Dear Reviewer,

As part of my submission for the simple breadboard circuit, I am including a written paper that provides detailed calculations and analysis using Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL) on a circuit with 4 nodes and a 5-volt power supply from an Arduino Uno R3 module. The paper is scanned and saved as a PDF document.

The paper covers the following key points:

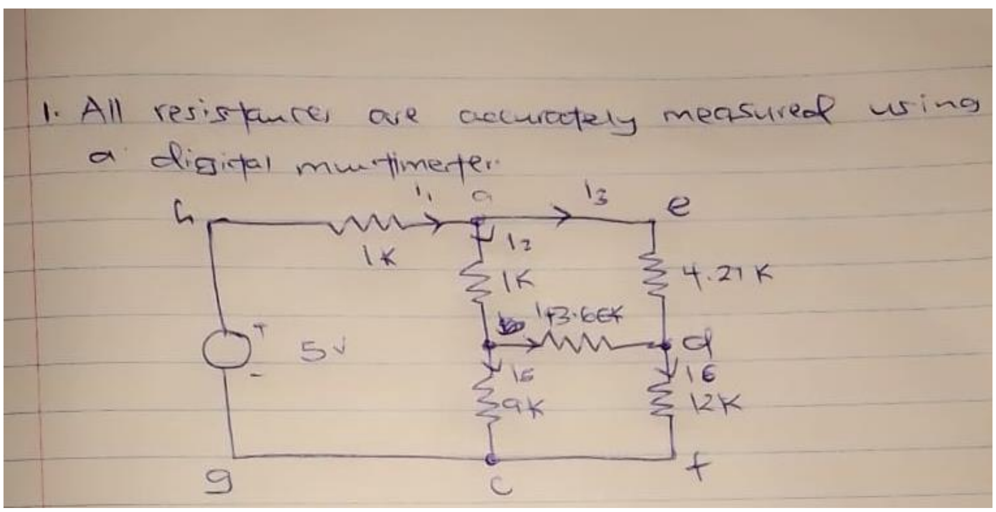
1. **Introduction**:

  - The circuit is made up of a 5V dc supply from an Arduino uno r3 module.

  - The resistor components are interlaced on a breadboard, whose rails have a –terminal (0V) +terminal

2. **Circuit Description**:

  - Circuit is as below: resistance component values are as measured by a digital multimeter



3. **KVL Analysis**:

- I identified 3 KVL loops and from those generated three equations.

- KVL allowed me to better understand my circuit in terms of voltage drops across the resistors summing up to sum of all voltage sources in the loop. Zero if none.

KVL loop1 : aeda

$$-4.27 I_3 + \cancel{kf}\, 3.66 I_4 - I_2 = 0$$

$$\boxed{-I_2 - 4.27 I_3 + 3.66 I_4 = 0}$$

loop2 : bdfcb

$$\boxed{-3.66 I_4 - 12 I_6 + 9 I_5 = 0}$$

loop3 : habcgh

$$\boxed{-I_1 - I_2 - 9 I_5 + 5 = 0}$$

4. **KCL Analysis**:

- I identified 4 nodes. 4-1 = KCL equations. On these nodes there are 6 unknown currents.

- I generated 3 KCL equations at 3 nodes namely node a, b and d.

- From these equations I substituted KCL equations to the KVL equations.

KCL eqns.

6 unknowns

$$I_1 = I_2 + I_3$$

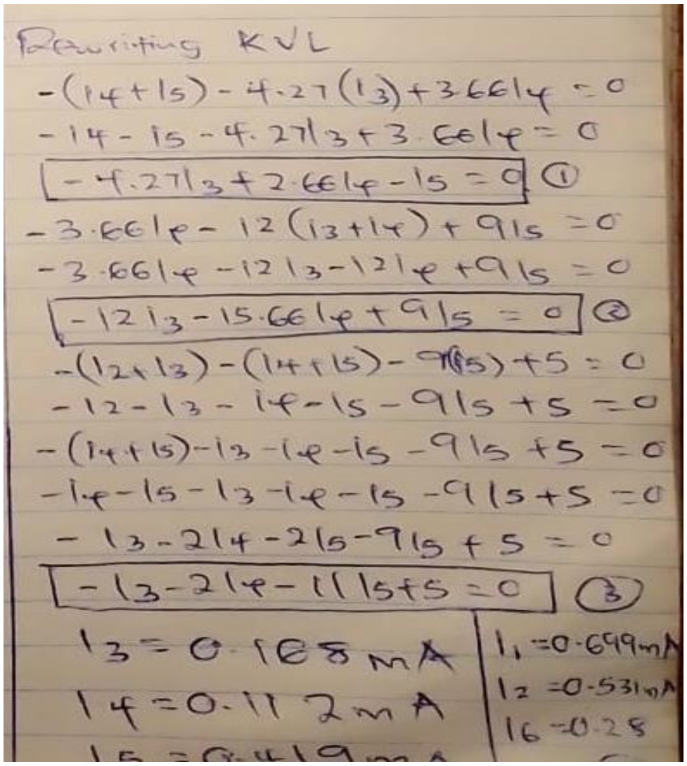
$$I_2 = I_4 + I_5$$

$$I_6 = I_3 + I_4$$

5. **Results and Discussion**:

- On combining the KVL and KCL equations I managed to obtain the results of all currents in the circuit

- The results obtained were as below:



Rewriting KVL

$-(I_4+I_5) - 4.27(I_3) + 3.66I_4 = 0$

$-I_4 - I_5 - 4.27I_3 + 3.66I_4 = 0$

$\boxed{-4.27I_3 + 2.66I_4 - I_5 = 0}$ (1)

$-3.66I_4 - 12(I_3+I_4) + 9I_5 = 0$

$-3.66I_4 - 12I_3 - 12I_4 + 9I_5 = 0$

$\boxed{-12I_3 - 15.66I_4 + 9I_5 = 0}$ (2)

$-(I_2+I_3) - (I_4+I_5) - 9(I_5) + 5 = 0$

$-I_2 - I_3 - I_4 - I_5 - 9I_5 + 5 = 0$

$-(I_4+I_5) - I_3 - I_4 - I_5 - 9I_5 + 5 = 0$

$-I_4 - I_5 - I_3 - I_4 - I_5 - 9I_5 + 5 = 0$

$-I_3 - 2I_4 - 2I_5 - 9I_5 + 5 = 0$

$\boxed{-I_3 - 2I_4 - 11I_5 + 5 = 0}$ (3)

$I_3 = 0.188$ mA	$I_1 = 0.699$ mA
$I_4 = 0.112$ mA	$I_2 = 0.531$ mA
$I_5 = 0.419$ mA	$I_6 = 0.28$

6. **Conclusion**:

- There was a clear voltage drop on the circuit across is resistor. This voltage drop was proportional to the current observed by the calculations and the resistance of the particular resistor between two nodes,

- I faced a challenge of inconsistency of resistor values between the color code method and the direct measurement using the digital multi-meter.

The scanned PDF document contains all the necessary equations, diagrams, and calculations related to the circuit and its analysis using KVL and KCL. I believe it will provide a comprehensive understanding of my work and its technical aspects.

Thank you for considering my submission. Should you have any questions or require further information, please do not hesitate to reach out to me.

Sincerely,

Victor Kipkorir