Circuit Simulpaper

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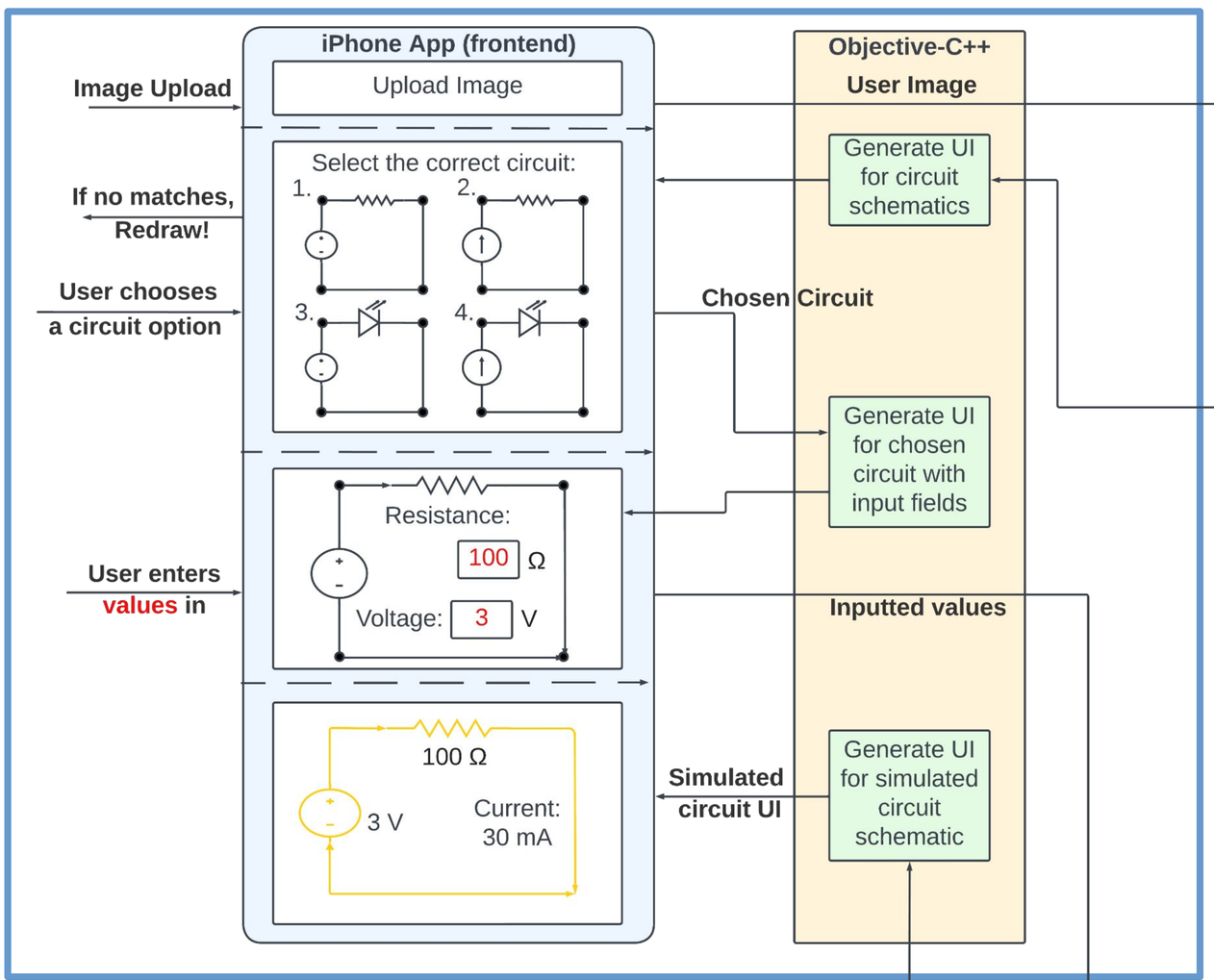
Product Pitch

