I.F.F. (Identification Friend or Foe) System

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1 Introduction

The purpose of this project is to create a system that quickly and accurately identifies friendly targets among military personnel on foot. Similar systems exist for aircraft, however not many exist for infantry.

The idea is to develop a two-way communication system so that when a soldier aims their weapon in the direction of a friendly target, they will receive notification through an LED that the target is, indeed, friendly and not an enemy. Throughout this document the infantry unit with the weapon will be referred to as the "friendly interrogator" and the target will be referred to as the "friendly target". In reality, many infantry units will have both an interrogator unit mounted to their gun, and a target unit mounted to their chest; the team has separated the hardware for these units to ensure that non-combatants can also be identified as friendly.

1.1 Objectives

1.1.1 Goals and Benefits

- Reduce the number of friendly fire & misfire accidents during combat [2].
- Notify friendly personnel location of particular friendly target when aiming in their direction.
- Other applications include, but are not limited to:
  - Paintball or Airsoft
  - Arcade laser tag and other recreation sports

1.1.2 Functions and Features

- Laser diode on friendly interrogator to transmit unique I.D. of friendly interrogator.
- Photodiodes on friendly target to detect unique I.D. and verify it is a valid signal.
- R.F. Transmitter on friendly target to send acknowledgement back to interrogator.
- R.F. Receiver on friendly interrogator to verify that the target is friendly.
- LED on friendly interrogator to indicate to the operator the status of the target.
- Quick response time (human reaction time is 190 ms[3]).

The friendly interrogator unit will consist of a 5mW red laser transmitter to send out a unique query to the friendly target, along with an R.F. receiver to detect any acknowledgment sent from the target. The friendly target consists of multiple photoreceivers to detect the friendly interrogator's query and an R.F. transmitter to send acknowledgment back to the interrogator. This is summarized in the system block diagram shown in Figure 1.

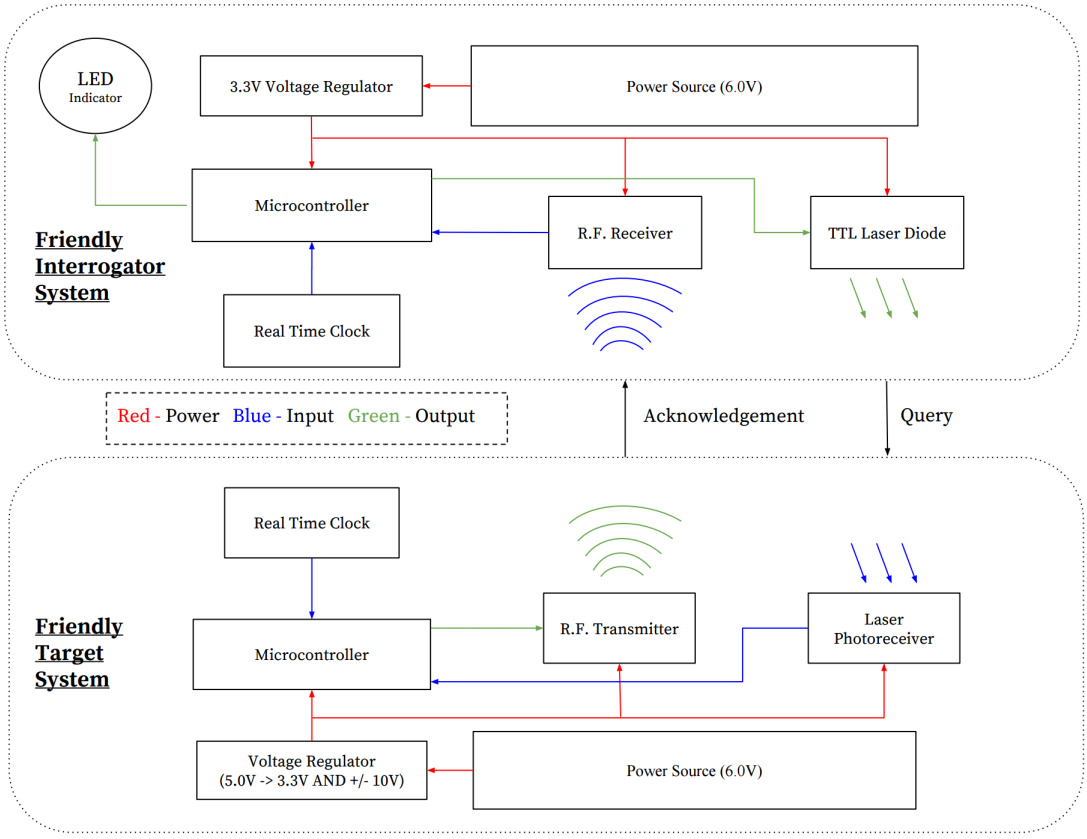

Figure 1: System Block Diagram

The two-way communication system on both units is further divided into two one-way communication channels. The laser transmitter on board the friendly interrogator will send a signal to the photoreceivers on the friendly target. The R.F. transmitter on board the friendly target will then send acknowledgement back to the friendly interrogator.

