ELP101

LAB REPORT

Speed Control of a DC motor by Armature Voltage Control

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- Entry No. – 2021CE10478
- Group No. - 29

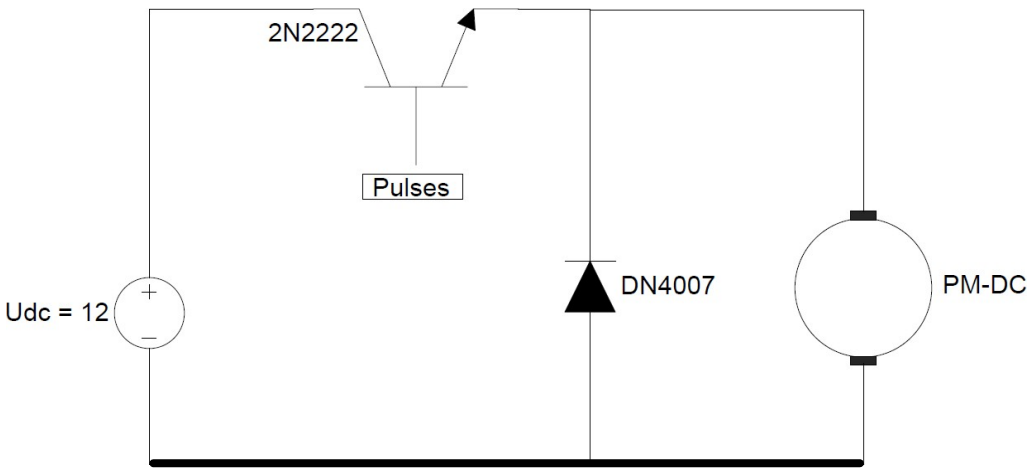
- AIM:
    - Use the armature voltage control method to regulate the motor's speed.
    - Show the motor operating at
        - (i) its rated speed
        - (ii) half its rated speed

- MATERIAL'S REQUIRED:
    - 555 Timer IC
    - Potentiometer
    - Capacitors
    - Permanent Magnetic DC Motor (PM-DC Motor)
    - Multiple Power Supply
    - Breadboard
    - Connecting Wires
    - TIP122 – NPN, BJT Transistor
    - Diodes

