The Design Process for Swiffy

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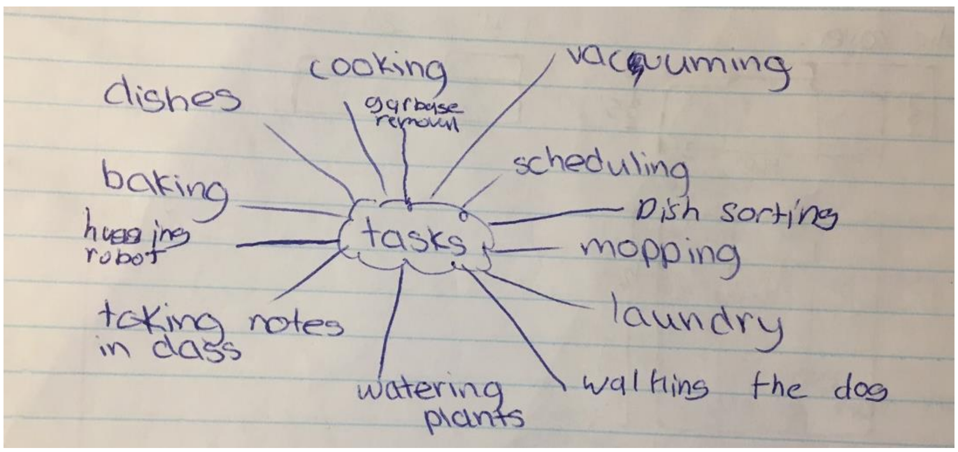
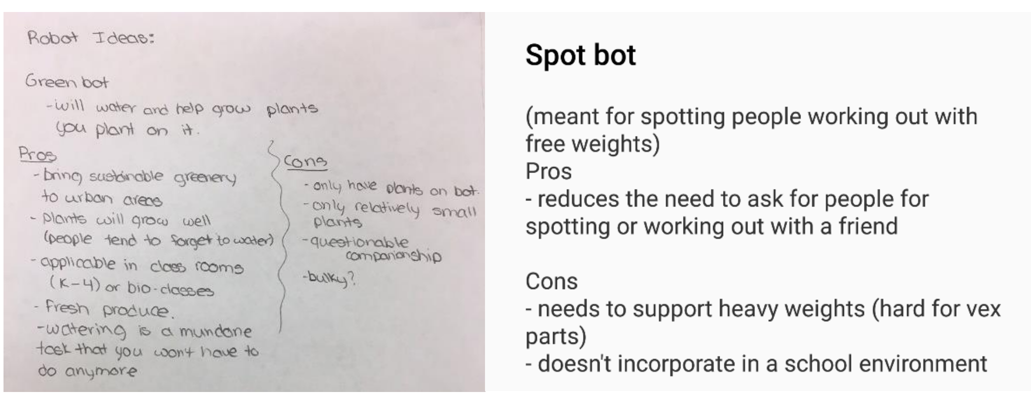
Swiffy is a robot that mops household, business, school and other flat, smooth floors. It is a companion robot that completes a day to day task that many people do not enjoy. Swiffy can be activate while you are at home, or on the way out the door, by simply adding on a wet mop pad and then pressing the on/off button. This is a simple, easy to activate, easy to build robot that autonomously and efficiently cleans floors in a variety of different areas.

The Design

In order to design a robot that would be useful and enjoyed by users, a quick version of the design process was followed. To start off, the team assembled to brainstorm on daily tasks that are tedious, annoying, potentially hazardous or gross as well as potentially moments in our day that we would enjoy a companion. As you can see in the image below of our brainstorming map, for the most part these tasks were household chores.



Following the brainstorming web, each team member went home with the task of coming up with a pro and con list for creating a robot to fit two of the tasks. The list was to include difficulty to build, how well it fits the award, size requirements, if it could be done with the majority of vex parts, etc. Below is a sample of the pro and con lists that were made.



At the following meeting the team went over the pro and con lists, discussed any further pros and cons and finally voted on which task our robot would complete. After a long discussion, the team decided on a mopping robot. It would be easy to make, interesting and informative to code for, small enough to fit in the size constraints, be made mostly of vex parts, complete an annoying daily task and be a nice cleaning companion to home owners, teachers and business owners.

Then the real design began. Would this robot simply mop or would it vacuum and then mop? Would this robot mop and then dry after itself? Would there be water and cleaning supply on board the robot? Would the water be in the same container as the cleaning supply or would they be pre combined? How big does the base, or drive train of the robot need to be? At what speed should this robot move? After much discussion, a base idea for the robot was created, keeping in mind the users, time constraints and functionality. The main features of the robot are as follows:

- Must be small to easily store the robot in a cleaning cupboard, or in a room without getting in the way
- A wet mop pad (like a Swiffer wet mop pad) would be used for cleaning
    - Because a Swiffer pad has a width of 10", the width of the robot need not be any larger than that
- The robot would have to be autonomous to actually be of any help to the user
    - The robot will thus need to be aware of its surroundings
- A slower speed would be best because if it moves to fast the floor would not get clean
- Mainly only forward and backward movement is required, with no need for side to side movement

Types of sensors were discussed in hopes of finding the perfect sensors to create an autonomous robot. Ultrasonic sensors, bumper switches and a gyroscope were all selected. An ultrasonic sensor will allow the robot to create a "visual" of its surroundings, the bumper switches will let it know if has not "seen" something and to change its directory and the gyroscope to help it understand the positioning. The line sensors were ruled out because it is simply impractical to ask the users to add a line to the floor that the robot will have to follow. Accelerometers, potentiometers, limit switches and light sensors were all ruled out either because of impracticality or because they were just simply not applicable to the task at hand.