An important aspect of this project is encryption and ensuring an enemy cannot pose as friendly to the interrogator. This will be addressed in two ways. Both systems will contain a locally synced clock so that ...

1.2 System Level Requirements

Requirements are imposed on both the R.F. subsystem and the laser subsystem to accurately receive packets. From a system perspective, the requirements are as follows:

1. R.F. Transmitter/Receiver - Must be able to both transmit and receive at least 90% of 8-bit packets sent over a distance of 5 meters with a carrier frequency of 315 MHz 50 MHz.
2. Laser Transmitter/Receiver - At least 90% of transmitted laser packets must be received by the photoreciever at 5 m.

Requirements are also imposed on the system speed. These are

1. Speed of System - A friendly target at 5 m should be marked friendly within 190 milliseconds.

2 Design

2.0.1 Design Procedure

Laser Transmitter

Laser Photoreceiver

R.F. Transmitter

R.F. Receiver

Microcontroller FROM TEMPLATE: Discuss your design decisions for each block at the most general level: What alternative approaches tothe design are possible, which was chosen, and why is it desirable? Introduce the major design equations or other design tools used; show the general form of the circuits and describe their functions.

2.0.2 Design Details

FROM TEMPLATE: Present the detailed design, with diagrams and component values. Show how the design equations were applied. Give equations and diagrams with specific design values and data. Place large data tables in an appendix.Circuit diagrams that are too large to be readable on a single page should be broken into pieces for presentation.The full diagram may be included in an appendix.Use photographs only as necessary and treat them, along with all other graphics except tables, as figures.

3 Verification

FROM TEMPLATE: Discuss the Requirement and Verification Table from your design review. Including the table in an appendix will help avoid lengthy and tedious narrative description in the main text, which may not be of immediate interest to your imagined audience of managers. Do not discuss lowlevel requirements unless they failed to verify, or you found that they were critical in some unexpected way, or you need to makes changesfor instance, to the tolerances or acceptable ranges of quantitative results. It is important to hit the main points and explain any requirement that is not verified, but keep the discussion concise and refer interested readers to the appendix for details. Note that the design procedure, design details, and design verification can be organized in different ways. The Word template provided by the ECE 445 staff puts the first two in one chapter and the second in another; however, a separate chapter for each is also common, with chapter sections reiterating the main project components. If you do the latter, avoid unnecessary repetition of component descriptions. Another option, though rarely used, is to organize the report according to components or blocks, with each chapter describing the design procedure, details, and verification for a single component or block.

4 Costs

FROM TEMPLATE: Labor cost estimates should use the following formula for each partner: ideal salary (hourly rate) actual hours spent 2.5 include estimates for electronics and machine shop hours, as applicable. For parts, use real values when you know them; make realistic estimates otherwise. List both

the retail cost and what you or the department paid (in this case you may list labowned pieces as free).If the project might be commercially viable, estimate the cost of massproduction by listing bulkpurchase costs. Make sure any tables are numbered appropriately, given titles, and cited directly in the text.

5 Conclusion

FROM TEMPLATE: Bring together, concisely, the conclusions to be drawn. It may be appropriate, depending on the nature of the project, to begin or end with a twoor threesentence executive summary. The reader needs to be convinced that the design will work. Summarize your accomplishments. If uncertainties remain, they should be pointed out, and alternatives, such as modifying performance specifications, should be spelled out to deal with foreseeable outcomes. Usewords, not equations or diagrams. Devote a section to ethical considerations with reference to the IEEE Code of Ethics and any other applicable code (e.g., the AMA Code of Medical Ethics for certain bioengineering projects).

6 References

FROM TEMPLATE: Follow the IEEE reference styles provided in this document for various kinds of sources. If you need to cite something for which there is no example, simply use common sense and providein a neat and orderly manner emulating the IEEE reference stylethe information necessary for another researcher to find that source. References [1][3] are examples of a manual, datasheet, and web page, respectively. References [4][7] are more standard, scholarly sources: a book, chapter in an edited book, journal article, and conference proceedings. Reference [8] is a technical report, and reference [9] is class notes. Cite all references consecutively in the text, as is done here. (ECE Editorial Services provides a more detailed description of IEEE reference style on its wiki: http://go.illinois.edu/ecethesis .)

References

[1] Lieutenant Colonel Charles R. Shrader, *Amicicide: The Problem of Friendly Fire in Modern War*, 1982.

[2] W. B. Garrison, *Friendly Fire in the Civil War: More than 100 True Stories of Comrade Killing Comrade*. Rutledge Hill Press, 1999.

[3] G. T. Taoka, "Brake Reaction Times of Unalerted Drivers," *ITE Journal 59 (3): 1921*, March 1989.

Appendix