Mathematical analysis of an electrical circuit

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Abstract: *There are some research about mathematical analysis of electrical circuits. In time when the scientists are in a deep search of invention new alternative ways for producing renewable energy, mathematic postulates and analysis can help optimize the construction of electrical circuits and prevent lost of energy. By themselves, the electrical schemas that represent Electrical circuits are a combination of interconnected electronical elements (components). According to the characteristics of the elements of Electrical schemas they are divided into the following groups: Passive and Active, Linear and Nonlinear, Bipolar and Multipolar. In our research we are going to switch from high to low power and vice versa, so we are going to us the abilities of diodes that switch from on to off state. The different values of low and high power of the electrical circuit will be represented programmatically with a cross-platform application - Arduino Integrated Development Environment and programmable language C++.*
KEYWORDS: ELECTRICITY, PROGRAMMING, ELECTRICAL CIRCUIT

1. Introduction

According to the definition, the electrical network is a combination of elements of interconnected circuits. The network may or may not provide a closed path to the flow of electricity. But an electrical circuit can be a combination of one or more networks that gives a closed path to the electric current. This means that when one or more networks are connected to each other to complete one or more current paths, an electrical circuit is formed.

An electrical circuit consists of the following topological elements: node, branch and contour. A node is a point where two or more circuit topological elements are connected together. Node is a point of connection in the circuit. When a structural element of the circuit is connected to the circuit, it is connected through its two terminals to be part of a closed path. When a structural element exists between two nodes, the path from one node to another through this element is called a chain branch. If it starts from one node and after passing through a set of nodes returns to the same initial node without crossing two of the intermediate nodes, it travels through one node contour of the circuit. [2]

2. Representation of electrical circuit with Arduino Uno and Breadboard

We are going to analyze an electrical circuit programmatically with the microcontroller development board Arduino Uno and Breadboard that is shown in Fig. 1.
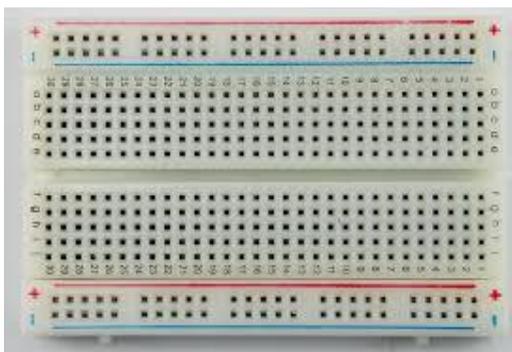

Fig. 1 *Breadboard.*

Breadboard is a patch panel with pins which will play the role of nodes of the electrical circuit and where it will be possible connecting structure elements and components, which will create branches. The structure elements that we are going to use in our electrical scheme, that is are shown in Figure 2 are: resistors, Tilt switch and LED diodes, which purpose is to assure one direction flow of electricity from one input node to end node through one contour. [1]

It is possible to make a table and represents each pin of Breadboard as a member of two - dimensional array, which first dimension is formed by the ordered set of a, b, c, d and second dimension includes the integer numbers from 1 to 30.
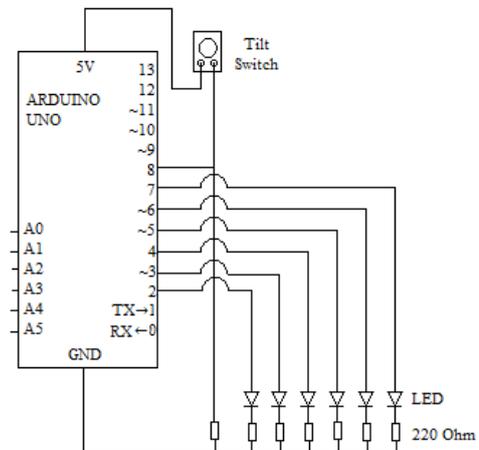

Fig. 2 *Electrical scheme.*

As Microsoft Excel name each cell of its tables, we are going to name the pins as a combination of the elements of the first dimension and second dimension that is illustrated in Table 1. [1]

Table 1. A table that represents each pin of Breadboard as a member of two - dimensional array.

