

Dancing FlagBots

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The Flag Bots:

Eva Goetz started exploring the theme of robots in her artwork several years ago. This exploration led to her Think A Bot It installation in December 2019 of robots of different shapes and sizes, several with moving arms and lighted digital messaging using communication methods of bygone eras. The installation provided a space for discussion and wonder and was also meant as a platform to discuss deep questions on technology and its impact on society. Of particular interest are her large ‘Flag Bots’ that move their arms in Semaphore language, signaling visitors to HELP, STOP, LISTEN and THINK. While from afar these are beautiful moving sculptures, at closer inspection they are robots with hardware and software and mechanical and electronic components that require sophisticated design and coordination. This project will allow students to elaborate, enhance, and extend the two Flag Bot robots with new software features. Ideally, this project would be a permanent art installation at Mines that students could add to in future years. The robot artwork has been donated to Mines by the artist, who has given permission for students to modify existing software to implement these new features.

Project Summary:

The goal of this project is to modify the software within the Flag Bots so that they are no longer sending a pre-programmed semaphore message back and forth to each other, but instead are move together in new ways, essentially dancing for and with humans around them. Inspiration for this project may be taken from demonstrations of the Spot robots from Boston Dynamics dancing to music and engaging humans to dance with them. Work on this project will require learning different software communication protocols, controlling stepper motors, RF sensor control, and potentially human motion tracking.

<https://www.theverge.com/2021/6/29/22555535/bts-k-pop-boston-dynamics-spot-robot-dancing-hyundai>
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Figure 1: The Flag Bot (left) and the dancing Spot robot (right) taken

Students will focus their efforts on 3-4 specific objectives:

- Understanding the current software used to run the semaphore routine with the two Flag Bots.
- Replacing the existing software with a “dance” routine in software that controls the arm movements of the two Flag Bots
- Integrating music into the Flag Bot routine.
- (as time permits) Extending the capabilities of the Flag Bots to track human motion and respond with appropriate arm movements.

The students will be involved in every phase of the project from design through implementation. During the design phase the students will interact with Prof. Bahar (and occasionally the robot artist, Eva Goetz) to better understand the current operation of the robots and their hardware and software components. The students are also

expected to research other works with dancing robots and come up with their own routine.

Desired Skills for Students:

- C++, Java, Python
- Embedded system design
- Prior experience with robot motor control
- Prior experience with motion tracking software (optional)

We understand not all the students in the group might have the desired technical skills. However, each student may bring unique skills to contribute to the project. All students are expected to work together to design, debug, and problem solve. Students pursuing the CS+computer engineering or CS+robotics tracks may find this project especially complements their coursework.

Preferred Team Size: 4 students

Given the scope of this project a group of 4 students is preferred but 3 students could also excel given they are willing to problem solve and learn.

Location Where Work Would Be Performed:

The Flag Bots will be house in the Labriola Innovation Hub over the summer. While some software development can be completed offsite, students are expected to spend significant time in Labriola working directly on the Flag Bots.