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# MOTIVATING STEM STUDIES THROUGH A SPACE EXPLORATION ROBOTICS SUMMER CAMP

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## ABSTRACT

In order to motivate the pursuit of and interest in a STEM curriculum for 12-17 year olds, an interactive space exploration robotics camp was developed by the Robotics and Spatial Systems Laboratory at the Florida Institute of Technology. The camp incorporated hands-on activities to explain robots and their practical uses. Problem solving with the versatile robot became the underlying theme of the camp under the guise of a space mission to Jupiter's moon, Europa. Team building exercises were designed and executed during the camp to teach about engineering and problem solving. Through teamwork, discussions, patience, and dexterity the two teams of the camp successfully completed the simulated mission to save the fictitious base on Europa. The summer camp curriculum was original work developed by RASSL to provide young people with an introduction to robotics. This paper discusses the robot kit development, the activities created for the week, the group competitions, the insight learned by RASSL, and the participant feedback about the camp. This work may be used as a template for creating a small scale robotics camp hosted by a university or high school robotics lab or club.

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## INTRODUCTION

The Robotics and Spatial Systems Laboratory (RASSL) at the Florida Institute of Technology hosted a 2015 summer camp for junior high and high school students. The purpose of the camp was to motivate interest in STEM among young people by hosting a hands-on experience with a 6 degree of freedom robot arm in an interactive and stimulating environment, i.e. a space adventure on Europa, Jupiter. The group mission allowed the students to collaborate for a cause: to complete the mission objective. This collaboration effort was shown to be an alternative and important form of learning in camps by Ayar, et al. [1]. An interactive camp environment was shown to increase learning in technology and engineering subjects compared to a classroom environment according to Nugent, et al. [2]. The students took home from the camp both robot skills and the robot itself to continue experimenting with after the camp was over. The purpose of this paper was to explain the events of the RASSL camp, what we learned, and how a lab in the future might host a robotics camp to promote STEM interest successfully.

The camp was held June 15th-19th, 2015 on the campus of Florida Tech. The theme of the camp was Europa: A Space Adventure. The camp theme was built around a robotics mission to save colonists on Jupiter's moon, Europa. The adventure theme tied a purpose to programming the robots; the rescue mission required specific goals and learned skills in order for the mission and group effort to be successful.

 

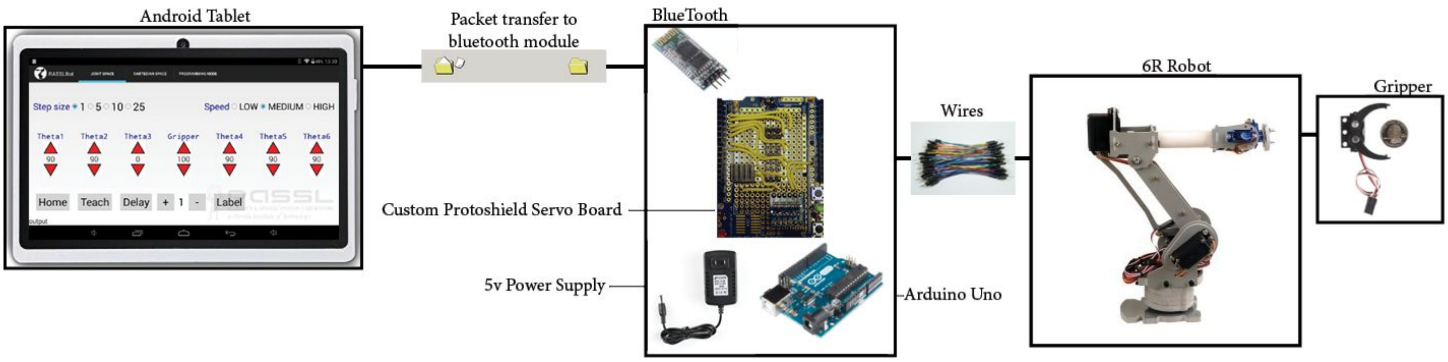


**FIGURE 1**. BLOCK DIAGRAM OF THE ROBOT KIT.

## PREPARATION

The preparation for the camp began with research and discussion about our camp goals. A specific list of items were chosen that were then combined to construct the robot kit. The goal of the camp kit was to provide the campers with a controllable 6 degree of freedom robot that could manipulate its environment. An android tablet was chosen to be used as a controller via bluetooth to the robot. The robot was purchased and tested to ensure it was a viable and durable choice before the camp supply was ordered. The robot servos were controlled by an Arduino Uno [3] microcontroller. The wiring and soldering of a custom servo control board was necessary in order to connect the robot servos to the Arduino. The details of this setup are discussed in the sections that follow.

