Robotics; or, the Modern Hephaestus
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Santa Barbara High School Robotics Club 12-0639

Robotics; or, the Modern Hephaestus [1] [2]

Fig.1

1. A Short History of Robotics at Santa Barbara High School

1.1 The Santa Barbara High School Robotics Club was started about two years ago. We started with the Lego Mindstorms kits, where we learned some basic programming and mechanical engineering. We quickly moved onto the more complex and flexible VEX kits. During the summer of 2011 the club experienced a surge in membership and partook in an online programming course, where we gained a more formal programming education. During the summer we had a student to mentor ratio of 3:1. This allowed everyone to learn the basics of robotics under an experienced industry professional or college student. During the fall we teamed up with the school's lowrider bike club to submit an entry into the Santa Barbara Holiday Parade. We built a motorized bicycle chariot, which was followed by a group of VEX robots. We then decided that we would like to achieve more and entered in the Botball competition.

1.2 As we have found out, due to budget cuts the school has not been able to provide funds for our club. They provide our workspace but not money. This lack of resources has made our group very self sufficient. We acquired our own funding, found our own equipment, and we gained programming experience outside of school. We have had no real formal robotics learning experience. At school there are no courses or even teachers who are really able to support us. The teacher who was our club advisor actually quit in the middle of the school year. Because we have such a shaky support at school, we have reached out into our community to create a more stable learning environment for ourselves. We found online classes to learn programming and we found a few mentors who were able to help us. Through this, we created lasting student-mentor relationships. Even with the mentors, though, a majority of our knowledge has been found through self-exploration. We go to our mentors when we can not figure out a problem, but other than that, we are basically on our own.

1.3 Every Tuesday at lunch our robotics club hosts a speaker from some sort of engineering or programming field. Being exposed to these people is not only a learning experience, but it also teaches us about how to take the knowledge into a career. For example, we have had speakers

from companies producing wind generators, speakers with robots used in hospitals, and speakers developing targeting systems for the military. It is a very valuable experience.

1.4 Our club's model consists of student-led groups with mentor guidance and help when needed. As the students, we do our best to solve problems that we run into. This is called "inverted learning," [3] where the focus is on the student and not on the teacher. This strategy allows the student to explore the topic by themselves while they have minimal help from adults.

1.5 Our principal wants to start a computer science academy at Santa Barbara High School, and wanted the robotics club to be the leaders and starters of it [4]. He had us speak to the board of education for the Santa Barbara School District on April 24 to show how robotics and programming are important and how it would benefit our school. Each member of the Botball team made a small speech on one of the reasons it is beneficial.

1.6 Every member of our team is planning on attending a college or university after graduation. This club allows us to explore the STEM fields and evaluate whether we are interested in pursuing a career in a technological field. The competition in addition to the weekly speakers has exposed us to the real world applications of the concepts we have been learning.

1.6.1 Our teachers have been very influential in driving us towards this engineering path. These teachers include, Marilyn Garza, Melissa Woods, and David Yale. Mrs. Garza was most of the team member's eighth grade science teacher. She has won multiple awards [5] for her teaching and her raw enthusiasm for the sciences drove our team into the field of hard science. Mrs. Woods is a Physics teacher at Santa Barbara High School. For many years she has been trying to implement an engineering/computer science curriculum at SBHS. This peaked around this year when the robotics club was started. Her drive towards the goal of a Computer Science academy has inspired many of us to go down this path. David Yale was our teacher advisor for last year and half of this year. He resigned midway through this year and is now associated in a non-official capacity. Yale has always been very passionate in the advocacy of having engineering classes.

Fig. 2

2. Botball

2.1 How we got into it: After our robotics club got well established, we wanted to branch out. We decided to enter a robot competition of some sort. Botball seemed like a good choice because it didn't seem too difficult and it used autonomous robots, which we wanted to focus on.

2.1.1 Why we chose Botball: The FIRST robotics competition [6], and why we chose Botball deserves mention. Both programs have their merits but we felt that the Botball competition best embodies the small group, self sufficient mentality that we have cultivated. For example, in the FIRST competition, the teams range from 10 to 100; even the lower bound of the team size is bigger than our team. Also, in FIRST, teams are allowed to go out and buy their own parts. In Botball teams are only allowed to use the parts in the kit and have very specific parameters for the size of the robot. In our mind, having these tight limits is conducive for building problem

solving skills. The emphasis in the FIRST competition is on mechanical engineering, whereas Botball focuses on programming. We are programming autonomous robots rather than remote controlled ones. [7]

2.2 <u>How we divided labor:</u> In the beginning, we made a chart that divided our seven teammates into three groups for the two robots. The first group was the programming group which consisted of four people: two freshmen, and two juniors. Next there was the building team which was made up of two juniors. Lastly, there was the documentation group which only one person was a part of. Later on the teams converged and started working together, building off of each others work and after our first Botball competition we gained another member for our team.