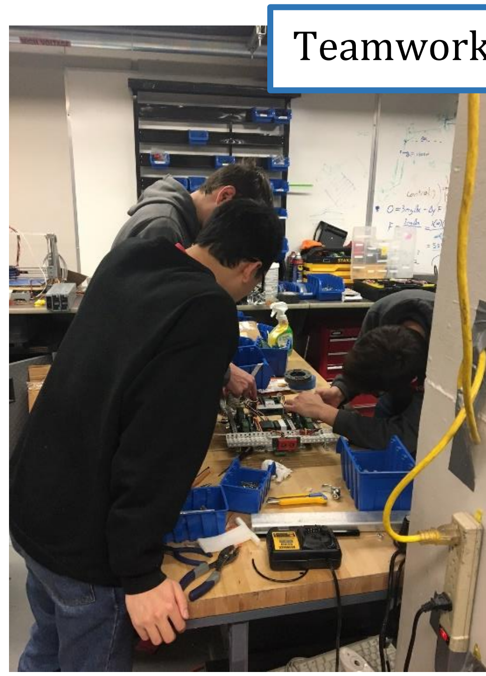
All of the vex wheels were considered as well, and simple traction wheels were chosen. Traction wheels would definitely work on tile, hardwood and laminate flooring without leaving scuff marks and will not slip on wet floors. Omni and mecanum wheels were ruled out because the side to side movement is not required. The simple slick wheels were ruled out because they may be too slippery on a wet floor combined with a 1:1.67 gear ratio will allow for a good balance between torque and speed.

The Build

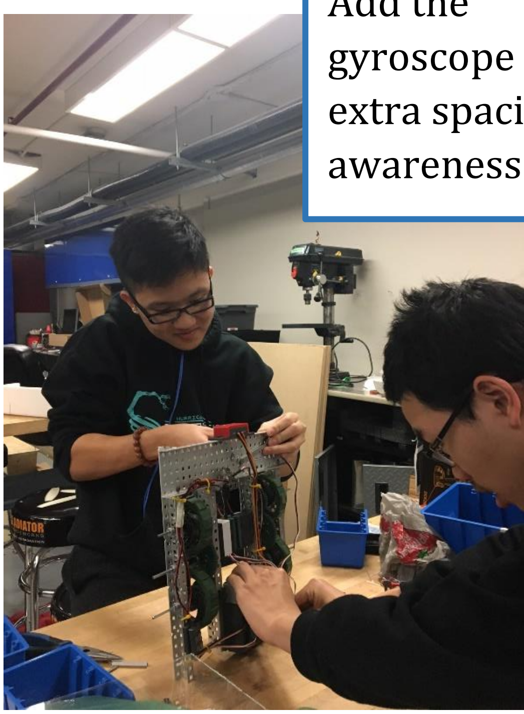
Knowing these main features, a preliminary sketch of the robot was created and a mock up CAD was created. Using these two visuals the team came together to build the drive base. Onto the drive we added the sensors, the power button, the gyroscope and the VEXNet. After adding all the base pieces to the robot, we realised that in order to make this a home friendly and more welcoming design it would need an on/off button and a plastic cover to hide the internal parts from the users.

Time to add the sensors!

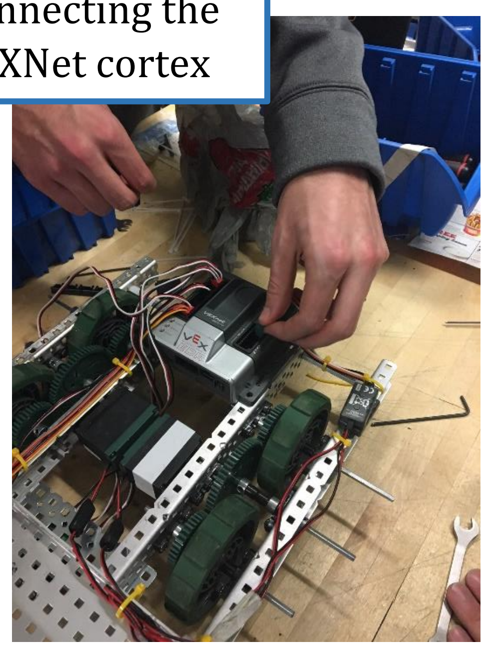
Teamwork!



Add the gyroscope for extra spacial awareness.



Connecting the VEXNet cortex



Future Work on the Bot

Although the robot is currently fully functioning, we plan to add more futuristic features to make the robot smarter and more home friendly. Due to us using the VEX EDR microcontroller, numerous limitations arise from not being able to run a linux based system on the microcontroller. In order to integrate the robot into the ecosystem of IoT devices, we plan to use the VEX PRO microcontroller which allows us to run linux, and in turn use ROS (Robot Operating System). We plan to do this because ROS has tools (such as rViz and Gazeebo) that use sensor data from robots to map environments and ease the process of increasing the robot's autonomy.