### Robot Kit

Refer to Fig. 1 for the robot kit items described below.

**Android Tablet & RASSLBot App:** The tablet with the RASSLBot app loaded is shown in Figure 1. Any android device can run the RASSLBot app to control the robot. More details on the app are contained in the Android App Development section. A wide variety of tablets and phones are capable of using the app to control the robot.

**Bluetooth Serial Module:** The bluetooth module was used to receive commands from the bluetooth function on the tablet. Using serial communication, a coordinate code is sent through the bluetooth connection to the Arduino which then transfers the command into the servo movement corresponding to the sent coordinate code.

**Protoshield:** This shield was used to solder together the required parts to connect the servo motors, power button, and bluetooth connection to the Arduino board. Fig. 1 shows the soldered prototyping shield which was purchased from Adafruit. [4].

**Tools:** Each camper was provided with a hex key tool and a screw driver tool, both of which had a variety of tool sizes built in. They were the only two tools required for complete assembly.

**Arduino Uno and Power Supply:** The Arduino Uno was the microcontroller programmed to control the robotic arm, purchased through Sparkfun [6]. It was chosen for its versatility and ease of programming. The 5v power supply was used to power the Arduino as well as the servos on the robot.

**Robot Arm and Gripper:** The robot arm features 6 degrees of rotational freedom, 7 with the gripper motion included. It was purchased through Sainsmart [5]. The gripper was attached with the help of a 3D printed part custom designed and printed by RASSL.

### Arduino Robot Control Program & Android App Development

The RASSL designed and programmed RASSLBot app controlled each joint angle on the robot using forward kinematics. As a state change button was pressed on the touchscreen shown in Fig 1, the app sent a packet containing the data of the new location command to the bluetooth module, which was then passed through to the Arduino. The Arduino code opened the packet and broke down the contents matching the content of the packet to the movement angle and increment of the correct joint, thus moving the robot arm to the state shown on the RASSLBot app display.

This constant stream of data was suited for the address specific protocol of bluetooth. The address for the bluetooth module was documented for each student and programmed into their RASSLBot app specifically in order for the connection protocols to be established. Hard-coded addresses prevented accidental mixed connections or deliberate hacking to occur during the camp.

### Documentation

A custom written and designed 15 page document was the step by step guide on how to assemble the robot kit with pictures and descriptions. A visual guide of the assembly gave the campers an idea of how the construction was accomplished. A

