

2016 BMES DESIGN COMPETITION

Hosted by the UT Biomedical Engineering Society

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DESIGN CHALLENGE

Parkinson's disease is a progressive disorder of the nervous system that affects the ability of fluid movement. It develops gradually, sometimes starting with a barely noticeable tremor in just one hand, but in late stages patients experience stronger symptoms, making them unable to perform daily tasks or live on their own. The tremor causes people to regularly spill food or require assistance when eating. As a result, products such as stabilized utensils (liftware.com) have been developed and marketed to Parkinson's patients.

Inability to eat independently is a huge disability not only for those with Parkinson's disease, but also for amputees or patients with paralysis or muscle weakness. The objective of this competition is to design a robotic device capable of scooping various foods from a bowl and bringing the food to the mouth of a seated individual. Food items will be solid, and the device must raise the next scoop in response to a stimulus. Once the device is set up, the user should be able to eat a meal without the use of arms or hands-- keep this in mind while designing your machine.

PROPOSAL

Each team must submit a design proposal by Tuesday, March 8th, 2016 at 5pm.

Proposals will be evaluated and selected teams will be notified by 10am on March 9th.

Part 1: Purpose of Proposal

Design proposals will be used to select qualified and motivated teams to participate in the Spring 2016 Design Competition. While we would like all students to have the chance to participate, due to limitations in the number of LEGO Mindstorm kits, funding, and space, we have to restrict the number of teams in the competition. The proposal is an opportunity for students to exhibit their motivation for competing and to describe their ideas about how to overcome this year's design challenge.

Each group will give a ten-minute presentation on the day of the competition, describing the background, motivation, defense and demo of their robotic design. The proposal is meant to initiate and accelerate the brainstorming process as

well as aid students when it comes time to put together final competition presentations.

Part 2: Format of Proposal

Each formal proposal should be limited to 1-1.5 pages and should include the following sections:

1. **Introduction:** short statement of purpose and the inspiration for the design
2. **Design Idea(s):** at least one; multiple variants are acceptable
 - i. **Materials:** main additional items used (e.g. wooden platforms, rubber bands, electrical tape for support, etc). See the rules section below for budget limitations and use of personal items.
 - ii. **Methods:** basic outline of proposed implementation (a diagram or drawing is recommended)

Providing detailed design descriptions is encouraged, however this is a creative exercise. We do not expect a final product. While the proposal will require time, it is also an important preparatory step for each team as it is meant to aid in development of solution ideas as well as provide preparation for final group presentations for the day of competition.

Part 3: Judging

Proposals will be graded based on feasibility, presentation, creativity and individuality of ideas. Each proposal must address how to best automate the task at hand. Clearly state the purpose of design components/layout so that application readers will understand the motivation behind the design.

Part 4: Submission

Proposals are due by **5 pm on March 8th** via email to designcomp.texasbmes@gmail.com by one group member, with subject line: "2016 Design Competition Proposal: Team Name". You will receive a confirmation email that will be sent to ensure that the proposal has been received.

LEGO Mindstorm Kits

Rules:

Each selected team must submit a **\$100 deposit** before receiving a robotics kit. The deposit check will not be cashed unless the robotic kit is damaged and/or parts are lost. Additionally, if all members of a team drop out of the competition prematurely (i.e. before the competition day), deposits will not be returned. Since deposits are made on a team basis, if individual team-members drop out of the competition, the rest of the team will still be fully refunded if they present a robot at competition and parts of the kit are not lost and/or damaged. **All members of each team will also be required to sign a form consenting to pay for all damaged and/or lost parts of the kit that are not covered by deposit fees.**

Teams are allowed to spend up to \$50 on their additions to the given kit, and up to \$30 will be reimbursed by BMES. Be wary of the spending limit if your team decides to use items which you already possess. On the day of the competition, teams must provide a list of all additional items used and estimate the price of personal items used. Original receipts must also be provided to receive the reimbursement. Reimbursement and prize money will be given out upon return of a complete kit. **Keep in mind that we cannot reimburse edible items.**

Components:

Each kit includes:

- three NXT motors with encoders
- two touch sensors that react to touch and release
- a color sensor that detects different colors and light intensity
- an ultrasonic sensor that measures distance and movements, and detects objects
- in addition to these main components, a list and description of the many kit robot-building components can be found at <http://shop.lego.com/en-US/LEGO-MINDSTORMS-NXT-2-0-8547> and a picture can be found below:



TASK

Your team must autonomously pick up three different kinds of food from a bowl placed in front of the person you will be feeding. Potential foods that may be used include grapes, cereal, M&Ms, etc. These are not guaranteed to be the food items used but are just ideas so that you consider all different shapes and textures of food. All teams will be tested with the same food items on the day of the competition. Your robot must scoop up the food somehow and then feed it to a seated individual. The device must raise the next scoop in response to a stimulus of your choice (cannot require limb or hand motion). For your ease, you may choose a group member to test the robot on during the presentation and adjust the chair height accordingly. Keep in mind that judges will take into account extra abilities, such as accommodating for variable heights or responding to the location of the mouth. The machine must complete the whole procedure alone during the presentation without any human aid. Your team will have unlimited tries in the given time period or until there is no food left in the bowl. Manual resetting of the machine is allowed in between tries. The time used to accomplish the task starts with the first attempt and will continue until the task is finished, or until time has run out. Each team will be given 10 minutes to present their robot. The amount of time from

those 10 minutes allocated for each the presentation, demo, and questions is up to each individual team's discretion, but all three must be completed.

COMPETITION DAY

Presentation and Task -- 10 minutes per team

Judges -- Professors and industry leaders will evaluate presentations and performances based on the following guidelines:

- Successful completion of the task (most important)
 - Effectiveness of Automation
 - Speed
 - Accuracy
- Design Process
 - Constructive Iterations
 - Solutions to Design Complications
 - Creativity of Design
- Presentation (of least importance compared to other tasks)
 - Design Defense
 - Preparedness and Speaking
 - Professionality

IMPORTANT DATES AND DEADLINES

Tuesday, March 1: Kick-off

Tuesday, March 8: Proposals due by **5pm**, emailed to designcomp.texasbmes@gmail.com by one group member, with subject line: "2015 Design Competition Proposal: Team Name"

Wednesday, March 9th at 10am: Selected teams notified; teams may pick up kits in the BME Advising office from March 9-11. If you are unable to pick up a kit between this time frame, please contact us via email to schedule a different meeting time. However, please keep in mind that this is the week before Spring Break.

- Make sure to sign a disclaimer form (which will be emailed out to selected teams).
- Submit the \$100 deposit (check or cash) in an envelope labeled:
 - "BMES Design Competition Spring 2016" and
 - "Your Team Name"
 - Put disclaimer forms (signed by all team members) in an envelope

Saturday, April 9: Competition will start at 10:00 am in the BME Seminar Room (BME 3.204)

April 11: Return Lego Mindstorms kit and submit receipts for reimbursements on any purchases of up to **\$30**.