Optical Gate Timing System

Pietro Faraggiana

Abstract

This personal project develops an optical gate timing system designed for sports applications. The system uses a laser beam and a photodetector (forming the optical gate) to detect the passage of an object; successive optical gates all communicate via RF to a microcontroller, allowing for high-precision time interval measurements. As I'm in the process of selling this project, the following description will be very approximate.

Contents

Chapter 1

Introduction

In sports timing, having reliable and precise measurement tools is essential. The system presented here employs optical principles to achieve accurate detection and timing, providing an innovative solution for recording athletic performance.

Chapter 2

System Description

The optical gate timing system consists of three fundamental components:

- **Laser:** Emits a stable light beam that serves as a reference.
- **Photodetector:** Detects the interruption of the light beam when an object passes through.
- **Measurement Unit:** The signal from the photodetector is encoded and transmitted to a receiver, where the time interval is recorded and displayed.

Chapter 3

Operation

The operation of the system follows these steps:

1. The laser generates a continuous beam of light.
2. The photodetector, positioned along the beam's path, senses any interruption caused by a passing object.
3. Upon interruption, the photodetector sends a digital signal which is encoded and transmitted to the receiver, where the elapsed time is recorded and displayed.

Chapter 4

Implementation and Components

The implementation of the system involves:

- Transimpedance amplifier to convert the photocurrent into a voltage differential.
- Electronic circuits designed to uniquely encode the signal generated by the photodetector.
- A transmitter circuit for sending the encoded signal wirelessly to the receiver.
- A receiver unit that decodes the signal, measures the time interval, and displays the result.
- LEDs to check the correct alignment of photodetector and lasers.
- 3D-printed structures to ensure optimal alignment of components and to minimize the effects of ambient light.

Chapter 5

Conclusions

After a simulation and a prototype built on a solderless breadboard, I proceeded to design, order and test the device. The resulting error was under 0.001s and the cost of production under 10€ per gate