Targets for the Southeast Con 2019 Team #305

Motion and Frame Module

In this section of the Target Summary covers the goals for the motion and frame module of the FAMU-FSU Southeast Con 2019 Robot. The need for this module was to move around the playing field in counter-clockwise orbit. The targets will breakdown the needed values for propelling, turning and wheel configuration of the robot. Also, design the frame to support future modules and meet the requirements of the Southeast Con Hardware competition 2019. This module is necessary to let the robot interact with the playing field.

Target 1 quantifies the necessary to move around the field at a competitive speed. This target is necessary to ensure that the robot can move around the field at its fastest rate of speed without tipping over. The marginal value for maximum speed of the robot was selected by calculating the top speed without slipping with a marginal error of 20%. The top speed before slipping was found by using the centripetal force ($f = \frac{mv^2}{r}$) and friction force formula ($f = \mu_f mg$) and solving for the velocity. The coefficient of friction was assumed to be 0.6, because average coefficient of friction was that. After finding the maximum speed (4.484 ft/s) it was given an error of 20 percent in case the carpet is more slippery then we expected. Leading to the value of 3.6 ft/s for the maximum speed of the robot. To assess whether the target has been successfully achieved, the robot will be placed on the practice field and drive across the field. The time to cross the field will be recorded and the velocity will be calculated. The importance of this target is rated at 5 because this function allows the robot to interact with the competition. Failure to meet this target would result in moving at low rate of speed or not moving at all, causing the opponents to gather more space debris.

Target 2 quantifies an effective method of turning to maintain a steady counter-clockwise orbit, and responsive enough to avoid planned and unplanned objects. This target is necessary to ensure the robot can respond to a changing environment as well as maintain a steady path to collect debris. The marginal value of pi/3 radians/sec was selected to ensure that the robot can readily turn to avoid obstacles. To assess whether the target has been successfully achieved, several measurements of the robot's angular velocity will be measured. The importance of this target is rated at 3 because the robot being able to respond to an unknown and changing environment is one of the core ideas of the competition. Failure to meet this target would result in missing debris and collisions with objects.

Target 3 quantifies the effectiveness of the wheel configuration. This target is necessary to ensure that the robot is efficient and capable of reliably navigating the playing field. The marginal value for be 3.5 ft/s was chosen to ensure the robot is capable of quickly traversing the playing field. This measurement will be taken when the robot is traveling in a straight path, after accelerating for 3 seconds, and the wheels suffer no slippage. To assess whether the target has been successfully achieved, several tests of different wheel configurations and combinations will be done, and subsequently compared to find an efficient wheel configuration. The importance of this target is rated at 4 because ensuring the robot has sufficient traction to navigate the playing field is critical to the robots performance in the competition. Failure to meet this target would result in slow, inefficient robot that will struggle to keep track of its current position, and result in an extreme disadvantage during the competition.

Target 4 quantifies the regulated dimensions of FAMU-FSU Southeast Con Team's robot. This target is necessary to ensure that the final design of the Southeast Con robot qualifies to compete in the competition. The marginal value chosen was based on the maximum size of the robot given by the Southeast Con Hardware Competition. As specified below, the final robot dimension goal is set at 8.5-in x 8.5-in x 10-in, as this dimension allows for a robot design that is within the regulated size and prevents the downgrade of some sensors and microcontrollers that are essential for developing a properly working robot. To assess whether the target has been successfully achieved, measurements from a CAD design will be initial used to verify that the dimensions of the components chose for the final design will retain the robots desired dimension. Once this initial measure is a success, another measurement will be conducted after the final robot design is assembled. If the assembled robot remains within the desired dimensions, then it would be concluded that this target has been met. The importance of this target is rated at 5 because failing to meet the specified size dimensions would make the robot ineligible to compete in the competition. Therefore, failure to meet this target would put the FAMU-FSU Southeast Con Team of the competition, without having competed in any of the rounds.

