Design and Development of IoT based Geiger Muller counter

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Abstract: *Public protection from radioactive accidents is important task and also need to prevent from radiation exposer. To detect how much radio movement is having, a set up is require a particular instrument like radiation detector. This paper reports on Internet of Things (IoT) based portable Geiger Muller counter which provides to measure radioactive particles. It consists of spark fun Geiger counter developed board (SEN-11345) and NodeMCU as host microcontroller. Blynk app is act as IoT cloud server. Radiation dose rate was recorded and sent to cloud server via Wi-Fi gateway for connecting network through TCP/IP-based network. Blynk app stores the data and visualize it in android mobile at any time. It is very convenient to alert the people from radiation. The system is designed and implemented successfully in our laboratory and tested. We found that the instrument is working properly and results were good agreement with standards.*

Keywords: Internet of Things, Geiger counter, NodeMCU.

1. INTRODUCTION:

Radioactive materials cause saviour damage to people. And many accidents were happened due to poor safety precautions, free transport of radioactive materials and also poor checking. Apart from this, lack of portable instruments for measurement of radiation. Keeping all this in mind, we made an attempt to built Internet of Things (IoT) based Portable Geiger Muller counter. Using this we can detect radiation and access data from anywhere. The system mainly consists of a Spark fun's Geiger counter (GM counter) developed board (SEN-11345) and NodeMCU as host microcontroller. Blynk app is used as cloud platform for data storage and visualize and TCP/IP protocol for network communication. The firmware is developed in Arduino IDE in embedded C. The system is designed and implemented successfully in our laboratory and tested. We found that the instrument is working properly and results were good agreement with standards [1-4].

2. SYSTEM DESIGN

The proposed system's block diagram is shown in figure-1. It mainly consist of a Sparkfun's Geiger counter (SEN-11345), NodeMCU as a host microcontroller, Wi-Fi module to connect internet, Blynk server and Blynk APP for cloud services.

