

2016 SUNY TYESA Mini UAV Competition

Friday, April 29, 2016

Monroe Community College, Rochester NY

Project

Teams of sophomore and freshman students will design, build, and pilot a mini Unmanned Aerial Vehicle (UAV) to transport a rescue kit through a series of obstacles, and return to the starting point. The UAV must be able to maneuver around and through obstacles, change altitude and carry/deposit payload. This project is designed to simulate a rescue kit delivery where human navigation is difficult or dangerous.

Project requirement

The UAV must pass all the given specifications: dimensions, cost, and part constraints. Participants cannot purchase and modify an existing commercially available vehicle. Participants can purchase individual components: a frame kit, propulsion, and control system for their UAV.

Participants are encouraged to engage in research and design a frame for their UAV. It is expected that participants will become fairly adept to line of sight piloting in preparation for the competition.

Time and Location

The competition will be held in the *PAC Field House* at Monroe Community College - Brighton Campus on Friday, April 29, 2016 at 10:00 AM. Participants should arrive and register at 9:00 AM. Directions to MCC can be found here: <http://www.monroecc.edu/depts/webmaps/>

Participating teams should report to Christopher Kumar at the MCC Engineering Department by Friday, April 1, 2016.

Christopher Kumar, SUNY TYESA Treasurer
Engineering Science and Physics Dept.
Monroe Community College
1000 East Henrietta Road
Rochester, NY 14623-5780
Phone: (585)292-2671
Email: ckumar@monroecc.edu

Vehicle Requirements

- i. The vehicle must be powered by batteries.
- ii. The device must be controlled through a wireless transmitter/receiver radio link. The following requirements pertain specifically to the device controller:
 - A radio transmitter may have its own batteries (rechargeable or non- rechargeable).
 - The transmitter/receiver radio link may be any commercially available model controller.
 - During the trial, the device must be completely controlled via the radio link. No other contact, interaction or influence is permitted.
 - One team member must control the device throughout the trial.
 - All radio controllers will be impounded and shut off during the competition, except during the team's run.
- iii. All devices must have a readily accessible and clearly labeled master shut-off switch.
- iv. All fully assembled UAV (propellers included) must be capable of fitting in a 24x24x12 inch box.
- v. All vehicles must adhere to the part specifications outlined on page 5. A brief bill of materials must be included for each UAV. The bill of materials needs only to provide for parts included in the parts table below (motor, speed controllers, etc.).

Course Description

The rectangular course of 16 ft. by 26 ft. will consist of a flat, level section of field marked off with masking tape, and the corresponding airspace will be above the field. The course contains a starting and a deposit platform, a rescue kit (payload) platform and rescue kit (payload), and two obstacle gates. The minimum distance between gates will be 6 ½ ft. The takeoff and deposit platform will be located diagonally from one another (figure 1). The judges will determine the gates and rescue kit platform locations on the competition day. The course will be located in the indoor field house (MCC PAC center field house).

Rules

- i. All teams must report before competition begins.
- ii. Team members must inspect the course and location of the payload (350 g rescue kit) before the judges signal to start the trial. Once the trial is commenced, the run counts as an official run. There is no redo.
- iii. If a UAV fails to operate after the judges have given the start command, the team members may work on their UAV to get it moving but the time will continue to count from the time when the start command was given. If the time exceeds 200 seconds of the start command, a score of zero will be assigned for that trial.
- iv. The UAV size will be measured. If the size is exceeded, judges may disqualify the team from the competition or may give severe penalty.
- v. The UAV must start from the starting platform, pick up the rescue kit from the payload loop, maneuver through two obstacle gates, then deposit the rescue kit on the deposit platform and return to the starting point. There will be no penalty for maneuvering outside the bounds of the defined course area. Extra

points will be awarded for going through the same two gates on the UAV's return trip. Extra points will also be awarded for locating the payload onto the deposit platform.

Note: All pilots must fly on a line of sight basis. No First Person View (FPV) cameras may be used to navigate.

