NAIT

Edmonton, Alberta

**Proposal for CNT Capstone Project**

**LEGO Turret**

Submitted to

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CMPE2960

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As a requirement of the CNT capstone course, we are submitting this project proposal for consideration by the CNT department. After careful consideration and discussion with JD Silver, we have elected to design and implement a LEGO Automatic Turret that shoots LEGO balls, using a Raspberry Pi embedded controller, LEGO Mindstorms NXT 2.0, and a BrickPi module for the embedded controller.

With some early research, we have decided to connect a BrickPi module to a Raspberry Pi embedded controller, and connect the LEGO parts from the Mindstorms NXT 2.0 set to the module’s motor and sensor ports. This will provide to the Raspberry Pi the ability to control the LEGO motors and sensors in written software rather than using RobotC or LabView to control the parts. Along with the module connecting to the Raspberry Pi, we intend to connect a PIR sensor to the Raspberry Pi which will provide the Raspberry Pi the ability to sense movement at up to 20 feet away. When a target approaches to the turret, the turret will fire its projectiles to the target with the help of the PIR sensor. We intend to use a remote controller to control the turret from a far distance which provides easy controls to the user. We do plan to write the software in the Python programming language utilizing the BrickPi libraries.

**Elements of the project that will require research include:**

* Design a stable structure to hold the shooting mechanism and allow x and y axis movement.
* Learn how to create the appropriate software in the Python programming language.
* Develop the PIR sensor to be able to sense nearby targets in the Python programming language. Additional code will be required to have the structure to lock onto a moving target.
* Develop code to allow a remote controller to perform the turret’s simple movement and shooting.

Mitchell, Gareth, (2012). The Raspberry pi single‑board computer will revolutionise computer science teaching. Engineering & Technology. 7(3), pp.26

McWhorter, W.I., O'Connor B.C., (2009). Do LEGO® Mindstorms® motivate students in CS1?. ACM SIGSCE Bulletin. 41 (1), pp.438, 442

McNally, M., Goldweber, M., Fagin, B., Klassner, F., (2006). Do Lego MindStorms Robots have a Future in CS Education?. ACM SIGSCE Bulletin. 38 (1), pp.61-62

**Elements of the project that are currently available:**

* Raspberry Pi microcontroller and a Wi-Fi dongle.
* BrickPi module and a battery pack.
* Python libraries for the BrickPi.
* LEGO Mindstorms NXT 2.0.
* LEGO Digital Designer.

**Elements that need to be acquired in order to complete the project:**

* PIR sensor in order to detect movement.
* Bluetooth dongle to connect remote controllers.
* Extra LEGO parts if the Mindstorms set does not supply enough.
* A game controller to control the turret.

We would like to propose the following timeline to ensure that we complete the project in a timely manner.

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| Week | Activity |
| 1 – Jan 6, 2014 | Project selection and research, discussion with capstone course coordinator. |
| 2 – Jan 13, 2014 | Creation of this proposal. |
| 3 – Jan 20, 2014 | Order missing elements. Research Python language and required BrickPi libraries. |
| 4 – Jan 27, 2014 | Start design of the turret. Test ordered parts. |
| 5 – Feb 3, 2014 | Status Report #1 – progress to date.  Build turret to design specs. |
| 6 – Feb 10, 2014 | Start coding the movement and the shooting mechanism. |
| X – Feb 17, 2014 | Reading Week, no classes.  Continue with coding core pieces. |
| 7 – Feb 24, 2014 | Research PIR sensor and start to code automatic mode using the PIR sensor. |
| 8 – Mar 3, 2014 | Status Report #2 – progress to date.  Continue coding automatic mode. |
| 9– Mar 10, 2014 | Research remote controllers to use with Raspberry Pi |
| 10 – Mar 17, 2014 | Implement manual mode utilizing a remote controller. |
| 11 – Mar 24, 2014 | Final polish of design and code. |
| 12 – Mar 31, 2014 | Status Report #3 - progress to date. |
| 13 – April 7, 2014 | Physical project complete, completion of report and presentation. |
| 14 – April 14, 2014 | Project Presentation to CNT and the English department. |
| 15 – April 21, 2014 | Project report complete and handed in for grading at the start of the week. |

During the creation of this project we will learn more about Python, the Raspberry Pi, LEGO motors and using different methods to control the machine. The CNT program does not cover these topics and will help us branch our learning and knowledge.