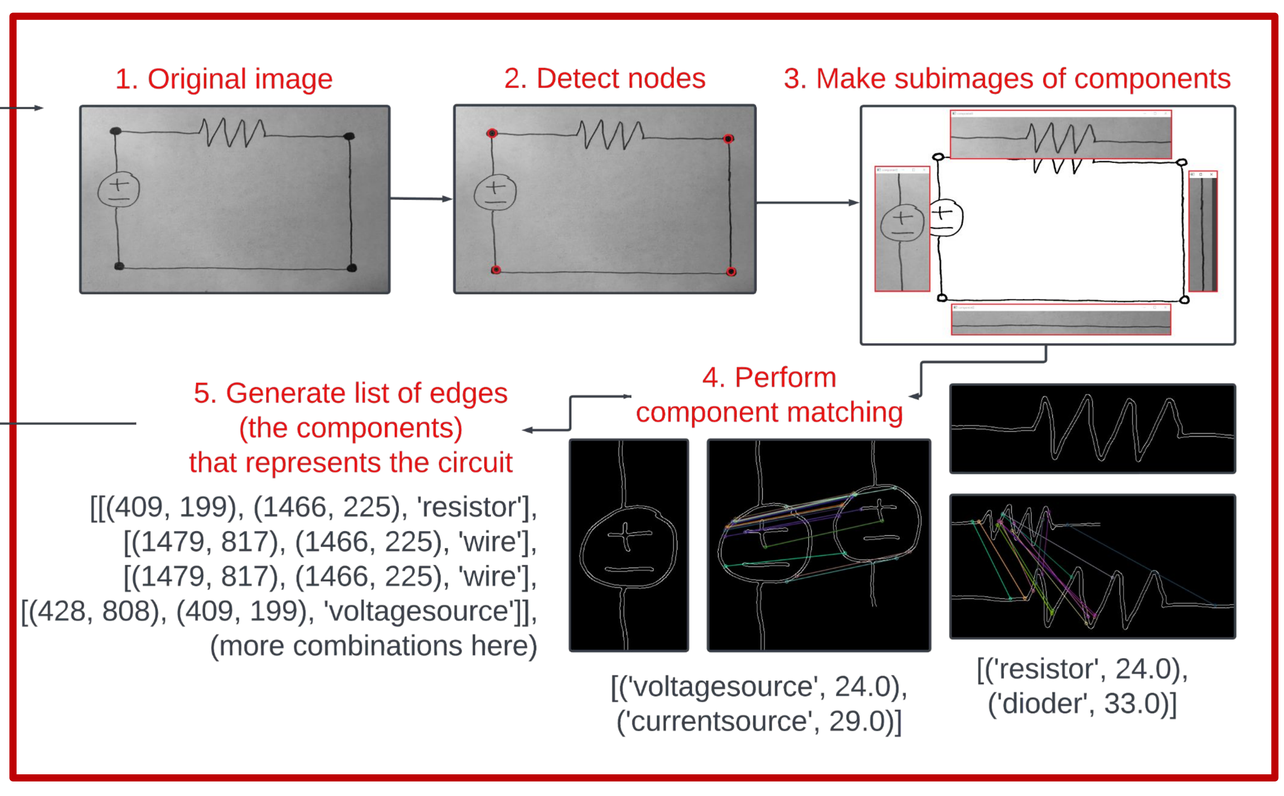
Working with electronic circuits is fundamental to learning electrical engineering. Unfortunately, this comes at a cost of requiring access to a power supply, electronic components, a breadboard, etc. Furthermore, there is a clear danger to working with real electrical current. We are targeting this inaccessibility and physical danger to learning electrical engineering with Circuit Simulpaper, a free, lightweight application that can scan hand-drawn schematics of electronic circuits, simulate current flowing, and render the schematic as a valid or invalid circuit with labeled voltage and current values.