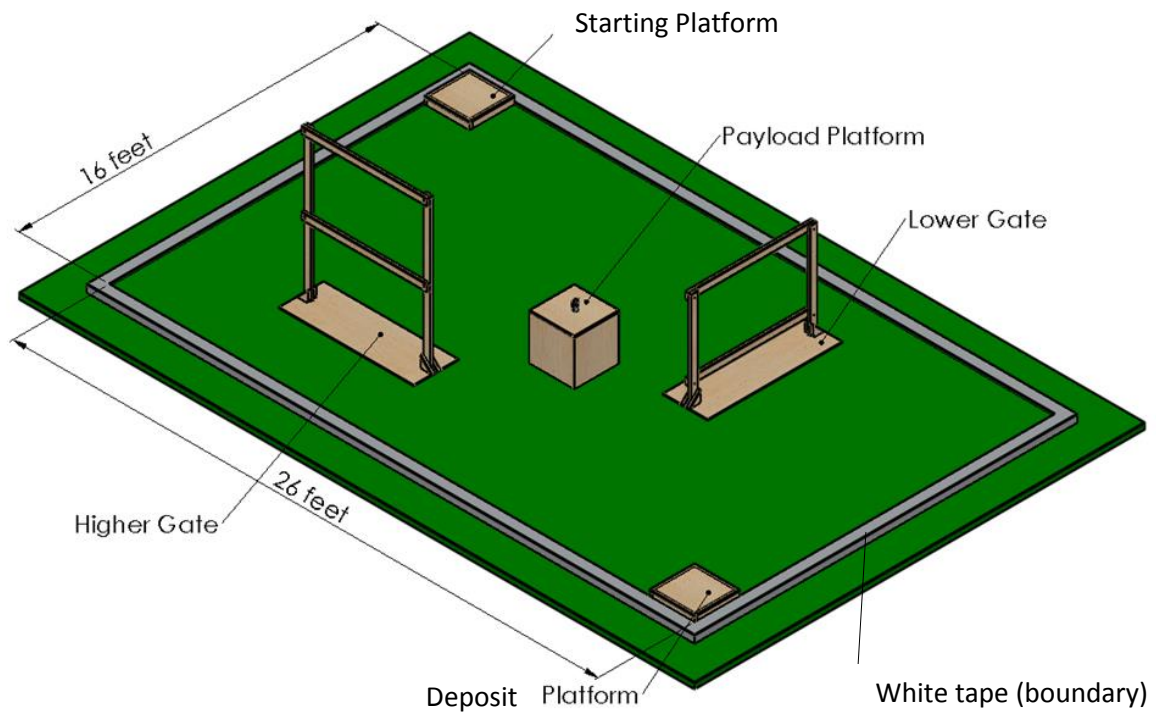


Figure 1: The isometric view of the course constructed in the indoor field house.

