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Abstract

Patients who are treated with radioactive iodine (I-131) for thyroid complications are instructed to avoid close proximity with other people after treatment [1]. The clients have requested a device which alerts patients if an individual is within a one meter radius. A prototype that couples a distance sensor and a thermal sensor was engineered. The prototype alerts the patient via a feedback cascade. An initial visual LED warning is fired followed by an auditory alarm after a timed delay.

Introduction

Background

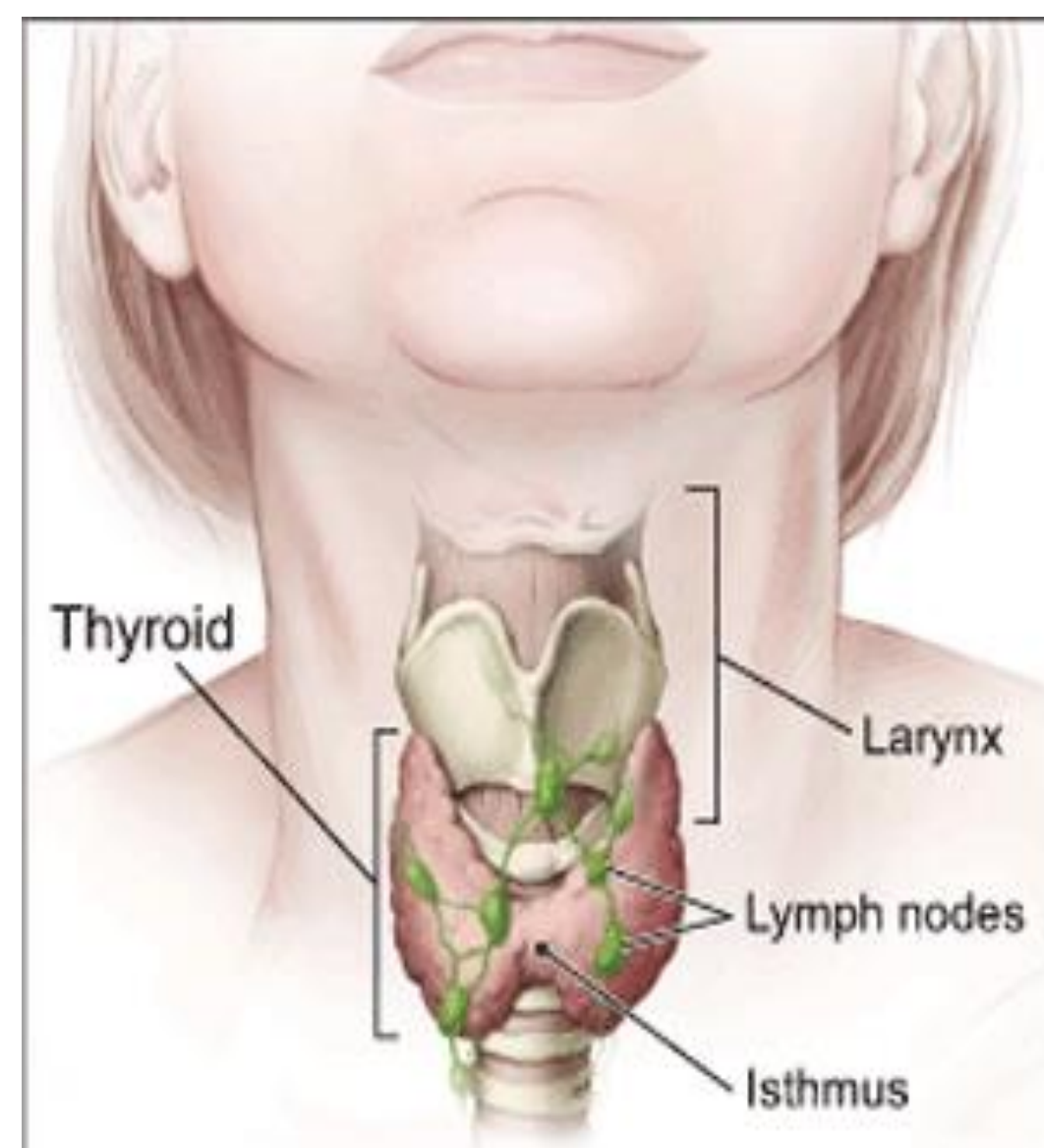


Figure 1: Thyroid gland rendering [3].

