

CIRCUIT ANALYZER

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Description of Problem

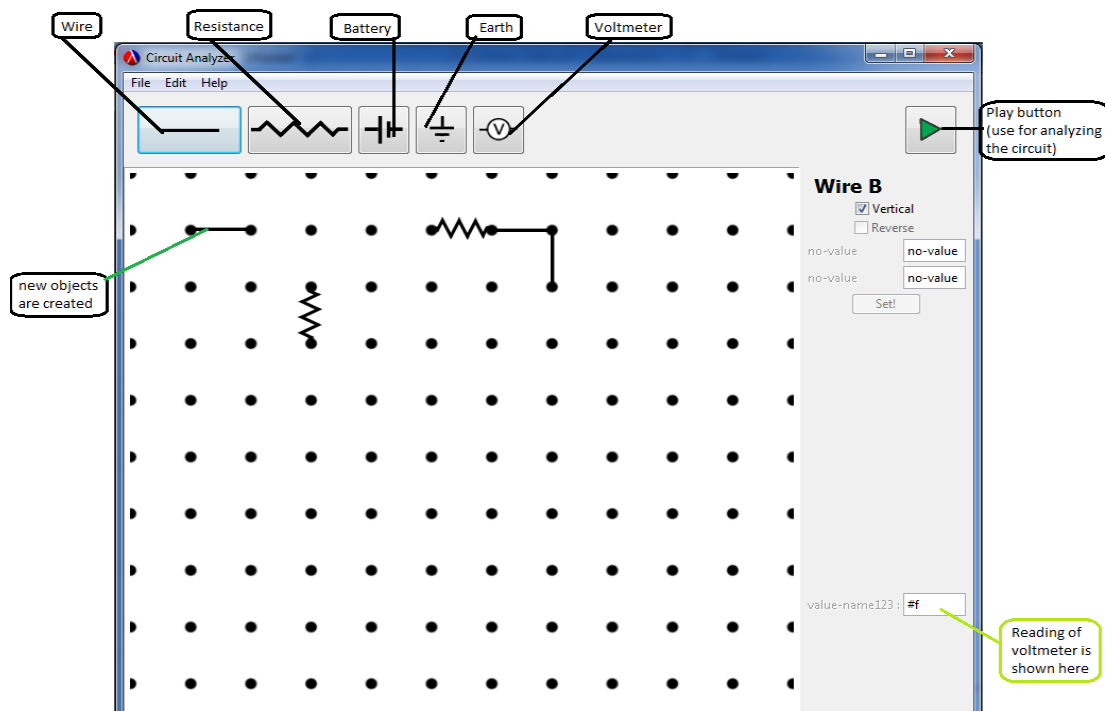
This project is an Electrical Circuit Analyzer which helps a user to analyze a given circuit i.e. the user can draw a circuit on his own and then analyze it by just clicking a play button.

