Autonomous Robotic Drop Table

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Senior Design I
Dr. Charles Kim
W – 2:10pm–5:00pm

Background Information

How the project came along

- Introduced through conversation in class
- Dr. Kim dreamt of it
- Researched thereafter

From our findings…

- Came up with our own specifications
- Assessed how implementation could take place

What is an Autonomous Robot?

Robots that can perform desired tasks in unstructured environments without continuous human guidance

Background Information cont…

- Uses sensors to detect what obstacles are around them
- It zips along in a straight line
- If it hits an obstacle, the impact pushes in its bumper sensor
- Programming redirects the robot

Our objective is to create an autonomous robotic system that can:

1. collect dishes during a gathering
2. return them to the kitchen to be unloaded by a user
3. maneuver throughout the party space without bumping into any surrounding objects
4. detect when to enter and exit the kitchen.

The Problem Defined

The underlying issue revolves around time management

When hosting a gathering you must be able to:

- You must be hospitable,
- Oversee the event
- Keep it clean simultaneously

Creating this robot would help to maintain a successful gathering and ultimately create an enjoyable experience for the guests while lowering the stress level of the host

Design Requirements

- Must have an interface that is both wired and wireless as its battery life will not exceed 5 hours
- Must weigh about 30-40lbs and have dimensions of 24” x 36” x 30”
- Must be able to travel comfortably between 2 and 5 miles/hour
- Must function at a noise level less than 20db at 1 ft from the device
- Robot will shut it off if the temperature exceeds 90 degrees F
- In a normal cycle, (cycle meaning circling the party to collect dishes then returning them to the kitchen), the robot must be able to hold up to 15 pounds comfortably.

  1. programmed to not accept any more dishes once the weight exceeds 13 pounds

  2. Containers integrated in the design to eliminate damage to the wiring

Alternatively, this design can be created in a non-autonomous way

The first way would be to control it by a Direct Wired Control

Advantages

- Not limited to an operating time since it's a direct connect
- No worry about loss of signal
- Minimal electronics/complexity

Disadvantages

- Tether can get caught or snagged
- Distance is limited by the length of the tether
- Dragging a long tether can slow/stop the robot from moving

The second way is through an Ethernet connection

Advantages

- Can be controlled through the Internet from anywhere in the world
- Not limited to an operating time
- Using Internet Protocol (IP) can simplify/improve the communication scheme

Disadvantages

- Programming involved is more complex
- Tether can get caught or snagged
- Distance is limited by the length of the tether

Hammacher Schelemmer Room Tidying PickUp Robot

- Picks up objects on command & loads onto cargo bed
- six rubber wheels at 2lbs each dimensions 13" L x 8 1/2" W x 8" H
- Is equipped with a remote to drive
- Picks up items around 1oz. such as balls, toys or socks .
- Can operate autonomously using its four infrared "eyes".
- Seek and discovers objects within an 8-12" range. Once object is secure it will be deposited into its cargo bay. The robot will vibrate in order to dislodge the objects from its bay.

Willow Garage PR2 Robot

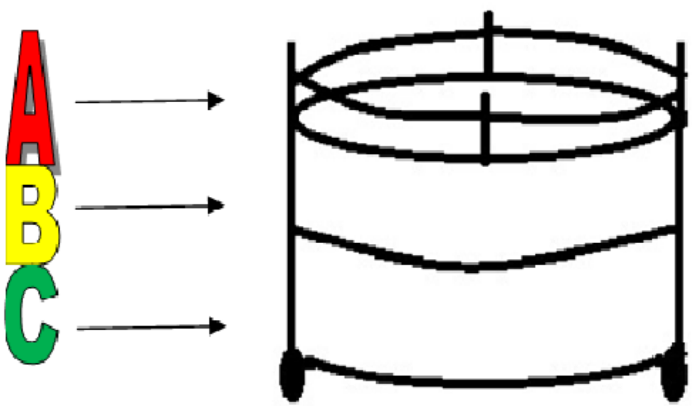
- 11 teams of roboticists at 11 different institutions to take in a beta robotics project in June 2010

