Proposal:

Application of IR-transmitter/receiver as an IR tripwire

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Abstract

An infrared tripwire is proposed as a novel and useful application for the transmitter and receiver modules of the Optical Uplink project. The importance of efficient and non-intrusive trip wire sensors for both defense and retail applications is outlined, in addition, the background theory for infrared sensors is described. Preliminary measured results of the Optical Uplink are provided as well as their ramifications on the tripwire sensor are discussed. Relevant qualifications of all team members is described and sufficient experience is with required technology is shown. Finally, a cost analysis for design and production of the proposed tripwire is performed.

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1 Introduction

This proposal is written in reply to a call for proposals for novel applications of the transmitter module of the Optical Uplink project. The overall block diagram of the Optical Uplink can be seen in Figure 1.

Figure 1: Block diagram for optical uplink

The Optical Uplink project was finalized with the implementation of an LED signal transmitter with a separate receiver/amplifier module. The entire device acts as a rudimentary wireless communication device capable of transmission over tens of meters.

An infrared sensor, widely known as a tripwire, is a popular device that has many applications, notably in both military and retail. In this proposal, the use of IR as trigger method for IR will be considered, and the importance of tripwire sensors in both defense and retail will be discussed.

2 Background

In both the defense and retail fields, tracking the movement of people or groups of people is paramount. Whether it is to protect the perimeter of military installation, or to monitor the foot traffic through a grocery store isle, understanding the flow of people through an area is fundamental way of understanding a system. Being able to effectively detect, monitor, and measure the number of people crossing and do so a non intrusive manner is of extreme importance to both the military and retailers.

Literature review of both craftpersons websites and scientific journals have aided in the development of this IR transmitter application. Journal articles [1] and [2] demonstrate the feasibility for the tripwire in defense applications. One application was for the protection of defensive perimeters, while the other was a novel approach, using IR sensors to detect anti-personnel mines. Both are vital in the modern climate of war on terror, where reconstruction and defense of destabilized countries is the current modus operandi. Journal [3] establishes a body of work using the tripwire as a sensor to measure foot traffic. The measuring of foot traffic in retail can not be understated. This provides retailers with way of developing metrics to determine total foot traffic through any given part of a store. This would allow retailers to determine sales per aisle per person and be able determine the most cost effective way of product throughput.

3 Proposed Work

The base level schematic or block diagram is shown below in Figure 2.

The optical uplink has the transmitter and receiver already constructed. The transmitter and receiver will transmit information to the microcontroller, which will count the amount of foot traffic in retail stores.

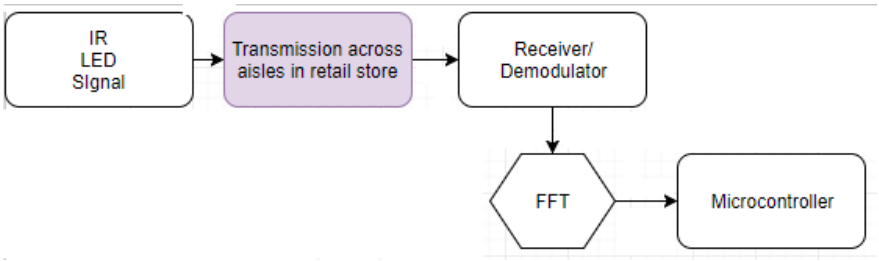

Figure 2: System level schematic of foot-traffic sensor

4 Preliminary Results

The previously constructed Optical Uplink transmitter modules is made up of CMOS astable multivibrator circuit which provides the driving signal for the LED. A schematic of the transmitter is shown below in Figure 3

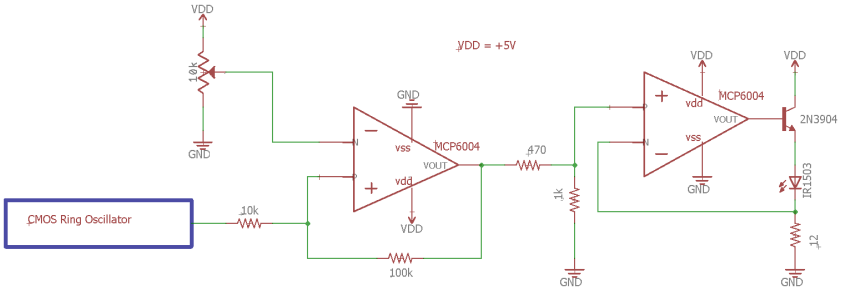

Figure 3: Circuit schematic of transmitter

The astable multivibrator is constructed on a signal CD4007 MOS DIP, which consists of three CMOS circuits. The waveform is then conditioned with a Schmitt trigger and then passed through a amplifier, both constructed on an MCP6004 quad-op-amp. This, in turn, drives an 2N3904 BJT, which controls the current through the IR1503 LED. The resulting current is seen in Figure 4.