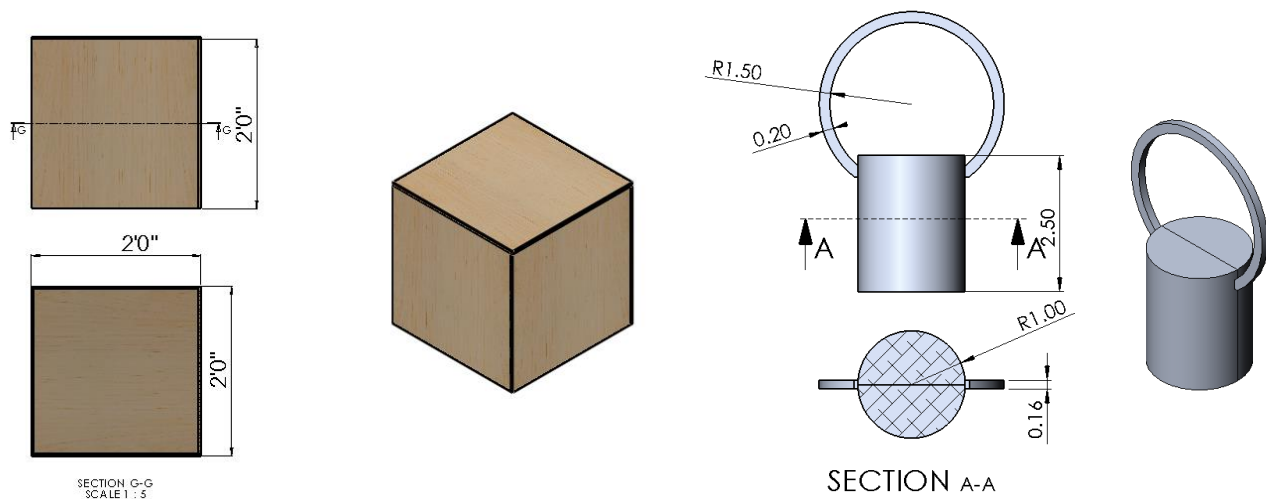


Figure 2: Schematics for the payload platform and payload (350g).

