A feasibility study of novel real-time personal dosimeter with position monitoring

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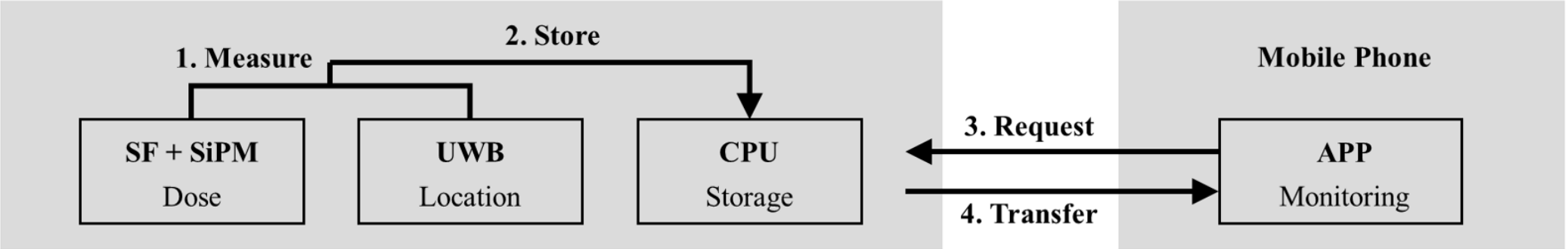
Purpose

- Occupational exposure of all registered radiation workers is measured routinely to maintain dose records. It is an essential part of monitoring the exposure of individuals to radiation. Also, dose estimation for radiation workers is an important factor for government and organizations to evaluate radiation risks and establish protective measures
- Commercialized personal dosimeters are not applicable for immediate checking of the exposure dose and the exposure position, and it is necessary to periodically replace them.
- We developed a personal dosimeter using a scintillator and an ultra-wide-band (UWB)-based location detecting system that is able to monitor the exposure dose and location in real time, and evaluated its feasibility.

Methods and Materials

System Configuration



1. The SF exposed by radiation emitted the light and the photons were amplified and converted to an electrical signal through the SiPM.
2. A host board was inserted into user's dosimeter and the four nodes were placed in the radiation management area as reference points for the calculation.
3. The dose and location information were stored in the central processing unit (CPU) of the dosimeter. When a request for the exposure dose and location made by the user was sent to the wireless communication system, the information stored in the CPU was transferred via Bluetooth system to the homemade application in a mobile device, such as a tablet PC or phone, and was monitored by the user

Methods and Materials

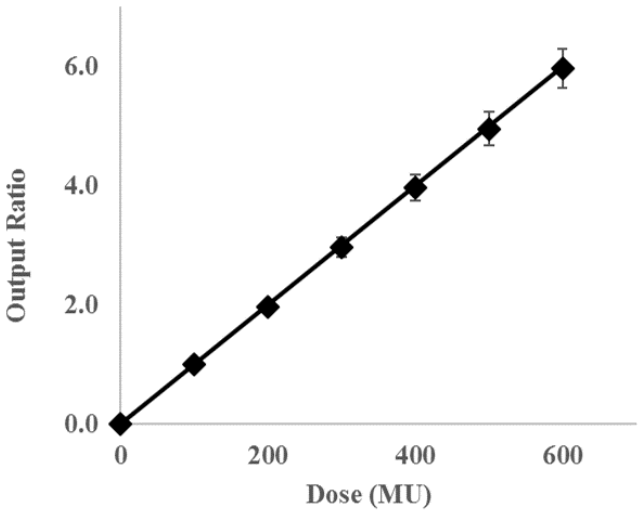
Characteristic Test

1. Dose linearity
2. Energy dependency
3. Angle dependency
4. Position measurement

Results

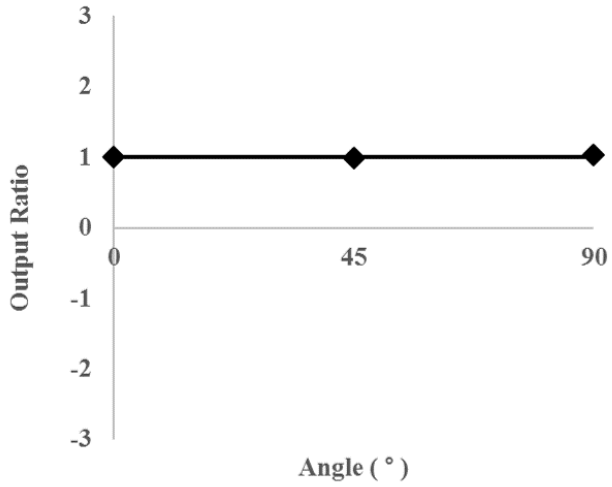
Characteristic Test

Dose linearity



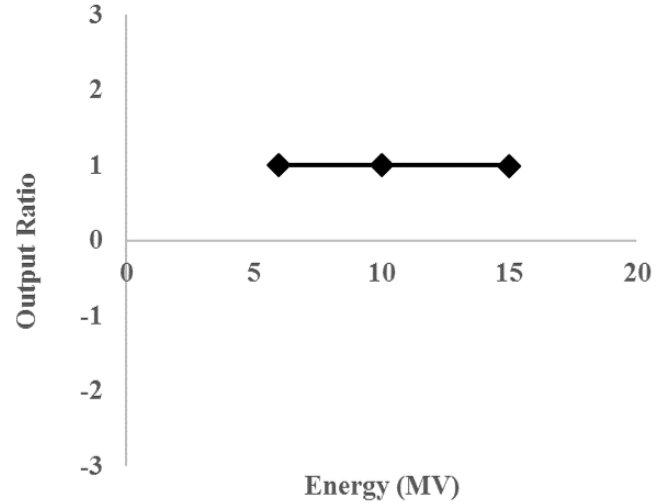
The relative sizes of the signals were 1.00, 1.98, 2.97, 3.98, 4.97, and 5.99, respectively, which corresponded largely with the increase in dose.

Energy dependency



The signal was consistent with standard deviation of 0.02.

Angle dependency



The signal was consistent with standard deviation of 0.02.

Results

Characteristic Test

Position measurement

Coordinate and error for random position compared developed dosimeter with ruler (Unit: cm)

The X-coordinate showed an error of -6 cm and the Y-coordinate showed an error of -4.8 cm on average.

	Ruler		Developed		Error	
	X	**Y**	**X**	**Y**	**X**	**Y**
Position A	0	70	-11	65	-11	-5
Position B	25	45	20	39	-5	-6
Position C	60	35	56	31	-4	-4

Conclusion

- We developed a real-time, scintillator-based dosimeter that effectively monitored the exposure dose and radiation location for radiation workers.
- Our results show that the developed SF-based dosimeter is advantageous in monitoring the exposure dose and location in real time, also has significant potential as a new personal dosimeter for radiation workers.
- Our device will be useful in protecting radiation workers from radiation accidents and enable them to work in safe environments.