2.3 <u>How well we did:</u> We did very well in our regional Botball competition this year. We were really impressive considering that this was our first robotics competition for any of us. We got fourth place in the double elimination rounds, and won two awards, the overall judges choice award and the outstanding documentation award. The judges choice award was for engineering. We won this because of a couple of factors. The judges were really impressed by the fact that we had one of our robots designed to perform multiple functions. We had one of our robots get botguy and the kelp, take them back to the beach, and then go over to the other team's side and go on their beach. They were also impressed by the fact that we attempted to and were sometimes successful in stacking the blocks. We were one of the only teams to even attempt stacking the three cubes. We were one of a small minority of teams to attempt stacking the cubes in the United States. We were successful three different times. The award for documentation was given to us because we were very thorough in our documenting process. We followed the rubrics and kept track of our progress. This was very helpful for us.
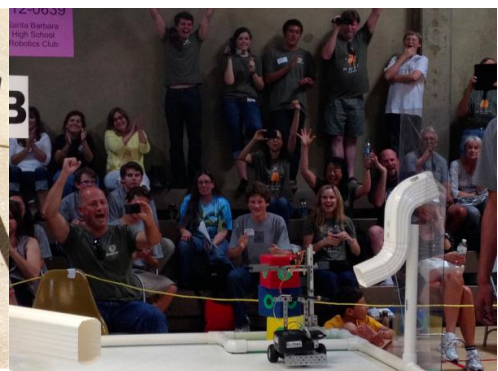

Fig.3: Our awards   Fig.4: Stacking the blocks

3. What We Have Learned

Throughout our robotics experience we have learned many things not just about programing but about the team as a whole, how to make a team work, and how the team functions together. Because of this we earned two awards. But we could not have done this alone. Thanks to the help of our great mentors as well as google docs we were able to have much better communication. We learned that we have to have clear communication to achieve full efficiency. Since we are working on different parts and programs that will go into a robot, knowing what your teammates are doing and working with that is key.

3.1 <u>Us:</u> Our club is defined by our small group mentality. Our mentor-student ratio is historically very low which allows for personal contact and a more effective learning environment. Our location has been transformed from a disused auto shop into a technology lab filled with

both mental and physical resources. We owe our success to the dedication of both our team members and our mentors, as well as as few strategies we used for effective communication and efficiency:

3.2 Work space: Our club occupies an old auto shop. It is infinitely helpful to have a room or space that is used only for robotics or other technological purposes. This way materials can be left out and there is no need to fully put everything away at the end of a session. Also, a space dedicated to robotics allows for more flexible scheduling (more about that below).

3.3 Google Docs: All of our code, contact information, scheduling, and brainstorming for the competition was shared on Google Docs. This allowed for a collaborative effort even outside of our regular meeting times. We could work together even when in our respective homes. Google docs also helped us get more used to documentation which we learned was a very important part of not only for points in the game but also for communicating our results to our colleagues as seen in Elakian Kanakaraj's "Keys to Successful Documentation"[8].

3.4 Scheduling: On our team are varsity athletes, choir singers, balloon makers, and people who have jobs. AP tests occurred in the two weeks prior to the regional competition, requiring a careful balance between studying and robotics. Since we had limited time, we needed to be dynamic in our scheduling. We created a flexible schedule that could be changed week by week. Flexibility is key when dealing with busy high schoolers.

3.5 Mentors: Our teachers and mentors were just as important to success. They put just as much time and effort into the club as we do and their support shows. We would never have gotten as far as we did without their help.

3.6 Sponsors: We are fortunate enough to be supported by a local tech company called BEI Sensors. They provided the funds for us to participate in the Botball competition. To get the team to GCER we able to secure additional funds from New Media Hollywood and Rincon Technologies. These companies have been integral to the club's ability to attend these regional and global events.

Fig.5

3.7 Frisbee: Every team will hit the wall at some point. In order to maintain a positive frame of mind, everyone needs a stress release. Studies and papers have shown that physical exercise can improve stress and mood. [9] For us that stress release was playing frisbee. It was a way to take our minds off the frustrations of the robot for a few minutes and allowed us to re-motivate and push on. Never underestimate the power of physical exercise.

Fig.6: Taking some time off

4. How We Would Improve Our Experience

4.1 Time Management: By the time we mastered the art of time management it was almost time for the competition. We underestimated the time required to adequately prepare for the competition at the beginning and consequently under scheduled our meeting time. During the week leading up to the L.A. regional we spent more time working than we did at home. Next time we will know what is required and can schedule our initial sessions better.

4.2 Setting Realistic Goals: On all the projects that we have done with the club we almost inevitably overextend ourselves. In the Botball competition we tried to get many more points than necessary and while we were successful at a few tasks we ran out of time before we could truly finish what we wanted to do. We failed to achieve full consistency and if we had more realistic ambitions we would have been able to do better.

4.3 Direct Credit: Our program is not accredited, which makes it difficult to set priorities. Even though we understand the benefit of this program, we need to juggle the rest of our activities, including school work, AP tests, SATs, athletics, and other extracurriculars. Placing a non-credit activity in the list is difficult because we receive nothing from it that will go on our transcripts, or anything concrete that will be given to colleges. With more support from the school we would be able to gain credits for the work that we do.

5. Conclusion: We believe that any school or group of students can, with some work and determination, launch a successful STEM based club within a couple years. Hopefully our experiences can be used by educators and students alike to introduce engineering and computer science concepts.

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