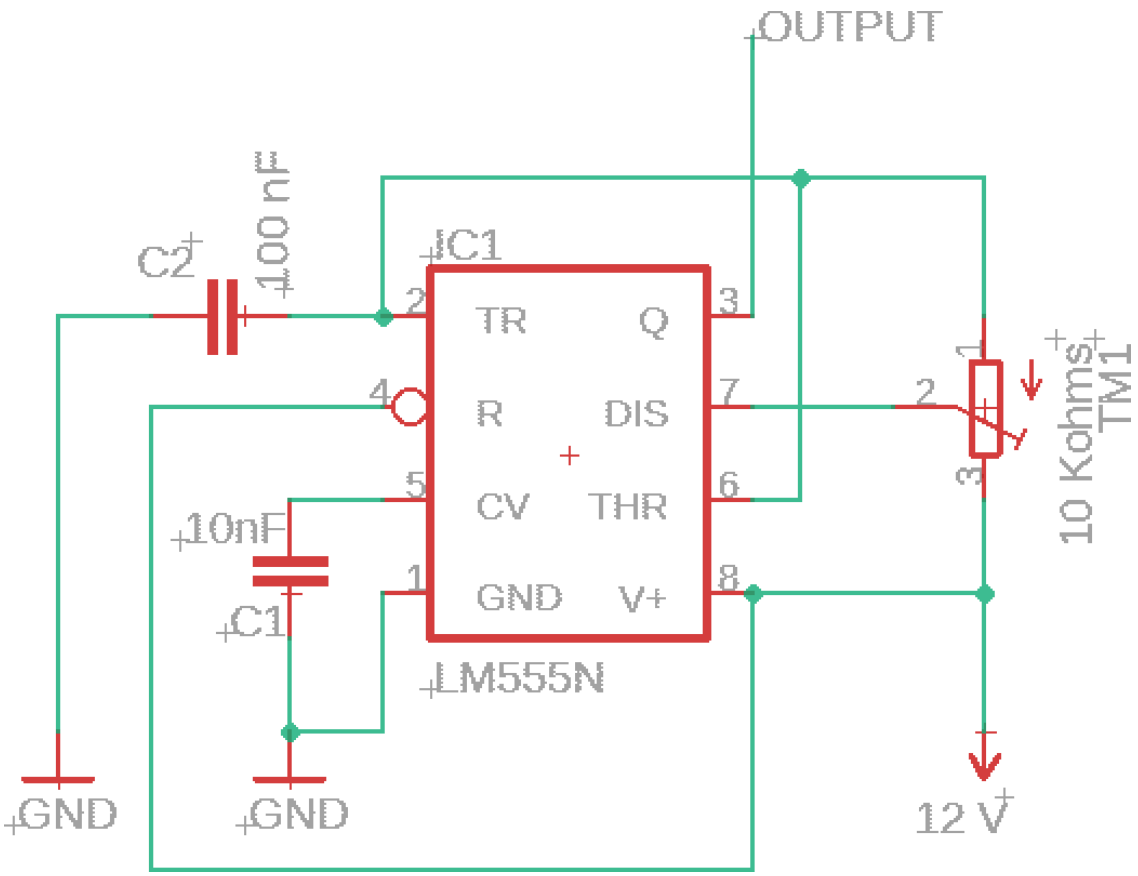
- THEORY:
    - Pulse Width Modulation (PWM):
    - By rapidly switching the power going to the electrical device on and off, PWM (Pulse Width Modulation) is a technique used to produce variable voltage. The duty cycle of the signal, or how long the signal is ON compared to how long it is OFF within a certain period of time, affects the average voltage.
    - 555 Timer (Refer Diagram For Details):
    - When configured in an astable mode, the 555 Timer can produce a PWM signal.
    - When the capacitor C1 is charging through the resistors R1 and R2, the output is HIGH.
    - Whereas, when the capacitor C1 is discharging through the resistor R2, the output of the IC is LOW.

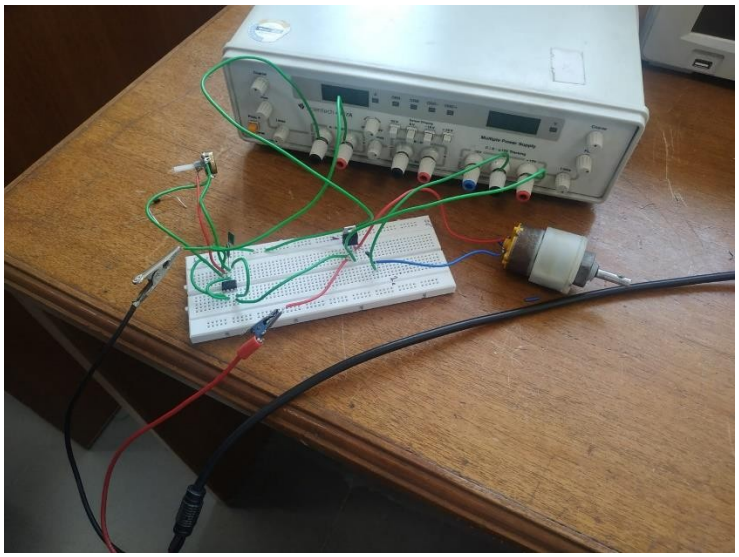
- We can see that changing the values of any one of these three components will result in a square wave output signal with varied ON and OFF periods or a different duty cycle.
- The 555 Timer's control pin is not in use, but it is linked to a 10nF capacitor to filter out any outside noise coming from that terminal.
- To prevent an unauthorised reset of the output, pin number 4, which is active low, is connected to VCC.
- The output of the 555 timer can sink or source a current of 200mA to the load.
- Power Circuit:
- Therefore, if the motor we wish to control is larger than this rating, we must drive it with a transistor or MOSFET.
- A NPN transistor (TIP122) that can take currents of up to 5A was employed.
- We must utilise a freewheeling diode linked in parallel with the motor to prevent any voltage spikes caused by the motor.

