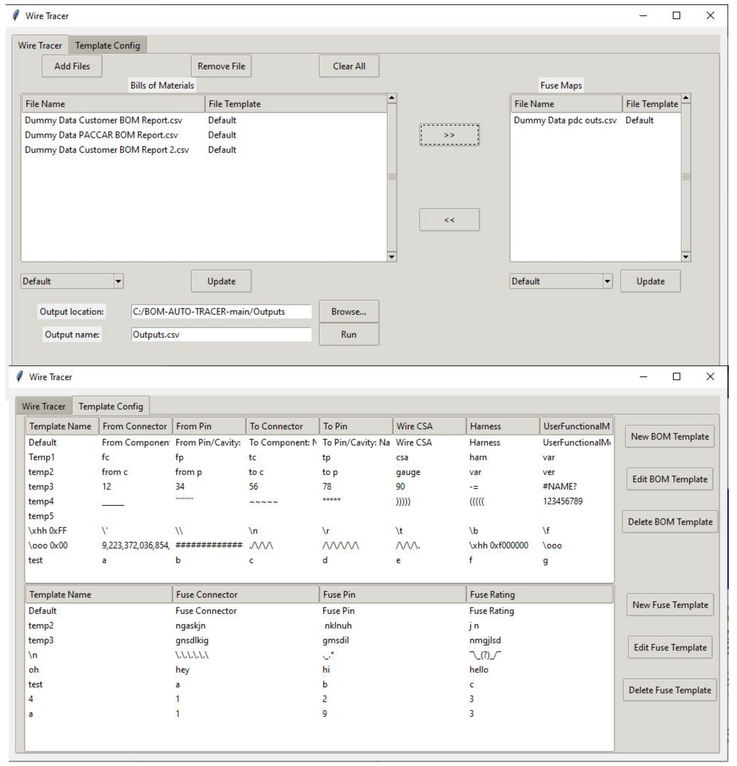

Figure 4. Graphical User Interface

Future Work and Conclusion

To shorten the time that PACCAR's engineers spent on the circuit safety test, the team developed a software to perform the circuit tracing process and output a comprehensive list of wires that are potentially threatening based on the safety standard. If the software can be used in practice, the time to conduct the circuit safety test would be halved.

Future actions includes

- Accepting pdf input files would be helpful since many BOM and fuse rating files are in pdf format
- Identify connections in the circuit that need to be grounded

References & Acknowledgments

Licenses of libraries used
- https://github.com/numpy/numpy/blob/main/LICENSE.txt
- https://docs.python.org/3/license.html
- https://github.com/pandas-dev/pandas/blob/main/LICENSE

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