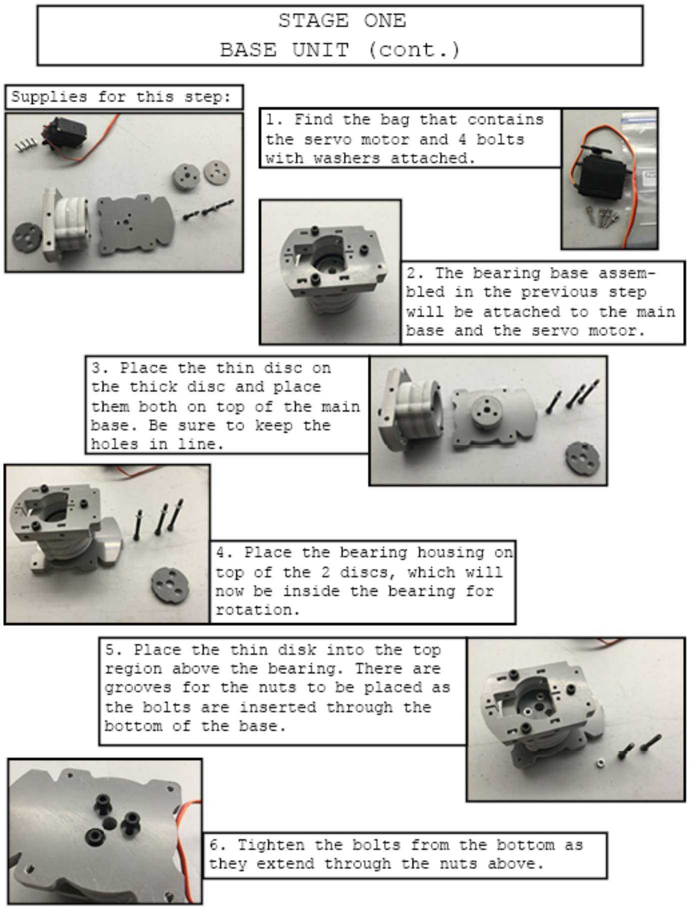


**FIGURE 2**. EXCERPT FROM THE GUIDE DOCUMENTATION.

sample of the guide can be seen in Fig. 2. Some campers followed the guide and were successful by themselves while others required more assistance from the leaders and other campers.

## CAMP WEEK ACTIVITIES

The 1st RASSL Space Robotics Summer Camp began on June 15th, 2015 at 9:00am with 9 enrolled students. A scheduled agenda was created to give structure and guidance during camp hours as shown in Fig. 3. Each day contained four distinct areas of focus with a break separating the different activities. The four areas of focus:

1. Aspects of Robotics
2. Robotics Work
3. Robot Demonstrations
4. Team building and Competitions

The four areas of focus were spread across each day, thus breaking up the areas of study and creating a dynamic learning environment. Each day contained at least one of the four areas of focus.

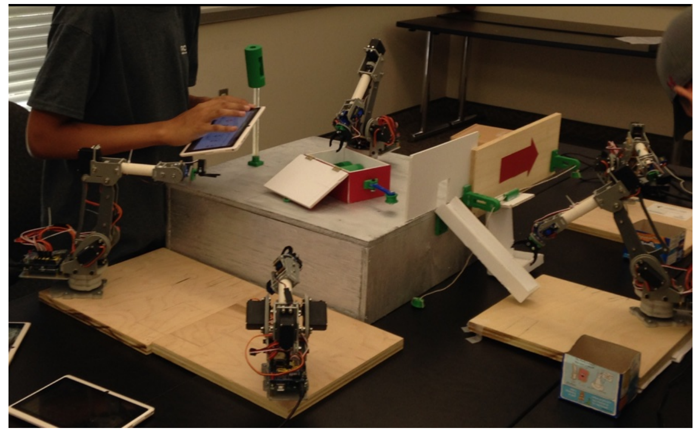

**FIGURE 4**. GAMMA-ONE MISSION

### 1. Aspects of Robotics

**History of Robotics** The team leaders gave a talk about the history of robotics: the development and rise of the machines. This 45 minute power point presentation was an interactive lecture about the history of robotics which started from the beginning with Isaac Asimov and his 3 rules of robotics and moved through to Boston Dynamics' "BigDog" mule robot. The campers were asked questions which started discussions among the moderate sized group of 9 campers.

**Robotic Arm Assembly: Introduction** The RASSL designed documentation, see excerpt in Fig. 2, was distributed to the campers. They read through the manual, saw a demo of an already completed robot, and followed the guidance of the RASSL leaders to begin the construction of Europa's Resolve, the 6R robot.

**Introduction to Arduino** The campers had already assembled their robot and completed some basic tasks with the robotic system before the Arduino platform was formally introduced. After having a hands-on experience with the ardiuno, the capabilities of a microcontroller became more apparent for the campers. The campers asked specific questions about projects with the Arduino and how it could be used to control specific robots that differ from the 6R camp robot.

**Project: Mission Briefing** The mission to save Europa was reintroduced to the campers with a problem statement, an interactive environment, and a team objective. The RASSL designed and built the workspace shown in Fig. 4 was brought out for the teams to begin their mission. The teams used two robots to grab an over-sized package that one robot could not lift alone. The package contained an antidote that was passed to central ventilation centers in order to distribute an antidote to heal the sick Europa Colony. A distributing robot opened the package and distributed the antidote to ventilation release points and to

