

## **Preparing Your Team for Competition: How to Not Embarrass Yourself**

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## **1 Background**

Managing a Botball team can be an enormous challenge. There are organizational, technical and logistical problems to overcome. More often than not, when I attend a Botball competition I see students failing to accomplish what they set out to accomplish, I see students, including my own, making the same mistakes, over and over again. This paper will outline some things you and your team can do in order to be more successful at Botball.

## **2 The Hints, Tips, and Tricks**

- **First and foremost, define success:** Define with your team exactly what success should mean. Rarely should you define success as "We will go the regional Botball competition and take first place in the all portions of the contest." Success should be defined in the context of goal achievement within the confines of the Botball contest and the ability of the students involved. Good success statements could be "We will go to the regional contest and score 40 points during the seeding rounds" or "We will go to the regional contest and our robot will be able to pick up 4 yellow cups and score with them." Defining what success means from the very start gives the team an exact and measurable overall goal to work towards.
- **Set goals:** The team should sit down at the start of the contest and evaluate what they wish to accomplish and set goals to work towards. The goals should be:
  - Specific
  - Measurable
  - Acceptable
  - Realistic
  - Time bound

The goals should relate directly to the contest at hand with the most important of the above characteristics being realistic and time bound. Guide your students into setting

realistic, yet challenging goals that can be accomplished in the time available to them based upon their experience level. Examples of goals could be:

- We will have decided on a workable game strategy by the end of week one.
  - The building team will have robots built to carry out the strategy by the end of week three.
  - The programming team will have workable code in the robots by the end of week five.
  - The team will spend week six testing.
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- **Develop clear and concise team management strategies PRIOR to beginning the contest:** During the contest students will tend to argue and fight among themselves for various reasons. The team, with the input and guidance of their mentor, should develop a team management strategy prior to beginning the contest; this leaves more time for actually building and programming. The team strategy should address such topics as running team discussions, who gets input into what, conflict resolution and arbitration, job assignments etc... The team should decide what constitutes possible removal from the team and the rules and procedures in order to remove a team member. The teacher or mentor should be the final judge in deciding team member removal.
  - **Don't just do Botball during Botball season:** Form a regular robotics club and meet after school year around. Teach the students C during the off-season or have more advanced students teach the others C, give them challenges or tasks to accomplish, use previous years Botball rules or design your own. This gives new students the skills they need in order to be successful and be a part of the team and keeps returning students on their toes and refreshed. By only doing robotics for six weeks and asking students to learn programming, robotics design, problem solving and a host of other skills in a very limited amount of time is setting students up for failure.
  - **Always use motor encoders:** Students believe, for some reason, that motor encoders are difficult to implement and use. This is simply not true and not using them can be disastrous. Without motor encoders a robot has no way to know how far it has traveled and cannot be moved and positioned precisely. Learning to use motor encoders properly can be something to learn during the off-season. You must also shield the encoders from ambient light; otherwise your robots may not work properly under the bright lights of the competition.
  - **Practice using conditions at the competition:** The military has a saying: "train the way you fight, and then go fight the way you trained." This also applies to Botball; your team should seek to mimic the lighting and board conditions of the competition as closely as possible. The exact lighting and board design is published each year and you should

follow it to the letter. This will help prevent your team from building perfect robots that work under your testing conditions but the bright overhead lights of the competition swamp your sensors rendering your robots useless at the competition.

- **Develop a standard code library:** Most of the robots built for Botball conform to a standard design; they have a number of drive motors and sensors. Developing a standard code library or template code can speed the coding portion of the competition immensely. Students will not have to write the same code over and over again, in other words they will not have to reinvent the wheel every time they sit down to write code.
- **Source Code Control:** A plan for developing the source code for the robots should be worked out and used. The plan should include the following elements:
  - Where will the source code be stored and how and when will backups be made?
  - Who has access to the source code? Can anyone edit the code or are only certain people allowed to edit?
  - Comment the code COMPLETELY. Include change logs and ways to back out the code changes.
- **Develop clear and concise team jobs or sub teams:** Make sure each member of the team has a clear and concise job description that they can conform to. For example, the team may want to break into programming, building, documentation and website teams. The documentation team documents everything that the team is doing they take pictures, notes and interview the other team members for information, and in essence they are the team reporters. The website team takes the documentation teams information, processes it and places it into the website. The building and programming team build and program the robots. Many times team jobs will overlap and that is perfectly fine.
- **Do the documentation website and do a good job on it:** The documentation website is 1/3 of the final score in the regional contest and I see many teams that simply ignore the documentation website or do not take it seriously. A good documentation score can easily power your team above another in the final scoring. A team that did a super job during the seeding rounds and then came out at the top during the double elimination rounds may be disappointed that they fall considerably because they failed to do a documentation website.

