Simulation of an Event-Driven Pet Aware Intrusion Detection circuit using eSim

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Abstract: This project presents a simulation of an event-driven, pet-aware intrusion detection circuit using eSim. The system reduces false alarms by distinguishing human motion from pet motion using pulse-width analysis of PIR sensor signals. An RC integrator converts pulse width into voltage, which is compared against a threshold. Only human-like motion triggers an alert. The circuit operates only during motion events, improving power efficiency. Simulation results validate accurate human–pet discrimination.

KEYWORDS: **Pet-Aware Intrusion Detection, PIR Sensor, Pulse-Width Analysis, Event-Driven Circuit, eSim, Ngspice**

INTRODUCTION

Intrusion detection systems commonly use PIR sensors but suffer from false alarms caused by pets. Such false triggers reduce reliability and user trust. To overcome this, a pet-aware detection approach is required. This project focuses on identifying motion type based on signal characteristics rather than simple detection. Using eSim, the circuit behavior is modeled and analyzed. The design emphasizes low power consumption and real-time response.

Problem Statement

Conventional PIR-based security systems cannot differentiate between human and pet movements. This results in frequent false alarms in homes with animals. There is a need for a low-cost and low-power solution that accurately identifies human intrusion. The challenge lies in processing PIR signals without complex digital processing. The system must operate efficiently and only during motion events. Hence, an analog event-driven solution is proposed.

Methodology

The PIR sensor output is modeled as voltage pulses of varying width. An RC integrator converts pulse width into a proportional voltage level. Short pulses (pet movement) generate lower voltage, while longer pulses (human movement) generate higher voltage. A transistor-based comparator compares this voltage with a predefined threshold. If the threshold is exceeded, an alert signal is generated. The complete circuit is designed and simulated in eSim.

CIRCUIT DIAGRAM

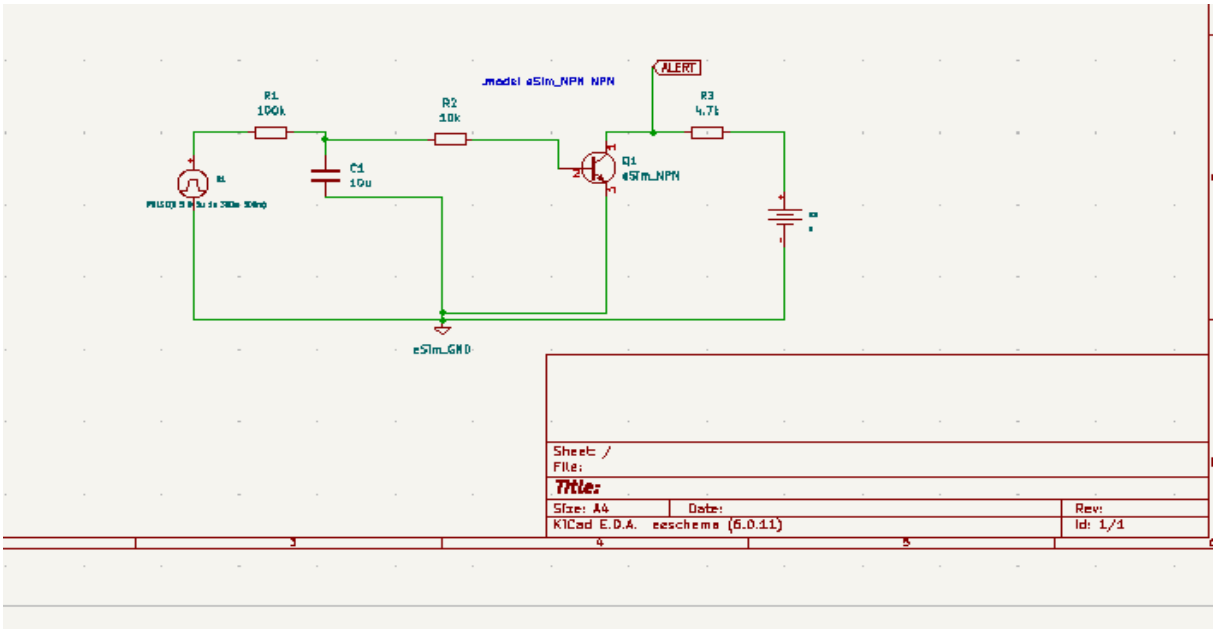

Fig 1: circuit

Working principle: When motion is detected, the PIR sensor produces a voltage pulse. The width of this pulse depends on whether the moving object is a pet or a human. The RC circuit integrates this pulse and produces a voltage proportional to its duration. This voltage is fed to a comparator stage. If the voltage exceeds the threshold, it is classified as human motion and triggers an alert. Otherwise, the output remains inactive.