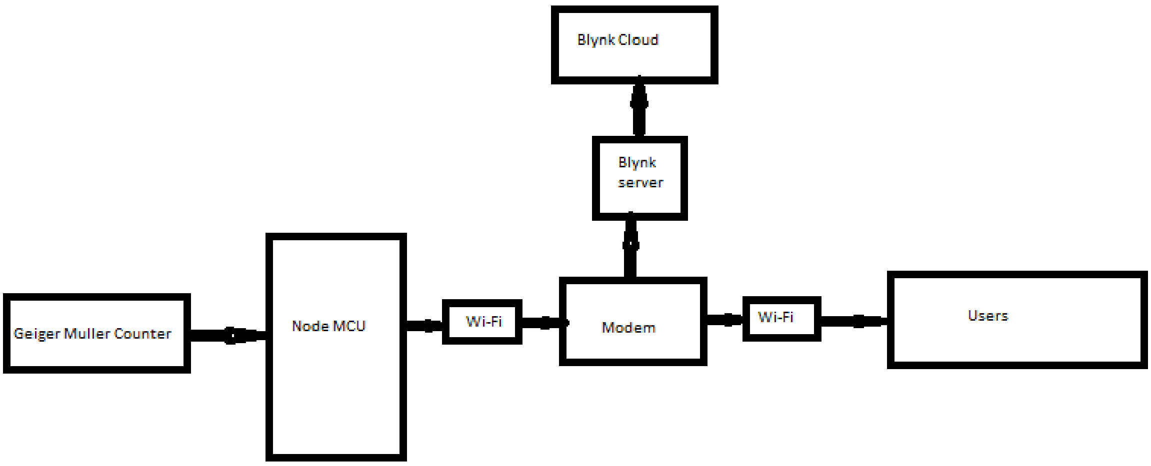


Figure -1: Block diagram of IoT based GM Counter

2.1 NodeMCU ESP8266

Arduino microcontrollers have a built-in ESP8266 Wi-Fi module in order to monitor and control them remotely over the internet. NodeMCU ESP8266 is a developed open source board. It has Wi-Fi enabled micro controller for the data transfer to the internet. It also supports to Arduino sketch using Arduino IDE. The nodeMCU esp8266 has all the necessary modules and it would be directly connected to the external peripherals. The data collected from sensors would be sent to the nodeMCU then send them to the cloud. Once the communication is established between host controller and cloud server then data will be transfer automatically. In this project, the data would be sent to Blynk app. Which is a cloud-based, open source an IoT App that enables us to store, retrieve, aggregate, analyze and visualize streams of live data. The nodeMCU having 1 analog input channel and 16 digital inputs outputs channels. The pin diagram of NodeMCU is shown in figure-2

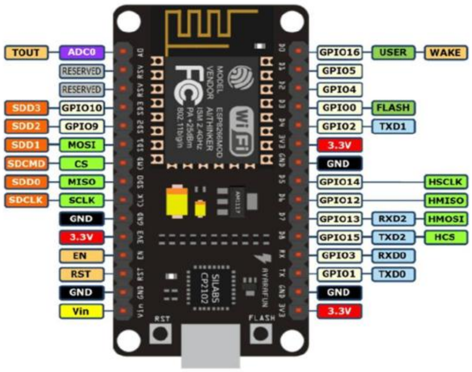


Figure-2: Pin specification of NodeMCU.

2.2 Blynk App:

Blynk app is purely designed for the Internet of Things based projects. By this we can control many hardware developed boards like Arduino, NodeMCU Raspberry pi and particle remotely and it can access sensor data to display, storage and we can visualize it. The Blynk app having mainly three parts like one is Blynk App, second is Blynk server, third is Blynk Libraries. Blynk works over the Internet, it means that the hardware you chosen should be able to connect to the internet. It provide unique token for every hardware to communicate.

2.3 Geiger Muller counter

Geiger counter board is used for radiation detection and is shown in figure-3. Geiger counter is powered through USB. It having in built an ATMega328 controller and it communicate at 9600 bps over any serial terminal and it generates random bits in reaction to background radiation. It has voltage regulation circuit for the Geiger tube, signal capture portion up to CPM limit to 100Hz of active high. By plug the unit into USB, it transmit random bits being generated from the random background radiation. Each bit generated (an ASCII byte 0 or 1). For power ON we need to put switch ON position by which it supplies high voltage to tube. For turn off, you must flip the tube power switch to OFF[5].

The Geiger tube have red boot to protect the end window during production. Its silent feature are given below;

1. 5V Logic with total current 30mA
2. LND712 Geiger Tube @ 560V
3. ATMega328 Microcontroller
4. FTDI USB Interface
5. TTL (Active High) Output Pin from Tube

Figure-3: GM counter

3. SYSTEM DEVELOPMENT

The system has been developed into two parts, one is radiation detection and second is radiation measurement. First one is a circuit design for detection of radio using ATMEGA 328. The ATmega328 is a microcontroller from Atmel mega AVR family. It is 8-bit AVR RISC microcontroller. It having 32 kb ISP flash memory, 1 kb EEPROM, 2 kb SRAM, 23 GPIOs, 10-bit A/D, 32 general purpose registers, three timer/counters with interrupts and also it has serial programmable USART etc. The system achieves throughput approaching 1 MIPS per MHz. The SEN-11345 board gives directly pulses. By using NodeMCU the pulses are counted. Same data is transferred to Blynk server. The flow chart of the system is shown in figure -4.

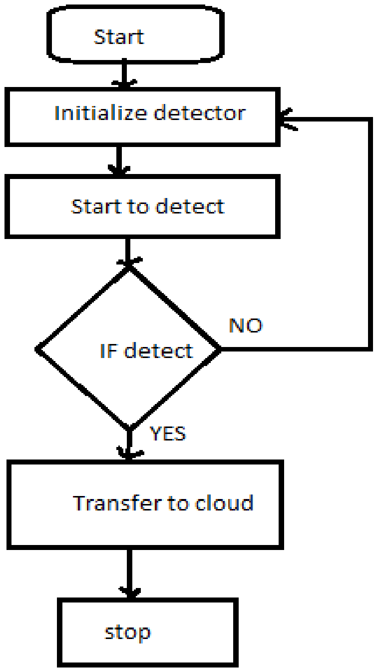


Figure-4: Flowchart of the GM systems

The processing of data, signal conditioning and counting is established by ATMEGA328 microcontroller board with pre-build program. This system is programmed to count the square pulse. And it send to in counts per second (CPS) format. The board also having boost converter circuit for high voltage conversion.

