The Walking Dead
George W. Woodruff School of Mechanical Engineering
ME 2110 - Creative Decisions and Design

Time: 5:00pm, Friday, July 19, 2013
MaRC Building Atrium

The Walking Dead are all over Atlanta and the surrounding countryside. Humans must be intelligent, resourceful, tenacious, and ruthless if they are to survive these challenging times. ME2110 students are being asked to help in this life-and-death struggle by designing and building a machine that can help humans survive the Zombie Apocalypse.

The devices will be tested in the Walking Dead Zone shown in Figure 1. Each machine will be assigned one of the four starting areas from which it can enter the Dead Zone. Immediately in front of the starting area is the machine’s home zone that it is tasked with helping. The other three starting areas will have machines built by other teams that are also trying to help humans survive. The machines will have 30 seconds to perform the following four tasks:

1) **Kill Zombies** Two zombies (dressed up plastic bowling pins) will be standing ready in each home zone to munch on any humans that come near them. The machine should eliminate the zombie threat. For each zombie that remains standing in the home zone, the team will be penalized -10 points. If any part of a zombie remains in the zone, the team will be penalized -5 points.

2) **Collect Food.** Given that zombie flesh is poisonous, food is always in short supply. At the center of the Dead Zone is a store that still holds delicious snacks. Each snack that the machine can retrieve completely into their home zone earns 8 points.

3) **Deliver People to Safety.** Each team will be given two people to protect. The only truly safe area is the prison located in the middle of the Dead Zone. Each human that the machine delivers to the safety of the prison earns 15 points.

4) **Send an SOS.** Near the center of the Dead Zone are 4 Walkie Talkies. The first machine to send an SOS by pushing the Send button on the Walkie Talkie in their home zone will earn 16 points.

Fig 1. The Walking Dead Zone.
To help direct your team through the design process, your devices will be tested on five occasions:

1) **Individual Preliminary (Week of June 17)**
   Every student will construct his or her own device for Killing Zombies. The device will not be computer controlled. The only energy sources that can be used are gravity and 3 mousetraps. You will trigger the action of your machine using one manual motion, but you cannot transfer any significant energy to the machine during the triggering process. Your device will compete by itself in the dead zone. You will have 5 minutes to run your machine at most three times. Your score will be the sum total of your three attempts. **One percent of your course grade comes from this test.**

2) **Individual Finals (Week of June 24)**
   Your individual machine will compete in both Killing Zombies and Collecting Food. The machine must be computer controlled and triggered from the start button on the dead zone. You cannot manually start its motion. Your device can use energy from gravity, 3 mousetraps, and the pneumatic pressure vessel. You will need to coordinate testing to share your team’s controller box and pneumatic supplies. Your device will compete alone, without other machines running. You will have 5 minutes to run your machine at most three times. **Two percent of your course grade comes from this test.**

3) **Team Preliminary (Week of July 1)**
   This team-constructed machine must be computer controlled and triggered by the zone start button. You can use the entire supply kit and 5 mousetraps. The machine will be evaluated by Killing Zombies and Saving People. Your device will compete alone, without other machines running. You will have 5 minutes to run your machine at most three times. Your score will be the sum total of your three attempts. **Two percent of your course grade comes from this test.**

4) **Qualifying Round (Week of July 8)**
   Your machine will compete against other machines in all aspects of the contest. You will compete several times during the studio period, against a variety of opponents. Your score will be ranked only against teams in your studio section. The results from this qualifying round will be used to seed the brackets for the zombie apocalypse. **Two percent of your course grade comes from this test.**

5) **Walking Dead (July 19)**
   Your machine will compete in two events: the Design Review and the Zombie Apocalypse.
   a) **Design Review:** Starting at 5:00pm a panel of judges will perform a design review of your machine. You will need to describe your machine quickly and clearly to the judges that visit your machine. The judges will evaluate your team on aesthetics, ingenuity, and presentation. **Five percent of your course grade comes from this evaluation.**
   b) **Zombie Apocalypse:** Each machine will compete in three rounds of competitions. The top eight teams in terms of total score, will qualify for the semi-finals. The top two teams in each semi-final match will then battle it out in the finals. **Eight percent of your course grade comes from this test.**

### 2. DETAILS

#### 2.1 Dead Zone

The dead zone is a square with 7-foot-long sides, as shown in Figure 2. The surface is supported by 2x4’s, so it is elevated approximately 4 inches above ground. There are also 2x4’s around the top perimeter. The dead zone is divided into 4 equal size home zones of different colors. These home zones are bounded by the inside edge of the 2x4 perimeter and the diagonal dividing lines on the left and right sides of each zone. The volume of space above a zone is also part of the zone.