OUTPUT WAVEFORMS

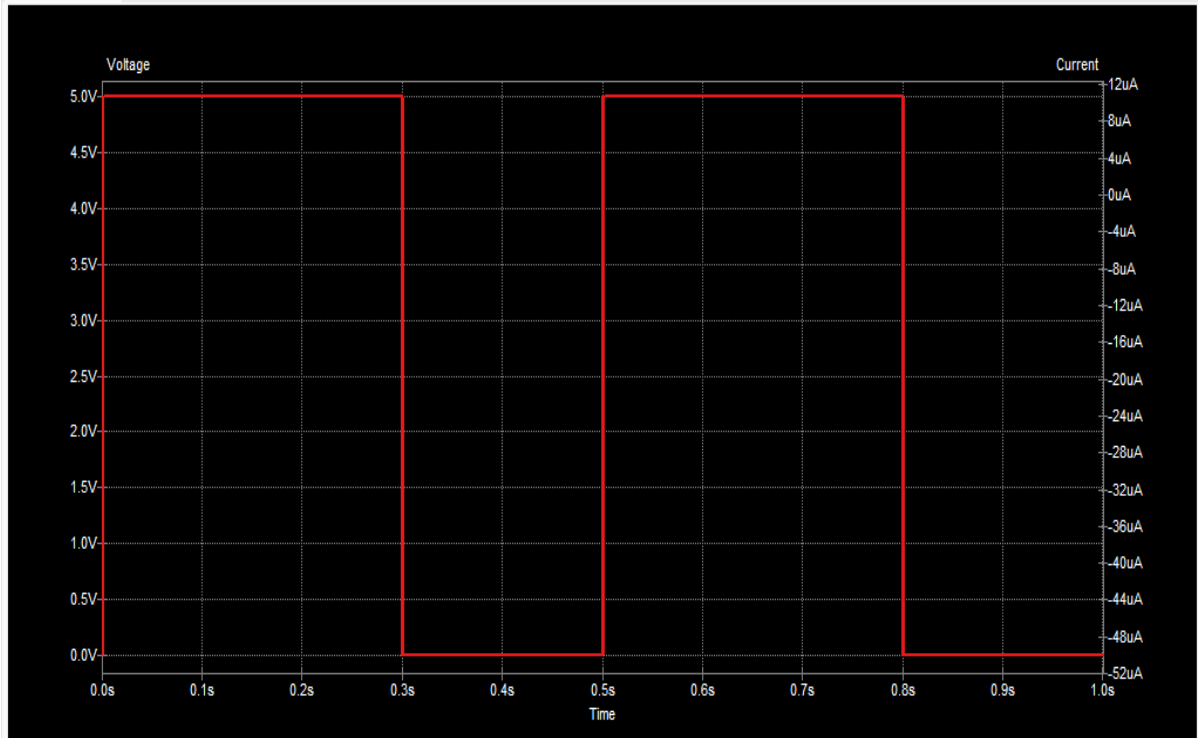

Fig 2: Input pulse V(Net_R1_pad1)

