Project Proposal

Project Team ID: 6

Project Title: Real Autobots and Decepticons: Programming a Self-Configuring Robot

Team Members

Member	Name	Email / Phone
Team leader	Carter Chase	chascw01@students.ipfw.edu
Member 1	Ben Smith	smitbd05@students.ipfw.edu
Member 2	Jeffery Ross	rossjj02@students.ipfw.edu
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Member 4		

Project Advisor

Name / Title	Dr. John Licato
Office	ET 125N
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Project Sponsor (Optional)

Contact person	Dr. John Licato
Contact info	licatoj@ipfw.edu
Company name	Analogical Constructivism and Reasoning Lab (ACoRL)
Address	

Project Description

Type	☐ Application ☐ Information systems ☑ Research-focused
Abstract	A senior project group in Electrical + Computer Engineering (ECE) has been creating a robot array consisting of several modular units that can reconfigure themselves into a wide variety of possible arrangements [1]. Ideally, the robots would be able to form (for example): a bridge, stairs, a wall, etc [2]. Additionally, the engineers have produced a robotic arm capable of lifting and moving the robots. All robots will communicate with each other using a well-

	known protocol such as WIFI or Bluetooth. The artificial intelligence still needs to be programmed. Choosing a possible shape to transform into is relatively easy, but actually designing a step-by-step plan so that the robot modules can move into place without any human assistance, is a more difficult AI problem. Every robot will communicate with a central server that handles the transformation algorithms. This server will receive all sensor data, compute actions, and send instructions to the modular bots. The team will be responsible for creating both the high level algorithms and the API for robot-server communication. Unfortunately, the CS senior design team will not have access to the final robots until midway through the project. To aid in development in the meantime, they will have access to the Webots 3D simulator. The team will first develop transformations for the simulation platform and then, once the robots are complete, they will implement the algorithms on the actual modular bots. The team will need to design the central server's API to be versatile enough to communicate with both the virtual robots and the real robots. In addition to working with Dr. Licato, the CS senior design team will work with the ECE senior design groups in a first-ever collaboration between departments here at IPFW. Progress made in this project will be used as a launching point for at least one external funding proposal to be written by Dr. Licato, in collaboration with other ETCS Faculty (Drs. PomalzaARaez (ECE), Liu (ECE), and Bi (ME)). The robotics projects and code completed by the CS and ECE senior project teams will be used in future robotics courses here at IPFW.

Requirements	• Basic movement control of the physical robots
	  o Send basic movement commands to the modular robots
	  o Send basic movement commands to the robotic arm
	• Virtual model of the modular robots in Webots
	  o Simulate identical virtual hardware of the real modular robots
	  o Report valid sensor data
	  o Listen for commands from an external API
	• Python control application for controlling both virtual and physical robots
	  o Create the Bluetooth API for the physical robots
	  o Create the HTTP API for the virtual robots

	○ Receive and interpret data from robot sensors • Python algorithms for arranging robots in 2-3 formations ○ Communicate with the robots through the control application ○ Receive sensor data from the control application
Optional features	• Add more advanced commands to the robot's internals library • Additional, more complicated, formation algorithms will be designed as time permits
Required resources	• Several Bluno Nano Arduino Microcontrollers matching the specifications used in the modular robots. • Several Bluetooth Low Energy receivers • Access to the Webots simulator
Required backgrounds	• Python, C (or willingness to learn) • Understanding of AI planning algorithms
References	[1] http://modlabupenn.org/smores/ [2] https://www.youtube.com/watch?v=dRA4sD_3xu0

As a member of Project Team 1, I agree to attend project meetings regularly, participate in developing project actively, and make a full effort to complete this project as proposed.

Team Leader	9/6/16 Date
Team Member 1	9/6/16 Date
Team Member 2	9/6/16 Date
Team Member 3	9/6/16 Date
Team Member 4	Date

As the Project Advisor, I agree to meet regularly with the student project team, manage their activities, and participate in the evaluation of project deliverables.

Project Advisor	9/6/16 Date

As the Project Sponsor, I agree to communicate with the student project team as needed to provide information related to project scope, requirements, assumptions, constraints or other items that may impact project success, and to participate in the evaluation of project deliverables.

Project Sponsor	9/6/16 Date