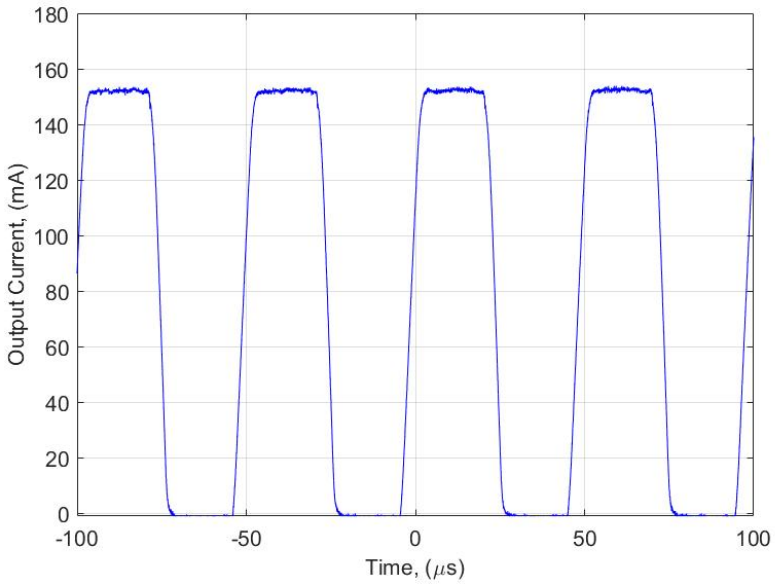

Figure 4: Current through LED

The maximum current was found to be 150mA, with a duty-cycle of 50%.

5 Team Qualifications

Ryan, Phil and Joseph have completed, at the time of this proposal, five semesters in the electical and computer engineering discipline. The most relevant skillsets for the purposes of this proposal is from the electronics course, ECE 342, which an optical uplink was simulated and designed by this team. This course focused primarily on microelecronic circuits and in-depth study of MOSFET's, BJT's and their implementation in circuits with operational amplifiers.

Ryan and Phil are double majoring in Computer and Electrical engineering at the University of Maine. Both have relevant skills from coursework in Microcomputer Architecture and Design, ECE 473, which implements Verilog in design of Microprocessors, which is of use when designing hardware for the tripwire. Joseph is an undergraduate majoring in electrical engineering at the University of Maine.

6 Cost Analysis

DISCUSSION GOES HERE

Table 4: Determining Selling Price	
NRE Costs	$6,552.00
Manufacturing Costs	$7,465.43
Sales/Marketing	$2,803.49
Profit Margin	52%
TOTAL SELLING PRICE	**$25,567.79**
PRICE PER CIRCUIT	**$25.57**

Figure 5

Figure 6

7 Conclusion

An infrared tripwire sensor was proposed as a novel and useful application for the transmitter module of the Optical Uplink project. The components and function of th IR tripwire sensor were described, including benefits. Preliminary measurements of the Optical Uplink transmitter/reciever were provided. A discussion was provided on the impact on tripwire functionality. Relevant qualifications of all team members were stated, and a cost analysis of the design and production of the device were performed

References

[1] Doug Richardson. (2002) "Sensors, Sentry Owls and smart dust: since the summer of 2002, Sentry Owls have been helping guard US units operating in overseas locations close to Afghanistan." Business Insights: Essentials.

[2] A. A. Faust, et Al. (2005) "Canadian teleoperated landmine detection systems." Avalable: Internation Journal of System Sciences.

[3] Vicaire, Pascal, et Al. (2009) "Acheiving Long-term Surveillance in VigilNet." Available: ACM Trans. Sen. Netw.