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Low-cost Radiation Sensor Network

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Abstract

A novel radiation sensor network has been developed for monitoring radioactive events in real-time. The sensor nodes consists of low-cost Geiger tubes which are read out using AVR microcontroller with a 2.4 GHz wireless interface. The receiver node is implemented with a Raspberry PI which provides the database interface and the network with other servers.

Keywords: Keyword1, Keyword2, Keyword3

1. Introduction

2. Sensor Node Design and Implementation

A sensor node consists of a radiation sensor (i.e. Geiger tube), a power supply unit and readout circuit, a microcontroller and a wireless transceiver as shown in Figure 1. The microcontroller is a 8-bit RISC-based AVR (ATtiny2313) made by Atmel and is programed in C for controlling Geiger tube high voltage, signal readout and wireless communication.

In the current design, we pick a Geiger tube (SBM-20) made by VNIITFA company in Russia. The stainless steel Geiger tube is filled with a mixture of Ne + Br_2 + Ar gases and has a dimension of 108 mm in length and 11 mm in diameter. Its operating high voltage is 350 - 475 volts (the recommended voltage is 400 volts). The tube life is about at least 2×10^{10} pulses and has a dead time of 190 μs. The Geiger tube high voltage power supply is deigned as a DC-to-DC boost converter as shown in Figure 2 for reducing both the cost and physical dimensions. The high voltage output can be program with the onboard microcontroller (ATtiny2313).

3. Receiver Node Design and Implementation

The receiver node consists of the same wireless transceiver and a host computer (i.e., Raspberry PI). An updated installation of Arch Linux and the ”bcm2835” class (required for communication of GPIO pins) and the SPI connection seen in Figure 6 allow the mini computer to receive data.