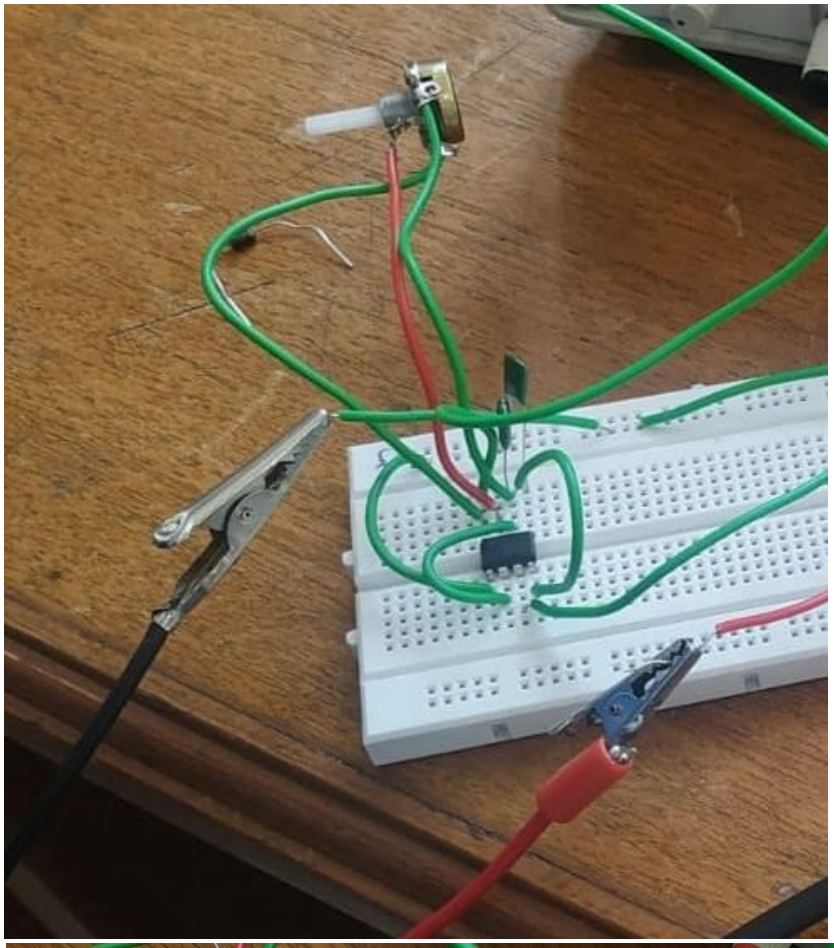
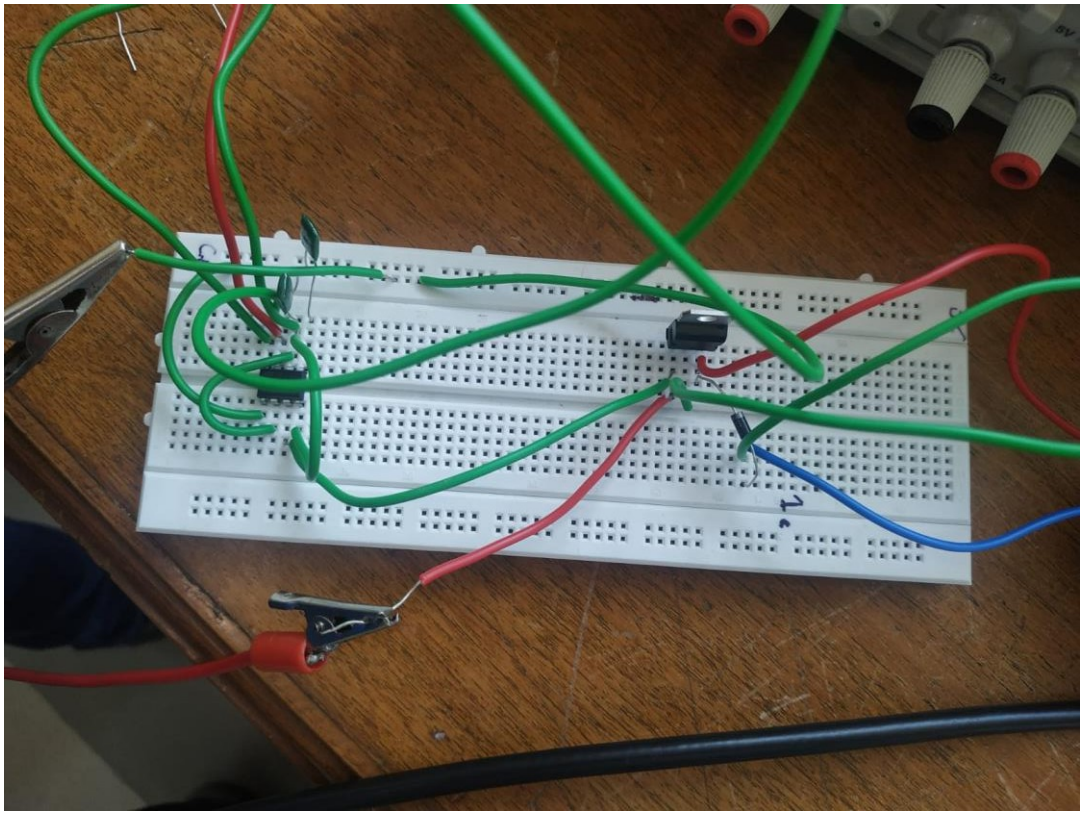
- CIRCUIT DIAGRAM:
  - Power Circuit:



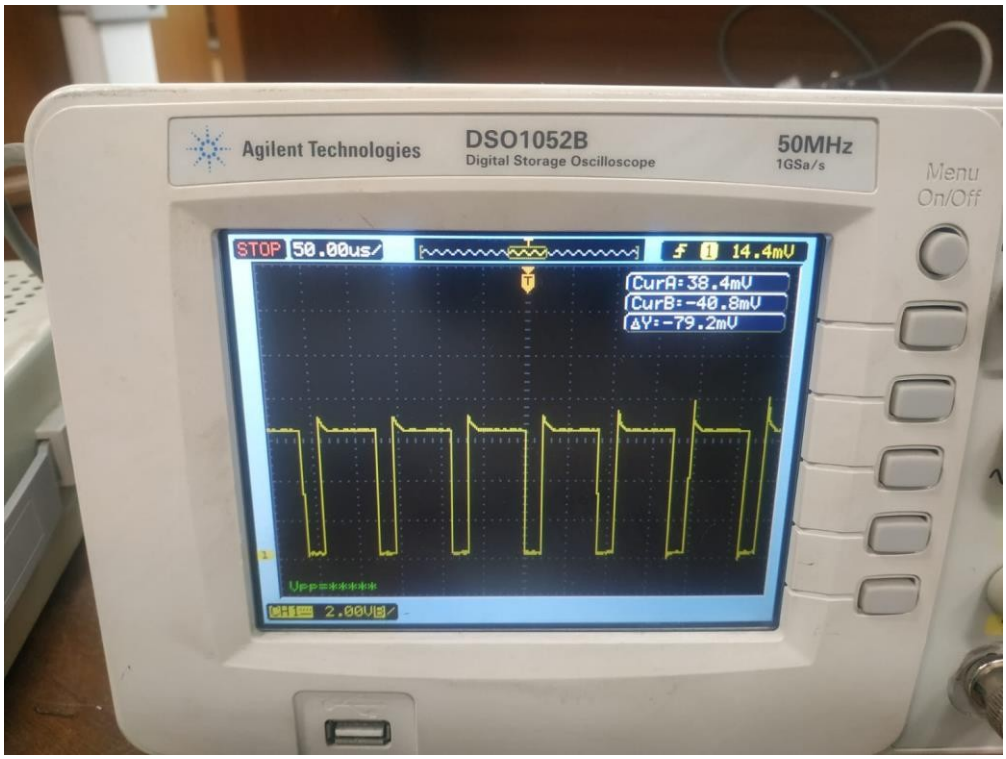
- 555 Timer Circuit:



