Final Project Discussion

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Final Design Project

Theme: Toy Story

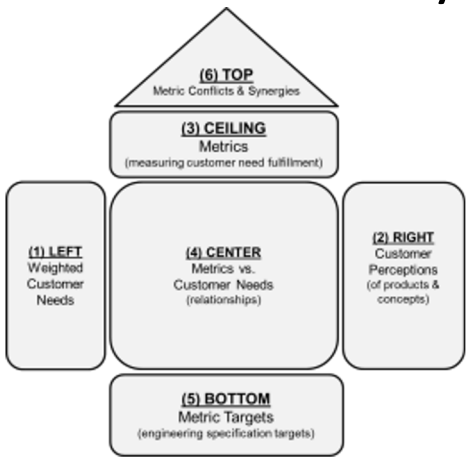
Learning Objectives:

- Tackle a constrained design problem
- Apply a structured design process to a real problem in a team environment
- Apply basic fabrication principles to produce a physical design to a functional specification
- Simulate, build and test designs to accomplish a physical task
- Communicate design outcomes

Design tools – complete process

Problem Understanding

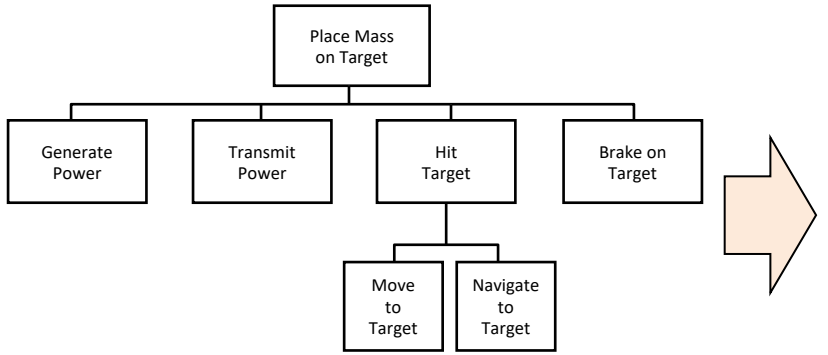
House of Quality



Specification Sheet

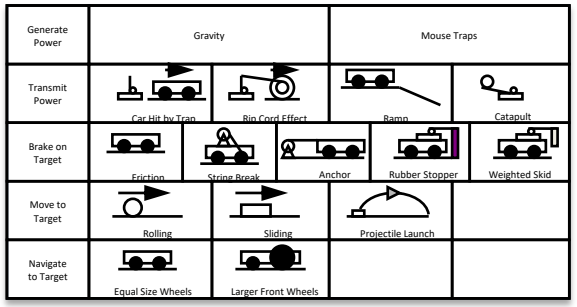
Changes	D/W	Requirement	Responsibility	Source
	D	Aide Recovery Efforts by Scoring Points	Design Team	Team
		Geometry		
	D	Starting Length: Maximum 23 inches	Design Team	ME2110 Specs
	D	Starting Width: Maximum 11 inches	Design Team	ME2110 Specs
	D	Starting Height: Maximum 17 inches	Design Team	ME2110 Specs
		Forces		
	W	Weight: 30 lbs	Design Team	Team
		Maintenance		
	W	Reset Time: Maximum 4 minutes	Design Team	Standard

Function Tree

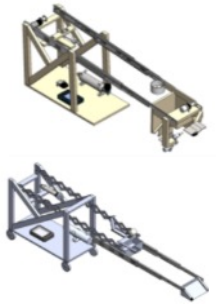


Concept Generation

Morphological Chart



Design Alts.

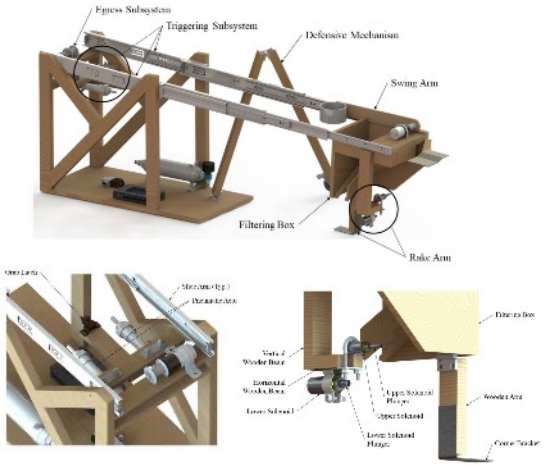


Concept Selection

Evaluation Matrices

Criteria	Importance	Design 1		Design 2	
		Rating	Weighted Total	Rating	Weighted Total
A					
B					
C					
Total					
Relative Total					

Final Design



Week 4 – brainstorming session

Activity 1

- 10-minute discussion
- Brainstorm customer needs and engineering requirements
- 1-2 minute report out

Activity 2

- 10-minute discussion
- Brainstorm specifications for supporting engineering requirements
- 1-2 minute report out

Activity 3

- 20-minute discussion
- Brainstorm functions and mechanisms, use of power sources and triggering, as well as sensors for control
- 1-2 minute report out

GEORGIA INSTITUTE OF TECHNOLOGY
George W. Woodruff School of Mechanical Engineering
ME 2110 - Creative Decisions and Design, Fall 2021
Studio #3 – Final Project Brainstorming

Studio Description: This week you will work in groups of four to five students to conduct a brainstorming session on the final design project. You will be given 10 minutes at the beginning of studio to review the final design problem and rules of the competition.