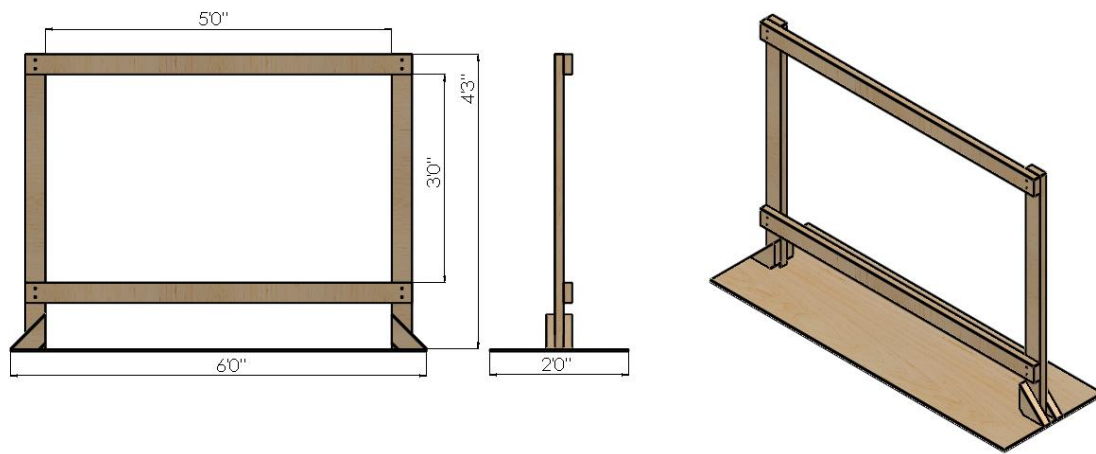


Figure 3.a Lower gate

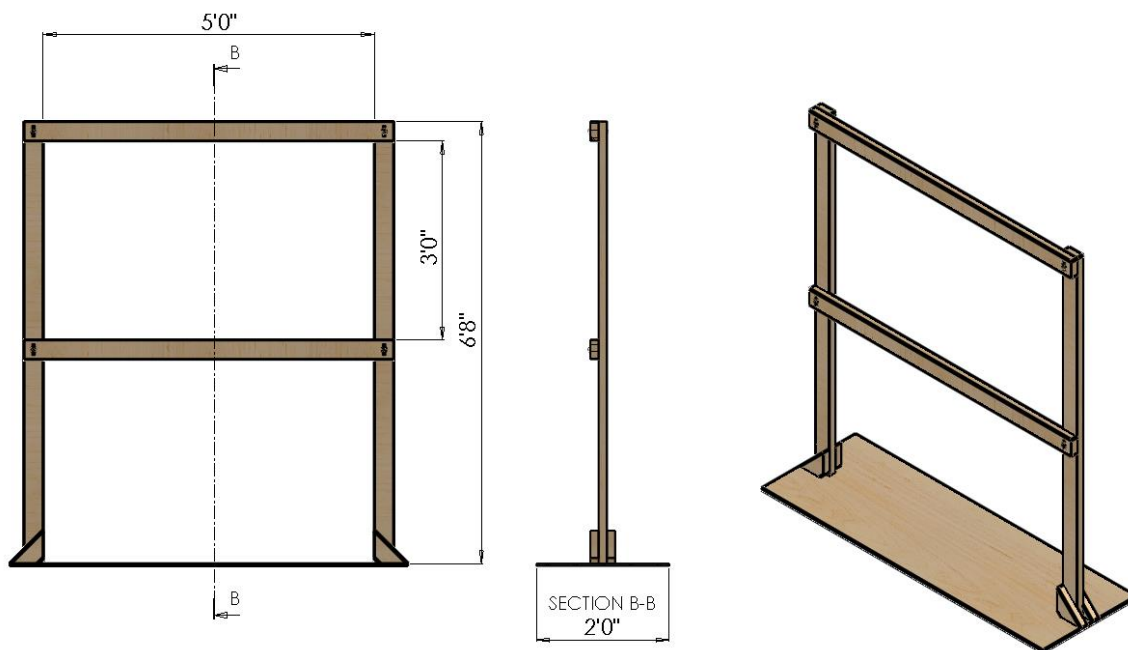


Figure 3.b Higher gate

Figure 3: Schematics for lower gate and higher gate. Each gate will be 5 ft. wide with a 3 ft. tall opening.

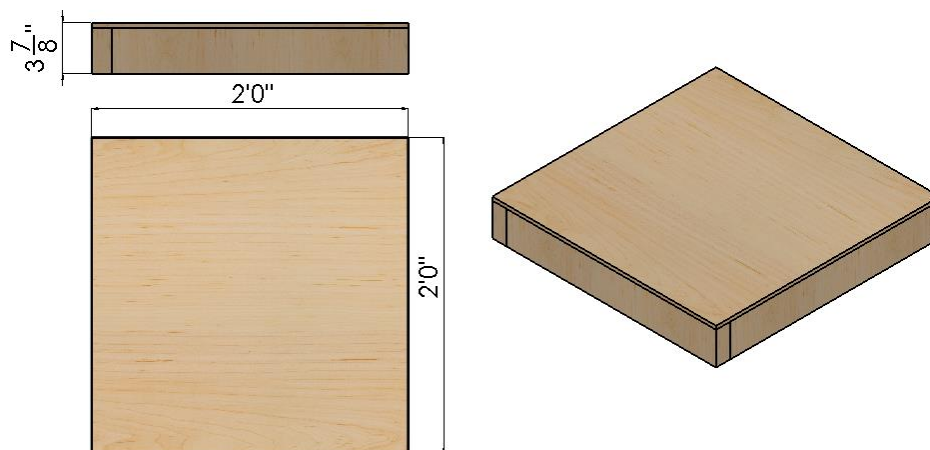


Figure 4: Schematics for the starting and deposit platforms.

Part Specifications

The following table is an example part list requirement to build a mini UAV. All vehicles that participate in this event must not have a cost exceeding \$200 (Excluding Tax). This build ends up with a net cost of approximately \$175 (not including small parts such as screws, hot glue, etc.). Students will need to devise a carry and release system for the payload in addition to the parts listed here. The carry and release system will not be considered when evaluating the budget for each UAV.

Part	Specifications	Example Build	Vendor	Qty	Cost per component	Net Cost
Required						
Control Board	Any.	CC3D	HobbyKing	1	\$19.99	\$19.99
Frame	Students are encouraged to fabricate their own frames, however commercial frames are allowed.	F330 Glass Fiber Mini Quadcopter Frame 330mm	HobbyKing	1	\$9.00	\$9.00
Motors	Must not exceed a 20A maximum current draw or 1200 kV rating.	NTM Prop Drive 28-30s	HobbyKing	4	\$16.20	\$64.80
Motor mounts	May be fabricated or purchased.	NTM Prop Drive 28 Series Accessory Pack	HobbyKing	4	\$1.89	\$7.56
Speed Controllers	Must be able to handle the motor current draw at least. ESC's with integrated BEC's are allowed.	Turnigy 25A	HobbyKing	4	\$9.19	\$36.76
Battery Eliminator Circuit	Any.	Turnigy 5A BEC	HobbyKing	1	\$4.90	\$4.90
Propellers	Must not exceed overall drone size specifications.	HobbyKing 10x4.5	HobbyKing	1	\$3.24	\$3.24
Battery	NiMH, LiPo, or NiCad allowed. No greater than 3-cells, or 12 volt rating.	Zippy 2200A 35 C compact motor	HobbyKing	1	\$14.75	\$14.75
Power distribution	Breakout Cabling or Boards may be used.	MultiStar Breakout Cabling	HobbyKing	1	\$4.38	\$4.38
Receiver Leads	Any.	JST-SH	HobbyKing	1	\$2.25	\$2.25
Battery Alarm	Any.	HobbyKing Low Voltage Alarm	HobbyKing	1	\$2.26	\$2.26
Recommended						
Battery strap	Any.	Turnigy Velcro Strap	HobbyKing	1	\$1.69	\$1.69
Mounting Foam/Shock absorbers	Any.	Gyro Mounting Pads	HobbyKing	1	\$1.99	\$1.99
					Net Cost:	\$173.57