Route Clearing Algorithm

This section of the Target Summary covers the goals for the route clearing algorithm of the FAMU-FSU Southeast Con 2019 Robot. The need for this module is to create an effective route for the robot to travel while searching for debris to clear. The targets will breakdown the needed values to create an effective route to find and remove debris from the playing field. Included in this module are the desired values of static object avoidance. This module is necessary to provide the route the robot will search to earn points.

Target 5 quantifies an efficient path that is necessary to quickly search the playing field for debris to clear. This target is necessary to ensure the robot has a path to search to clear debris from the field. This value was chosen based on the time limit of a single round of competition. The selected value of 2 minutes to complete a full search of the field without having to deviate to collect debris was chosen to ensure the robot had enough time to collect debris and return home. The primary assumption is that if the robot can complete the route within the set value, then it will have enough time to gather debris, avoid obstacles, and return to home base. To assess whether the target has been successfully achieved, the robot will be placed in the playing field and allowed to travel the route while being timed. The importance of this target is rated at a 3 because searching the playing field for debris to remove will be the primary source of points for the Southeast Con competition. Failure to meet this target would result in the robot traveling a route that will miss debris, however if some debris is missed by the robot it is still possible for the team to win the competition.

Target 6 quantifies the avoidance of planned objects. This target is necessary to ensure that the team does not lose points for hitting structures or damaging the playing field. The marginal value was selected to ensure the robot is capable of safely avoiding planned obstacles. The value of 6 inches was chosen to ensure the robot will not accidently hit any planned objects. Through the assistance of internal and external sensors the robot will keep track of its location relative to the planned obstacles and avoid them. To assess whether the target has been successfully achieved, the robot will be set into the playing

field at various position, must localize where it is, and return home without any collisions. The importance of this target is rated at 3 because if the robot hits any object the points lost for the collision will greatly increase the difficulty of achieving advancement to the next round. Failure to meet this target would result in the FAMU-FSU Southeast Con team at a severe disadvantage, and if the damage to the playing field is extensive, possible disqualification.

Sorting Software and Hardware Module

In this section of the Target Summary covers the goals for the sorting component of the FAMU-FSU Southeast Con 2019 Robot. The need for this module was to find a way to take in the space debris and sort it within the robot. The targets will breakdown the needed values for gathering, sorting and storing the space debris within zone 2 of the playing field. This module is necessary to increase the possible points that the robot can earn during the competition.

Target 7 quantifies the gathering mechanism on the robot. This target is necessary to ensure that the gathering mechanism has obtain enough space debris to make it competitive during the competition. The marginal value was chosen so that if the opponent robot gather about half the amount of space debris available, then FAMU-FSU Southeast Con 2019 robot gathers one more than half. This would put the FAMU-FSU Southeast Con 2019 Team ahead by two space debris. During the competition there will be 12 space debris in the zone 2 that the teams can gather. To have the marginal amount would be 7 pieces of space debris. This assumes that the team will go to the second round which then they will compete against another robot. To assess whether the target has been successfully achieved, the robot will be placed in a practice field (design to mirror that within the competition) where it will try to gather 7 pieces of space debris. The importance of this target is rated at 4 because during the competition there are other ways to gather points, however it is necessary for sorting the space debris. Failure to meet this target would result in unable to properly sort the space debris, but the team can still win the competition without this module.

Target 8 quantifies the sorting mechanism on the robot. This target is necessary to ensure that the sorting mechanism takes the space debris from the gathering mechanism, organize them, and then deposit the space debris into the storage unit. The marginal value was chosen so that the robot would be able to sort the debris and be competitive to against the other competitors. The marginal value is 80% of the space debris is sorted correctly by color. The shape of the space debris does matter how it is sorted because there points gain for sorting base on that. This percentage was selected under the assumption that the opponent gathers half plus one of the available space debris, and return all of them home. If the opponent robot gather 7 pieces of space debris (70 points) and returns home with them (70 points), then the FAMU-FSU Southeast Con 2019 robot must earn 140 points. If it gathers the remaining 5 pieces of space debris and return home, then it would have 100 points. To catch back up, the team must sort four out of five space debris and put it the proper corner. To assess whether the target has been successfully achieved, the robot would consume five pieces of space debris then sort them. The importance of this target is rated at 2 because the robot can still gather points without this function, but increases the maximum points the robot can gather. Failure to meet this target would result in not storing sorted cubes.