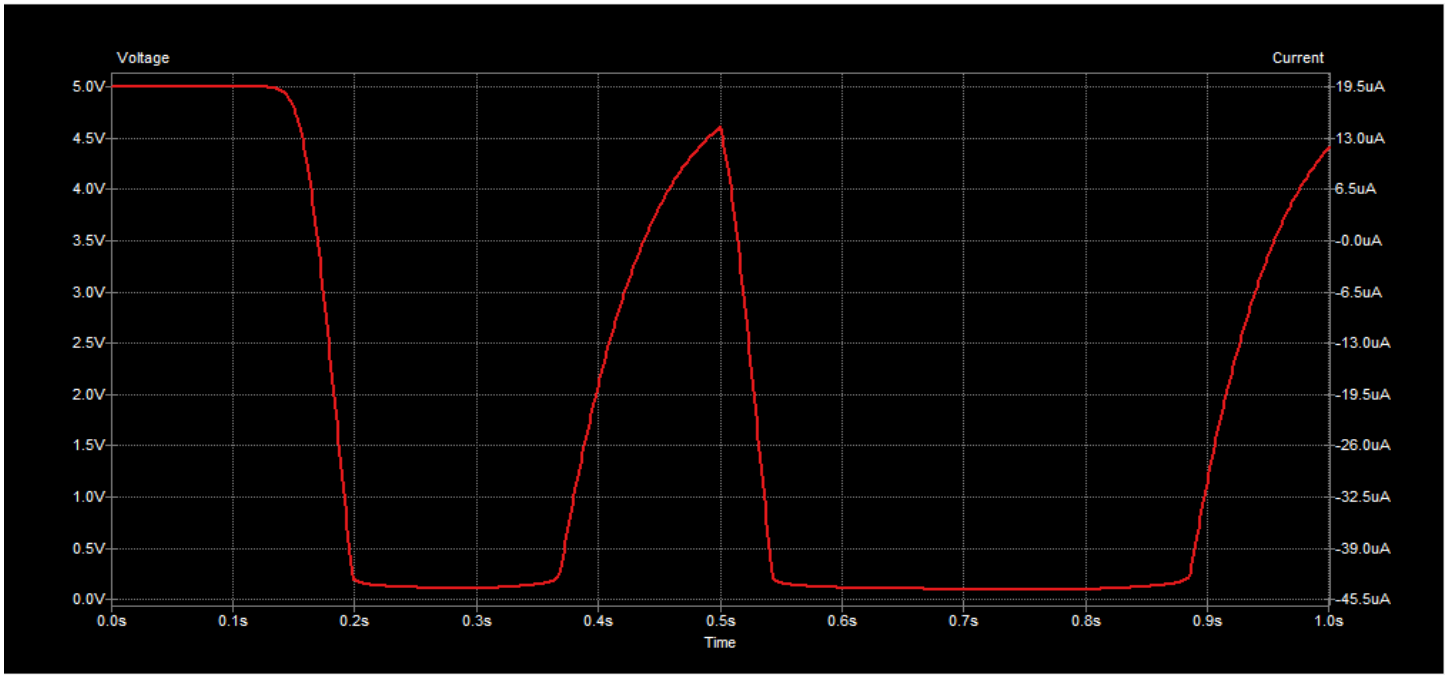

Fig 3: final output V(ALERT)

LOW -Human motion detected , HIGH – short motion (pet)

