2017 BMES DESIGN COMPETITION

Hosted by the UT Biomedical Engineering Society

Contact Email: designcomp.texasbmes@gmail.com

DESIGN CHALLENGE

The future of patient care is likely to contain robots which can perform minor medical procedures. These machines would significantly reduce healthcare costs and allow nurses and hospital employees to dedicate more time to other procedures that may not be as easily automated.

When it comes to treating wounds, time and precision are essential to ensuring proper recovery. The complications that can occur from improper treatment are numerous. Improper sterilization can lead to infections which can rapidly spread to other parts of the body. And of course, if wounds are not properly bandaged, blood loss can lead to low blood pressure, stroke, and death. A simple cut can often turn into a more serious condition if sterile techniques are not followed, costing a patient gratuitous time and money.

The objective of this competition is to create a unit capable of detecting, cleaning, and bandaging a wound.

PROPOSAL

Each team must submit a design proposal by Monday, February 27th, 2017 at midnight. Proposals will be evaluated and the eight selected teams will be notified by noon on March 1st.

Part 1: Purpose of Proposal

Design proposals will be used to select qualified and motivated teams to participate in the Spring 2017 Design Competition. While we would like all students to have the chance to participate, due to limitations in 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 **11:59pm on February 27th** via email to designcomp.texasbmes@gmail.com by one group member, with subject line: "Team Name: 2017 Design Competition Proposal." 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 design a robot that will be able to autonomously provide first aid to a wounded person. The wound will be located on the forearm in this competition. The robot must be able to correctly identify a wound on a person's forearm utilizing any of the resources at your disposal; creativity will be a factor in the judging. The wound will be composed of some type of viscous fluid, such as ketchup, mustard, or a similar medium that will not be too difficult to remove. Also, the dimensions of the wound will not exceed around 2 cm by 8 cm. One of your teammates will act as the wounded patient (we will prepare the "wound") and may position his/her hand wherever, so long as it is not moved once the challenge begins. Your robot must be programmed to clean as much of the wound as possible in any way your team can come up with. However, how efficiently your team's robot can clean the wound could be a deciding factor in the judging phase. Lastly, after cleaning the wound, your robot must then pick up a provided 5 cm width compression wrap with a total length of 45 cm and conceal the wound. The wrapping must completely cover the wound in order for your team you succeed in completing the challenge. 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 the presentation or the demo is up to each individual team's discretion. A 5 minute Q&A session with the judge will follow after the presentation.

COMPETITION DAY

Presentation and Demo -- 10 minutes per team
Q&A with judges -- **10 minutes**
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
    - Design Defense
    - Preparedness and Speaking
    - Professionalism

IMPORTANT DATES AND DEADLINES

Thursday, February 16: Sign-ups close, Challenges sent shortly after

Monday, February 27: Proposals due by **11:59pm,** emailed to designcomp.texasbmes@gmail.com by one group member, with subject line: "Team Name: 2017 Design Competition Proposal"

Wednesday, March 1st at 10am: Selected teams notified; teams may pick up kits in the BME building on March 3 or 6. If you are unable to pick up a kit between this time frame, please contact us via email to schedule a different meeting time.

- 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 2017" and "Your Team Name"
    - Put disclaimer forms (signed by all team members) in an envelope

Saturday, April 1: Competition in the BME Seminar Room (BME 3.204)

Week after the competition: Return Lego Mindstorms kit and submit receipts for reimbursements on any purchases of up to **$30.**