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| **NASA Exploration System Mission Directorate Higher Education Project** |
| F:\logos.jpg |
| Project Funding Proposal |
| Lunar Regolith Excavator Student CompetitionTeam #19 |
|  |
| **FAMU-FSU College of Engineering** |
| 2525 Pottsdamer StreetTallahassee, Florida 32310 |

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**Executive Summary**

In May 2011, the National Aeronautics and Space Administration (NASA) will be hosting its second annual Lunabotics Mining Competition. The goal of an entry into the competition is to design a robot that will result in innovative ideas and solutions that could shape the future of lunar and extra-planetary missions performed by NASA. The project team consists of undergraduate and graduate students from Florida A & M University and Florida State University majoring in Electrical, Computer and Mechanical Engineering. The team’s mission is to design and build a robot that can excavate 10 kilograms (kg) of regolith (lunar soil) and transfer it to a container within 15 minutes. The robot will be competing in a box containing eight tons of simulated regolith. The innovative design of our lunar excavator will be based on a hexapedal walking platform. Along with the fabrication of a lunar mining robot, the team will perform community outreach for K-12 grade students in the areas of Science, Technology, Engineering, and Math (STEM) at both schools and community events. The total amount of funds raised to date is $4,000. The current projected budget is $16,610. Any denomination or material(s) donated will go directly towards the construction of the robot and community outreach.

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# Introduction

This year, the Florida A & M University-Florida State University College of Engineering is continuing its interdisciplinary collaboration between the Electrical/Computer Engineering and the Mechanical Engineering Departments for their Senior Design Projects. The goal of the project is to expose senior students to the concepts of design, project management, engineering team organization, and professionalism. Five undergraduate students from both universities have been selected to participate in this project, as well as five graduate students for advising and construction assistance. The requirements of the Lunar Regolith Excavator Student Competition are as follows: design a robot capable of excavating 10 kg of regolith in 15 minutes while weighing less than 80 kg.

The team is tasked with creating a robot capable of meeting and exceeding all requirements set forth by NASA for the competition. As the students are designing, constructing, synthesizing and analyzing their robot, they will perform community outreach for K-12 grade students in the areas of Science, Technology, Engineering, and Math (STEM).

# Procedure & Scope of Work

The design team will be applying the systems engineering approach to the development of the robotic platform. The approach of incorporating a multidisciplinary engineering team is the first step toward successful systems engineering. Subsystems of the project have been identified as Excavation Subsystems, Locomotion Subsystems, Power Subsystems, Micro-Controller & Communications Subsystems, and Control Subsystems. These subsystems cover the required functions of the platform and all solutions will be integrated into a single functional body.

This project is included as a Senior Design Capstone Project and as such follows a rigorous schedule of deliverables and presentations. The design team is following typical systems engineering procedures for the concept generation, selection, prototyping, manufacturing and testing. The schedule of the class provides a timetable for each portion of the design process to be completed.

The team will not only apply the systems engineering approach to the design and fabrication of the Lunar Excavator, but will also consider the life cycle of the platform. These considerations include verifying that the excavator performs the specified functions in the intended, designed manner, as well as review the operational controls and autonomous functions. The team will also ensure the robotic platforms’ interchangeability during design by using standard electrical fittings and circuit boards, reducing the amount of custom-made parts, and allowing for easier adaptability and repair of the robot. As required, the design team will document and report all design procedures, fabrication, and operations of the excavator via photographs, video, papers, and operations manuals.

# Goals and Deliverables

The main objective of this project is to compete and win in the Lunabotics Mining Competition hosted by NASA on May 27-28, 2011. The project views this competition as not only an opportunity for prestige among its members, but also an opportunity to bring pride to our universities and sponsors, aid in space research and serve as a means of outreach to the public. Similar to the objectives of the NASA sponsored competition itself, the project is highly motivated in educating the public through outreach on space exploration and the importance of science and education in America. Educational outreach programs will include demonstrations at the Challenger Learning Center, presentations at the Mary Brogan Museum, interactive activities at local schools, and working with engineering student organizations to develop lasting outreach activities.