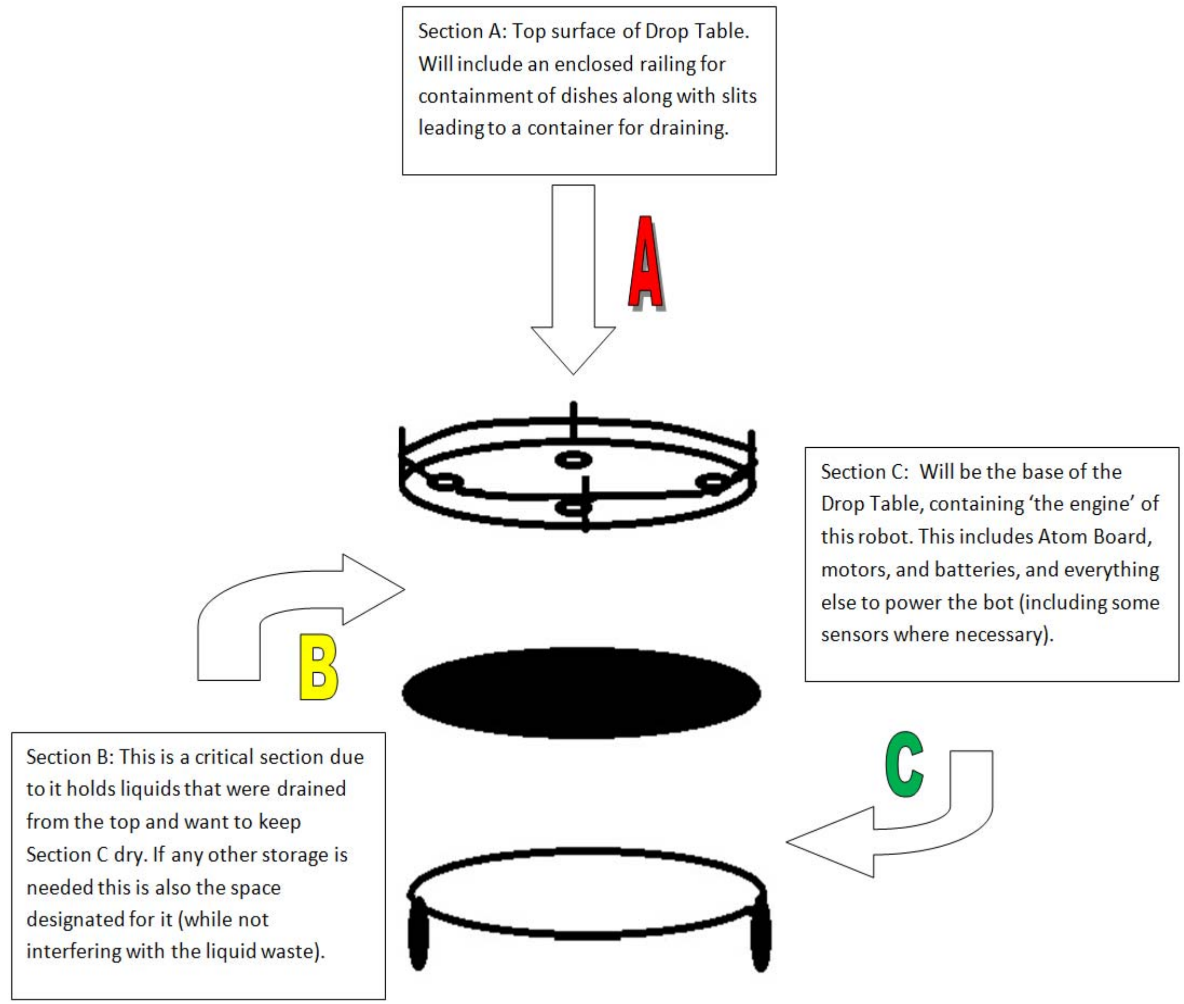
Teams received:

- two-year loan of a Personal Robot 2. This Personal Robot 2 (PR2) which is a completely programmable machine
- free, open-source Robot Operating System (ROS) framework with software libraries for perception, navigation and manipulation.
- One team is looking at getting the robot to learn how to carry an object through a crowded space.