Target 9 quantifies the necessary storage container for sorted space debris. This target is necessary to ensure that the space debris collected from the gather mechanism is held within the robot

after being sorted by the sorting mechanism. The marginal value for this target was selected based on the size of the spherical space debris and wiggle room to slide into the container. The cube space debris was not the focus on the size of the storage container because the cube space debris (2”) have smaller width compared to the pit balls (2.5”). An extra 1/2” is applied to the width, height and depth to prevent space debris from seizing in the storage bin. Resulting internal space of the storage bin should be able to support a volume of 242 in^3 or the maximum amount of space debris, 12 pieces. 12 pieces of space debris was selected because the team assumes that robot will gather all the space debris during the competition for the module. To assess whether the target has been successfully achieved, 12 pieces of space debris will be place in the storage container to test that it can hold maximum space debris. The importance of this target is rated at 3 because even if the space debris is not able to be sorted by the sorting mechanism, the robot can still carry the space debris to home base for extra points. Failure to meet this target would result in unable to store the space debris, leading to maximum total points that can be earned during the competition drops by 240 points.

Return Home Module

In this section of the Target Summary covers the goals for the home returning of the FAMU-FSU Southeast Con 2019 Robot. The need for this module was to have the robot go back to the home base. The target will breakdown the needed value of how to find the best route to go back to home base which is one of the colored corners where it begins. This module is necessary to get the points for getting back to home base and put the matched debris to colored corner.

Target 10 quantifies the dropping off mechanism of the robot. This target is necessary to ensure that the dropping off mechanism is able to drop off the sorted debris to a specific colored corner. The marginal value was chosen based on that it counts really much to deliver the matched debris to a colored corner, if the debris cannot be dropped off properly, sorting and gathering the robot did before would be useless. To assess whether the target has been successfully achieved, some similar debris will be loaded on the robot, and we will test the percentage of successful dropping off. The importance of this target is rated at 3 because only bonus points will be gotten if this target accomplished. Failure to meet this target would result in that we may transport all the debris back to home base which will cause 3/4 of the bonus points.

Target 11 quantifies detection and location mechanism of the robot. This target is necessary to ensure that the robot is able to locate where it is and then calculate the fastest route to home base. The marginal value was chosen based on that only if the robot gets the information of where it is and the location it is heading to, the robot can find the fastest way to get there. To assess whether the target has been successfully achieved, some tests will be done. In the test, the robot will be placed in a random location on a simulated playing field, and there will be four similar walls around the playing field and four LED obstacles on an orbit line. Then the robot will run this module to test how fast and accurate the robot can get the information about the location. The percentage of successful locating will be recorded. The importance of this target is rated at 3 because this module is going to be the last part of the whole game, the failure of this module will not be very influential to frontal parts of the game. Failure to meet this target would result in that we will lose the points for transporting the matched debris to the specific

colored corner and returning home base, though returning home base counts not very much but there may be a lot of bonus points to lose if the robot can't transport the debris to the colored corners.

Target 12 quantifies the returning home mechanism of the robot. This target is necessary to ensure the motor inside is able to drive to robot back to home base. The marginal value was chosen based on if the robot was able to return to the home base reliably. If the robot can return home 80% of the time, the it would be viewed as a success. To assess whether the target has been successfully achieved, we will test the robot if it is able to move to the home base without collision with other robot when knowing the location and the destination of the robot. The importance of this target is rated at 3 because only if the robot returned to the home base, we can get the points of returning home base and the last part of transporting debris. Failure to meet this target would result in that even if we successfully found the route back to the home base and sorted the debris, it would still be useless.