4. Sensor Network Integration

5. Results and Summary

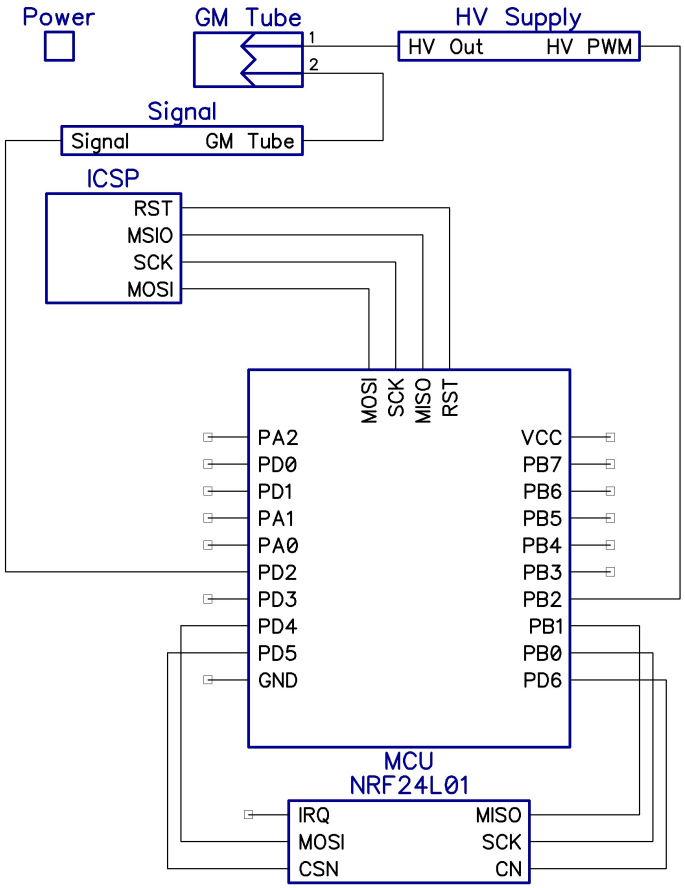

Figure 1. Sensor node assembly

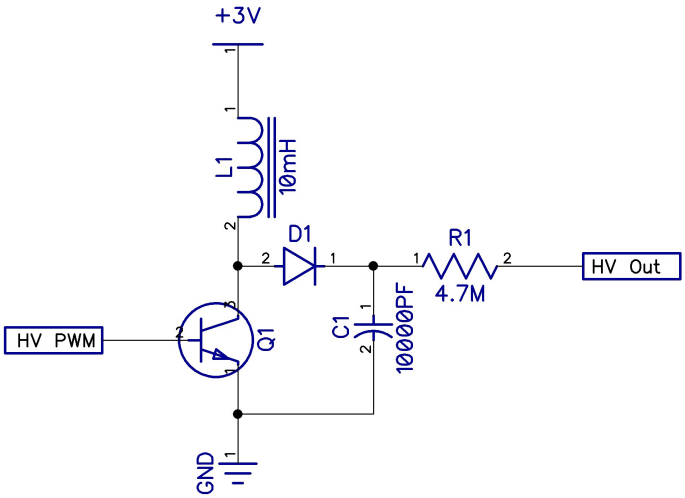

Figure 2. High voltage power supply circuit design for the Geiger tube.

