BME 301 Tong BME Design Award: Executive Summary
Radiation Distance Safety Meter

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Nearly 200 million people are affected by thyroid disorders worldwide. The thyroid gland is crucial for metabolic processes and hormone regulation, and serious symptoms can arise when the thyroid gland is malfunctioning. Treatments of thyroid disorders include medications and lifestyle changes. However, in more severe disorders such as cancer and hyperthyroidism, radioactive iodine (I-131) is utilized to destroy malignant tissue surrounding the thyroid, sometimes also including the thyroid. In these instances, of which an estimated 20 million are in the US alone, radioiodine is taken into the body via liquid or capsule and concentrated in the thyroid cells, where it will spend four to six weeks decaying and destroying surrounding tissues. Because of its radioactive properties, radioiodine can also damage healthy tissues of those near the patient in treatment, warranting the need for a device that alerts the patient when he or she is within close proximity of another person.

A previous design used a wireless dongle coupled to smartphones via Bluetooth to detect distance between the patient and family members. A notification will be sent to the user when the dongle comes within the one-meter range. Drawbacks are that a dongle must be carried to establish a distance measurement, and multiple dongles have not yet incorporated into the device. Furthermore, it is limited to users with access to a compatible Bluetooth smartphones.

The current design consists of distance and thermal sensors embedded in a belt-like framework, powered by a 9V battery and controlled with an Arduino microcontroller. To detect humans, the Maxbotix Ultrasonic Range Finder EZ0 sensors must first detect movement within a one meter radius at a 120° field of view in front of the patient. In turn, the Arduino then powers the Omron D6T8L06 thermal sensor, which will trigger the feedback mechanisms when temperatures between 30°C and 36°C are detected. A positive signal will activate 30 LEDs and a vibrational disc motor to alert the user and nearby people of a distance breach. This design is based on simplicity and adaptation for the user.

With this ease of use, the product is easily recycled between users. The marketing stance the device takes will focus on clinics and radiation treatment centers. The shelf-life of a commercialized product is potentially decades long allowing these devices to be used over a span of multiple patients. If clinics become equipped to prescribe this device following radioiodine treatment, the annual number of potential users spans up to 30,000 annually in the United States alone.

This design could further be adapted for applications involving the aid of blind individuals. Using the belt as an interface between sensing a type of object and its distance has broad potential to be applied in therapeutic settings as described above but also more generally in the “wearables” market.