Detection and Avoidance Module

This section of the Target Summary covers the goals for the detection and avoidance of UFOs and field architecture for the FAMU-FSU Southeast Con 2019 Robot. The need for this module is to find a way to detect and obstacles in the robot's path and avoid the detected obstacle by rerouting navigation path to a more suitable route. The targets will breakdown the needed percentage of detection and avoidance of UFOs and architectures within zone 2 of the playing field. This module is necessary to prevent point deduction or expulsion from the competition during each round of the competition.

Target 13 quantifies the detection and avoidance mechanism for the robot. This target is necessary to ensure that the robot is able to navigate the playing field freely, without colliding with other UFOs or field architects. The marginal value chosen for module 5 is based on the assumption that no other robot will intentionally attempting to block the pathway of this robot during the second round. As one of the stipulations for this competition, no robot should purposely attempt to collide with other robots in the playing field during each round, and so to ensure that this condition is met, the accepted marginal value is set at 95% to guarantee that the FAMU-FSU Southeast Con 2019 Team will not get points deducted or get disqualified from competition. To assess whether the target has been successfully achieved, various trails will be conducted on a practice field, where football size objects will be introduced at random times in random areas of the field to simulate playing condition at the competition. During each practice run, the amount of successful detection and avoidance of obstacles in the field will be record, then will be compared with the number of objects introduced to the field; and therefore would give a reliable percentage of how well the robot can detect and avoid obstacles. The importance of this target is rated at 5 because failing to avoid any UFOs on the field could be viewed, by the judges, as a purposeful attempt to disable other robots in the field and therefore would result disqualification from the competition. Therefore, failure to meet this target would put the FAMU-FSU Southeast Con Team at a disadvantage, as this would greatly increase the possibility of having points deducted

Target 14 quantifies the detection and differentiation of the four colors (red, green, blue, yellow) associated with the debris scatter across the playing field. This target is crucial to ensure that the

Southeast Con robot is able to accumulate as much points as possible during the preliminary round, as each debris that is placed in the corner associated with its color will award 10 points; therefore, the marginal value chosen for this module is very high, since placing each debris collect to the area associated with its color will provide a substantial about of point during each round. As stated in the competition rules, the separation of the debris based on color is not an essential requirement, however, color separation does provide a substantial amount of point, so therefore, and the importance of this module was set to 3. To ensure that the color differentiation algorithm is sufficient to score the Southeast Con robot sufficient points, this target will be assessed through the use of a numeric unit of measurement. During the assessment of this target, various practice runs will be conducted in which a record of the amount of debris detected and placed in the right colored corner will be collected. From the collected data, it will be determined whether the robot was able to detect the colors of the majority of the debris (8 or more debris). Although this target is not a crucial part of the overall robot design, it is important that the final robot design is able to meet this target, since the goal of the Southeast Con robot design is to score as many points as possible during each round of the competition.

Appendix C: Target Catalog

Target No.	Need	Metric	Imp.	Units	Marginal Value	Ideal Value
1	1	Speed of the Robot	5	Ft/s	3.6	4.5
2	1	Maximum angular velocity of the robot	3	Rad/sec	Pi/3	Pi/2
3	1	Acceleration of the robot with various wheel configurations	4	Ft/sec	3.5	4.5
4	1	Minimized Size of the robot	5	inches	9 x 9 x 11	8.5 x 8.5 x 10
5	2	Time to search the field	3	Seconds	120	90
6	2	The closest distance the robot comes to collision	3	Inches	6	3
7	3	Space debris gathered	4	Space debris	7	10
8	3	Amount space debris sorted versus how many were gathered	2	%	80	90
9	3	Storage Capacity	3	In^3	242	192
10	4	Amount of debris being dropped off	3	debris	8	12
11	4	The percentage of successfully locating	3	%	80	100
12	4	The percentage of successfully returning	3	%	80	100
13	5	Detection and Avoidance	5	%	95	99
14	5	Color Differentiation	3	color of debris	10	12