Your documentation website should contain a wealth of information and should be very descriptive. Do not put in entries such as "We worked hard on robot number one today." Instead be more descriptive such as "Today we met for four hours in order to try and get

robot number one working properly. This robot is designed to pick up the orange ball and place it into scoring position. The robot has been missing the orange ball, going wide to the right instead of straight at the ball. After numerous tests we determined we were not using the camera properly. We had thought the resolution of the camera was 300X150 when it was actually 320X140"

- **Think simple:** When students first see the rules for the current year's competition they tend to want to score as many points as possible or are immediately attracted to the largest scoring object on the board. Try to get your students to think in terms of simple, easy to implement strategies and implementations of those strategies based upon their skill level and the time involved.
- **Do not invent your own calibration and timing functions:** Do not re-invent the wheel, KIPR has provided well-tested functions for starting on the light and stopping after 90 seconds. Use these functions and resist the temptation to write your own. Each and every year I always have at least one student that decides, for what ever reason, that the provided library functions are inadequate and decides to write his own and usually ends up changing back to the KIPR provided functions at the last minute or right after a disastrous defeat caused by the malfunctioning of their wait for light or shut\_down\_in function.
- **Build robots that can be calibrated quickly and easily:** For whatever reason, my students like to build robots that have long and difficult calibration routines; this has lead to numerous mistakes while playing. Try to make your calibration routines as simple as possible. If your calibration takes a long time or seems difficult you may need to go back and rethink what you are doing.
- **Make a calibration checklist:** Make a checklist for calibrating your robots and checking their operational status at the table. Include such things as checking that motors and sensors are plugged in, that critical pieces that tend to fall off are secure and any other items specific to each robot that needs to be checked. Then test this list over and over making corrections and changes to it as needed. During competition one person should read off the check list and another perform the actions on the checklist. This helps to insure that mistakes such as having a motor or sensor wire unplugged do not happen.
- **Label all sensor and motor wires:** Motor and sensor wires have a habit of falling out of their respective sockets at the most inopportune times. Small bits of tape can be used to label sensor wires so students will know what ports they go into if they happen to fall out during the competition. A bit of nail polish can be put on the motor wires to indicate which pin goes in which side of the motor connector

- **Always include the shut\_down\_in() function:** I have seen students decide that they did not need the shut\_down\_in() function as it was obvious that the robots strategy would not take more than 90 seconds to complete. Invariably the students learn the hard way that robots are unpredictable at times and their robot only shuts down if it follows the path laid out for it and everything occurs as expected. In Botball things rarely occur as expected. Use the shut\_down\_in() function so that your team does not get disqualified after a run.
- **An organized workspace is a key to success:** The team should buy some form of organizing equipment such as containers meant to organize small parts such as screws or tackle boxes and spend the first day organizing and sorting their parts. This allows students to see and handle each and every part in the Botball kit to familiarize them with what is available for use in that year's kit. A well-organized workspace leads to more proficient building, it is easier to build and design when you know exactly where to go to get a part rather than searching through a bin of thousands of Lego pieces. The team may want to put a person or two in charge of keeping things organized.
- **Develop in nice, easy to chew chunks:** Students have a tendency to develop a strategy, build a robot and then program the entire program into their robot and then try and debug from there. This is a frustrating development process. Encourage your students to develop their robots and programs in small, easy to test pieces. For example: If the robot the students are to program is supposed to go forward and stop in front of a cup, lower it's claw, pick up the orange ball, turn until it sees the goal, move forward to the goal and then drop the ball, program it in easy to test sub steps instead of writing one gargantuan program to start. Have the robot go forward and stop in front of the cup reliably, once that is complete, add the code to lower the claw then retest. Once that is complete add the code to pick up the ball etc... Although it may seem, especially to students, to be a tedious way to work, it works and is far easier in the long run than debugging one giant program to start with.
- **Support your students:** One of the saddest things I have ever seen at a Botball contest involved a reporter interviewing a team "leader/mentor" for a TV spot. The reporter asked the teacher about the rules of the contest and the teacher had to respond that she was not familiar with the rules and she did not know how point scoring was done. The reporter then asked about the electronics and programming portion of the contest. The teacher replied that she was not familiar with the electronics or the programming portion of the contest. Her students did not fare very well in the contest and the students' lack of success can be directly attributed to the teacher/mentors lack of support of her students. It was the teacher that had failed, not the students.

The absolute worst thing you can do to your students is hand them the Botball kit and say "Here you go, have fun, see you in six weeks." The rules for Botball prevent the teacher/mentor from building and programming the robots for the kids and from forcing the kids into various strategies and modes of thinking. The rules do not prevent a teacher/mentor from giving advice, showing students how and where to get information, guiding students through problem solving, teaching students programming, robot construction and good engineering methods. The rules do not prevent the teacher/mentor from showing examples and grading or critiquing students work. The rules do not prevent the teacher/mentor from providing motivation for the students.

Botball is supposed to be about education and learning; students that are simply given a kit of parts and told "good luck" will learn that engineering is a hard and frustrating field full of failures and not worth pursuing. Students that are given the proper amount of support will learn a great deal of valuable lessons and skills that will help them throughout their lives and possible engineering careers.

### **3 Conclusion**

These hints and tips are by far not a comprehensive list of everything a team can do to be successful but it has helped our teams. Teachers, mentors and students may wish to use many of these tips or develop their own. Botball is first and foremost, a learning experience disguised as a contest. It is the learning experience or the journey that matters most.