| Time | Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|---|
| 9.00 – 9.45 | Registration & Ice Breaking | Robotic Arm Assembly: Introduction | Robot Control: Software introduction | Intro to Arduino Programming | Project: Mission Briefing |
| 9.45 – 10.00 | Break | Break | Break | Break | Break |
| 10.00 – 10.45 | Introduction and History of Robotics | Robotic Arm Assembly: Hardware | Robot Control: Interfacing hardware and software | Toy soldier robotic manipulation | Project: Team Mission |
| 10.45 – 11.45 | Outdoor Robot Activity | Robotic Arm Assembly: Hardware | Robot Control: Interfacing hardware and software | Sword Fight Competition | Project: Team Mission |
| 11.45 – 12.45 | Lunch | Lunch | Lunch | Lunch | Lunch |
| 12.45 – 1.45 | Demo: Motoman/ Roomba | Demo: Motoman/ Roomba | Demo: PantherBot / MotoSim | Demo: PantherBot/ MotoSim | Project: Team Mission |
| 1.45 – 2.00 | Break | Break | Break | Break | Break |
| 2.00 – 3.00 | Robotic Arm Intro | Robotic Arm Assembly: Electronics | Robot competition | Tower builder | Project Showcase |
| 3.00 – 3.45 | Snack Tour | Snack Tour | Snack Tour | Snack Tour | Project Showcase |
| 3:45 – 5.00 | Gripper Assembly | Robotic Arm Assembly: Electronics | Free play robot competition | Pass the baton team competition | Closing Certificate, Badge, Picture |

**FIGURE 3**. CAMP AGENDA.

other robots. The next robot placed the antidote in a ventilation duct and placed one onto a gondola. The final robot pulled a wire that brought the gondola with the antidote closer to the pulling robot.

The Gamma-One team accomplished the pick and place mission objective once the final antidote was loaded onto the last ventilation distributor. Two mission fields were built allowing for a team of 5 and a team of 4 (with an extra robot added to the team of 4). The teams were alloted time to devise strategies of how to best complete the mission in the minimal amount of time.

## 2. Robotics Work

**Outdoor Robot Activity** The outdoor activity was a chalk drawn grid maze that teams of two worked together to mimic the command and execution aspect of a robot. The activity was held on the first day which helped build trust and comradery between the new campers. Beyond the social gains of the activity, the campers executed a basic aspect of robotic control. The "robot" person was blind folded while the "controller" person gave verbal commands for the robot to follow. Every team was on the grid at the same time so the campers experienced the "noise" that a robot experiences in diverse environments. By connecting a real example of a robot controller to physical action we established a reference point to explain how the controller for the robot functioned. This experience was referred back to on multiple occasions to the campers during the robot assembly and programming and helped them understand the important concepts behind the controller and the robot.

**Robotic Arm: Introduction** The campers received their robot kits and were introduced to each part in the kit one by one. The tools, tablet, parts, and main pieces were introduced and described. Referring to the documentation in show in Fig. 2, the campers had everything they needed to assemble their robot.

**Gripper Assembly** The gripper assembly was the first component to be pieced together by the campers, see Fig. 1. The seemingly simple process of gripper assembly became a good example of how even the smallest of components can be complicated. The campers assembled the gripper using their tools and the reference guide. For the first assembled part, it gave the campers the opportunity to build up technical skills while they worked together to accomplish a common goal.

**Robotic Arm Assembly: Hardware** Half of the second day was spent constructing the mechanical aspect of the robot. The campers worked together, asked for help, and followed the documentation guide to complete each section of the robot. The RASSL leaders used a step-by-step introduction approach for each aspect of the assembly which the campers followed along with in kind. The final step of the mechanical construction was attaching the robot to a workspace and support base. Before lunch on the second day, every camper had completed the mechanical assembly of the robot.

**Robotic Arm Assembly: Electronics** The custom protoshield, the Arduino, and the wiring were installed onto the robot. The hardware connection aspect of the electronics was a technical skill that the campers practiced and improved. First, the Arduino board was screwed down onto the electronics platform connected to the robot. The protoshield was then added by being push connected onto the Arduino board. The wires from the servos on the robot were connected to the protoshield. The bluetooth module was inserted into the connection port on the protoshield. By connecting the power supply to the Arduino, the campers had a fully operational robot.

**Robot Control: Software Introduction** The RASSLbot app was preinstalled on the camper's tablets. They accessed the app and were able to connect via bluetooth to the robot to start moving the robot. The app and its features were introduced through a powerpoint presentation and a comprehensive app walk-through tutorial. The main control screen on the robot app is shown in Fig 1.