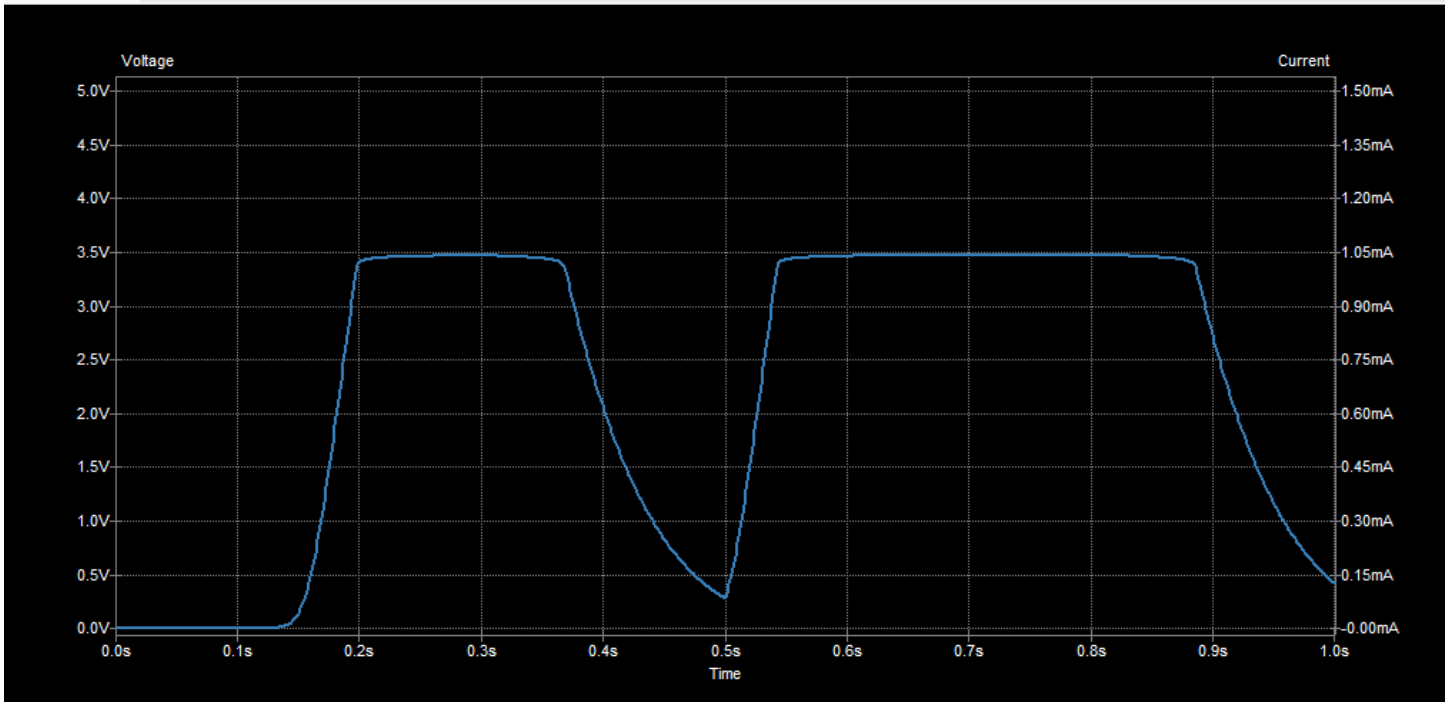

Fig 4: collector current (when Transistor is ON)

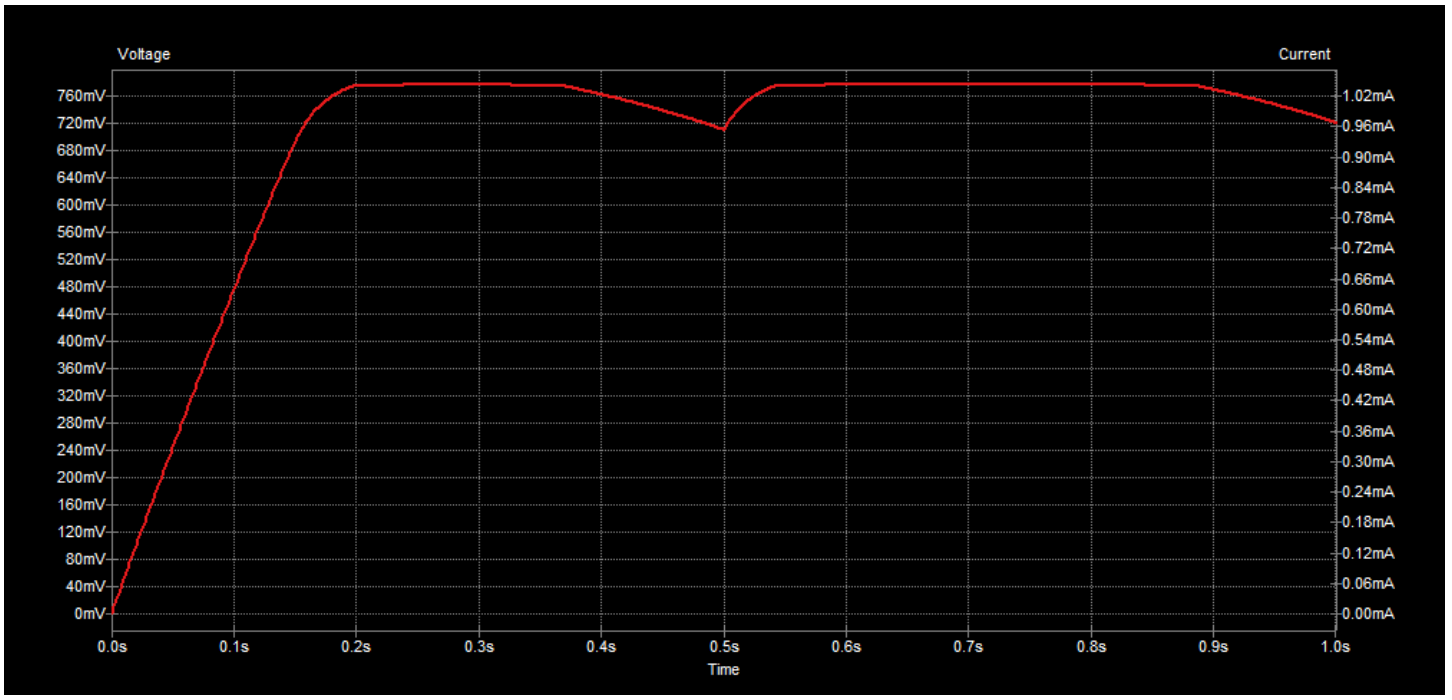

Fig 5: Base voltage (Decision threshold between pet and human motion)