Activity 1: You will be given 15 minutes with your studio group to brainstorm customer needs and engineering requirements to fulfill each need for this project. Develop an initial prioritization rating for each customer need and have a reasonable justification of why you assigned a specific prioritization rating for those needs. Needs can include performance on main competition tasks, overall aspects of the final design in terms of usability, maintenance and performance. In terms of prioritization of these needs, you should have a logical reason for numbers assigned. For example, if scoring on a particular task is a customer need and given a high rating relative to another main element, then you should have a logical reason for that. Usability, maintenance and performance of your system might be related to major needs in terms of how the team is using the final robot. Brainstorm engineering requirements as well that are tied to these customer needs. Develop a quick assignment of relationship values (e.g., 1, 3, 9) for each customer need to each engineering requirement and determine important engineering requirements for your design. Brainstorm some tradeoffs in design you will have to make for the most important engineering requirements. At the end of the 20-minute period, you will be asked to give a brief 1-2 minute oral explanation of the most important and least important customer needs, as well as the most important and least important engineering requirements. You are welcome to use a working document/slide for this purpose.

Activity 2: You will be given 15 minutes with your studio group to brainstorm specifications to support meeting of the engineering requirements. These specifications should be measurable and tested during the fabrication and assembly of your robot. They can include aspects of average performance, team performance, geometry, timing, setup, maintenance/failure, etc. Your team should use back of the envelope calculations where needed to demonstrate that specific values were arrived at in a reasonable manner. At the end of the 20-minute period, you will be asked to give a brief 1-2 minute oral explanation of some critical specifications, as well as from where they were derived.

Activity 3: You are given 15 minutes to brainstorm functions for the device and mechanisms to potentially address these functions. For each mechanism, develop some alternatives for how these mechanisms can be powered and triggered using the mechatronics components and other power sources available in the competition. Discuss which of these power sources might be most attractive for critical higher value tasks given their physical capability (e.g., speed, force, controllability, reliability). Discuss what kinds of quantitative analyses might be helpful to support such a power source allocation. Discuss sensors or sensing mechanisms that might be useful for overall control and which might be most attractive for their performance capabilities (e.g., sensitivity, reliability). At the end of the 30-minute period, you will be asked to give a brief 1-2 minute oral explanation of some these functions and mechanisms and thoughts on how power can be allocated effectively.

Swaghetti Bois

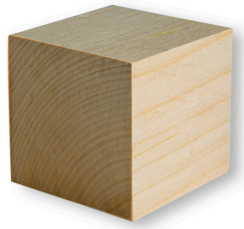
Dillon Wells
Jeonghun Lee
Philip Sneller
Tim Foster