The app allowed for direct forward kinematic control and the ability to teach the robot to repeat a task. When the teach command is used, the app saves the joint position locations in a command line and into a text file. This file can be accessed, named, edited and saved by the user. The campers practiced using the teach command to get the robot to perform many pick and place tasks which was the basis for most of the projects.

## 3. Robot Demonstrations

**Demonstration: Motoman 6R Industrial Robot and Roomba Programmable Mobile Robot** RASSL has had an industrial 6R robot in its lab for 15 years. The Motoman [7] series robot shown in Fig. 5 has been featured in multiple research projects by RASSL members. The camp's robot has the same degrees of freedom as this industrial grade robot; a demonstration of the Motoman teach feature was shown in order to give a direct relationship between the two. By seeing the industrial version of their hobby robot, the campers saw the connection of science fiction robotics to practical industrial use.

The Roomba [8] demonstration involved a custom control program developed in python used to command the movement


**FIGURE 5**. THE RASSL MOTOMAN ROBOT WITH AN ATTACHED GRIPPER.

of the Roomba mobile robot. The Roomba mobile robot shown in Fig. 6 moves by controlling two wheels at specified rates, i.e., both move at the same rate to go straight, the right faster to go left, and the left faster to go right. The campers controlled the robot by entering defined directions into a command prompt on a laptop. They entered commands for the mobile robot to follow a predefined path and were able to see the reaction of the robot to both the commands and the environment. Linking back to the outdoor robot activity, the connection between commands and actions was shown in a physical mobile robot example.

The camp was split into two groups to experience the demonstrations in order to give each camper the opportunity to control the robot and participate in the demonstrations.

**Demonstration: Large Mobile Robot and Robotics Simulator Program** The PantherBot is a large mobile robot equipped with sonar, lidar, bumper sensors, and a 6R robot arm. The campers saw the capabilities of a high tech sensor equipped


**FIGURE 6**. THE ROOMBA MOBILE ROBOT.

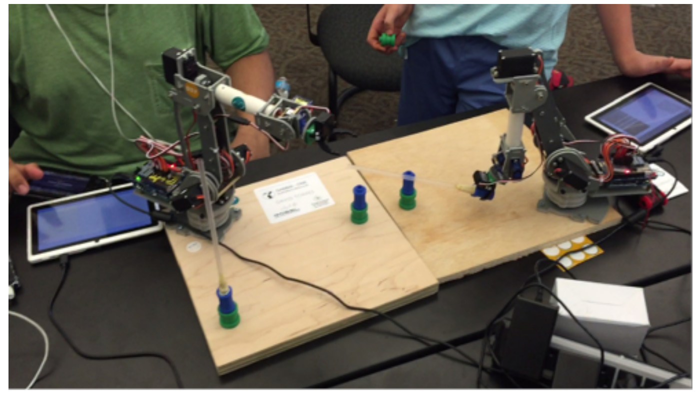

**FIGURE 7**. THE SWORD FIGHT COMPETITION SETUP.

robot as the PantherBot performed SLAM (Simultaneous Localization and Mapping) while they controlled the movement of the robot. The 6R robot arm, similar to the camp robot arm, was equipped with an encoder on each joint of the robot arm. The campers used this system to physically move the arm in a position and save the position coordinates to the program file. Similar to the "teach" method of the RASSLBot app, the campers used the pick and place technique to move water bottles from the floor to on top of the PantherBot. Through their learning in the aspects of robotics and robotics work they understood the mechanisms behind the mobile robot with a 6R robot arm attached.

Meanwhile, the other group was experiencing a robotics simulator program called MotoSim. This software from Motoman allows the user to simulate and program any motoman robot on the computer. This versatile program showed the campers how computer simulation allows robot engineers to test robots in a risk free environment before dealing with the hardware of the system.

## 4. Team Building and Competitions

**App Game Competition** The campers were given two apps that were official competition apps, where the high score at the end of the week would be awarded for their achievements.

**Pick and Place** The first official task assigned to the Gamma-One crew was to learn and master the technical skill of pick and place. Each camper was given a green army man. This man was to be set up in the robot workspace. The task was to use the dexterity of the robot to pick the man up and place him in a box. The non-uniform shape of the green army man forced the campers to come up with clever ways, i.e. use the gripper as a scoop rather than a claw, or claw through the legs to hook the man, to pick and place him into a box. Although pick and place was a repetitive tactic used, this activity showed the versatility behind this generic technique.

