**CNT Capstone Project**

**3-axis Self-Stabilizing Camera Mount**

**Ervin Hernandez & Gabriel Natividad**

As a requirement for CMPE2960, CNT Capstone, our team, composed of Gabriel Natividad, and Ervin Hernandez, are submitting this project proposal for consideration. After discussions and lectures with our capstone instructors, we have decided to design and build a “3-Axis Self-Stabilizing Camera Mount”, an idea suggested to us by one of our capstone instructors, AJ Armstrong.

We have done some preliminary research and have decided on a design for our camera mount. We plan to utilize the *I2C* bus to interconnect an LSM6DS3 Inertial Measuring Unit board (IMU), which will then move and control the stepper motors/servos that the mount uses. The IMU board accelerometers will provide the necessary data, such as sudden changes of acceleration in all 3 axes (x,y,z), as well as changes in angles. The Arduino microcontroller will then gather the data through the *I2C* bus, process it, and send the necessary voltages that will enable the motors to move. The stepper motors/servos rotate a total range of 180 degrees, with 90 degrees for each direction. The commands programmed in the Arduino Microcontroller will determine which direction along the x-axis the motors should move. All software will be written in C programming language.

Elements of the project that will require research include:

* Learn how to program the IMU board to acquire the 3 necessary values (pitch, yaw, and roll).
* Learn the physics that govern a gyroscope.
* Understand the structure and capabilities of the 3 stepper motors/servos.
* Create a circuit that can use the data from the microcontroller and independently move the 3 stepper motors/servos.
* Design a stable structure to house the 3 motors so they could independently move according to the coded instructions.
* A circuit that can acquire the *I2C* data from the IMU board and output it to the Arduino microcontroller.
* Learn the mathematical formula/algorithms to produce the 3 values that will direct the 3 motors.

Elements of the project that are currently available:

* Arduino microcontroller, power supply.
* Arduino libraries for the IMU board.
* Servos C libraries.
* Materials for building the frame.

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

* IMU board and drivers for interfacing to the Arduino microcontroller
* 3 Stepper motor and H-bridge to driver the motor. Servos and servos drivers.

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| **Weeks** | **Activity** |
| 1 - January 6, 2016 | Project selection and research, discussion with capstone course coordinator. |
| 2 - January 11, 2016 | Creation of this proposal.  Researching necessary components to build capstone project.  Planning the general structure of the prototype. |
| 3 - January 18, 2016 | Researching and understanding how to drive the stepper motors/servos with Arduino microcontroller.  **Proposal Due Date (Jan. 21)** |
| 4 - January 25, 2016 | Developing test code for Inertial Measuring Unit Board (IMU). |
| 5 - February 1, 2016 | Developing the code to make the IMU board communicate and send data to the Arduino Microcontroller. |
| 6 - February 8, 2016 | **1st Progress Report Due (Feb 11)**  Continue developing code for the IMU board. |
| **Reading Week** - February 15, 2016 | *No classes.* |
| 7 - February 22, 2016 | Start building the frames that support the stepper motors. Begin prototype assembly. |
| 8 - February 29, 2016 | Wire together the necessary components to power or control the motors. |
| 9 - March 7, 2016 | Continue hardware assembly. |
| 10 - March 14, 2016 | **2nd Progress Report Due (Mar 17)**  Begin testing prototype. |
| 11 - March 21, 2016 | Debug test code - add necessary components or modify existing ones.  Final features check. |
| 12 - March 28, 2016 | Continue testing and optimizing. |
| 13 - April 4, 2016 | **TBS Report Due (April 7)**  Make final adjustments to project.  Start planning the presentation. |
| 14 - April 11, 2016 | **Technical Report Due (April 14)** |
| 15 - April 18, 2016 - **Deadline** | **Final Presentations (April 22)** |

During the creation of this project we hope to learn more about the IMU system and interfacing a component to the Arduino microcontroller while also connecting several motors. These topics are not covered in the CNT program and will demonstrate that we are ready to extend our knowledge beyond that provided by the CNT program.