3.1 Experiment:

The experiment was carried out with two different conditions. In first time we have not taken any radioactive material/source near to the GM counter. And noted the radiation intensity in counts per 10 seconds. In second time we placed radioactive source near to the system, and noted the readings of radiation and also noted distance between radiation source and GM counter. Same reading are taken with different distances, then results are tabulated. The results are converted into radiation units by using 1 cps = 0.06 mrem/hr. And sensitivity = cps/ (mrem/hr).

4. RESULTS AND CONCLUSION

The Design and development of IoT based Geiger Muller counter has been successfully developed in our laboratory which is shown in figure-5 and 6. And tested with different conditions. The experimental results were tabulated in table-1. And compared with Indian SAR limit for mobile devices (limit is 1.6 w/kg). The system is working satisfactorily and it is very helpful for personal radiation detection. This system is light weight, portable instrument which offer detection of multiple types of ionizing radiation like alpha, beta, X-rays, and gamma. It very easy-to-use by users working in potentially explosive environments.

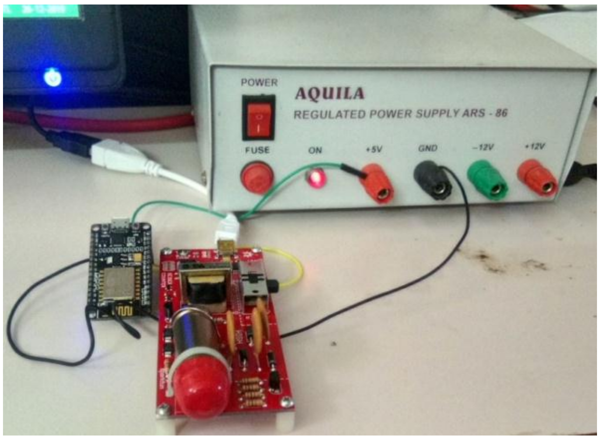
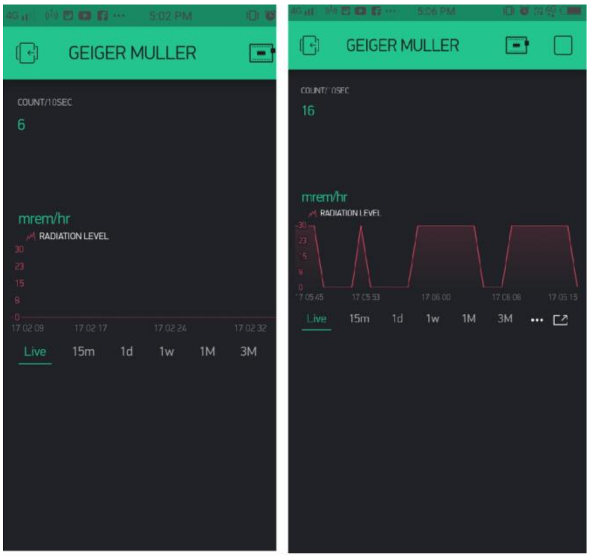


Figure-5: IoT based GM counter system



Figuer-6: IoT based GM counter's Blynk app

Table -1: Detected radiation levels of the system

Sr. No.	Distance between source and GM counter	Radiation intensity in counts per 10 sec	Radiation level in standard unit; mrem/hr
1	no source nearby	6 counts /10 Sec	0.0360
2	<18cm	11 counts/10 Sec	0.0660
3	<0.4cm	16 counts/10 Sec	0.0960

5. References :

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