The Store and Prison are approximately 2 feet in diameter and rotate at approximately 6 rpm. The food is located on a level that is elevated approximately 12 inches. The prison is another 6 inches above the store level. **Your device should be robust to uncertainties in these dimensions.**

#### 2.2 Building Materials.

Your device should not be expensive or complicated. To limit the expense and complexity of your design,
Fig 2. Approximate Dimensions of Dead Zone.

you are permitted to use energy only from the controller box, the pneumatics, five mousetraps, and gravity. Your team will be provided with a set of actuators, such as motors, solenoids, and pneumatic cylinders. No other actuators may be driven by the computer. The computer also powers the sensors, which include an IR range detector, an encoder, and some switches. You may purchase additional building materials and sensors as long as your team budget remains under $100. You are required to turn in a bill of materials with the associated cost for each part in your final report.

2.3 Contest Format

From 5:00pm-6:00pm your devices will be on display in the MaRC building for the design review. The design review score incorporates aesthetics, ingenuity, and presentation. You are allowed to “dress up” yourselves, your machine, and your presentation area in order to maximize your score. One team member will need to be in attendance during the design review to discuss the features of your machine. There will also be an award given for “Best in Show”, which does not count towards your grade. The Zombie Apocalypse will begin at 6:15pm.

2.4 Details of Competition Scoring

All scoring is based on the state of the dead zone at the end of the 30-sec competition.

Killing Zombies.

Two zombies (dressed up plastic bowling pins) will be standing in each home zone before the start of the competition. If they are not moved in a measurable way, then each one will count as -10 points. If they are moved partially out of the home zone, then they count as -5 points. Zombies originating from other zones can migrate into your zone and also subtract points.
Table 1. Scoring Summary.

<table>
<thead>
<tr>
<th>Scoring Method</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kill Zombies</td>
<td>Zombie -10, Partial Zombie -5</td>
</tr>
<tr>
<td>Collect Foods</td>
<td>Each Snack: 8</td>
</tr>
<tr>
<td>Deliver People to Safety</td>
<td>Each Person: 15</td>
</tr>
<tr>
<td>Send SOS</td>
<td>First Team: 16</td>
</tr>
</tbody>
</table>

Table 2. Grading Breakdown.

<table>
<thead>
<tr>
<th>Maximum Points</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Individual Preliminary</td>
</tr>
<tr>
<td>2</td>
<td>Individual Final</td>
</tr>
<tr>
<td>2</td>
<td>Team Preliminary</td>
</tr>
<tr>
<td>2</td>
<td>Qualifying</td>
</tr>
<tr>
<td>8</td>
<td>Zombie Apocalypse</td>
</tr>
</tbody>
</table>

Collect Food.

There will be 10 snacks located in the store. These snacks will be of various sizes, shapes, and weights. Your machine must gather the entire snack into your home zone in order to get the 8 points. Snacks only 99.99% within your zone score 0 points.

Deliver People to Safety.

To move a person (small doll) to the safety of the prison, the person must be contained completely within the prison. The prison is a hole in the center of the dead zone. No part of the person can be sticking out above the top rim of the prison. You can place the people into your machine before the start of each contest, but they cannot be permanently bonded to your machine. Each person must be able to be pulled out of the prison individually by the scoring judges - they cannot be bound together. They must be returned to the starting area during the clean-up period so that the next round can use them. Any team not returning the people will suffer a DQ in that round.

Send on SOS.

Each home zone has a walkie-talkie button that is activated by pressing a push button that is in the center of the home zone. The buttons are monitored by an electronic circuit. The first button that is pushed will illuminate a light corresponding to the home zone.

Tiebreaker.

In the case of a tie score, the following tiebreakers will be applied in order until one team is declared victorious. 1) The team with the most points from food. 2) The team with the most people safely in the prison. 3) Coin toss.

The methods of scoring are summarized in Table 1.

2.5 Grading

The 15% of your grade that comes from the performance of your machine is divided into five components, as shown in Table 2.

Individual Preliminary.

Devices that do not move or are disqualified score -30 points per attempt. Devices that score the maximum value of 0 after 3 tries will get 1 grade point. Devices that score -90 (the worst possible), will get 0 points. All other scores come from a linear interpolation between -90 (0 grade pts) and 0 (1 grade pt).

Individual Final.

Devices that do not move or are disqualified score -30 points per attempt. The sum of your three attempts will be ranked as a percentage of the scoring range in your studio section. The top scoring device will get 2 points. The lowest score will get 0 points. All other scores come from a linear interpolation between these values.
Team Preliminary.
Devices that do not move or are disqualified score -30 points per attempt. The sum of your three attempts will be ranked against teams in all studio sections. The scores are linearly interpolated between a maximum score of 2 and a minimum score of 0.

Qualifying.
Each team will compete several times. The sum total points from all tests will be used to rank the teams within the studio section. The scores are linearly interpolated between a maximum score of 2 and a minimum score of 0.

Zombie Apocalypse.
Your grade points are based on the sum total of all the points that your team scores. The team(s) with the most points earn 8 points; the teams with zero points (or less) get 0 points. All other scores come from a linear interpolation between these values.

Design Review.
The judge’s scores will be summed and divided by the number of judges that evaluate each machine. These average scores will be ranked across the entire class. The maximum score is 5 points; the minimum score is 1 point.