Scoring Guidelines

Trial Score:

- i. 100 points will be awarded if the UAV successfully picks up the payload. This may only be done once per trial.
- ii. 100 points will be awarded each time the UAV passes through a gate. This may only be done once per gate before and once per gate after the payload delivery for a total of 400 points maximum per trial.
- iii. 20 points will be awarded if the payload makes physical contact with the drop zone.
- iv. 50 points will be awarded for successful release and landing of the payload on the deposit platform. Only 25 points will be awarded if the release payload touches the deposit platform and does not land on it.
- v. Time reward = $(200 \text{ seconds} - \text{Trial time in seconds})$ will be given. Each trial terminates after returning to the starting position and landing or after the vehicle is otherwise not able to progress any further.

Deductions:

- i. 20 Points will be deducted each time the drone or payload makes physical contact with a gate.
- ii. 200 points will be deducted if the budget for the drone exceeds the \$200 limit. Note: If the budget exceeds the limit substantially, scores will be more heavily reduced or disqualified.

Poster Presentation

Prior to the mini UAV competition, each team must participate in the poster presentation session, where each participating team will exhibit and present their UAV project to the event attendees, spectators, and judges. During the exhibition period, judges will visit each participating team and request a poster presentation. This will be followed by questions. This process will take approximately 10 minutes per each team. The entire poster presentation session is scheduled to last approximately 1 hour; however, this may change depending on the number of participating teams.

The poster presentation will occur on the same day before the mini UAV competition on Friday, April 29, 2016 at 10:00 am in the MCC PAC Field House. All the team members must be present for the entire poster presentation period along with their UAV. Teams may use laminated posters, written documents, physical prototypes, multimedia displays, and other visual aids at their booths. Each team will be provided with a table and tripod.

Judges will score on the following categories: Design Evolution, Mechanical Analysis, Electrical Analysis, software Analysis, and Exhibit Quality. They will score on a scale of 0 to 10 (10 being the best). The score will be calculated by deleting the highest and lowest scores from the judges and averaging the remaining scores.

Note: must include cad dimensions of major components (propellers, motors, frame, flight controller, etc.) and overall design of the assembled UAV. Motor and propeller selection must be briefly explained, along with calculation for thrust and maximum payload lift.

The final score will be the sum of scores from the three trials, including any broken rule deductions and bonuses and presentation scores.

Note: On the competition day, designated judges will interpret the rules and determine all decisions. The decision will be final and will not be negotiable. All teams must respect the decision. The purpose of this competition is to support students' interest in mathematics, engineering, science, and technology. We expect the competition to be a learning environment, and to be cordial and courteous.

Example Trial Score:

Event	Trial 1	Points	Trial 2	Points	Trial 3	Points
Time:	100	100	120	80	40	160
Gates:	4	400	3	300	2	200
Contact With Drop Zone:	Yes	20	Yes	20	No	0
Payload Released:	Yes	50	Yes	50	Yes	50
Payload in Drop Zone:	Yes	50	No	0	No	0
Deductions						
Contact with gate?	3	-60	0	0	1	-20
Unacceptable Budget	No	0				
Score:	1400					