IJRRECS/April 2014/Volume-2/Issue-4/2188-2192 **ISSN 2321-5461**

INTERNATIONAL JOURNAL OF REVIEWS ON RECENT ELECTRONICS AND COMPUTER SCIENCE

DESIGN OF A PRECISION MONITORING SYSTEM FOR GAMMA RADIATION DETECTION

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ABSTRACT:

The capability to notice and determine radiation dose is of enormous significance, and requires the use of susceptible and precise devices intended for these functions and it is subsequently imperative to discover optional detection strategies. This novel system is based on the constant attaining of radiation information which is present in the environment all the way through the detectors that are connected with the system. This system alerts the people who are working in radiation prone regions to acquire required measures on the basis of alarm criticality. The system moreover has configurable alarm levels that can be modified within the application and makes use of a modbus TCP/IP connectivity to bond the system with additional remote PCs functioning as MASTER-SLAVE in the network. The data and commands are stored by means of a date/time stamp. The device can be configured from distant location and is tested successfully for detecting the gamma ray sources within the areas of radiation prone in a radiation field of 0 - 100 uR/hr above the ambient background level.

Keywords: Alarm levels, gamma,Radiation, Doserate.

1. INTRODUCTION:

In environmental monitoring, therapeutic medical procedures, as well as military applications, Ionising radiation is used expansively where accidents may possibly pose severe health risks to those in the propinquity of these sources of radiation. To make sure that they are not emitting radioactive material into the surrounding atmosphere flourishing and safe remediation of radioactive waste sites is dependent on precise monitoring of radioactive plumes [4]. A cost effectual prototype system was intended for monitoring remote ionising radiation which is required to decrease the requirement for human interaction and consequently possible exposure in the areas such as Radiology Departments, Radioactive waste storage sites and Atomic Power Stations [10]. Our goal is to build up and commercialize low-priced, faster, and integrated smart radiation monitoring systems that can be put into operation at nuclear facilities of our country.

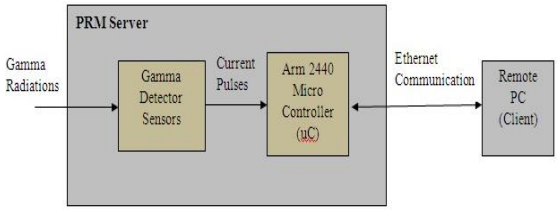


Fig:1 Precision Monitoring System

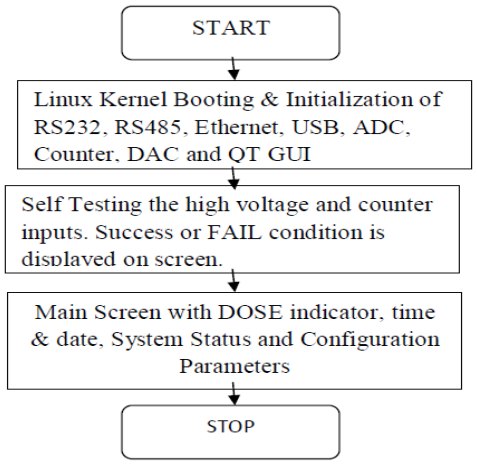
The Precision Monitoring System shown in Fig. 1 is a detection device proficient of operating in a networked or a stand-alone configuration [8]. It is competent of detecting gamma rays, comparing the detected levels against configurable alarm setpoints, and subsequently notifying the people working in the location, by means of generating alarms respectively. Even though the detection system can be used as a stand-alone unit, it is primarily designed to be integrated with the systems of network radiation monitoring [1]. In order to achieve high precision dose values, traditionally two separate detectors are used. The device is intended to find the location of the radioactive source. The system operates on one rechargeable battery. The high voltage is provided as input for the detector unit by means of external wiring connection to the detectors. At present there are few other commercially available single devices that can detect gamma radiation fields, however, none of them has faster network capabilities [11]. Besides preventing the smuggling of special nuclear material, this device can moreover alert an individual to the occurrence of harmful gamma radiation. The objective of this scheme is to build up a networked gamma radiation detection

system with special nuclear material tracking and surveillance technologies to make available real-time alarm detection and notification of unauthorized nuclear activities [3].

2. METHODOLOGY:

A simplified outline of the prototype setup of system consists of ARM 2440 micro-controller and the detector sensor. The system contains Gamma radiation detectors which are associated to the analog circuit front-end, whose output is associated to the Analogue to Digital Converter of the PSOC (Programmable System On Chip) [9]. The pulses from PSOC are passed to the ARM micro-controller through UART channel. The System accumulates the output of the PSOC within its internal memory and outputs the dose values to an on-board LCD TFT display and towards the Modbus connection [7]. Modbus TCP/IP is a messaging protocol used to transfer request response packets in the form of Protocol Data Units between server and client systems connected in master-slave network

A sequential start up of the system is mentioned using flowchart diagram below. The system can be operated in two different modes of operation as explained below in scenario 1 and scenario 2.



A) SCENARIO 1: FOR STAND-ALONE SYSTEM:

The device would be conditioned to alert the user in the event preset level thresholds were exceeded by means of an audible alert or a visual alarm resembling flashing the LCD screen [2]. In addition, the display would give an indication to the user concerning the continuous changing levels of gamma ray radiation by means of a doserate plot where x-axis represents time and y-axis represents dose level, which is easily interpreted as a set of changing curves. An audible alarm would be activated if the preset radiation levels are exceeded [12]. A relative measure of strength indicated on the device may possibly be relayed to those authorities to

provide an indication of the severity and response methods to be taken.

B) SCENARIO 2: FOR REMOTE MONITORING OF RADIATION DETECTION DEVICE THAT IS PLACED IN AREAS EFFECTED WITH RADIATION:

This radiation monitoring system could be connected in network with number of clients using master slave technology; as a result the remote PC (client) can query the dose rate information at the site to the Server (Radiation Monitoring System) [5]. The server generates response and sends to the client in the form of packet. Each and every interaction (request – response) between the two systems is logged into the system [6]. The network diagram is shown in the figure given below.

3. RESULTS:

The Precision Monitoring System, is a detection device proficient of operating in a networked or a stand-alone configuration. To authenticate the reliability, repeatability and the stability of the system unlimited tests with numerous experimental setups were carried out and the system provides a simple method of collecting, storing and displaying data from one or additional radiation sources.

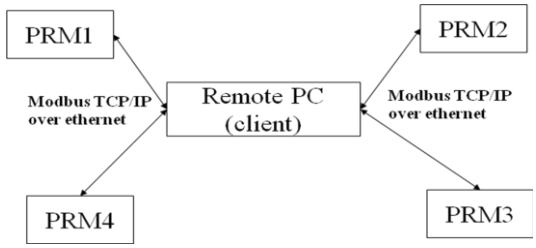


Fig: 2 Network Diagram

The device can be used for detecting the gamma ray sources within the areas of radiation prone in a radiation field of 0 - 100 uR/hr above the ambient background level.

4. CONCLUSION:

It is a cost effective circuit by means of requiring very few components. The system is portable, as it is battery operated and data can be saved locally for subsequent downloading and analysis. It is real-time since it outputs its readings immediately to an LCD display. The described system, provides a simple method of collecting, storing and displaying data from one or additional radiation sources. It also can be expanded to alpha, beta sources. The facility of optional optically isolated digital inputs will be provided for future expansion for monitoring and control of any other system parameters.

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