Final Design Project

Specification: ME2110 website

Primary Tasks

- Rescue Buzz (avoid Aliens)
- Launch the Rocket
- Return RC cars

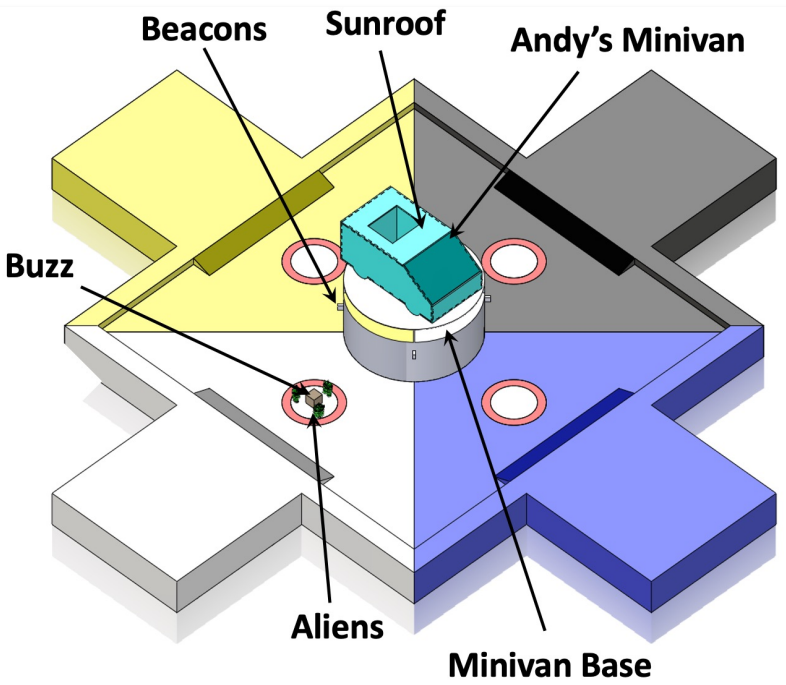


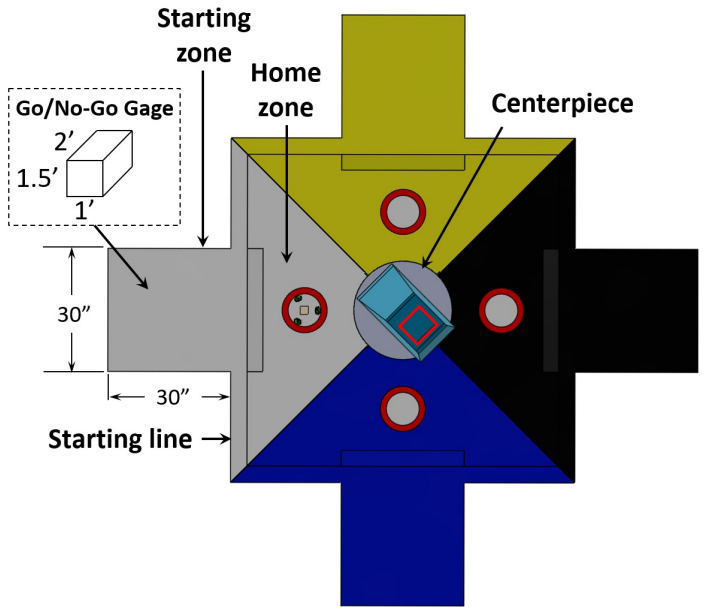
Buzz

Aliens

Rocket

RC Cars





Competition Requirements

- Device can not be placed on track until track judge signals start of the round.
- You will have 3:00 to get your device ready and set for the start of the round.
- Your device must clear a go/no-go volume and height gage (the box) to compete.
- Before the start of a round in the competition, your device must be set in a condition such that it is: (1) static, (2) has cleared the go/no-go volume and height gages and (3) behind the starting line.
- Your device must be plugged into the track and all competition items must be loaded before clearing the go/no-go gage. After clearing the go/no-go gage, you will only be allowed to translate your system on the starting zone.
- Your system must be deactivated and static at the end of the 40 second round, failure to do so will result in disqualification.
- The source of power in your device is limited to the five mousetraps provided to you, power provided to your system from a controller box, the mechatronics kit components, 5 rubber bands, and gravity.
- Limited to $100 final BOM.

Clearing go/no-go gage

Goal: Box must be cleared and hands off within 3m

To clear the box:

Device must fit inside the box

All competition items must be loaded before boxing

Wires, cables, tubing must be plugged in before boxing

All pneumatics must be charged before boxing

Nothing can expand (e.g., bloom) when picking up box

Must be static when picking up box

No adjusting of any mechanisms after clearing the box

Tips:

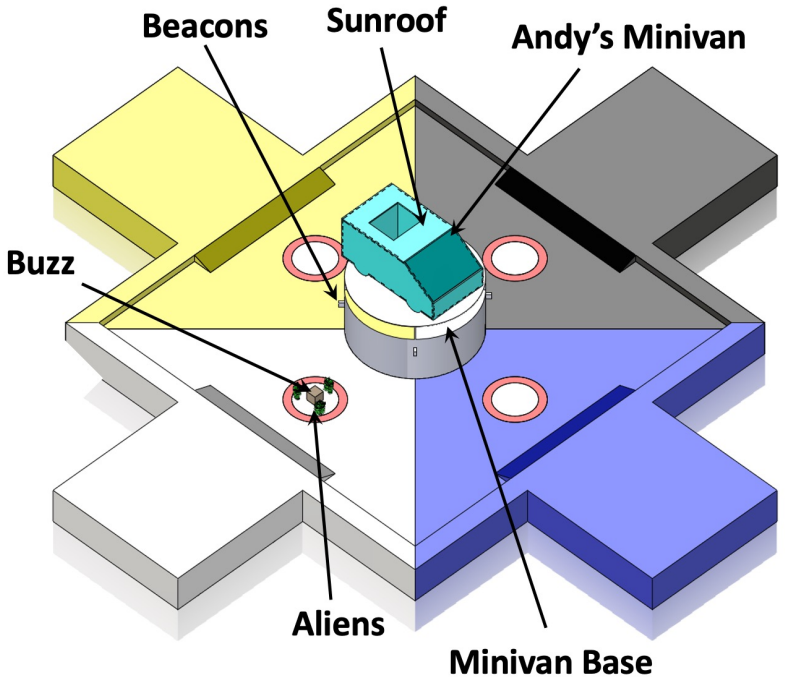
Work together and build in allowances

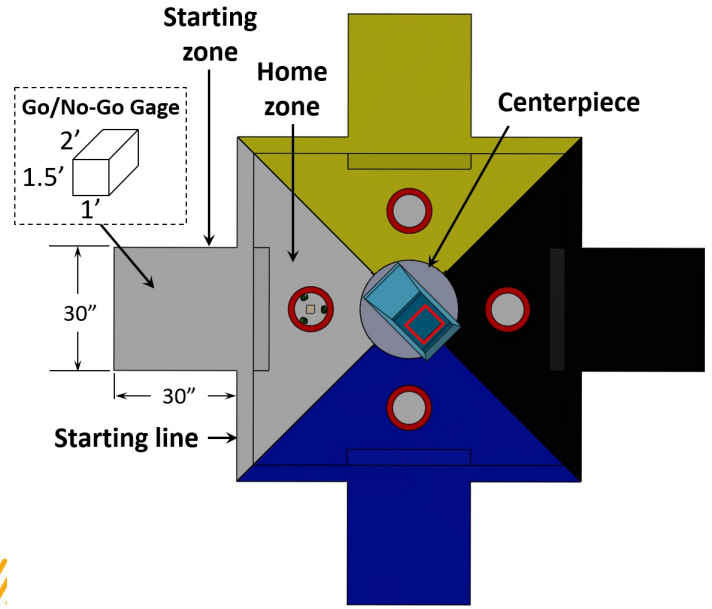
Practice and time yourselves (e.g., specification sheet!)

Task points

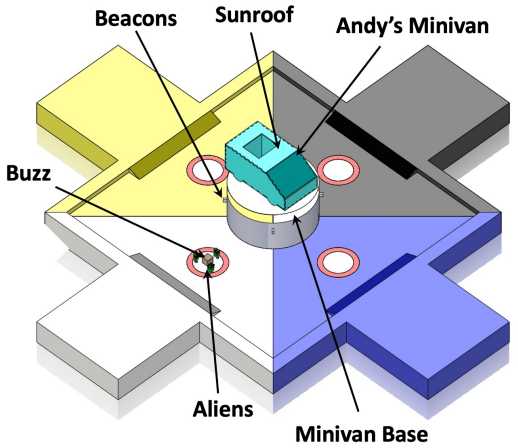
Task	Task	Competition Point Value
1	Launch	5 points for successful deployment
2	Rescue Buzz with the Claw	36 points for Buzz in fully/partially in team's starting zone 18 points for Buzz fully outside zone 2 12 points for Buzz partially outside zone 2 3 points for each Alien fully inside zone 1 1 point for each Alien partially inside zone 2 0 points for each Alien fully outside zone 2
3	Launch Rocket To Infinity and Beyond	20 points for rocket clearing 42 inches above competition floor 10 points for rocket clearing 36 inches above competition floor 5 points for rocket clearing 24 inches above competition floor +30 points for highest rocket in round* +10 points for second-highest rocket in round*
4	Return RC Cars to the Minivan	15 points per RC in the top of the Minivan Sunroof 7 points per RC in team's marked quadrant in Minivan Base
5	Egress	2x points T4 score for full egress (from center and start)

* All rockets reaching 100 inches will receive 20+30 = 50 points.





Competition Scoring



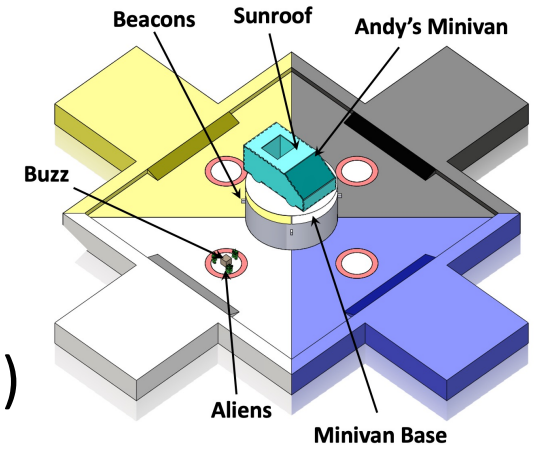
Sprint 1: all tasks (week 8)

- Task 1: launching the system (5 points)
- Task 2: partial Buzz rescue (12 points)
- Task 3: launch rocket 24 inches above competition floor (5 points)
- Task 4: 1 RC Cars in team's marked quadrant (7 points)
- Scoring: 3 trials, maximum grade is 29 points/trial, grade will be the average of all trials.

