

## Homework 5: Packaging Specifications and Design

*Due: Thursday, February 17, at Classtime*

Team Code Name: \_\_\_\_\_ Group No. \_\_\_\_\_

Team Member Completing This Homework: \_\_\_\_\_

NOTE: This is the first in a series of four “design component” homework assignments, each of which is to be completed by one team member. The completed homework will count for 10% of the team member’s individual grade. It should be a minimum of five printed pages.

### Report Outline:

- **Introduction (brief description of design project, with a focus on its packaging considerations)**
- **Analysis of *at least two* commercial products that are similar to your project**
  - illustration and description of packaging used
  - discussion of positive and negative aspects of the product’s packaging
  - aspects of the commercial product’s packaging you plan to copy or adapt
  - aspects of your project’s packaging that are unique (or that differentiate it from the commercial product under consideration)
- **Specifications for the design of your project’s packaging**
  - detailed scale CAD drawing illustrating size and shape
  - materials list
  - tooling requirements
- **Estimate of packaging weight and unit cost**
- **List of references (include links to commercial products considered)**

### Evaluation:

Component/Criterion	Score	Multiplier	Points
Introduction	0 1 2 3 4 5 6 7 8 9 10	X 1	
Analysis of Commercial Products	0 1 2 3 4 5 6 7 8 9 10	X 3	
Specifications for Packaging	0 1 2 3 4 5 6 7 8 9 10	X 3	
Estimate of Weight and Cost	0 1 2 3 4 5 6 7 8 9 10	X 1	
List of References	0 1 2 3 4 5 6 7 8 9 10	X 1	
Technical Writing Style	0 1 2 3 4 5 6 7 8 9 10	X 1	
		<b>TOTAL</b>	

*Include this sheet as a cover page for your report*

The Fully Integrated Robotic Extinguisher roBot (FIREBot) will be able to detect and extinguish household fires using a fire extinguisher. The robot will be equipped with a variety of sensors to allow the device to maneuver around a house and to detect, approach and extinguish fires. The robot will be powered by an onboard rechargeable battery and controlled by an Atmel Mega 32 microcontroller. Finally the robot will have a 4 lb. fire extinguisher onboard to be able to extinguish fires.

Due to the extreme conditions the robot and it's peripherals will be exposed to, the packaging is carefully designed to protect delicate parts without sacrificing operation. One of the main considerations is the fact that the robot will be very close to fires. Due to the large amounts of heat that it will face, there is the need for a heat shield that can protect the microprocessor and some of the other various sensors. The robot will also need it's structure to be constructed using some material that is resistant to fires to prevent destruction of the robot while it is fulfilling it's duties. The other consideration is the fact that the fire extinguisher releases a chemical to put out fires and the electronic components need to be protected from this chemical.

