4.3 Kirchhoff's Current Law

Kirchhoff's Current Rule, also known as the first Kirchhoff ~~law~~ rule, states that the total current entering a junction in a circuit equals the total current leaving the junction. This law is based on the principle of conservation of charge and is expressed with eq. 1:

$$I_{x_1} + I_{x_2} + ... = I_{y_1} + I_{y_2} + I_{y_3} + ... \tag{1}$$

where:

- electrical currents with index I_x are entering currents and
- currents with index I_y are leaving junction currents.

We will explain the Kirchhoff's current rule on the same example shown in fig. 1

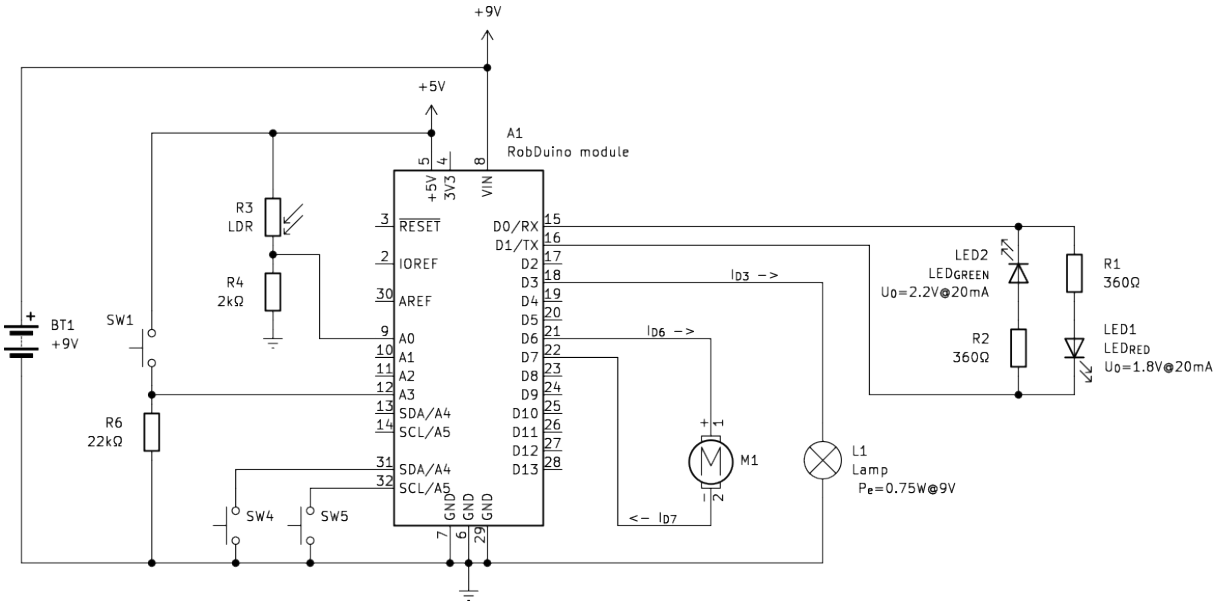

Figure 1: Electrical sheme of robotic device.

Practical Example in Robotics:

Imagine a robotic hand with multiple sensors (e.g., touch sensor and light sensor) connected to a single microcontroller. If the sensors draw 0.23 mA (when SW_1 is closed) and 1.0 mA, and they are all connected to the same power supply junction, the total current entering the junction is:

$$I_{tot} = I_{tch} + I_{light} = 0.23mA + 1.0mA = 1.23mA \tag{2}$$

This information is critical for designing the power distribution network of the robot, ensuring that the power supply can handle the total current draw.

4.3.1 Questions

1. What is the total current of actuators (motor, light bulb, LEDs) when they are all on?
2. Current into input pin A_0 is approximately $I_{A_0} = 20nA$. Compare this current to other two currents at the middle junction in the light sensor. Can it be ignored?