**Sword Fight** The sword fight was a competition designed to establish learning through robot hand to robot hand combat. The combatants placed the work space of their robots next to each other as shown in Fig. 7. The sword is sheathed on its stand in the corner of the workspace. The goal is to knock-down the opposing robot's tower. The process completes as follows:

1. The robot moves to pick up the sword.
2. After the sword is in hand, the robot swings to knock down the opposing robot's tower.
3. The robot then returns the sword to its sheath.

The robot that successfully completed all three tasks first was declared the winner. This competition utilized the teach feature on the RASSLBot app. By optimizing the program code, the campers learned how to limit the amount of movements necessary to complete a task and thus increase speed.

**Team Tower Builder** Teams of three worked together to build a tower using their robots. The tower was made out of small building blocks that the robot easily lifted. This timed activity did not use the teach method, but was a technical skill activity similar to operating construction equipment to move heavy objects when building large projects.

**Pass the Baton Team Race** This competition was a 5 vs 4 + 1 event (one team was given an extra robot since we did not have an even 10 campers). The teams set their robot workspaces up next to each other in a line as shown in Fig. 8. The goal was to move a baton from one end of the line to a box on the other end of the line. The robots passed the baton to one another in any creative way imaginable and placed it in the box. The team that finished first was declared the winner.

**Project: Team Mission** The team mission was the capstone of the week. The final day was dedicated to saving the colony on Europa. The colonists on Europa had discovered a creature in the deep oceans of Europa and had brought it in for

**FIGURE 8**. THE PASS THE BATON COMPETITION SETUP.

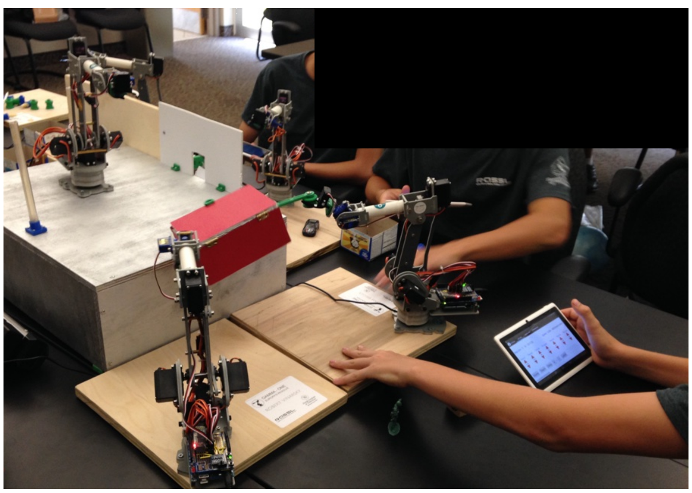

**FIGURE 9**. THE IN-PROGRESS GAMMA-ONE MISSION PROGRESS.

study. While examining the creature, a noxious gas was released that induced a sickness amongst the colonists. A few scientists were not exposed to the gas and were able to take a sample of the gas. They sent the data home to Earth where Gamma-One was in charge of creating an antidote and devising a plan to distribute it to the colony using robots since the air was toxic to the colonists.

Now was the time for Gamma-One to save the colony. The campers set up their robots in a replica scenario that mimics the colony as shown in Fig. 4 and Fig. 9. With the antidote arriving in a package in the subzero temperatures on Europa, two robots are used to hoist it onto a loading bay that acts as the distribution point. The setup and description can be found in Fig. 4 and in the mission briefing.

**Showcase** Gamma-One was done rehearsing the action to save the colony and was ready to put it to use. The two teams compete in timed runs through the mission. Using everything learned in the camp, the teams manipulated the environment to accomplish the necessary task. Using verbal communications and teamwork, the first two robot operators were able to lift the heavy box onto the unloading bay. The distribution robot opened the box and distributed the antidotes. The gondola loading robot loaded the gondola and also placed its antidote onto the ventilation chamber. The gondola operating robot pulled the gondola across the ravine and loaded the antidote onto the final ventilation chamber.

The teams worked and cheered for each other as the tasks were completed. The fastest time was declared the winning team. Both teams completed all of the tasks, and thus the Europa Colony was saved from certain peril.