- Thyroid gland controls:
 - heart rate
 - blood pressure
 - body temperature
 - weight
- 1/92 people will be diagnosed with thyroid cancer [2]
- Doses of I-131 are used to treat thyroid complications

Motivation

- Patients become temporarily radioactive after treatment
 - Exposure is dangerous to nearby individuals
 - Pregnant women and children are at highest risk of harm
- Patients need to:
 - limit their exposure to nearby individuals
 - be alerted to nearby individuals' proximity

Design Criteria

- A successful device will be:
 - able to uniquely detect a human (body temperature above 23° C) within a one-meter range
 - able to alert patient of detection
 - aesthetically pleasing
 - comfortable
 - durable
 - light weight (less than 2 kg)

Design

Final Design

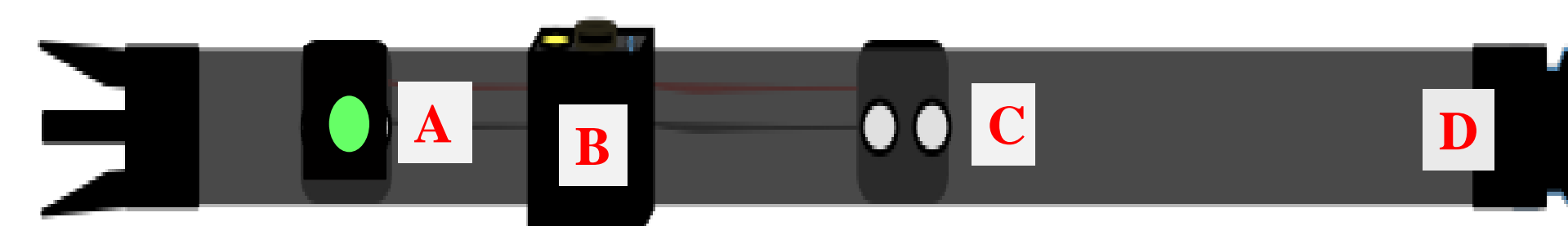
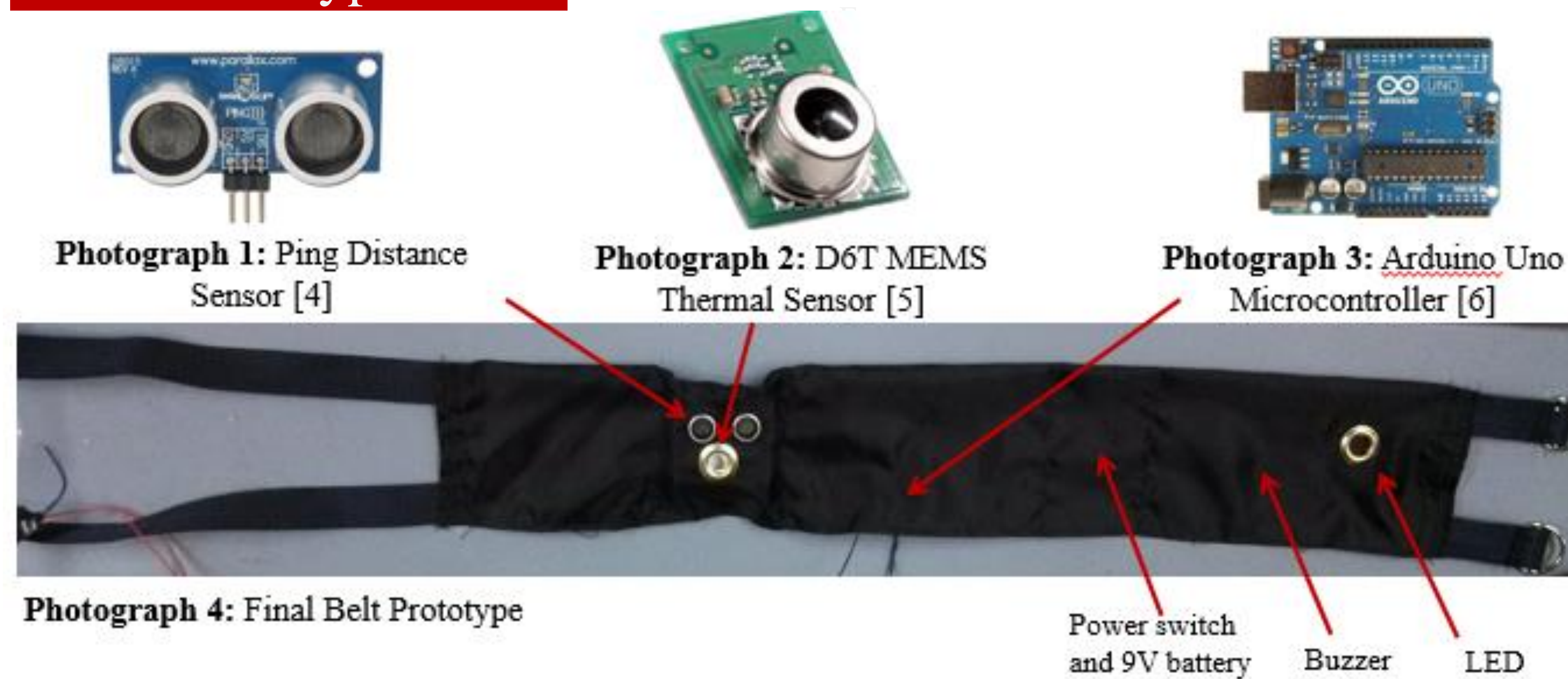


Figure 2: Final design sketch with ventral feedback mechanism (A), hip microcontroller with battery supply (B), dorsal thermal and distance sensors (C), and buckle attachment (D).