## **Similar Commercial Components**

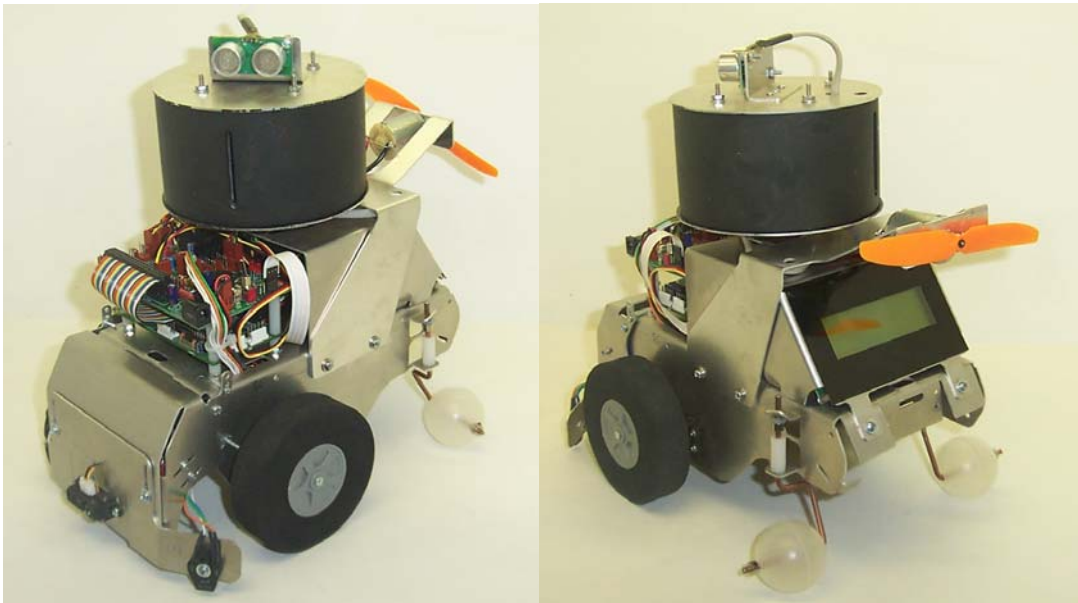
### **Trekker Fire Fighting Robot Kit**

The Trekker Fire Fighting Robot is a commercially available kit that costs about \$599.00. It includes all parts necessary to build the robot seen in figure 1 including microprocessor, motors, sensors, and housing. The design is fairly similar to ours in terms of the sensors and output devices used. One major difference however is that this kit uses a fan to extinguish fire while ours will be equipped with a fire extinguisher. The vital electronic components of the robot are housed in a chassis made of aluminum.

The Trekker kit has a nice chassis built from aluminum where the motors, LCD, PCB, and other components are located. This provides both protection as well as aesthetic value. The major problem with this is that our components are different and have different requirements. We will have a large fire extinguisher to carry around as well as a raised platform for locating and approaching the fire. Also the Trekker robot is designed to put out candle fires which do not release much heat compared to our robot which will be fighting household fires. This will require some amount of heat shielding

for our components as well. Also due to the fact that ours will be using an extinguisher to fight fires we will need to protect the electronics from the chemical as well. Finally since we will most likely be performing a large amount of modifications on the design through the testing phase, ours needs to have easily accessible parts and connections to allow easy modifications and a large empty area for additional parts we may need.

Our packaging design will be similar to the Trekker robot in a few ways but will have many more unique components. First we will use aluminum for the base, platform, and heat shielding due to it's strength and light weight. Also it is relatively heat resistant and will be able to withstand the heat coming from nearby fires fairly well. Also the sweeping platform will be constructed in a very similar way on our design and also will be created using aluminum. Beyond the materials used, our design will be significantly different. We will have a much larger base platform to allow us room to locate the extinguisher, batteries, servo, sensors, and PCB. Also due to the chemical used, we will have our PCB completely encased and protected to prevent any of the chemical from reaching the electronics. Next since we will be fighting household fires which will give off significantly more heat than a candle so electronics will need to be protected from heat as well. Finally our design will have an easy way to remove each electronic component individually to allow for testing which the Trekker does not do.