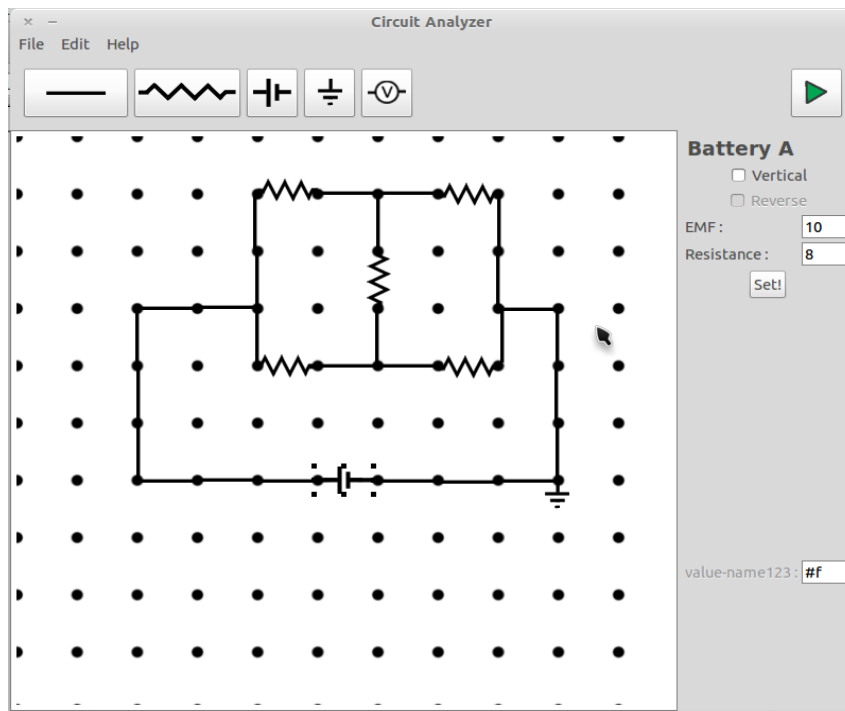
Idea of Design of Program

We have made this project using simple GUI and mathematical strategies to solve a circuit. A method called Modified Nodal Analysis is used to represent the drawn circuit in form of a Matrix and then solve it to get the values of various unknown elements. The circuit is made with the help of GUI where a user draws a circuit with ease using simple mouse movements and can set values of parameters like resistances of resistors and EMF of batteries by simply clicking on that element.

Sample Input and Output

The user draws the circuit by dragging and dropping circuit elements.





Final Circuit

Functionality of The Program

The program is working on a primitive level where a user can solve any given resistive circuit by drawing it. The limitation of this program is that it is working only for resistive circuit and small bugs are occurring in case when we are adding ammeter in the circuit. As solving a advanced circuit is very difficult we had to chop this project down to match are requirements as it needed us to study a new course of electrical engineering to solve for higher circuit elements!!!

How it works? (Modified Nodal Analysis)

The method we have used to solve a circuit is Modified Nodal Analysis (M.N.A). This method creates two matrices and then solves them to get a final matrix with the help of which we find all the unknown variables. The method is described below:-

Modified Nodal Analysis:

Suppose there are two matrices A and Z and we need to find a matrix X such that--- $[A].[X]=[Z]$

Then the matrix X is found out with the help of gauss elimination method. $[X]=[inverse\ A].[Z]$

MNA helps us to form these 3 matrices by following method:-

“n”-denotes the number of nodes with unknown voltages

“m”-denotes the number of voltage sources

Matrix A:

$$A = \begin{bmatrix} G & B \\ C & D \end{bmatrix}$$

It is a $(n + m) \times (n + m)$ matrix.

It is broken into 4 parts G, B, C, D.

Matrix G:

It is a $(n \times n)$ matrix.

(i, i) element is filled up by sum of conductance's of all the resistances connected to the 'node i'.

(i, j) element is filled up by negative of reciprocal of resistance connected between 'node i' and 'node j'.

This matrix is a symmetric matrix with (i, j) element being equal to (j, i) element.

Matrix B:

It is a $(n \times m)$ matrix.

It is filled only with -1, 0, 1.

(i, j) element connects 'node i' with 'battery j'.

If node i is connected to positive of battery j then the value is 1.

If node i is connected to negative of battery j then the value is -1.

Otherwise the value is 0.

Matrix C:

It is a $(m \times n)$ matrix.

It is also filled with -1, 0, 1.

It is just the transpose of matrix B.

(i, j) element connects 'node j' with 'battery i'.

If node j is connected to positive of battery i then the value is 1.

If node j is connected to negative of battery i then the value is -1.

Otherwise the value is 0.

Matrix D:

It is a $(m \times m)$ matrix.

It is only filled with 0s.

Matrix X:

It is a $(n + m) \times 1$ matrix.

The first n elements are the unknown voltages at each node.

The rest m elements are the unknown current through the voltage sources.

Matrix Z:

It is a $(n + m) \times 1$ matrix.

The first n elements are current from external sources into each node.

The rest m elements are the voltages of the known voltage sources.

What we have learnt?

We have included many of racket's features in our code let it be moduling, objects, GUI or even higher order functions. We have extensively used classes in our code in form of resistor class, node class, battery class etc.

Also we have broken our code into separate modules and provided and required them in other files. The complete GUI is made with the help of higher order functions. Paste boards are used to draw the circuit and then that code is parsed into a scheme code.