Prototype



Cost - \$176.60

Item category	Cost
Sensors	\$100.17
Processor	\$33.22
Component housing	\$23.61
Fabric	\$3.03
Miscellaneous electronics	\$16.57
Total	\$176.60

Table 1: Cost breakdown for prototype materials.

Code Block Diagram

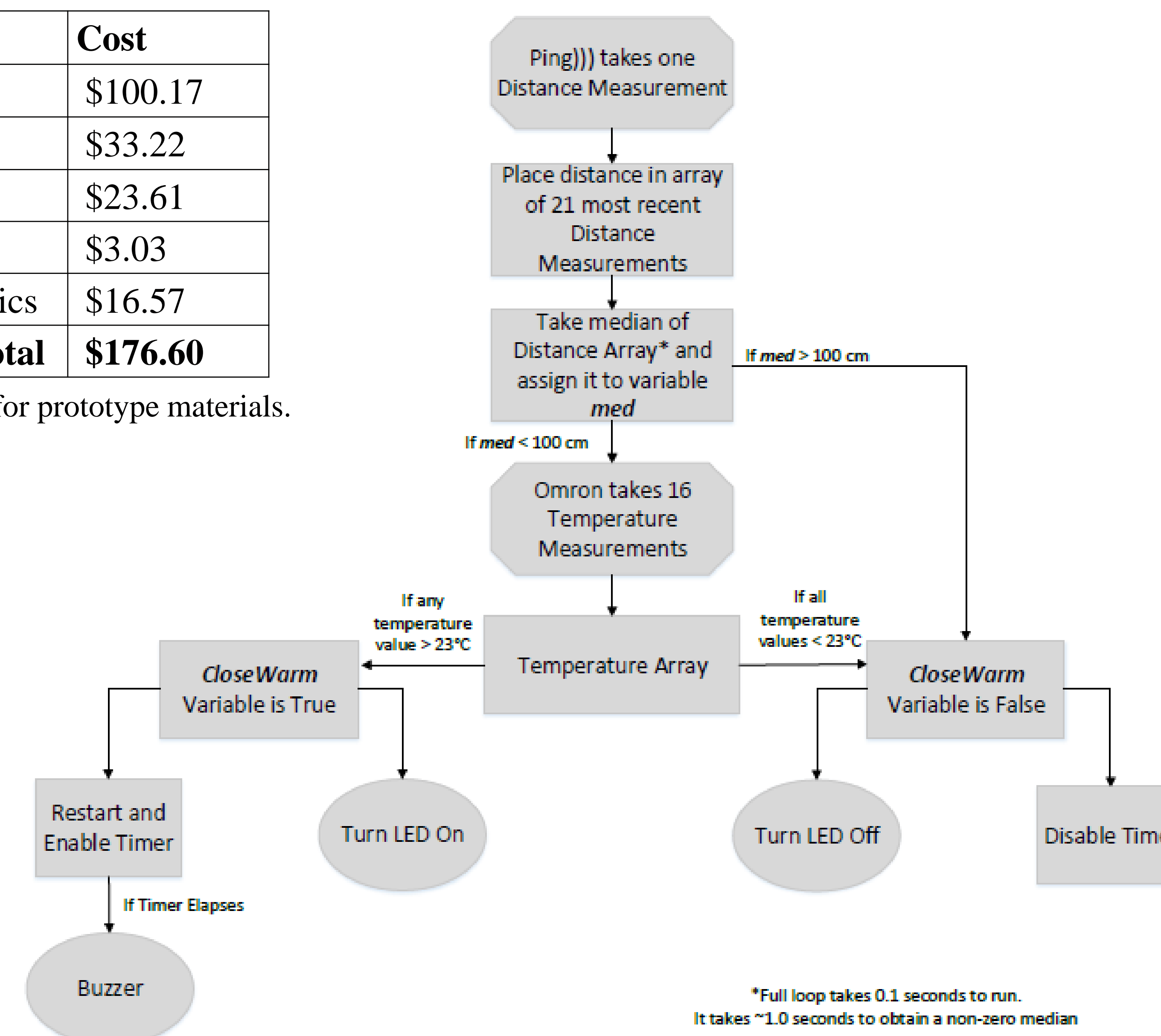


Figure 3: Code block diagram for microcontroller.