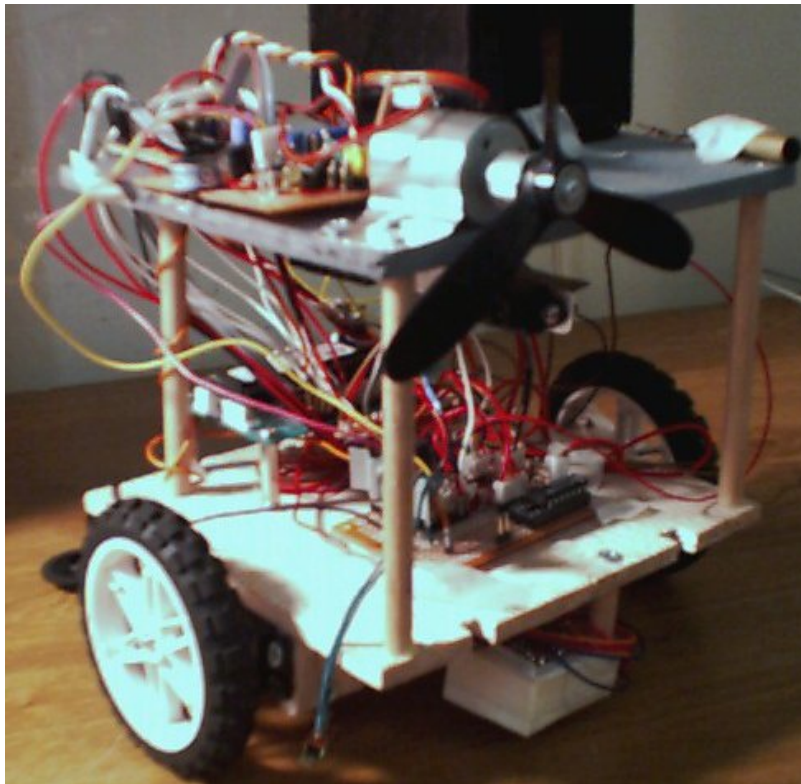


**Figure 1 – Trekker Fire Fighting Robot Kit**

## **GoRobotics.com Fire Fighting Robot**

Robots competing in the Trinity College Fire Fighting Robot Competition usually follow a similar basic packaging scheme, of which the following is a good example. The Robot below consists of two ground-parallel platforms separated by bolts. On the bottom of the base platform are mounted two drive wheels and a caster wheel. Electronics, sensors, and other motors (or sometimes servos) are mounted on top of the base and upper platform.

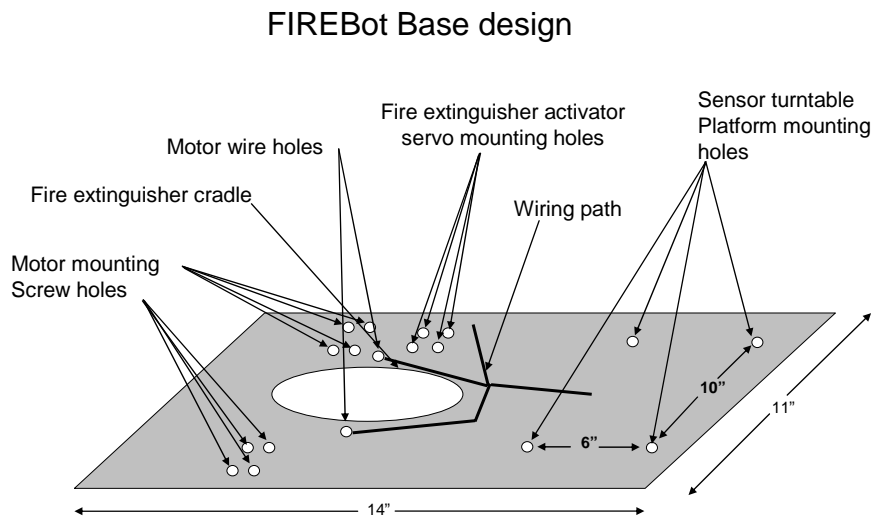
This design is based upon the requirements of the robots. The robots are generally built for simplicity and effectiveness rather than attractiveness and security, because they are intended to be used and modified only by the builder and are not usually intended to be sold commercially. Because the robots are intended to be easily prototyped and modified, all parts must be easily accessible. The robots are generally powered by small batteries, so they must be light. Finally, the robots must be inexpensive, so they are usually hand-built using inexpensive and easily worked components, such as plywood, plastic, or aluminum stock, fastened by bolts or screws, and have no parts that require molding, casting, or other involved construction techniques.



**Figure 2 – GoRobotics.com Fire Fighting Robot**

## Package Description

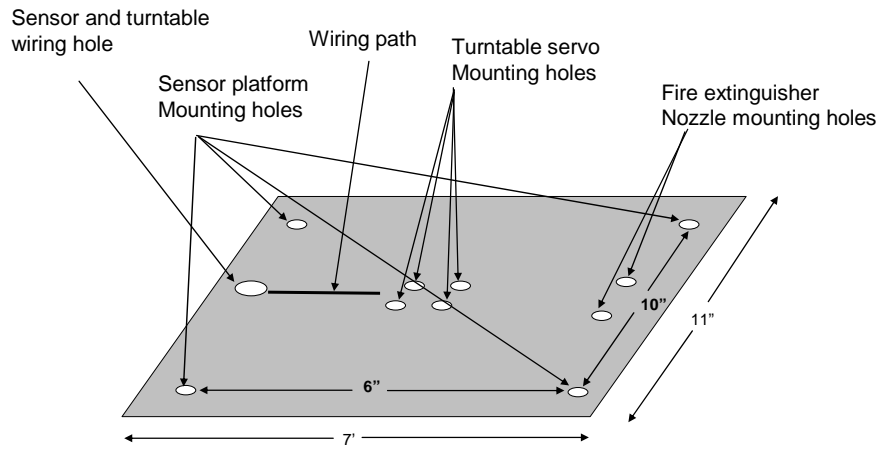
Figure 3 shows the base platform for the robot. It will be constructed using aluminum and shows the tooling requirements for the mounting holes and other needed parts. Figure 4 shows the sensor turntable platform which will also be constructed using aluminum. These two parts will be connected using 6" bolts to create the elevated platform. Figure 5 shows the protected electronics area. This is where the PCB and sensitive components will be placed to protect it from the heat from the fires as well as from the chemical from the extinguisher. The rear of this cube will be easily removed to allow easy access to the electronic components.