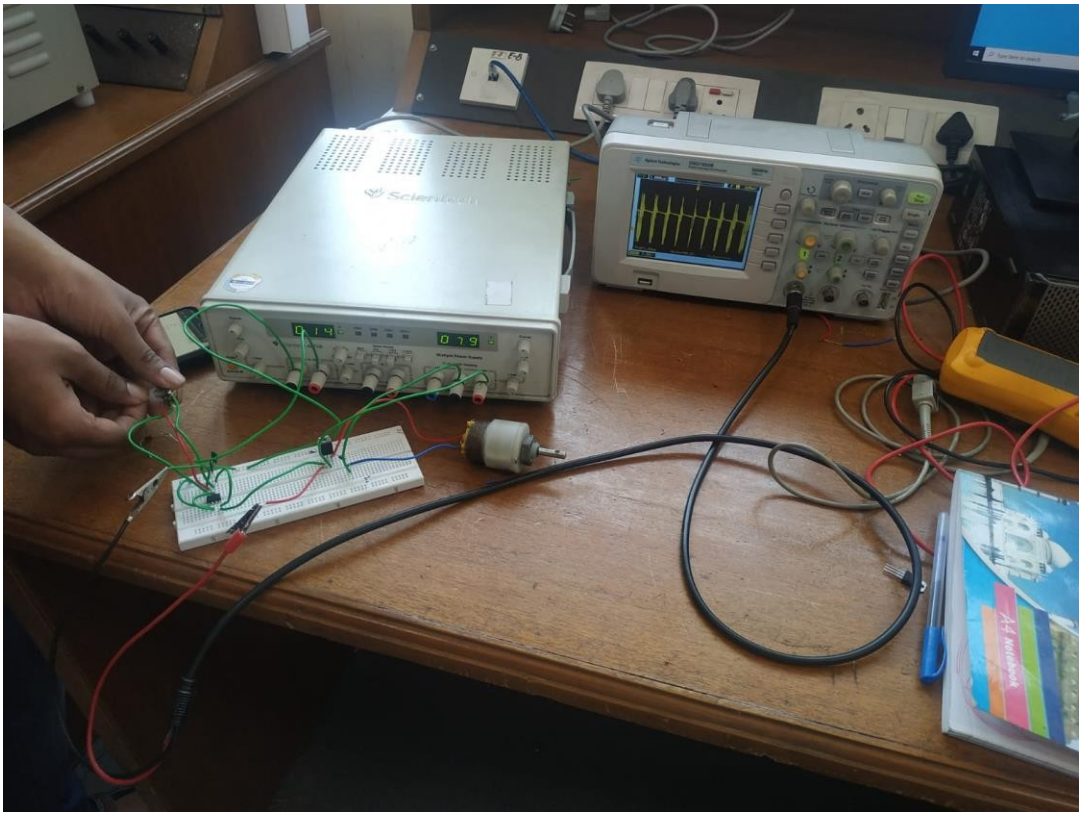
- BREADBOARD SETUP:
  - Power Circuit:
  - 

- Control Circuit:
  - 
  - 

- DSO IMAGES:



555 Timer DSO Screen



Power Circuit with DSO Screen

- SOURCES OF ERROR:
    - Changes are made in the circuit while the circuit is closed
    - There are a lot of loose connections.
    - Resistance of the wires is not taken into account.
    - DSO scale is set in a way such that they are not appropriate for measurement.

- PRECAUTIONS:
    - Tools that are insulated should be utilised.
    - Electric wires (jumpers) must be clipped properly.
    - Shoes that are appropriate for the situation should be worn.
    - The circuit should not be left on for an extended period of time.

- CONCLUDING REMARKS:
    - By attaching a potentiometer to the DSO, the output waveform for various R1 and R2 values can be evaluated. The following is what we see:
        - R1's value shouldn't tend to zero. If the value is very nearly 0Ω, the circuit faults. Ideally, we should maintain R1's constant value and vary R2. R1 should have a value of no more than 1k Ω, while R2 should have a potentiometer with a 100k Ω value.
        - We confirmed that the waveform across the output terminal of the 555 timer IC and the motor are same.
        - When R2 is reduced, motor speed increases, and when R2 is zero, then the motor operates at its fastest.
        - An NPN transistor is used in the circuit (TIP122). In our case, it serves as a switch. The transistor is in the OFF State when the output waveform is 0V.
        - The motor is crossed by a freewheeling diode. When the transistor is in the OFF state, the inductive load of the motor can freewheel via the diode.

- DETAILS OF TEAM MEMBERS:
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