Testing

Field of View

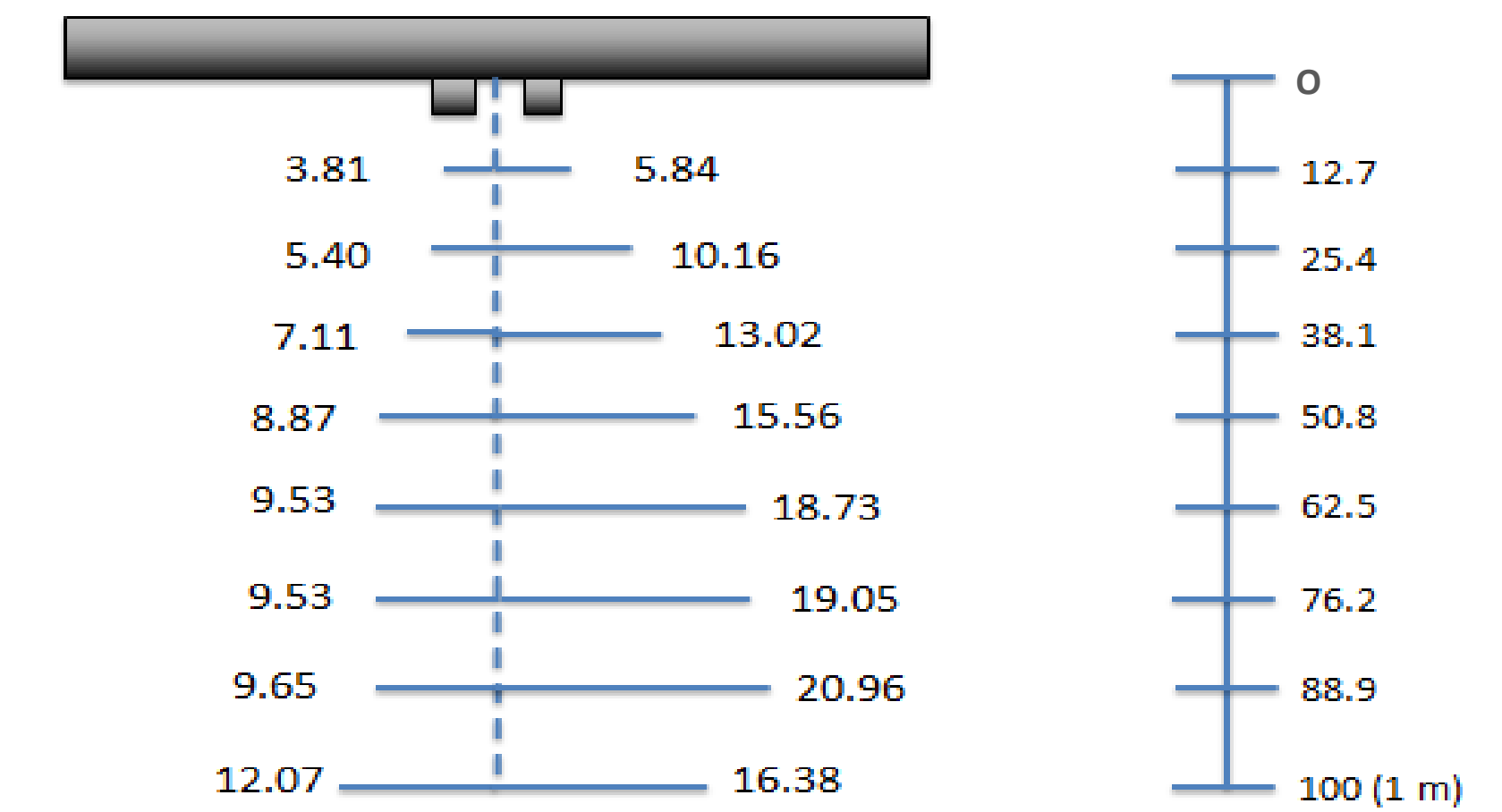


Figure 4: Field of view testing diagram (all measurements in cm). Horizontal field of view was found to be 15.7 degrees.

Time Accuracy

- Auditory alarm programmed to fire ten seconds after person enters detection zone
- Results showed there is no significant evidence to conclude the timer takes any time other than ten seconds

Calculations	
Mean	11.124 sec
Variance	5.706 sec
Standard Error	0.7026 sec
T test value	1.5997
P-value	0.14412

Table 2: Statistical analysis calculations for auditory response time

Future Work

- Optimize code to expand device capabilities
 - Distinguish multiple individuals simultaneously
 - Mark a specific individual on multiple occasions
 - Store exposure time for marked individuals
- Expand the field of view
 - Add swivel capabilities
 - Add multiple combinations of sensors
- Enhance patient feedback for specific alerts
 - Multiple LED colors
 - Various buzzer tones, volumes, and rhythms
- HDPE sensor housing

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References

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