### Miscellaneous Events

**Snack Tour** The building and programming of the robot was an indoor activity. The campers spent a bulk of their time indoors working on mechanics and electronics. By having a long, outdoor break in the afternoon, the campers explored the campus while enjoying a snack and playing games. By adding the physical exercise aspect to the camp, the energy of the campers was able to be controlled in a meaningful and productive manner.

**Closing** The closing ceremony awarded those that won the competitions, as well as the Gamma-One crews that saved the Europa Colony from decimation. 3D printed prizes were distributed to the winners of the app game competitions, the sword fight competition, the pass the baton team race, and the Gamma-One mission.

Each camper individually received a certificate of completion. Parents were invited in for the award ceremony and took group photos of the campers. They gathered their kits, said their goodbyes, and went away with a new sense of robotics and the tools to learn more through individual effort as well as through pursuing STEM courses in high school and beyond.

## REVIEWS AND SURVEY BY THE CAMPERS

A survey was emailed to the campers after the week was over to anonymously review the camp. Over half of the campers responded and every review gave high marks for the camp. The only criticism received was about having a more organized closing ceremony for the parents to attend. Receiving feedback for the camp helped us understand the mindset that was behind the each of the campers. The anonymous system allowed for honesty

without fear of judgment or conflict.
The questions on the survey were:

1. **Overall, how would you rate the Intro to Robotics Summer Camp?**

| Survey Response Options | Results |
|---|---|
| Excellent | 5 |
| Very good | 1 |
| Fairly good | 0 |
| Mildly good | 0 |
| Not good at all | 0 |

2. **How much value for the money ($1300) was the Intro to Robotics Summer Camp?**

| Survey Response Options | Results |
|---|---|
| A great deal of value | 3 |
| A lot of value | 2 |
| A moderate amount of value | 1 |
| Little value | 0 |
| Almost no value | 0 |

3. **How organized was the Intro to Robotics Summer Camp?**

| Survey Response Options | Results |
|---|---|
| Extremely organized | 5 |
| Very organized | 1 |
| Somewhat organized | 0 |
| Slightly organized | 0 |
| Not at all organized | 0 |

4. **How likely are you to recommend the Intro to Robotics Summer Camp to a friend?**

| Survey Response Options | Results |
|---|---|
| Extremely likely | 4 |
| Very likely | 2 |
| Moderately likely | 0 |
| Slightly likely | 0 |
| Not at all likely | 0 |

5. **How friendly and helpful was the staff?**

| Survey Response Options | Results |
|---|---|
| Extremely friendly and helpful | 5 |
| Very friendly and helpful | 1 |
| Somewhat friendly and helpful | 0 |
| Slightly friendly and helpful | 0 |
| Not at all friendly and helpful | 0 |

6. **How knowledgeable was the trainer?**

| Survey Response Options | Results |
|---|---|
| Extremely knowledgeable | 5 |
| Very knowledgeable | 1 |
| Moderately knowledgeable | 0 |
| Slightly knowledgeable | 0 |
| Not at all knowledgeable | 0 |

7. **Mention a few things that could be improved about the camp**

| Survey Respondent | Comment |
|---|---|
| Respondent 1 | "I think the camp was great, would like a follow up camp" |
| Respondent 2 | "Invite parents for a 'closing ceremony.' A few of us showed up, but we were not sure if we were supposed to be there or not." |
| Respondent 3 | "nothing at all" |
| Respondent 4 | "very friendly and clear" |
| Respondent 5 | "Everything was great." |
| Respondent 6 | N/A |

8. **Did the camper learn new things about robotics?**

| Survey Respondent | Comment |
|---|---|
| Respondent 1 | "Yes, Very much so." |
| Respondent 2 | "Definitely!" |
| Respondent 3 | "yes" |
| Respondent 4 | "yes, robotics is a very interesting subject and I always been intrigue about it, I am hoping to continued in this path" |
| Respondent 5 | "Yes. Quite a few new things." |
| Respondent 6 | N/A |

9. **Did the camper end the camp excited and enthusiastic about robotics?**

| Survey Respondent | Comment |
|---|---|
| Respondent 1 | “Yes, Very much so” |
| Respondent 2 | “Definitely!” |
| Respondent 3 | “yes” |
| Respondent 4 | “yes, I love to continued with the studies and become well trained on the subject. I will like to graduate with a robotic engineering degree.” |
| Respondent 5 | “Yes, very.” |
| Respondent 6 | N/A |

10. **Can we use your responses to promote future camps?**

| Survey Response Options | Results |
|---|---|
| Yes | 6 |
| No | 0 |

The camp hosted nine campers and each one was sent the survey. Six of the nine gave feedback for the camp, giving us a supermajority of two thirds perspective on the overall quality of the camp as perceived by the campers. As can be seen from the survey results, the camp was met with enthusiasm and satisfaction with the knowledge and skills gained from attending the robotics summer camp.