	a	b	c	d	e
1	a1	b1	c1	d1	e1
2	a2	b2	c2	d2	e2
3	a3	b3	c3	d3	e3
4	a4	b4	c4	d4	e4
5	a5	b5	c5	d5	e5
6	a6	b6	c6	d6	e6
7	a7	b7	c7	d7	e7
8	a8	b8	c8	d8	e8
9	a9	b9	c9	d9	e9
10	a10	b10	c10	d10	e10
11	a11	b11	c11	d11	e11
12	a12	b12	c12	d12	e12
13	a13	b13	c13	d13	e13
14	a14	b14	c14	d14	e14
15	a15	b15	c15	d15	e15
16	a16	b16	c16	d16	e16
17	a17	b17	c17	d17	e17
18	a18	b18	c18	d18	e18
19	a19	b19	c19	d19	e19
20	a20	b20	c20	d20	e20
21	a21	b21	c21	d21	e21
22	a22	b22	c22	d22	e22
23	a23	b23	c23	d23	e23
24	a24	b24	c24	d24	e24

25	a25	b25	c25	d25	e25
26	a26	b26	c26	d26	e26
27	a27	b27	c27	d27	e27
28	a28	b28	c28	d28	e28
29	a29	b29	c29	d29	e29
30	a30	b30	c30	d30	e30

Moreover, it is possible to form another table, that is shown in Table 2 which values will be the Volts digital pins 2, ~ 3, 4, ~ 5, ~ 6, 7 and 8 of Arduino Uno that connects with each pin of Breadboard, according to the names and rules of the two - dimensional array that we illustrated in Table 1. [1]

Table 2. A table which values are the Volts of digital pins 2, ~ 3, 4, ~ 5, ~ 6, 7 and 8 of Arduino Uno that connects with each pin of Breadboard.

	a	b	c	d	e
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	8	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	7	0	0	0	0
10	0	0	0	0	0
11	~6	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
17	~5	0	0	0	0
18	0	0	0	0	0
19	0	0	0	0	0
20	0	0	0	0	0
21	4	0	0	0	0
22	0	0	0	0	0
23	0	0	0	0	0
24	0	0	0	0	0
25	~3	0	0	0	0
26	0	0	0	0	0
27	0	0	0	0	0
28	0	0	0	0	0
29	2	0	0	0	0
30	0	0	0	0	0

The digital pins of Arduino Uno, that is illustrated in Fig. 3, define the output voltage level of the pins of the Breadboard. Also, the digital pins of Arduino Uno and the pins of the Breadboard forms a separate contour which activation depends entirely programmatically through the functions: digitalWrite(pin, value) and digital Read (pin). [1]

***Fig. 3** Arduino Uno.[5]*

The Volt of digital pin 8 of Arduino Uno is the OUTPUT point of the circuit and the other 6 a the INPUT points of the circuit. [1]

3. Analysis of electrical circuit with Arduino Uno and Breadboard

The digital pins of Arduino Uno define the input and output voltage level of the pins of the Breadboard. Also, the digital pins of Arduino Uno and the pins of the Breadboard forms a separate contour which activation depends entirely programmatically through the functions: digital Write (pin, value) and digital Read (pin). According to this it will be possible to be created a dashboard time - table and the activation of each contour will be illustrated with "1" and the lack of voltage with "0". It can be named as A dashboard time - table of activating contours, that is shown in Table 3, which will be switched on in a time span of 600 000ms that each digital pin of Arduino Uno will be set programmatically. [1]

Table 3. A dashboard time - table of activating contours.

	2	3	4	5	6	7
10 min	1	0	0	0	0	0
20 min	1	1	0	0	0	0
30 min	1	1	1	0	0	0
40 min	1	1	1	1	0	0
50 min	1	1	1	1	1	0
60 min	1	1	1	1	1	1

5. Conclusion

With programmable dashboard time - table it will be possible electricity suppliers to monitor the current consumption of their subscribers, and in addition if it is implemented a controller with a combination with a trigger will provide less voltage to a household, which at some time point in the day does not consume full capacity of electrical appliances. With the software program it will be possible to change the input and output nodes and not only change the active contours, but also to control the flow of current in one or another circuit, which if implemented in the electricity network, it will reduce unnecessary energy consumption and unnecessary maintenance of resources to supply electricity that is not used and consumed. This would reduce the use of natural resources as such as the vital factor for life - water that is used by thermal power plants and the cost of electricity supply to both suppliers and consumers of electricity.

6. References

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