The CATastrophe is an autonomous search-and-destroy robot that hunts down and deactivates robotic mice. The cat is an intelligent machine that utilizes a ROS-powered Raspberry Pi 2 in conjunction with a Pi Cam to accomplish its tracking. It will also employ 2 IR sensors and 2 sonar sensors on its front and rear to perform obstacle avoidance that interface with an Arduino Mega. The Arduino and Pi will work together to simultaneously track mice and avoid obstacles. Upon chasing down a mouse, the cat will charge an electromagnet to pull magnetic battery leads off the mouses' battery and "kill" it. It will then use an arm to grab the mouse and dispose of it in a hopper on its back.

A mouse will consist of two 1.5 V DC brushed motors wired to two bump switches and AA batteries. There will not be a micro-controller in the mouse, which causes it to be unintelligent. A mouse will always travel forward using the motors, until a bump switch is triggered, which will briefly reverse the direction of current in one of the motors, causing a change in direction; this is analogous to an H-bridge. There will be a caster wheel or smooth knob underneath the mouse, providing a third point of contact for stability. The motors will be connected to the batteries by a magnetic switch (to be designed by hand) located at the top of the mouse, which will allow the cat to "kill" the mouse with a magnet. There will be a total of three mice, with each mouse having a colored shell that the cat can track using vision. There will also be a potentiometer in the mouse that can be adjusted to either speed up or slow down the mouse.

The cat will be much more intelligent and deliberate with its actions. It will consist of a base with two 12 V DC brushed motors for differential steering and a 3 cell Li-Po battery. It will be on two large front wheels and have a single caster wheel in the back. Again, the cat will utilize a Raspberry Pi 2 with a Pi Cam to track the colored mice. The Arduino Mega on board will command the motors, operate the sensors (2 IR and 2 sonar), and communicate with the Pi. A fuzzy logic controller will be implemented on the Arduino for obstacle avoidance. Blob detection will be used in conjunction with the Pi Cam to detect and home in on the mice. The cat, at rest, will be in a prowl mode where it slowly roams around the course, performing basic obstacle avoidance maneuvers. It will utilize IR sensors at its front corners to avoid obstacles and a sonar detector at its front center to do the same. The last sonar will be placed directly at the back and used for reverse operations. If necessary, whiskers (bump switches) will be installed to give it redundant obstacle avoidance capabilities. While slowly roaming in the resting state, the cat will be on the lookout for mice. Once the cat detects a mouse, it will pounce into action. It will either double or triple its speed and dart after the mouse. As the cat approaches the mouse, it will lower an arm that has an electromagnet on it. Upon charging, this magnet will upset the magnetic battery connection in the mouse and “kill” it. If the electromagnet can be made strong enough, it can pick up the mouse itself, else I will design a mechanical arm with a servo that can retrieve the mouse. Time permitting, I will install a small speaker on the end of the arm which will emit a “squeak” when the mouse is killed.

Within the arena, there will be three mice of different colors (red, blue, yellow) that the cat has to chase and kill. Upon beginning the demonstration, the mice will be turned on and set loose. They will bump into walls, but immediately turn and resume motion. The cat will start in patrol mode and chase a mouse on sight. The cat will not bump into walls, but detect and avoid them. Upon seeing its first mouse, the cat will only target that specific mouse until a capture has

been accomplished. It will them resume looking for any remaining mice. The cat will be faster than the mice and by the end will have captured all three mice and resume patrol mode.

The primary concern for this demonstration is the cat being able to accurately chase and secure the mouse. The benefit of creating a magnetic switch within the mouse is that the cat can halt the mouse's motion and then retrieve it. Should this prove too difficult in practice, I will work on corralling the mouse and then deactivating it.

Sensors:

- IR

- Sonar

- Bump Switch

Special Sensor:

The Pi Cam is my special sensor; I will use blob detection to home in on mice, one at a time. I will also use thresholding to speed up processing time, as well an increasingly narrow fields of view to eliminate processing unnecessary pixels. The cat will will attempt to keep the blob in the center of its field of view, so that it is always traveling straight towards the mouse.