This is the base design for the robot. It will be constructed out of aluminum to provide resistance to flame, and a light strong base for the various other components of the device.

**Figure 3 – Base platform**

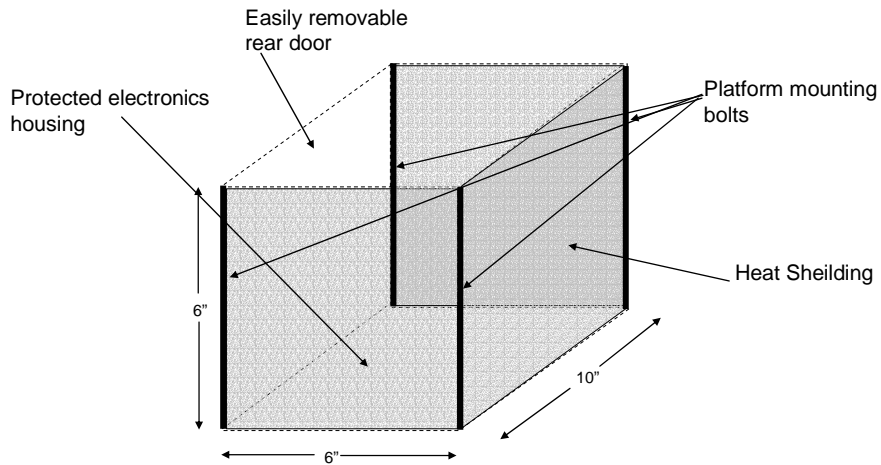
## FIREBot sensor turntable platform



The sensor turntable will be mounted approximately 6" above the base of the robot using bolts with nuts. This platform will also be constructed using aluminum.

**Figure 4 – Sensor turntable platform**

## Heat protected electronic area



This area will be located directly beneath the sensor turntable platform. The area below this will create a 6x10 square which will be sufficient to house the PCB board and other sensitive electronics. The front and sides will have heat shielding to protect the components from the fire's heat.

**Figure 5 – Protected electronics area**

### List of materials

Quantity	Part
1	24" x 12" 3-pane plywood base *
1	7" x 7" 3-pane plywood sensor turntable platform *
1	Nylon strap extinguisher cradle
2	Nylon extinguisher securing straps
1	Nylon extinguisher trigger strap
19	3/4" 1/4" bolts
4	6" 1/4" bolts
23	1/4" nuts
23	1/4" washers
1	(Standard) servo HS-475HB
1	(Micro) servo HS-81
1	Servo turntable platform
2	Planetary gear motor
2	Hubs
2	Green dot sumo tires
1	Universal caster wheel
4	Motor mounting brackets

### Tooling Requirements

The tooling requirements are very simple and only require hand tooling. This includes drilling screw holes and cutting a hole for the fire extinguisher cradle.

### Estimated Weight and Cost

The weight of the robot as currently designed is 4lb 2oz. The cost of materials is estimated at \$150.00.

GoRobotics.com Fire Fighting Robot

<http://www.gorobotics.net/articles/article.php?name=ffbot>

Trekker Fire Fighting Robot Kit

[http://www.superdroidrobots.com/trekker/trekker\\_packages\\_fire\\_fighter.htm](http://www.superdroidrobots.com/trekker/trekker_packages_fire_fighter.htm)