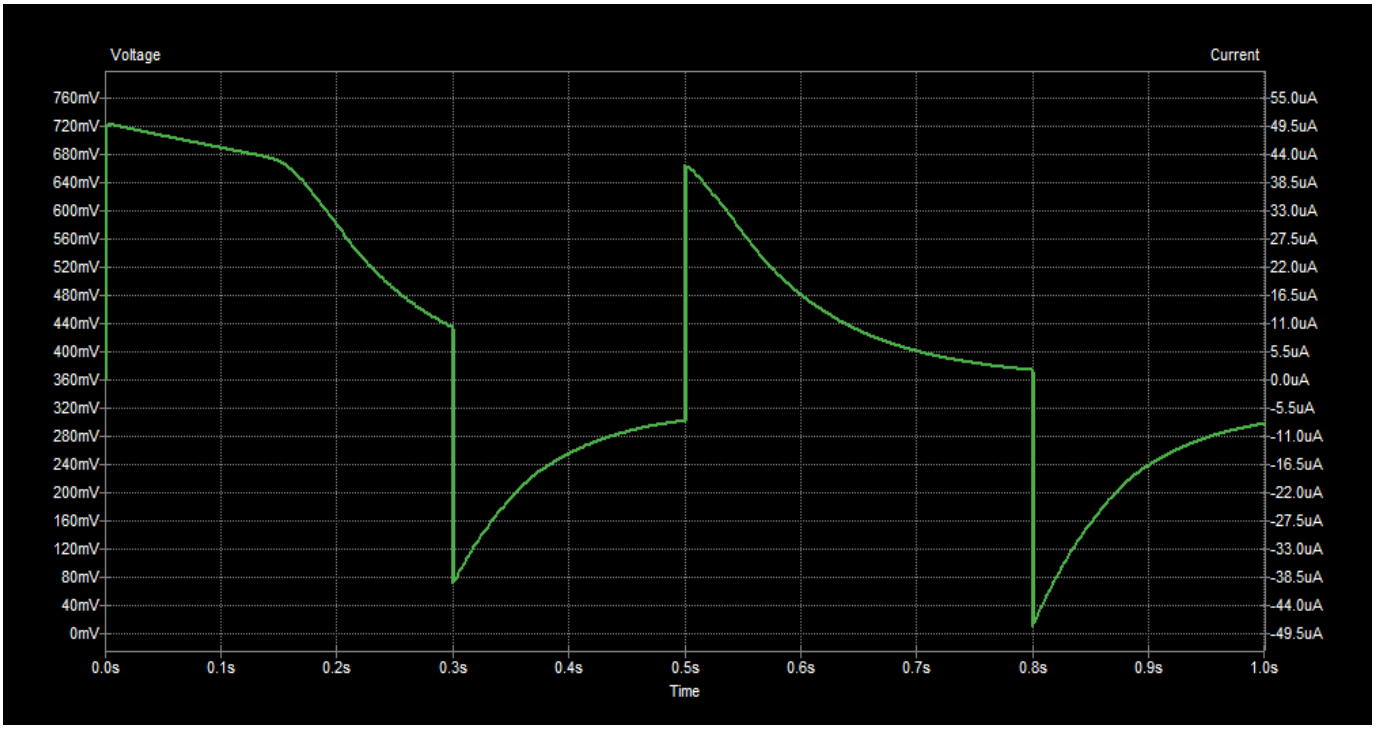

Fig 6: The capacitor current waveform illustrates the charging and discharging behavior of the RC integrator in response to motion pulses.

CONCLUSION

The pet-aware intrusion detection circuit was successfully designed and simulated using eSim. The system effectively differentiates between human and pet motion using pulse-width analysis. False alarms are the significantly reduced compared to conventional PIR systems. The event-driven operation minimizes power consumption. Simulation waveforms confirm correct alert generation. The design is simple, efficient, and suitable for real-time security applications.

REFERENCES

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