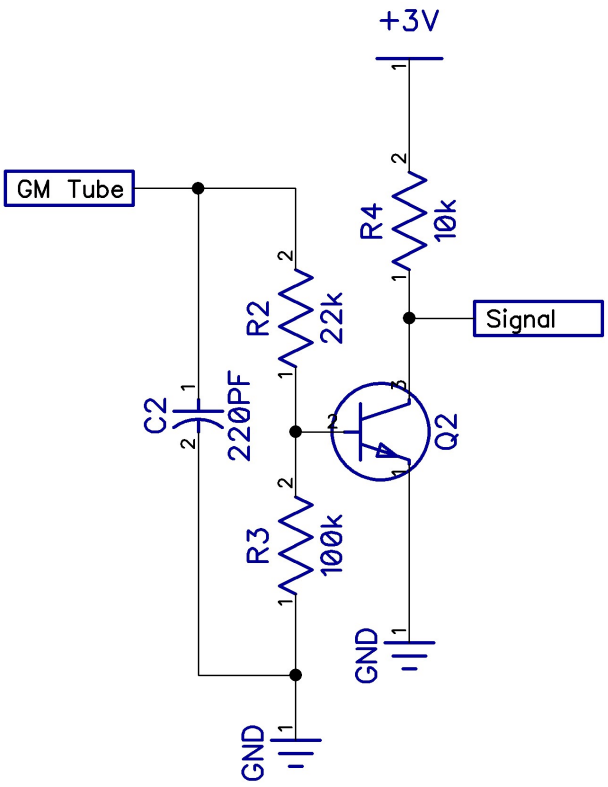

Figure 3. Digital signal output

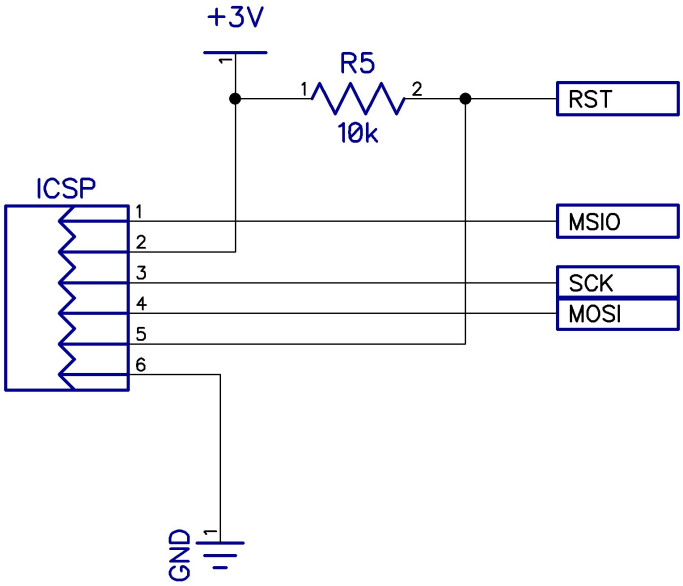

Figure 4. Header

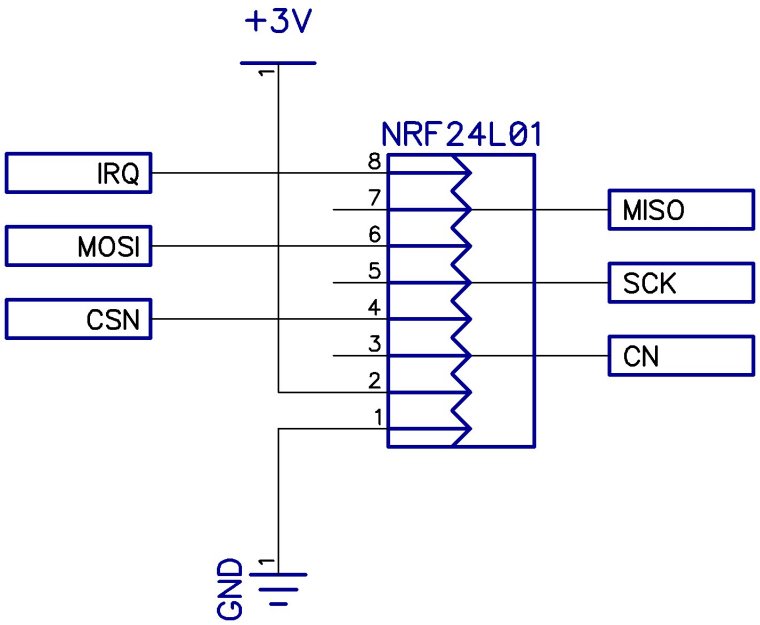

Figure 5. Wireless module interface circuit.

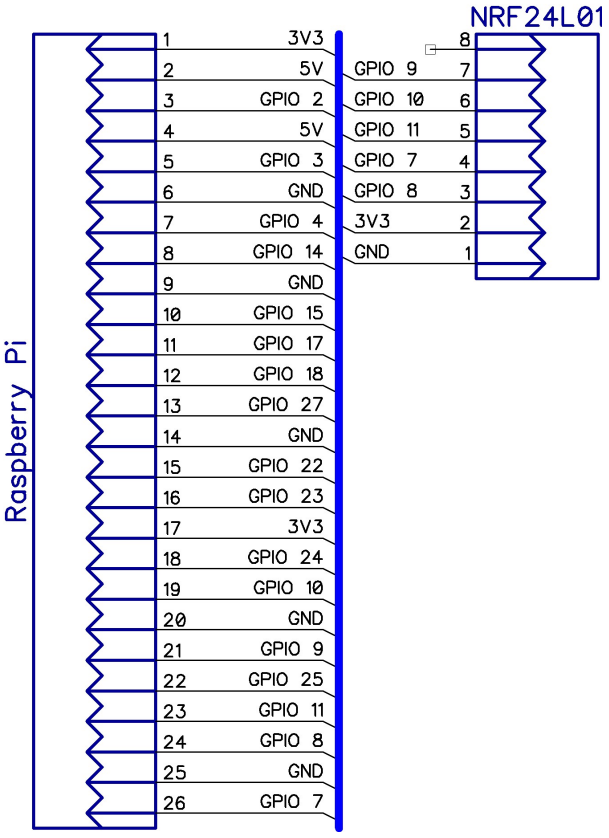

Figure 6. Wireless module interface with Raspberry PI.

References

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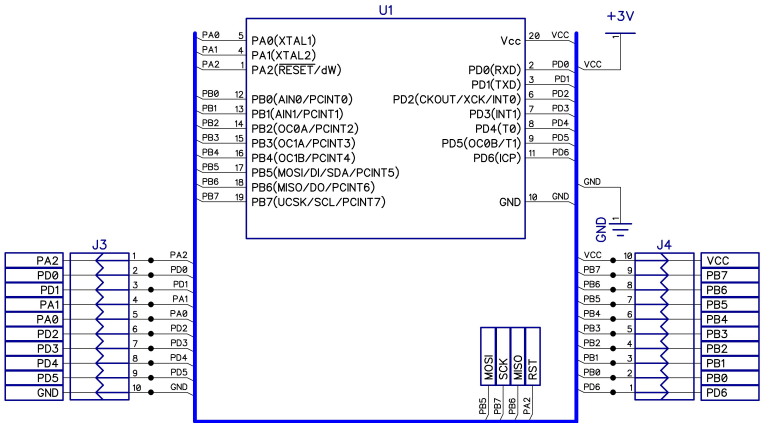

Figure .7. Atmel Microcontroller of the sensor node.

Schematic Diagrams