Sprint 2: all tasks (week 11)

- Task 1: launching the system (5 points)
- Task 2: full zone 2 Buzz rescue and 1 Alien fully within zone 1 (21 points)
- Task 3: launch rocket 36 inches above competition floor (10 points)
- Task 4: 2 RC Cars in team's marked quadrant (14 points)
- Scoring: 3 trials, maximum grade is 50 points/trial, grade will be the average of all trials.

Competition Scoring



Final: all tasks (week 12)

- Task 1: launching the system (5 points)
- Task 2: full zone 2 Buzz rescue and 2 Aliens fully within zone 1 (24 points)
- Task 3: launch rocket 36 inches above competition floor (10 points)
- Task 4: 2 RC Cars in team's marked quadrant (14 points)
- Scoring: 3 trials, maximum grade is 53 points/trial, grade will be the average of all trials.

Robot/tool storage and demerits

Shelves can be used for robot storage

Mechatronics kits should be stored in cabinets at front of laboratory

Materials cannot overhang past team tray boundary

Demerits (e.g., stewardship grade) will be issued if materials are stored unsafely

Competitions and Reports/Presentations

Schedule and grading:

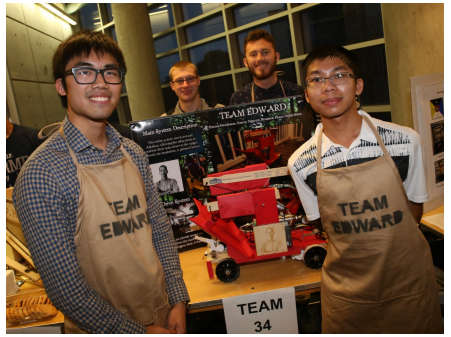
Competition (type)	Week	Date	% of Final Grade
Competition 1 (studio)	8	October 11-15	2%
Competition 2 (studio)	11	November 01 - 05	3%
Final (class-wide)	12	November 12	5%

Report/Presentation	Week	Date	% of Final Grade
Design	6	Sept. 28 – Oct. 1	10%
Alternatives	9	Oct. 19 – 22	10%
Final	13	Nov. 16 - 19	15%

*All report descriptions are provided on the ME2110 website

Design review

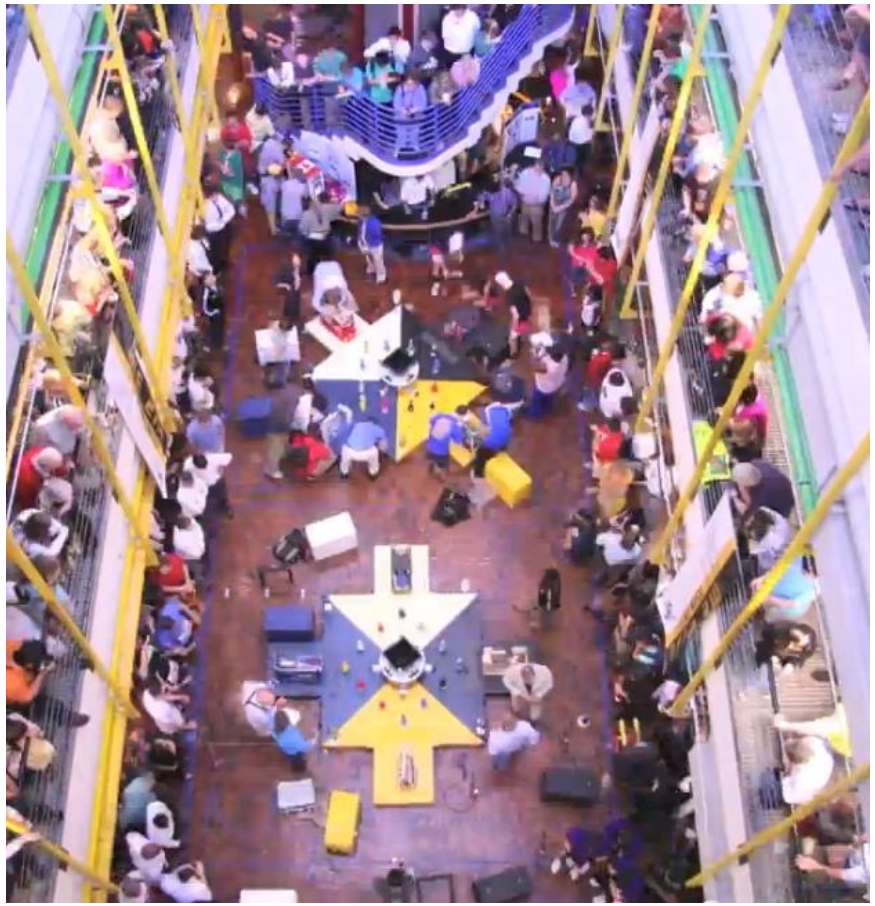
- **Save the date**: **430-6PM on Friday November 12, 2021**
- **Attendance**: all students must attend and participate
- **Format:** in-person in Love Building
- **Grading**: accounts for 5% of overall course grade
- **Presentation items:** system design, fabrication, operation, performance
- **Evaluators:** corporate sponsors, faculty, graduate students
- **Evaluation categories:**
  - Design ingenuity (design creativity, design approach, design performance)
  - Fabrication (methods, cost, material utilization)
  - Presentation (oral communication, visual communication, presentation style)



*All of these teams were in the top 10 design review.

