INTISARI

SISTEM AKUISISI DATA DOSIMETER PERSONAL *REAL-TIME* BERBASIS JARINGAN SENSOR *NIRKABEL*

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Radiasi gamma telah terbukti bermanfaat dalam bidang kedokteran nuklir. Namun, paparan radiasi gamma potensial dapat menyebabkan efek negatif bagi kesehatan dan keturunan (genetik). Juga radiasi gamma tidak dapat diamati secara langsung sehingga diperlukan suatu detektor nuklir sebagai alat pemantau radiasi. Salah satu bentuk detektor yang berfungsi untuk mengukur dosis radiasi yang diterima perorangan disebut dengan dosimeter personal. Umumnya yang biasa dipakai adalah jenis dosimeter personal pasif, yang perlu durasi waktu pemantauan yang lama, harus dibaca oleh lembaga terakreditasi, dan perlu waktu pengiriman hasil yang lama. Pada disertasi ini hendak ditunjukkan upaya penelitian membuat beberapa dosimeter personal aktif yang terhubung melalui jaringan sensor *nirkabel* (JSN). Penelitian dimulai dari proses rancang bangun dosimeter radiasi, karakterisasi komponen sistem, sistem akuisisi data *real-time* dan terpusat yang dikendalikan oleh satu unit pemprosesan data untuk memantau pengukuran dosis radiasi oleh beberapa dosimeter personal. Dalam sistem ini, terdapat *multi-sensor* dimana tiap modul sensor mampu melakukan pengumpulan dan pengirim data hasil pengukuran radiasi. Setiap modul sensor menggunakan radio digital standar IEEE 802.15.4 jenis Xbee modul dan dikendalikan oleh mikrokontroller jenis Mikrokontroller Arduino. Pengujian sistem dibandingkan dengan hasil pengukuran dosimeter terkalibrasi. Hasil penelitian menunjukkan bahwa respon detektor terhadap waktu pengiriman data tidak mempengaruhi nilai dari keluaran detektor sehingga proses pengiriman data hasil pengukuran dosis radiasi dapat dilakukan secara *real-time*, baik dalam akumulasi dosis radiasi setiap menit, jam atau setiap hari dan memenuhi distribusi Poisson. Berdasarkan analisis nilai *packet error rate* (PER), perangkat komunikasi yang digunakan mampu bekerja baik pada jarak 140 m di ruang terbuka dan 45 m di laboratorium dalam bentuk bangunan yang memiliki tembok-tembok penghalang. Sistem yang dibangun ini efisien, murah dan proses pengumpulan data paparan radiasi dapat untuk memantau paparan radiasi yang diterima pekerja radiasi secara *real time*. Karena itu, teknik ini dapat membantu mempercepat pelaporan paparan radiasi yang diterima pekerja radiasi.

Kata Kunci : Dosimeter, *real-time*, jaringan sensor *nirkabel*.

ABSTRACT

PERSONAL DOSIMETER REAL-TIME DATA ACQUISITION SYSTEM BASED ON WIRELESS SENSOR NETWORK

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Gamma radiation has been proven useful in the field of nuclear medicine. However, exposure to gamma radiation can potentially cause negative effects on health and heredity (genetic). Also gamma radiation can not be observed directly, so we need a nuclear detector as a radiation monitoring tool. One form of detector that functions to measure the dose of radiation received by an individual is called a personal dosimeter. Generally what is commonly used is the passive type of personal dosimeter, which requires a long duration of monitoring, must be read by an accredited institution and requires a long time to send results. In this dissertation a research effort has been made to make a number of active personal dosimeters connected through a wireless sensor network (JSN). The research began with the design of the radiation dosimeter, the characterization of system components, a real-time and centralized data acquisition system that was controlled by a data processing unit to monitor the measurement of radiation doses by several personal dosimeters. In this system, there were multi-sensors where each sensor module was able to collect and send radiation measurement data. Each sensor module used an IEEE 802.15.4 standard digital radio type Xbee module and was controlled by an Mikrokontroller Arduino type microcontroller. System testing was compared with the results of calibrated dosimeter measurements. The results showed that the response of the detector to the time of sending data did not affect the value of the detector output so that the process of sending data resulting from measurements of radiation doses could be done in real-time, either in the accumulation of radiation doses every minute, hour or every day and have fulfilled the Poisson distribution. Based on the analysis of packet error rate (PER), the communication device used was able to work well at a distance of 140 m in open space and 45 m in the laboratory in the form of buildings that have barrier walls. The system built was very efficient, inexpensive and the process of collecting radiation exposure data can monitor radiation exposure received by radiation workers in real time. Therefore, this technique can help speed up the reporting of radiation exposure received by radiation workers.

Keywords: Dosimetry, real-time, wireless sensor network (WSN)