Measure Voltage in Raspberry Pi without using External ADC

When working on Embedded Projects with Raspberry Pis, it becomes essential to monitor battery or power supply voltage. In various projects, sensors providing analog output, such as Gas sensors, Current sensors, and Soil and moisture sensors, are commonly employed. As Raspberry Pis lack internal ADC, a common solution is to connect an external ADC IC. However, these ICs are often expensive and may necessitate numerous external components.

In this article, I aim to introduce a simple, cost-effective solution that facilitates voltage measurement with minimal components. This approach relies on a PWM output, a GPIO interrupt input, and a few components to efficiently measure analog voltages.

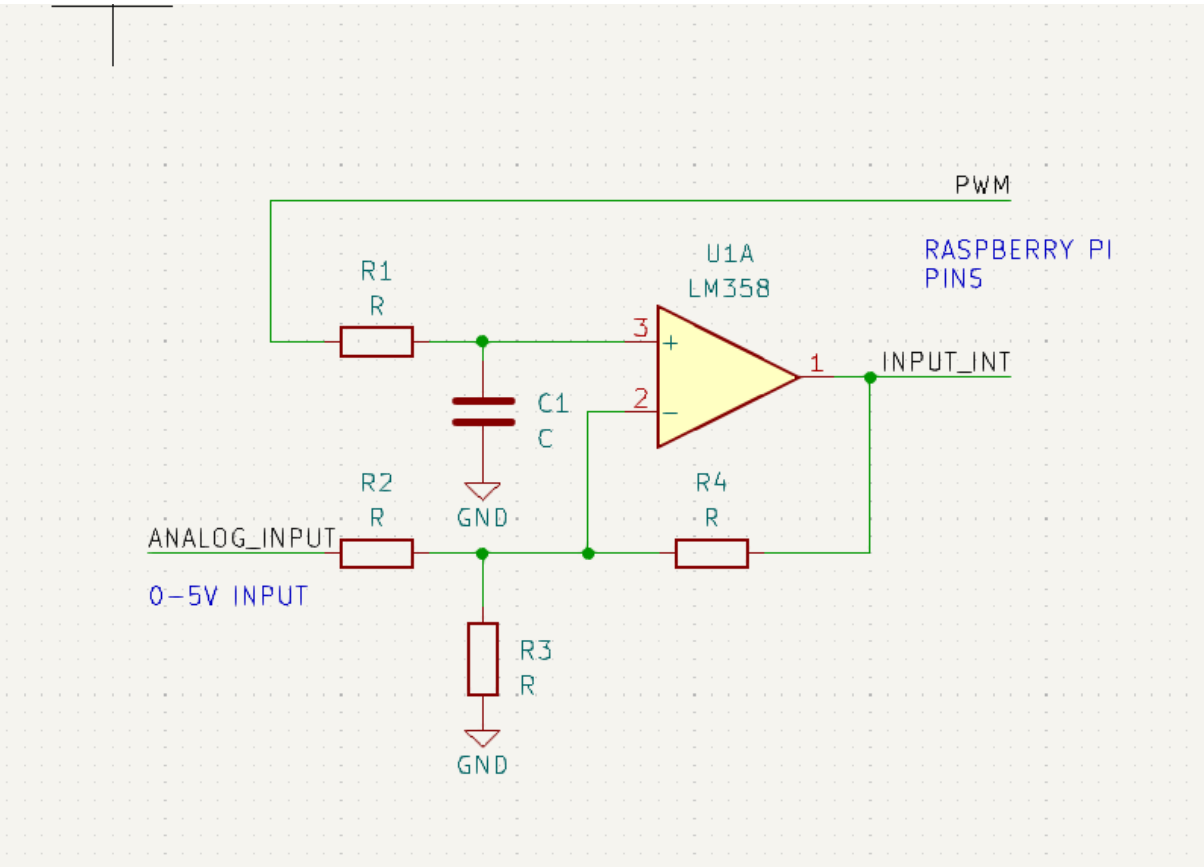
Components Required:

1. Raspberry Pi

2. TLC272 OP-Amp

3. Resistors

4. Capacitors



Operational Mechanism

R1:10K, C1:1uF, R2:0 Ohm, R3:NC, R4:NC

Note : Include R3 and R4 in case if hysteresis required.

The proposed method utilizes a PWM pin and a GPIO interrupt configured for a falling-level interrupt. Upon closer inspection of the circuit, the PWM pin is interconnected with the RC circuit, responsible for converting the PWM signal into a DC voltage. For instance, if the high logic level of PWM is 3.3V with a 50% duty cycle, it will generate 1.65V. The output of the RC Circuit is linked to the non-inverting terminal of the op-amp.

The op-amp is configured as a comparator, essentially comparing two voltages and providing a digital output. The analog signal to be measured is connected to the inverting input of the op-amp through a voltage divider.

Now, let's delve into the operational process. Suppose we have connected a 1V signal to the op-amp, and we are generating a duty cycle ramping up from 0 to 100%. When the PWM voltage (RC output) is less than 1V (the connected input), it will produce a logic high. As this voltage surpasses 1V, the output will transition from high to low, generating a falling-edge interrupt on the interrupt pin.

At the precise moment of receiving the interrupt, the PWM and input voltage are in equilibrium. Since we have the PWM voltage in the code, the output voltage can be accurately measured.

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