Student proposed?	**Y**	*Justin Wylie* *WYLJUS002*
Can this project as described below be completed outside a lab, i.e. done remotely?	**N**	*See adaptation/alternative Plan B below*

ID:	**SW-11**
SUPERVISOR:	**Simon Winberg**
TITLE:	**Laser Tag using Narrow Beam Infrared Radiation**
DESCRIPTION:	Laser tag is a sport much like paintball or airsoft however rather than physical projectiles digitally encoded pulses of light are fired from the tagger (gun) at targets worn by opponents. Players use the tagger to fire beams of IR light at opponents which are detected by targets worn on the body. This project constitutes the design of a tagger and target system. With the focus of the investigation on the documentation and development of a narrow beam (directional) IR radiation module (used in the tagger to 'fire' shots) as well as a direction insensitive IR radiation detector (for use in detecting a fired shot). The IR beam produced should contain encoded information uniquely identifying the shooter and this information should be retrieved by the target. Both the tagger and target systems should operate as independent systems. The target system should be extendable to monitor multiple targets using a single main board (although the creation of multiple targets is not required). The problem of designing a narrow beam of IR radiation is atypical as usually a wide beam is desirable for use in TV remote control or RC controllers. The design should be tested in harsh conditions such as outside under direct sunlight (a source of large amounts of IR radiation). It may be possible to use a low power IR laser (VCSEL technology), however care needs be taken to ensure the safety of such a device in the proposed use case. An appropriate encoding scheme for transmitting (shooter identification) data through the IR radiation is to be investigated. Various standards already exist for use in devices such as TV remotes. The target (receiver) design requires an investigation into the most appropriate means of capturing an incoming IR beam with a large 'radiation pattern' to register 'hits' from as many angles as possible. Analysis should be done on cost vs. performance to determine the differences between various IR photodiodes (used in the target) under different operating conditions. (For example, sensitivity to sunlight interference).

DELIVERABLES:	• Design(s) for a narrow band IR radiation module • Design(s) for an IR receiver module • Experimental results showing a performance comparison of different narrow band IR radiation module designs • Experimental results showing a performance comparison of different IR receiver module designs • Design and implementation of supporting circuity for the tagger and target modules • A detailed report (following the specified report guidelines) • A summary poster
SKILLS/REQUIREMENTS: Include any software requirements	Good programming skills, DSP, Embedded Systems Design
GA1: Problem solving: *Identify, formulate, analyse and solve complex* engineering problems creatively and innovatively*	*(Explain what needs to be done to meet the GA requirement)* The problem of a narrow beam IR transmitter is non-trivial and requires design considerations ranging from power, optics and safety of operation. Similarly, the design of the receiver and data encoding protocol involves careful investigation of current practices to determine a cost optimized system to meet the requirements. Specifications regarding the rest of the module's design (such as main processor and power requirements) are vague or absent and will require careful consideration by the student.
GA 4: Investigations, experiments and analysis:** *Demonstrate competence to design and conduct investigations and experiments.*	*(Explain what needs to be done to meet the GA requirement)* To successfully implement the laser tag system the student will need to combine knowledge from various disciplines such as the study of optics, embedded system design and DSP for encoding signals. Experiments will need to be performed to determine the appropriate component choices as well as module design to optimize for performance in terms of range, price, power and safety.
EXTRA INFORMATION:	https://en.wikipedia.org/wiki/Laser_tag
PLAN B	*How to get hardware to a student not on campus:* The items will be ordered and delivered to the student. While lab facilities will likely be of much benefit to this project, it is possible to make headward on the topic with adequate space as well as measuring tools and means to place boards, sensors and other equipment needed for experiments. *Adaption for reducing reliance on hardware:* While the IR components and appropriate embedded board are essential to this project, if necessary this project can be reworked to focus to a larger extent on the aspect of embedded software, in order to implement and trial protocols for, e.g., imparting the ID of the shooter to the receiving sensor and deciding efficient ways to keep track of the score and how to share this information with other players.
AREA:	Embedded Systems, Optics, Electronic Design
Project suitable for ME/ ECE/EE/ All programmes?	ME/ECE