3. Detailed Design Constraints

1. The device must be safe. It must not have the potential to injure bystanders or yourself. It must not damage, stain, or permanently change the competition area or its surroundings. It must not scratch the floor. The faculty will disqualify any device they deem unsafe or damaging.
2. If a team is disqualified for a rules violation, then they lose the current contest in which they are competing. If the team can eliminate the violating offense, then they are eligible for future contests.
3. Your device will be assigned to a 7-minute time block. All devices will be automatically activated at 4:00 min, and must be removed by 7:00 min. If your device is not ready to go at 3:45 min, then it will be removed from competition so that the contest can start at 4:00. The contest will proceed for 30 sec. The following 2:30 min will be used for scoring and cleaning up. By the end of the 7-minute period, you must have removed your device (and any bits and pieces) and clean up the arena. Disqualification can be imposed for taking longer than your allotted time.
4. Once your device has been activated, you may not touch the device or enter the competition area until the field official indicates it is time to clear out your machine. Doing so results in a disqualification.
5. It is your responsibility to be on time with a working machine. If you are not present during your assigned time, then you are disqualified for that contest.
6. Your machine must fit within a 24 x 12 x 18 (length x width x height) inch box. The 12-inch dimension describes either the width or the length of the device. The 18-inch dimension is the maximum starting height of your system. Your device will be measured with a go/no-go box during the 4-minute setup period. When the box is removed, your machine may not “bloom” out and occupy a larger volume. Doing so requires a reboxing of the machine.
7. The device must be launched from within the 2.5 X 2.5 foot starting area outside each home zone. The outside of the lumber perimeter defines one side of the starting area. You may place your device in any configuration or orientation within the starting area; however, the go/no-go box must be able to fit over the device prior to its start. You can only reposition your device after it has been checked for size; you cannot set triggers, adjust components, turn on your controller, etc. Your machine cannot overhang into the competition area - defined by the outside of the 2x4's.
8. A three-foot perimeter around the arena, marked off by tape, will be off limits during the competition.
9. The device must be activated by using the start plugs near each starting area. The start plug circuits will be closed during the 30-sec competition, and open otherwise. Your control code must sense the closed circuit and activate its actions.
10. Power for your control box will be available from outlets near each starting area. If your computer travels far out into the competition area, you must supply your own extension cord.
11. The device must shut down at the end of the 30-sec competition when the start-plug circuits are opened. Failure to stop operations will result in disqualification. The uncontrolled release of potential energy such as in bent plastic or the release of compressed air can continue after the 30-sec period.
12. The device must operate autonomously. No remote control is allowed.
13. The device may touch or otherwise utilize any part of the arena or its surroundings. It may not utilize or interact with any living entity, such as trained monkeys, during the competition. While machines may go outside of the arena, there are no guarantees as to what will be located outside of the arena. E.g., a wall, motor, or a person may be located outside of the arena.
14. False starts that disrupt the arena such that it cannot be reset in time for the scheduled start will result in a disqualification of the offending device.
15. The source of power in your device is limited to the five mousetraps provided to you, a compressed-air tank provided to you, the controller box power, and gravity. You may not use energy that is pre-stored in your machine by other means, such as bent plastic parts that spring out during the competition. You may modify the mousetraps as needed and you can replace the mousetraps with exactly the same model if they break.
16. The only permitted actuators are those supplied to you by the ME2110 staff. (For example, no additional magnets are allowed.)
17. The pneumatic actuators given to you consist of the pneumatic piston and the tubes. The air released from the cylinder must first pass through the tubes and apply air-blowing forces, or the air must extend the cylinder to apply forces. You cannot create your own pneumatic actuator or cannon to harness the air pressure (things could get dangerous if you do).
18. Each team may not spend more than $100 on the device. You will be required to document the cost of your materials by submitting your receipts, as well as a bill of materials and costs in your final report. Material may be prorated for costs. The cost of an object is defined to be that which Joe P. Citizen must incur in obtaining the object. For donated or scrounged material, an equivalent price must be specified. The cost of the kits supplied to you is NOT included in the $100. The $100 is out of pocket expense. The School will not reimburse you for the expense.
19. The cost of any aesthetic materials (e.g., paint and stickers) and fasteners (e.g., staples, tape and glue) are not included in the $100 budget.
20. All supplies provided to you (electronics, motors, etc.) must be returned in good working order at the end of the term. Failure to do so will result in an Incomplete (I) for your course grade. No exceptions!
21. The faculty will assign the teams. The teams will remain constant for the duration of the project. The faculty has the right to remove or otherwise penalize disruptive members of any team.
22. If you do not play, you cannot win. If your device does not make any perceptible movement, then you lose that round of competition or score the minimum possible points if this occurs in a preliminary competition.
23. Swearing, spitting, vulgar scratching, or other rude behavior at the competition will result in disqualification and possibly physical expulsion from the MaRC Building.
24. Each team will be given one bowling pin to create a zombie. These zombies will be randomly distributed to the home zones. The zombie cannot weight more than 1 lb. and it cannot have appendages that stick out more than 2 inches in any direction from the surface of the bowling pin.
25. Wanton destruction of the opposing devices and/or the arena is prohibited.
26. Faculty rulings on any clarification or dispute of these rules are binding and final.