Final competition

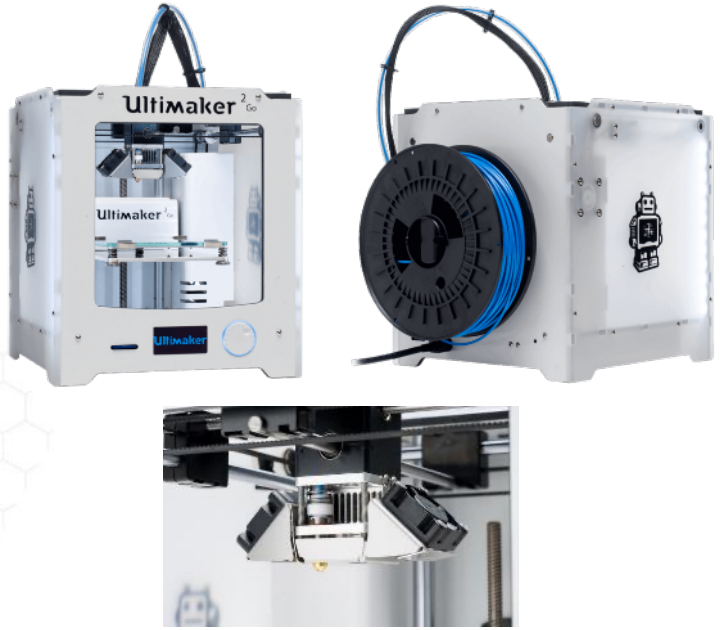
- **Save the date**: **6PM-close on Friday November 12, 2021**
- **Attendance**: all students must attend and participate
- **Other attendees:** friends, family, corporate sponsors, faculty, students
- **Format:** in-person in GTMI Building
- **Grading**: accounts for 5% of overall course grade
- **Competition details:**
  - Head-to-head event
  - All teams compete in 2 rounds used for determining final competition grades
  - Rounds 3 onward used to determine winners
  - To advance to round 3 and beyond, team must have placed among top two teams in a prior round



On in-laboratory work

Laser Cutter

3D Printers



- Utilize CAD-based design for manufacturing (potentially quicker design revisions)
- Maximize your utilization available for these equipment by preparing job files ahead of time, do not waste time in Inkscape and Cura when using your budget allotment!

IDEA laboratory studio hours

Open studio schedule

- Monday – 930AM-9PM
- Tuesday – 8AM-9PM
- Wednesday – 930AM-9PM
- Thursday – 8AM-9PM
- Friday – 8AM-6PM
- Saturday – closed
- Sunday – 12PM-9PM

*You may not enter the IDEA lab when it is not staffed (e.g., outside of open studio or section)

Competition thoughts

Communication is key, develop a strategy, stick to it

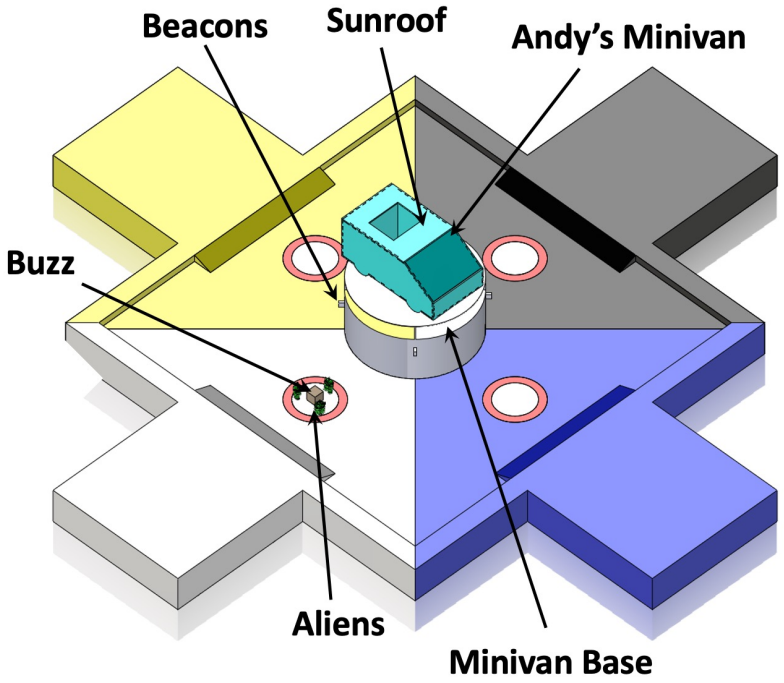
Build early, constant vs ramped effort

Learn from others

Reliability and repeatiblity

- Mechanisms – careful with springs, alignment
- Triggering – careful with strings
- Boxing – make this easy as possible
- Setup procedure – have a list, physical guides
- Teamwork

