Conversion of Hand Drawn Electrical Circuit Schematics into LTSpice Format using Deep Learning Methods

Konvertierung von Handgeschriebenen Elektrischen Schaltungen in LTSpice Format mithilfe von Deep Learning Methoden

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Thesis Description

An electrical circuit schematic (ECS) is a way to represent an electrical circuit in a formal way. ECSs consist of symbols representing electrical circuit components (ECC) and wires (lines) connecting those components. Additionally an ECS can contain component annotations describing the name and value of a component. As an example, an annotation for a resistor could be "R0 1000 Ω" where "R0" represents the name of the resistor and "1000 Ω" its component value.

The knowledge of the schematic symbols and the corresponding calculations to acquire different values, such as voltage, current or component values is taught in school and university [LEHRPLAN]. To verify results of performed calculations Students rely on solutions, or on dedicated circuit simulation software such as LTSpice. In the latter case the hand drawn electrical circuit has to be rebuild in the application. Application based approaches are considered to be 90% more expensive, than hand drawn methods [1] and also require a priori knowledge of the underlying program. Hence an automated method to convert a scan of an ECS into a digital format, recognizable by a simulation software, would greatly benefit the result verification efficiency.

So far various researches have been conducted on the segmentation, recognition and the tracing of inter ECC connections. The proposed approaches can be structured in the following way. 1) Classification of already segmented ECCs [2, 3, 4]. 2) Segmentation and classification of ECCs [5, 6]. 3) Segmentation and classification of ECCs and tracing of the wire to acquire the underlying ECS topology [7].

1. Object detection of ECCs in a scan of a circuit (YoloV4-tiny)

2. Segmentation of the circuit from the gridded / non-gridded paper (Mobile-UNet)

3. Tracing inter ECC connections, and building topology (Connected Components, Breadth-first search)

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