

Simplicity in Robotics

Joe McCormick

Malden Catholic High School

mcsoccer11@hotmail.com

Simplicity in Robotics

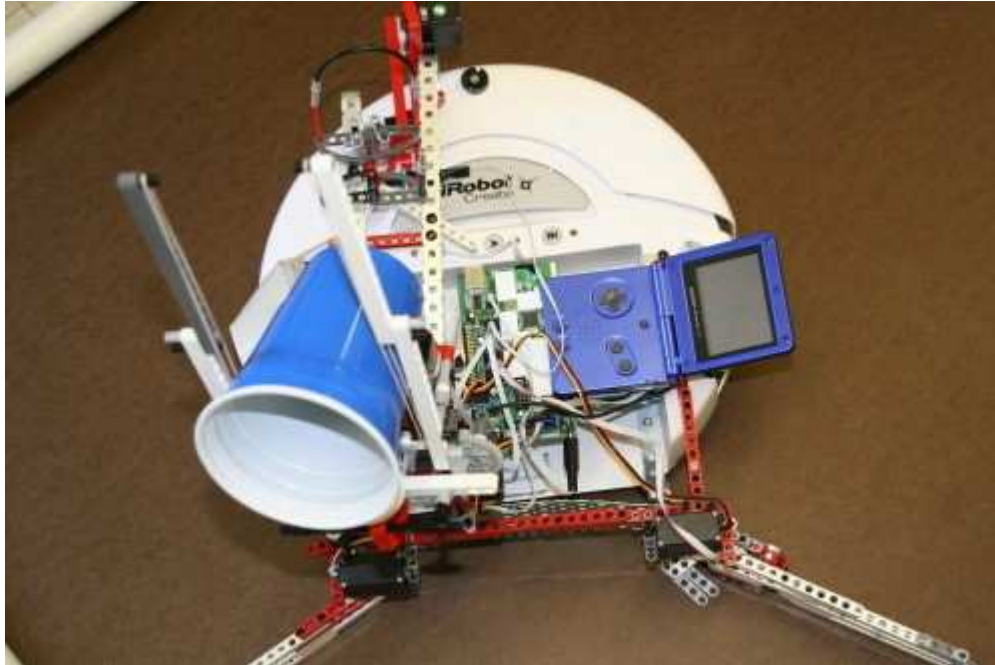
1 The Necessity of Simplicity in Robotics

Simplicity is defined as “freedom from complexity, intricacy, or division into parts.”[1] It is very important to have simplicity in all aspects of robotics. Whether it be in the robots design, its mechanical structure, its programming or the way in which it will be completing its mission. This is especially important in a robotics competition like Botball®. As said in the motto by the KISS Institute for Practical Robotics “Keep it simple, Stupid” , it is truly necessary for the robots to be simple. The concept of simplicity does not only apply in the competitions, such as Botball®, but also in real world robotics, like those working on an assembly line.

2 Simplicity in Robotic Design

The design of the robot is the most important aspect that should remain simple. When designing our robots for this years competition, one of our goals was to try to remain as simple as possible. In the previous years of our history in the competition, our designs had been far to complicated and were bound to fail from the get go (which they did). The knowledge acquired from the last two years in the competition truly showed that the winners of each region and the real competitors in the international competition kept to a simple design. On the first Monday after our Botball workshop we knew the designs had to be the simplest possible, and that they were. Our Roomba® based robot, Trogdor, was designed with simplicity in mind. Trogdor contains only 3 moving parts, each of which is designed to be truly simple. The funnel for collecting the crew is designed to just be two servos, each of which have a lego wall below that the servo swings so that the funnel can close to grab onto the crew (bottom of Figure 1). The arm on Trogdor was also meant to be simple by using servos not mounted on gears but rather screwed directly onto Lego pieces in order to keep the number of moving parts required to operate it low (middle of Figure 1). The final moving part is the cup stacker and dumper, this is basically a small cup holder made of Legos screwed directly onto a servo horn so that at the correct time it can easily and simply dump the satellites off of the board. This simplicity helped lead us to win a judges award for consistency, because with the simple design also came along great consistency. The simple design in a robot leads to a robot based on a few parts that can easily complete its goals.

Figure 1



3 Simplicity in Mechanical Building

When building a robot, the mechanical aspect should try to remain simple. Some of the best robots in this world were built using simple principles. Even such robots as Honda's ASIMO is a robot made up of many small, simple mechanical systems. The Legos used in the competition in some ways make most robots have a tendency to be simple, but most teams make the robots far too complicated. During my two years witnessing the competition I have seen multiple robots fail because something was built far more complex than it should have and it failed in what should have been its moment to shine. Another disadvantage to a complex design is it multiplies the chance of mechanical failure a hundred fold then if you built a robot with one or two moving parts to complete the task. The other robot, Peasant, used by our team was built as simply as possible. The drive train of the robot is simply two white gear motors attached to a simple gear train, only containing two gears. Because of this base structure our robot was able to keep a high level of consistency while completing its mission (somewhat shown in figure 2). The only other moving part on peasant is a claw that is almost like a snow plow, but a mechanism is attached to close it to keep the plants in while making turns. Again, not trying to be repetitive, this was built with the utmost simplicity by just mounting a single motor directly to the moving aspect of the claw (figure 2), then when the motor is programmed to turn it would close the claw in one simple command.

```
//Close Peasant Claw  
mrp(0,500,500L);
```

The simplicity in the mechanical build of a robot helps lead it to a reduced risk of failure as well as the increased consistency of the robot. Both factors help to increase the success of a robot and it is necessary to win a competition such as Botball®.

Figure 2



4 Simplicity in Programming

Like all other aspects of robotics, programming also has to remain simple. The programming of the robot truly controls what that robot does and how it will accomplish its mission. The programming done by our team this year was all based on simplicity. Like mechanics, programming can fail when it is over complex and has too many parts. Over the year some problems occurred regarding the complexity of the program and at times a whole program could fail depending on the placement of one brace in one function. The final program for both of our robots was simple which helped us to win our regional competition. The final program for our robot Trogdor actually only contained ten lines of code in the main function.

```
void main() {  
  init();  
  leaveShelter();  
  turnToTribbles();  
  collectTribbles();  
  trackBlob(2,5,20,270,1,0);  
  approachPipe();  
  turnToSolarium();  
  dropPlants();  
  lineUpTape();  
  crossBridge();  
}
```

All of those lines of code were commands to run a function that helped to keep the program simple. By splitting the program into a variety of small tasks, or functions, it can reduce the complexity and increase the success of a robot. By keeping the program of the robot simple and avoiding “overprogramming” the robot, the success of the robot will increase dramatically in the final competition.

5 Simplicity in the Mission Plan

The success of the mission is not only determined by the design of the robots, the mechanical building that took place, or even the programming, it is also determined by the plan on how to complete that mission. The mission this year could have seemed like a very complex one unless a careful strategy was thought out in order to limit this. Our team immediately thought of the simplest way to complete its goals and not go through any long process of separating the piles or trying to perform a task that does not achieve a lot of points like taking Bot Guy or the hydroponic garden. The mission we designed it to complete was very simple and this strategy helped us to complete one of our goals, to win the New England Regional Competition.

References

[1] "Simplicity." *Dictionary.com Unabridged (v 1.1)*. Random House, Inc. 03 Jun. 2008.
<Dictionary.com <http://dictionary.reference.com/browse/simplicity>>.