In order for this objective and vision to become a reality, several goals must be accomplished, these goals are as follows:

* Construct a solid, reliable, automated excavator by May 23, 2011 to compete in competition
* Write a concise, comprehensive paper on the systems engineering based design by April 18, 2011
* Compose a slide presentation outlining the methodology behind the project by April 18, 2011
* Perform various community outreach activities to excite and educate the public on the importance of science and education
* Submit a report detailing the team’s community outreach by April 18, 2011
* Create and submit a video documenting the process and creation of the excavator by May 23, 2011
* Actively update our website detailing the team’s vision and progress

# Timetable

|  |  |  |
| --- | --- | --- |
|  | Description of Work | Start and End Dates |
| Phase One | Needs Assessment Report/ Project Scope Report | 01 Sep 2010 – 15 Sep 2010 |
| Phase Two | Product SpecificationProject Procedures/Product Plan (schedule) | 15 Sep 2010– 29 Sep 2010 |
| Phase Three | Concept Generation and Selection  | 29 Sep 2010 – 13 Oct 2010 |
| Phase Four | Interim Design Review | 13 Oct 2010 – 03 Nov 2010 |
| Phase Five | Final Design Review* Final Design Package
* Spring Proposal
 | 03 Nov 2010 – 01 Dec 2010 |
| Phase Six | Ordering Parts | 01 Dec 2010 –15 Feb 2011 |
| Phase Seven | Construction of Robot | 16 Jan 2011 – 28 Feb 2011 |
| Phase Eight | Final Testing and Debugging | 01 Mar 2011 – 23 May 2011 |
| Phase Nine | NASA Reports* Collaboration Notification
* Competition Registration
* System Engineering Paper
* Outreach Report
 | 01 Sep 2010 – 18 Apr 2011 |
| Ongoing | Community Outreach* Lego mind storm
* Math is Fun (K-5)
* Zoom (6-8)
* Engineering Interact (9 -12)
 | 01 Nov 2010 – 15 Apr 2011  |

# Budget

|  |  |  |  |
| --- | --- | --- | --- |
| **Category** | **Description** | **Cost per Item** | **Total** |
| Motors | * (6) Drive Motors with encoders
* (6) Gearing box
* Linear Actuator
* (2) Auxiliary Motors
 | $100.00$400.00$150.00$200.00 | **$3,550.00** |
| Excavation | * Sprockets
* Roller Chain
 | $100.00$50.00 | **$150.00** |
| Batteries | * (6) 48V 800W Battery
 | $400.00 | **$2,400.00** |
| Electronics | * Microcontroller
* Gyroscopes
* Pressure Sensor
* WiFly Communication link
* (6) Motor Controllers
* (2) Network Webcams
* Misc: Wiring, Fuses, etc…
 | $425.00$50.00$50.00$50.00$700.00$130.00$125.00 | **$5,160.00** |
| Raw Materials | * Aluminum Stock
* 12K Carbon Fiber
* Mechanical Fasteners
 | $725.00$250.00$75.00 | **$1,050.00** |
| Travel | (2) Vehicles x 5 days Fuel for 600 miles* (4) Rooms x 5 days
 | $700.00$200.00$1600.00 | **$2,500.00** |
| Outreach | * Props and travel
 | $800.00 | **$800.00** |
| Repair | * Broken Parts, Replacement Electronics
 | $1100.00 | **$1,100.00** |
| **Total** |  |  | **$16,610.00** |

# Key Personnel

**Contact Information**

**Undergraduate Team Members**

Mechanical

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**Graduate Team Members**

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 Chris Kulinka cmk04d@fsu.edu

Electrical

 Nick Stroupe nps06c@fsu.edu

# Sponsorship

The project is looking for monetary and material sponsorship. All donations will be used for the completion of the robot, repairs associated with the competition and/or travel costs associated with the project. There are several benefits associated with being a sponsor. Sponsors will have their company logos featured on the robot itself. This robot will be competing in the televised NASA competition. In addition, the robot will be part of outreach programs with local students. All sponsors will also be credited in all presentations and reports. Any interested sponsor may request a copy of any deliverable the team submits. Donations of any amount or size will be gladly accepted.

For more information about sponsorship opportunities please contact:

Duncan Haldane

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**Current Sponsors**

**National Space Grant Consortium**

Monetary sponsorship

**Florida A&M University /Florida State University College of Engineering**

Research facilities

**Scansorial and Terrestrial Robotics and Integrated Design Lab**

Workspace, Tools

# Appendix

For more information on the second annual NASA Lunabotics Mining Competition, please visit the competition website at:

<http://www.nasa.gov/lunabotics>

For more information on the Mechanical Engineering Department’s Senior Capstone Project, please visit the course website at:

<http://eng.fsu.edu/me/senior_design/>

For more information on the Scansorial and Terrestrial Robotics and Integrated Design Lab, please visit the lab website at:

<http://www.eng.fsu.edu/stride>