Practice on the track

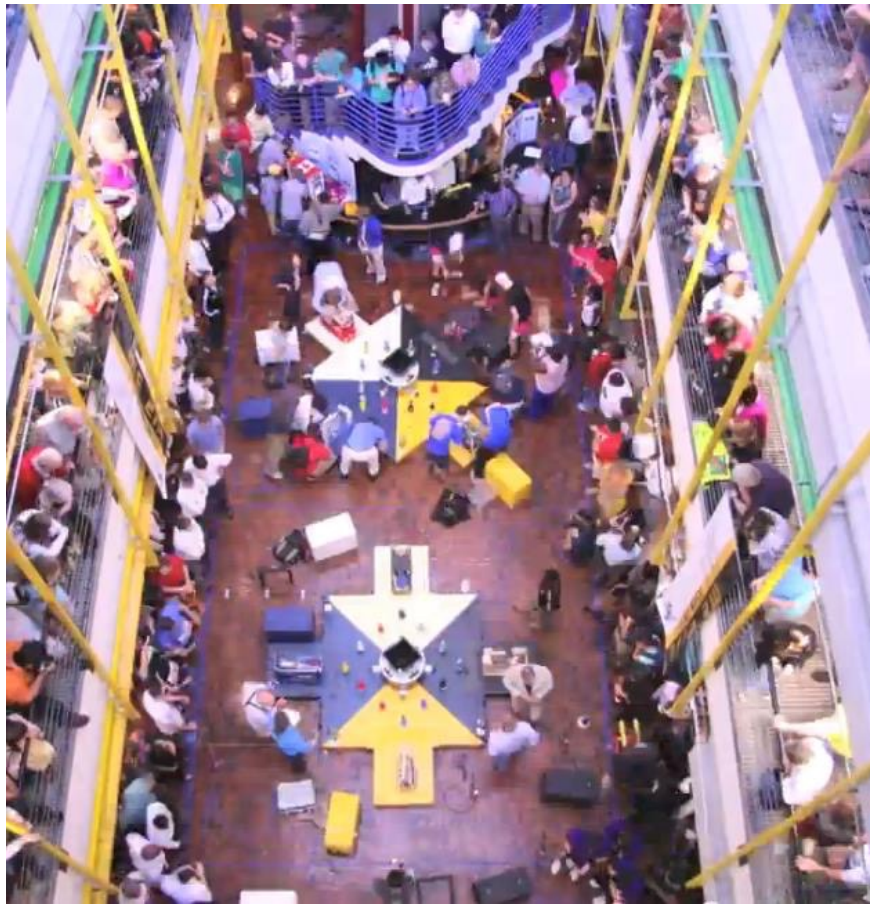


Mark your calendars!

Design review: 430PM-6PM on Friday, November 12

Final competition: 6PM-close on Friday, November 12

Guests/friends/family are welcome to attend, invites to follow



Final Design Project

Learning Objectives:

- Apply structured design process in a team environment
- Apply basic fabrication to produce a physical design to functional spec
- Simulate, build and test designs to accomplish a physical task
- Communicate design outcomes (writing, presentation)

Helpful Materials:

- Past competition pictures / video: ME Flickr, ME Youtube
- Youtube: past designs, ideas
- Material sources: Home Depot / Ace Hardware / McMaster-Carr / Amazon
- Invention studio: laser cutters, 3D printers, etc.
- Mechatronics CAD files: ME2110 website (resources tab)

Appendix – Communication/Teamwork

Notes on teamwork/communication

Due to our schedules, we struggled to meet as consistently as we would have liked.

Earlier deliverables were not our strongest work because we all left it for the last minute due to our other assignments so it was stressful having to coordinate the report and presentation the couple days before hand, especially since we were not together and had to coordinate the assignment via group messages and emails. However, the final report worked out much better because we instead meet up and sat down together to work out all aspects.

We still had communication problems, namely not responding to messages in a timely fashion so we ended up having to rush a lot of the work and stress even though we allocated roles for each person. I think we should have met more in person versus just allocating roles so that everything would flow more, not be as rushed, and it wouldn't be up to one person to edit everything the morning before class.

Synchronizing when the work gets done. Doesn't really depend on the individuals, sometimes others have lots of stuff to do while others don't have as much.

Lack of communication and equal input was definitely prevalent amongst some members.

