Tennis Boundary Ball Detection

ECE 445
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Mock Design Review
Team 12

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1.0 Design
1.1 Block Diagrams
1.2 Block Descriptions

Optical System
This is the detection portion of the system. The system consists of an infrared emitter and collector. These are two separate devices that both play a role in detecting things that land close to the boundary line. For each boundary line (three on each side of the court) there is one emitter and one collector. The spacing between the devices is approximately 13 meters. The IR Emitter outputs an infrared beam to the IR Collector. The IR Collector takes information from IR Emitter and during specific amounts of infrared light it detects determines whether to turn on LED Indicator and what data to log.

2.0 Schematics, Calculations, Plots

2.1 Circuit Diagram
2.2 Calculation

Emitter/Collector Supply Voltage (10 - 30 V): 10 V
Emitter/Collector Current Requirement: 30 mA
Desired Battery Life: 3 h

Amp Hourage:

\[ \Sigma I \times t = (30 \text{ mA} + 30 \text{ mA}) \times 3 \text{ h} = 90 \text{ mAh} \]

Energy:

\[ E = V \times \text{amp hourage} = 10V \times 90 \text{ mAh} = 0.9 \text{ Wh} \]

2.3 Simulation - IR Collector Data Log

![IR Collector Data Log](image)

**Figure 1: 100ms of Data from IR Collector**
3.0 Requirements and Verification


<table>
<thead>
<tr>
<th>Requirements</th>
<th>Verification</th>
<th>Score</th>
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</thead>
<tbody>
<tr>
<td>Optical System</td>
<td></td>
<td></td>
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<tr>
<td>- Receive signal at 13m</td>
<td>Place sensors about 1m apart and gradually increase the distance, while</td>
<td>10</td>
</tr>
<tr>
<td>(emitter to collector</td>
<td>keeping track of alignment and data, to 13m.</td>
<td></td>
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<tr>
<td>distance)</td>
<td>- Bounce ball into beam and verify there is a disruption through readings</td>
<td></td>
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<tr>
<td>- Be able to detect a</td>
<td></td>
<td></td>
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<tr>
<td>tennis ball moving/bouncing</td>
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4.0 Safety Statement

This device is made to be able to work on a traditional tennis court, and so there are some safety risks and guidelines that should be taken into account when using the devices.

- Device is not weather-proof. Do not use device in weather that is not suitable for playing tennis, such as rain. In situations where the court floor is hot, place a level non-conductive mat under the device to keep it from overheating and potentially malfunctioning.
- Any component of the device should not be altered from intended use. Infrared beam or laser should only be pointed at either the ground or device.
- Battery should be kept in a safe case
- Power supply and delivery to components of device should be kept in check since there are several paths (solar panel, power supply, emitter/collector, LED indicator, microcontroller)
5.0 Citations

https://www.adafruit.com/products/1057?gclid=Cj0KEQiw6uO-BRDzujiwtuzAzfkBEiQAAnhJ0F3bG-l5R4ZEh0NPajC5CFwMaeei5uBLYGaDP8J81AkaAsAn8P8HAQ