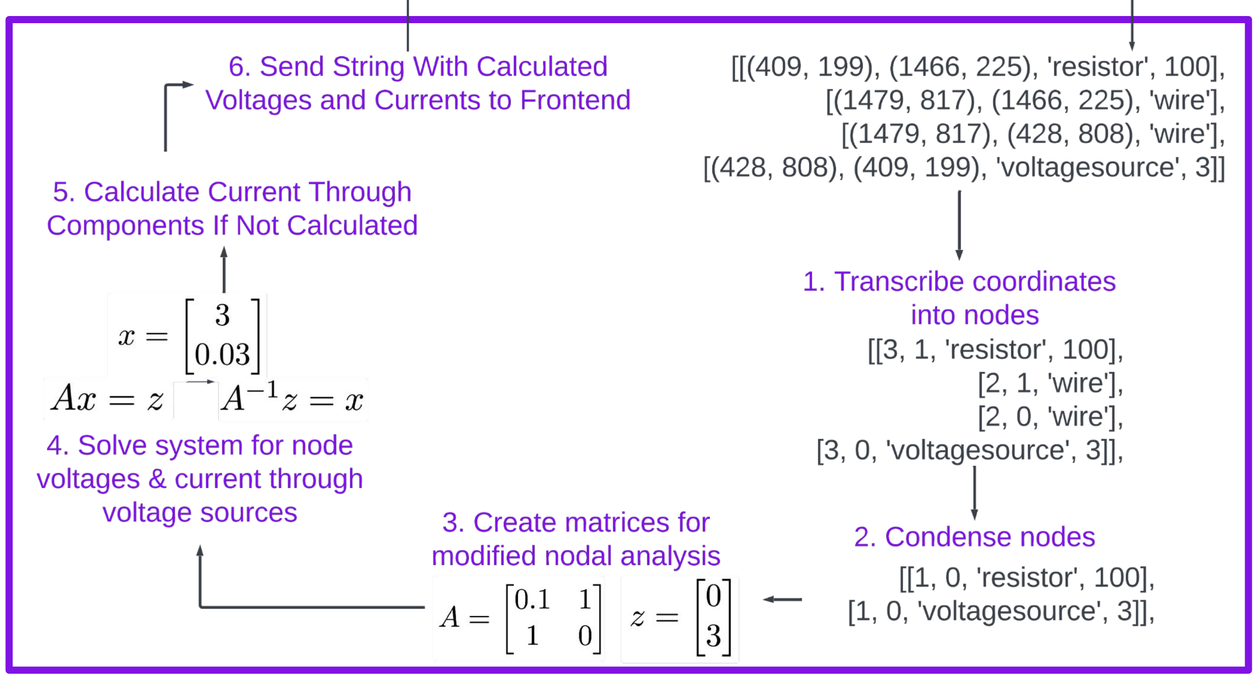
System Architecture

Our product is an application for iOS devices that was written in Swift. Our computer vision system and circuit simulator are written in C++.
In order to bridge Swift and C++, which are incompatible, we create Objective-C++ wrapper functions which are compatible with both languages.
The computer vision system uses a classical computer vision approach that uses feature descriptors for component classification instead of a neural network to ensure our mobile application is lightweight.
The custom circuit simulator performs modified nodal analysis using Eigen matrix libraries in order to determine voltages at nodes and currents flowing through components and wires.

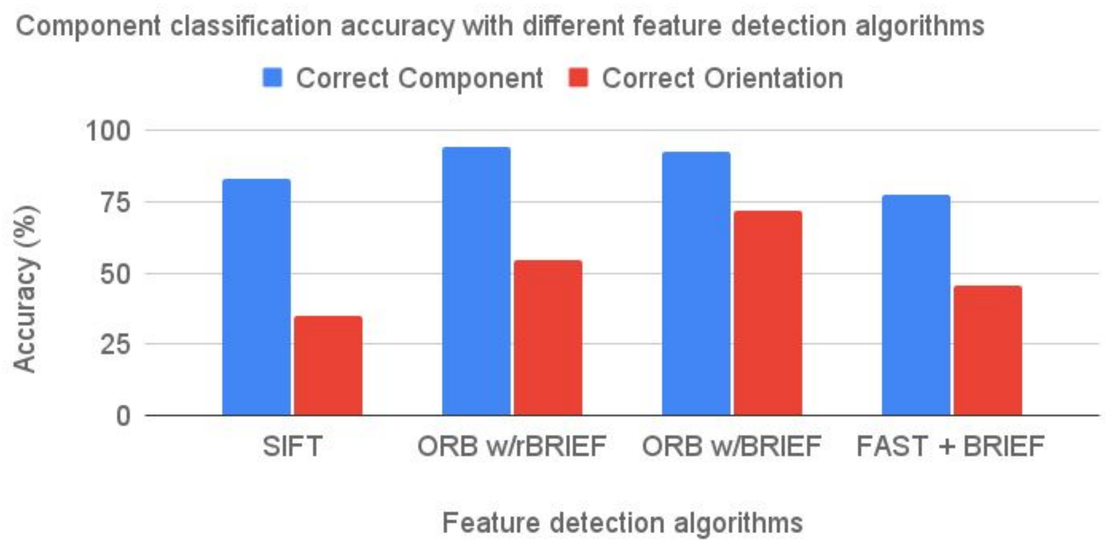
System Description







System Evaluation



Requirement	Specification	Current
Application size	<= 100 MB	21.3 MB
Component classification accuracy	90%	83.5% (76/91)
Circuit classification accuracy	90%	85.3% (29/34)
Simulation accuracy	100%	100%
Computer vision latency	8s	5s
Supported components	Current/voltage sources, LEDs, resistors, wires, lightbulbs, switches	Current/voltage sources, resistors, wires, lightbulbs, switches

Conclusions & Additional Information

https://course.ece.cmu.edu/~ece500/projects/f23-teamb1/

Our team created a system that allows young students to experiment with circuits from their phone. We hope this could also be a tool used by electrical engineers that want to analyze basic DC circuits. As a group we learned technical skills such as Swift, Computer Vision, and Circuit Simulation. If this project does continue we hope to integrate both AC and DC components and introduce a circuit suggestion feature when the user draws an invalid circuit.

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