2014 BMES DESIGN COMPETITION

Robotic Suturing

DESIGN CHALLENGE: *To design a robotic device capable of removing a tumor (plastic toy) from tissue (gelatin-like clear plastic) with as little tissue disturbance as possible..*

PROPOSAL: *Each team must submit a design proposal due by Friday, February 7, 2014 at 5pm. Proposals will be evaluated and selected teams will be notified February 8, 2014.*

Part 1 - Purpose of Proposal:

Design proposals will be used to select qualified and motivated teams to participate in the Spring 2014 Design Competition. While we would like all students to have the chance to participate, due to a limitations in number of LEGO Mindstorm kits, funding, and space, the number of teams in the competition must be restricted. The proposal is an opportunity for student to show exhibit their motivation for competing, as well as their ideas on how to overcome the challenging nature of this year's design competition.

Further, each group will give a ten-minute presentation on the day of competition, describing the background, motivation, defense and demo of their robotic suturing device 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 between 1-2 pages and should include the following sections:

1. **Introduction**: detailing the Reason of Interest and how the design will aid surgeons in the suturing procedure.
2. **Materials**: should include main additional items used (e.g. wooden platforms, rubber bands, electrical tape for support, etc). See rules section below for budget limitations and use of personal items.
3. **Methods**: basic outline of design idea(s) and proposed implementation.

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 and feasibility 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 **6 pm on February 7, 2014** via email to poorvi_bhargava@utexas.edu by one group member, with subject line: "2014 Design Competition Proposal: Team Name". A confirmation e-mail will be sent upon receipt of proposal to ensure that the proposal has been received.

LEGO Mindstorm Kits:

Rules:

Each team-member must submit a **$20 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 an individual basis, if individual team-members drop out of the competition, the rest of the team will still be fully refunded if it presents 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 $100 on their modifications 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 is a consulting firm for which a doctor

Your team is a consulting firm for which a doctor has hired you to make suturing surgical incisions easier for him. The doctor regularly creates straight line incisions, about 5 inches long, for which he is looking to automate. Your task is to automate all or any individual part of the task of suturing using a LEGO Mindstorms Kit which will be provided to you. You must research the task at hand (i.e. techniques, etc.) and apply what you learn to create a functional design.

On the competition day, you will have 10 minutes to present to the judges. You must justify why you chose to automate the part of the process which you chose, why you used the materials which you did, and show a demo of how your robot works on a model which will be provided to you. The model will consist of layers of felt - representing skin. Your suture should penetrate the felt model at a depth of about 5-6mm (about 3 layers of felt). We will provide you with the LEGO Mindstorms kit, curved suturing needles, and felt for practicing on. During the demonstration, focus on defending your design and selling your product. Show that you have made the most valuable use of your time and the doctor's money (practicality, ease of use, functionality).

COMPETITION DAY:

Presentation and Task -- 10 minutes per team

Judges -- Professors and industry leaders will evaluate presentations and performance based on the following guidelines.

- Design Process
    - Customer satisfaction: How much does your design help the doctor?
    - Ease of use: Is the design overly complicated?
    - Effective automation: How much of the task has your robot completed and does it actually make sense for the doctor to invest in your product idea?
    - Speed: Does the device execute its function in a reasonable time frame?
    - Quality of suture: How much damage to the underlying tissue did the procedure cause? How neat is the suture?
    - Creativity of Design: How resourceful was your design?
- Presentation
    - Design defense: How convincing is your argument for the design?
    - Preparedness and Speaking: Make sure you can answer questions about your design.
    - Professionality

IMPORTANT DATES AND DEADLINES:

January 24: Turn in a sign-up sheet
February 7: Proposals due by 6pm, emailed to poorvi_bhargava@utexas.edu by one group member, with subject line: "2014 Design Competition Proposal: Team Name"
February 8: Selected teams notified.
February 9: Teams may pick up kits from 12 - 5pm in the BME Lobby. 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 a $20 deposit **PER PERSON** (check or cash) in an envelope labeled:
    - "BMES Design Competition Spring 2014" and
    - "Your Team Name"
    - Put disclaimer form in envelope

March 21: Competition will take place on Friday evening, with presentations starting promptly at 6:30pm, and competition ending at approximately 9:00pm.
March 28: Return Lego Mindstorms kit and submit receipts for reimbursements on any purchases of up to **$30.**

Contact Info

Design Competition Chair**:**

Poorvi Bhargava - poorvi_bhargava@utexas.edu

BMES Officers:

Charlie Walker - cawalker@utexas.edu

Gunjan Singh - gunjan1@gmail.com

Committee Members:

Shafat Hossain - shafat77@gmail.com

Esteban Esquivel - estebanesquivel@utexas.edu