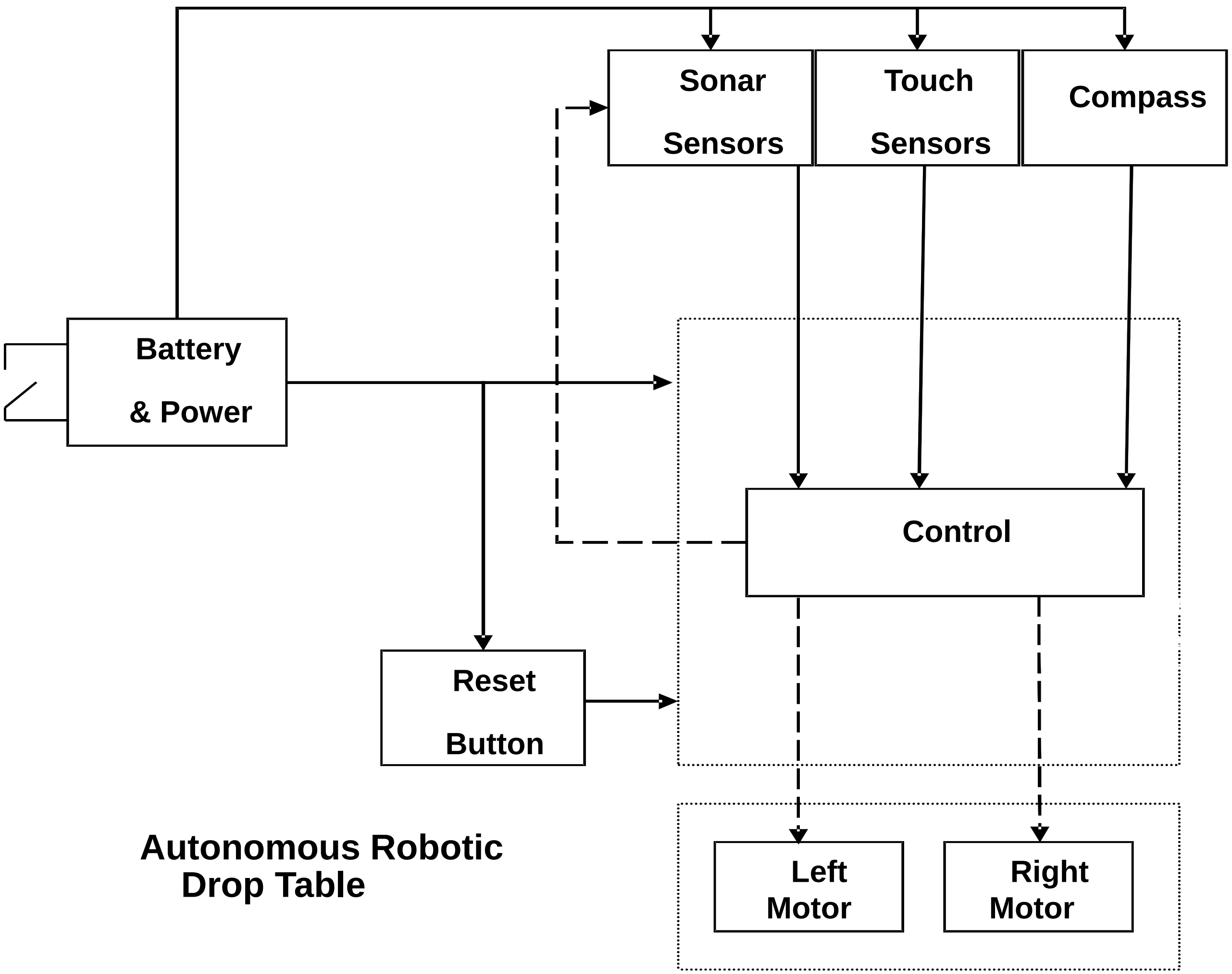
Solution Approaches

- Our proposed solution is to create an autonomous robot which will assist a human being in conducting a successful party and eliminating stress and clean up during and after the event.