Actuators:

- DC Brushed Motors

- Servo for cat's "arm"

- Electromagnet

- Speaker

Timeline:

1/19 - Use Arduino with IR, sonar, serial communication

1/25 - Use Arduino with motor driver, motors, battery

2/1 - Platform designed, finish work from previous week, begin working with the Pi

2/8 - Mount all hardware, interface sensors with motors, continue programming the Pi

2/15 - Have obstacle avoidance programmed, begin working with the Pi cam

2/22 - Show obstacle avoidance, continue working with the Pi cam

3/7 - Show special sensor demo, software control

3/14 - Oral report 2, design experiments to get and process sensor data

3/21 - Demo software, working behaviors, streamline image processing to get robot as fast as possible

3/28 - Robot essentially built, demonstrates all behaviors, continue streamlining program

4/4 - Demo day, finished robot

Parts Submitted for 3D Printing:

- Battery brackets

- Standoffs

- Motor mounts

- Wheel couplers

- IR mounts

- Sonar mounts

Bill of Materials:

Mouse	**Piece**	**Quantity**	**Multiplier**	**Specs**	**From**	**Price, $**	**Total**
	Gearmotor	2	3	Hobby Motor - Gear, 6600 RPM, 6mm, 10 tooth, 1-3V	Sparkfun	1.95	11.7
-	Wheels	2	3	None	-	0	0
	Battery Holder	1	3	#1150 2-AA Battery Holder	Pololu	0.79	2.37
	Battery	2	3	AA batteries	Walmart	0	0
	SPDT Switch	2	3	three pin	lab	0	0
	Magnet	1	3			0	0
	Shell	1	3			0	0
	Potentiometer	1	3	three pin	lab	0	0
	LED	1	3	RGB	lab	0	0
	Resistor	1	3	75 Ohm	lab	0	0

Cat

Raspberry Pi 2	1	1	Raspberry Pi 2 Model B Project Board - 1GB RAM - 900 MHz Quad-Core CPU	Amazon	37.2	37.2
SD Card	1	1	SanDisk 8GB Class 4 SDHC Memory Card - Frustration-Free Packaging	Amazon	6.01	6.01
micro SD Card	1	1	8 GB with larger adpater	Amazon	5	5
Pi Cam	1	1	Raspberry PI 5MP Camera Board Module	Amazon	24.95	24.95
Gearmotor	2	1	#3215 20.4:1 Metal Gearmotor 25Dx50L mm HP 12V with 48 CPR Encoder	Pololu	36.95	73.9
Wheel Hub	2	1				
Wheels	2	1			0	0
Casters	2	1			0	0
Battery	1	1	#T3000.3S.20/15009 Turnigy 3000mAh 3S 20C Lipo Pack	Hobby King	15.13	15.13
Charger	1	1	#9052000063-3/63446 Turnigy E3 Compact 2S/3S Lipo Charger 100-240v	Hobby King	12.6	12.6
Monitor	1	1	#HKing-3S/39085 Hobby King Battery Monitor 3S	Hobby King	4.3	4.3
Bump Switches	2	1	three pin	lab	0	0
Sonar	1	1	SunFounder 2 pcs Ultrasonic Module HC-SR04 Distance Sensor for Arduino UNO MEGA R3 Mega2560 Duemilanove Nano Robot XBee ZigBee	Amazon	8.99	8.99
IR Sensors	2	1	GP2Y0A21YK0F Sharp IR Analog Distance Sensor 10-80cm + Cable, Arduino Compatible	Amazon	10.25	20.5
Regulators	2	1	5V	lab	0	0
Motor Drivers	2	1	2 of DROK® L298N Motor Drive Controller Board DC Dual H-Bridge Robot Stepper Motor Control & Drives Module	Amazon	6.99	13.98
Magnet	1	1			0	0
Arm	1	1			0	0
- 2 Pivot Motors	2	1			0	0
Hopper	1	1			0	0
Grasper	1	1			0	0

- Motor	1	1			0	0
Speaker	1	1	two pin	uP	0	0
Arduino	1	1	Mega	Amazon	37.77	37.77
LEDS	8	1	RGB	lab	0	0
Resistor	8	1	330 ohm	lab	0	0
9V adapter	1	1	with leads	lab	0	0