We may have been able to communicate better so that individual work goes well together with each other's and it can then be seamlessly integrated into a single report. Sometimes the work a person did was not what someone was expecting which delayed things a bit

As a whole, there was a little too much procrastination than what I am used to.

We tend to split hairs a lot and overthink design aspects, failing to address other aspects. We don't come to a consensus quickly enough which is limiting the amount of time to do other things.

Notes on teamwork/communication

Everyone did their deliverables well and on time without much reminding. We met to discuss the status of everyone's work and if anyone needed help but everyone appeared/and did have their work under control!

Our team communicated well and got the work done in an adequate amount of time. No one person made all of the decisions and everyone listened to the suggestions of other and didn't shy away from asking for help when needed. This made our meetings run smoothly and helped us stay on track with what we were working on.

We were able to effectively delegate tasks to each person and accomplish our goals on time.

We were always in constant communication with each other every step of the project. We always met the deadlines we set for ourselves. We all worked hard enough to make the overall quality of our project as good as we wanted it to be.

We implemented a better form of communication. Our group met multiple times before deadlines and we divided up segments of the work to allow for more efficiency. We exchanged ideas and collaboratively discussed ways to make our deliverables more thorough.

Our group worked very well. We exploited each other's strengths to allocate work and finish up in time.

All of us were willing take on equal parts of work. We all showed up on agreed meeting dates and times. Everyone's opinions were heard.

Although specific parts of assignments were delegated to individual group members, each member did a good job of asking for feedback from his teammates. Likewise, the teammates were proactive in reviewing each other's' work to give quality feedback.

Frequent meetings have helped us keep a close track of what is not started, in progress, and completed. This is accomplished either in person or online. We have also split up tasks and brought them together to review/edit.

The group works really well on communicating our progress and we utilize Google Drive so we can easily help each other whether it be checking others' work or offering assistance.

Notes on teamwork/communication

We tend to not work ahead.(Last minute)

When certain members do not respond on GroupMe or show up to outside meetings it makes it hard to complete assignments. It is also hard to coordinate things when they do not meet with the rest of the team after lecture.

Not all group members completed the work they said they would before attending meetings.

In terms of cooperation and communication, there weren't really any difficulties. However, when we were assigned work due next meeting, some of us did not have it completely done, which delayed our completion and decreased our efficiency of the group meeting when we got together. But in general, we worked cohesively and cooperatively.

Finding time to meet up (especially with the whole team) was difficult, particularly with some of the team living off campus. Time management was also challenging, as we definitely underestimated the amount of work certain assignments would entail.

We spent less time reviewing our work than we should have. We worked quickly and didn't leave enough time at the end to go over very much.

The only thing to work on is starting the project earlier in order to better space out the work load.

The only thing I would say about this group is that we are all busy, so it was hard to schedule time to meet. However, we all could make it work and get everything done.

The only major problem came with trying to find a time to meet up since each of us had various other extracurricular activities. As a result, some people missed sections of some of the meetings.

We accomplished our task on time and performed well, it was just stressful to be working up until the last minute. Time management is a skill we will need to work on in the future.

Communication about task delegation was poor at times. The team left a good portion of work for the night before due dates

Trying to manage schedules was very difficult. GroupMe and Google Docs definitely helped, but each member seemed to be busy when others were free.

Notes on teamwork/communication

Google drive works well as well as actually meeting in person. We are more efficient when working together

The group continued to have solid communication. We maintained a divide and conquer mentality when approaching all parts of this project, and it worked perfectly. Everyone successfully completed their respective individual assignments and contributed to all group discussions. We completed everything with time and even requested feedback multiple times from the instructor to further improve our deliverables.

We divided work effectively and everyone contributed. Our group completed some work early and were able to take the pressure off later assignments.

The communication between the groups was very well organized. When we set a time for a group meeting, the group was prompt on time ready to work. In terms of cooperation, although some parts were individually divided, the overall work was reviewed by all of the group members and thus was cohesive.

Utilizing tools like GroupMe and Google Drive to organize our communication and documentation. Creating task lists to break up the workload also helped us take individual efforts and turn them into collaborative deliverables.

We maintained communication outside of class/studio very well. There was never real need for delegation because everyone would volunteer or jump at a task. Everyone did something and gave valuable input. We began working early on; not much procrastinating at all.

The google drive that was set up allowed us all to work on things in our own time, so that worked well. The quality of our deliverables was also satisfactory because of each individual group members strive to do the best they can.

We all did a great job of cooperating and communicating when we would be available to work together on the Project. We recognized that at times it is best to work separately and then come together to discuss work we had accomplished and then combine thoughts and ideas.

We also made great use of everyone’s individual strengths such as technical writing, creating a presentation, or modeling in Solidworks.

Meeting earlier in the week and multiple times for shorter sessions made meetings more productive