## SUGGESTED IMPROVEMENTS AND FUTURE CAMPS

RASSL organized and hosted a summer camp with the goal of influencing a STEM curriculum in order to close the gap between academia and middle/high school students. To motivate the STEM field, RASSL introduced a space exploration themed introduction to robotics camp.

This paper provided details on how the camp was prepared, organized, and implemented. The survey results show that the campers were satisfied with the learning experience the camp had to offer.

Here are some key items to keep in mind when planning a future camp that would have improved the execution of this camp:

1. Student Leadership: Experience interacting with and guiding young adults.
2. Hardware Reliability: Choose a robot with more reliable servo motors.
3. Surveys: Implement an active survey distributed throughout the camp to measure metrics of the camp after each day.
4. Theme Oriented: More organized theme implementation with more theatrics and focus on the theme in most activities.

### 1. Student Leadership

Our lab had limited experience working with young people in a formal setting for teaching. Before the camp began, a trial run with a volunteer advisor assisted the RASSL members with instructing and guiding a test group of two high school aged participants. The trial participants tested the mission workspace to confirm the goals were achievable. They spent three hours testing each of the work station tasks as well as the other competitions. The advisor gave the RASSL members advice on how to be better teachers by improving communication and clarity.

### 2. Hardware Reliability

The hardware chosen for the camp was tested, but not with the vigor that young people impose on new technologies. The gripper on the robot was calibrated by the campers when they assembled the component. Improper calibration resulted in large stresses on the servo gears which in turn broke or fried. Stronger servos that can withstand a bit of misuse would serve the new student well while they learn the boundaries of a new technology.

### 3. Surveys

Surveys give clear goals for the purpose of every activity. If the purpose is lost on the camp leader or the camper, maybe it should not be included in the curriculum. By writing and distributing surveys about events, the camp leaders will know what is effective and what is ill-received. It also opens a forum to talk about the purpose and learning point behind every activity so the camper will understand why they are learning a certain skill or fact that they might not understand at the first introduction.

### 4. Theme Oriented

RASSL hosted their first summer camp and with it came different hurdles. Focusing on the established theme through most activities proved to be a trying task. Since the camp was technical, the majority of the explanations focused on camper understanding rather than on fitting the theme. Establishing teaching points directly related to sub-missions around the theme would have given the theme more of a connection to the camp.

### Key Points Of Success

While there were areas of weakness for the camp, we also learned about the strengths of different techniques we implemented.

1. A chant associated with the theme created a sense of the mission and also doubled as a way to get everyone’s attention.
2. Having a ring leader to take control and guide the students in a direction was critical to the organization and flow of the camp.
3. Team meetings after the camp day ended to prepare for the next day was the reason for our successful organization. By being committed to the week and planning ahead, the campers were never without a new task to work on.

## CONCLUSION

In summary, the implementation of the camp had a positive impact on the campers as shown by the survey results. By implementing a space exploration themed robotics camp, the campers were motivated to pursue STEM education as evidenced from their interest and pursuit of the technology and engineering aspects of the camp. Through games and activities in both indoor and outdoor environments, problem solving scenarios encouraged the campers to work together to understand the concepts and begin the start of a STEM education.

Over all the camp ran smoothly. The campers and their guardians reported positive feedback for the camp. The RASSL leaders worked hard to ensure understanding and mission successes for the campers. Through this robotics camp, STEM studies were given practical application which can be lost in formal teaching settings. The motivation to pursue a lifestyle in these areas of study were encouraged to all of the campers through the work and the goals.

## ACKNOWLEDGMENT

Thanks go to Florida Institute of Technology for hosting the camp. Thanks also to RASSL members for volunteering countless hours to develop and run a well reviewed and memorable robotics camp.

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