Solution Approaches



Strategic Approach

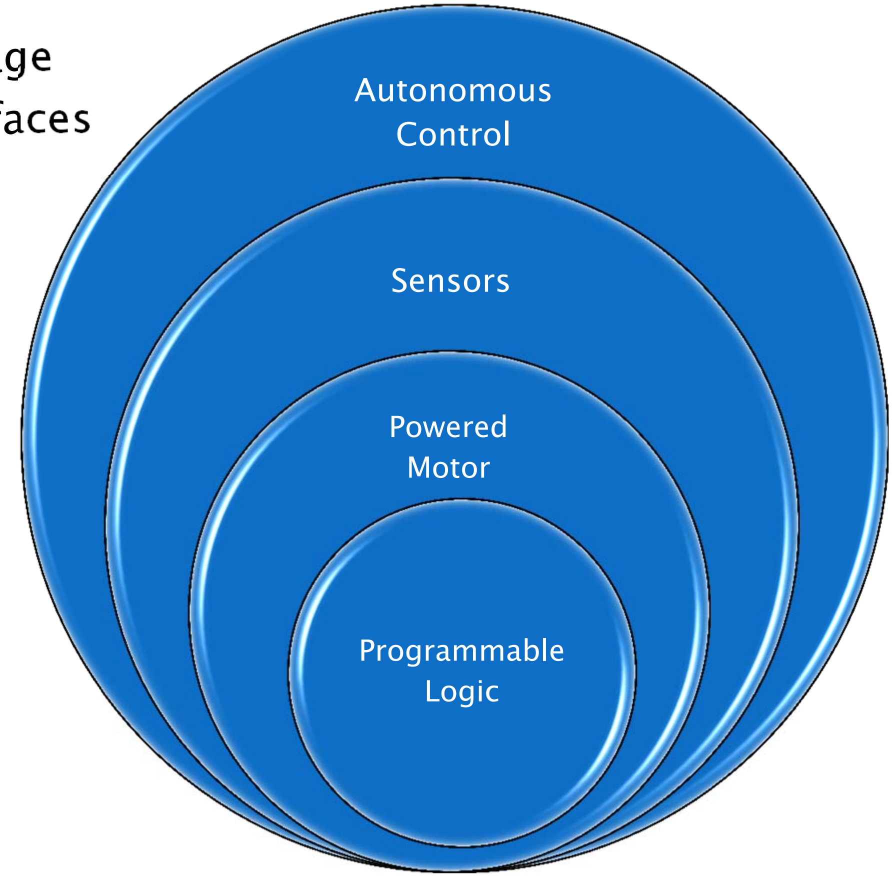
- Batteries, Motors, & Load all play an essential part to design and approach

- So far, Research has lead us to…. **Two Gear head Motors with 64mm Sponge Tire set**

2 powerful gear head motors	2 high grip sponge tires
Support approx. 2kg	w/ total weight of approx. 4kg.
380K75 motor running from DC7.2V power source	Rotational speed of 242 rpm (unloaded)
Running speed is 1m per 0.74 secs (w/ 4kg load)	Total weight of set is 480g

Solution Approaches

- Microsoft Robotics Developer Studio is a Windows-based environment for robot control and simulation.
- Features include:
- a visual programming tool
- Microsoft Visual Programming Language
- web-based and windows-based interfaces
- 3D simulation
- access to a robot's sensors
- primary programming language is



Solution Approaches

- Device must follow EMC standards and FCC part 15.
- Must be marketable and not interfere with the audio/visual systems of the party.
- Must not infringe on any patents previously created in regards to autonomous robots.
- Cannot be named after any other autonomous robots and/or their systems and must be unique with respect to all design constraints, appearance, and functionality.

Tasks and Project Management

Tasks involving engineering solutions are as follows:

- Hardware design for the autonomous robot
- Building the hardware for the autonomous robot
- Software design for [all] programming: including sensors, weight requirements, heat requirements, etc.
- Software implementation (i.e coding for the atom board)
- Assembling of the entire autonomous robot both hardware and software

Tasks and Project Management

November	The team should prepare in all aspects of the preparation. This includes the gathering of all materials for the design requirements and which they require.
December	The beginning of the implementation for the design.
January	The group will continue will the implementation of both hardware and software.
February	The final product should start taking form and testing shall begin by the end of the month.
March	Testing will be implemented.
April	Finishing touches are available at this time.
May	ECE Day Party, host by Autonomous Drop Table (Refreshments for A.D.T provided by Dr. Chouikha)

Verification & Deliverables Plan

- We Will Deliver!

- Hardware Design and Building- Joseph Ignatius
- Software Design and Implementation- Mecaela Holmes & Tiffany Hall
- Assembling of the entire autonomous robot – Team required

- Come ECE Day we will have a working autonomous bot for everyone to drop by and drop off!

Costs and Resources

Materials				
Battery	$60-$100	(possibly free)		
Sonar Sensors	$80-$130			
Touch Sensors	<$80			
Compass	<$40			
Weight Senor	$10-$50			
Control (Atom Board)	(Sponsored)			
Motors	$10-$50 (per motor)	(possibly free)		
Hardware Materials	Max $100	(possibly recycled)		
Miscellaneous	$50			
			Total [Max] Cost:	<$500

Any other additional boards and/or resources, or simply being assisted may come from sponsors through our advisor or through the professor of the

Conclusion

Overall after assessing the situation, we have decided that creating this robot would be beneficial because its completion can assist its user in a great deal. It does not have a need that is substantially large however since convenience is an aspect that humans strive for on a daily basis this will prove to be a worthy device to purchase. From the design requirements that we mapped out, to the price that it is going to cost this device can be constructed and be fully functional by the project completion date.

Questions ?