

New Horizons Regional Education Center  
520 Butler Farm Road, Hampton, VA 23666

FIRST 2002, 2003, 2004 Robotics Competition(s)

**Final Summary of Research for Cooperative Agreement NCC-1-02011**

A Three (3) Year Cooperative Agreement

The third (final) year completion date was 10/15/2004.

**1) Introduction**

The New Horizons Regional Education Center (NHREC) in Hampton, VA sought and received NASA funding to support its participation in the 2002, 2003, and 2004 FIRST Robotics Competitions. FIRST, Inc. (For Inspiration and Recognition of Science and Technology) is an organization which encourages the application of creative science, math, and computer science principles to solve real-world engineering problems. The FIRST competition is an international engineering contest featuring high school, government, and business partnerships.

**2) Problem summary**

Within the context of good sportsmanship, the competition encouraged New Horizons high school students to practice the engineering design and building process. Our students brainstormed, designed, constructed, and tested a 30" X 36' X 60" robot which in turn competed in regional and national events. During each of the three years of this Cooperative Agreement between twenty and twenty-five students along with three New Horizons instructors participated on the New Horizons FIRST Team 122. Approximately five currently employed and/or retired NASA Langley engineers assisted with the more technical aspects of the robot design during each of the three years, along with engineers from local firms. The students came from a variety of educational programs at New Horizons: Governor's school science students, welding, computer networking, and electronics students from the career and technical program, all worked together to accomplish the team's tasks.

New Horizons has an Peninsula-wide commitment to inspire the minds of our students to pursue technological careers. Getting students excited about learning and about how to apply their knowledge is one of our major goals along with providing potential good employees to local businesses. We recognize the need to provide training for both the college and non-college bound student. This FIRST project is a great example of how diverse student populations can learn and work together side-by-side on a team project, a valuable skill for all in future employment.

### **3.) Approach**

During early Fall of 2001 (and similarly Fall 2002, 2003), teachers from New Horizons met with NASA engineers to create a time table of events to aid the team to meet its goal to have a fully operational robot completed by mid-February 2002 (and similarly by Feb. 2003, 2004). During October-December of 2001, 2002, 2003, students broke up into small teams and each team spent two months building (or learning about) different sub-components of the robot. One team built several types of telescoping arm mechanisms. Another team worked on a wheel/transmission assembly for a prototype mobile platform. Omni wheel designs were improved from one year to the next. Another group learned how to program a Stamp II processor and then in later years programmed an integrated chip with C-programming commands to operate the robot.

By mid-December 2001 (and similarly by Dec. 2002, 2003), a prototype platform was constructed. In early January 2002 (and similarly 2003, 2004), the official FIRST rules and a kit of robot parts were distributed to the students. Mid-January saw the team in intensive evening design/brainstorm sessions. By February of each year a cart on which to place the robot was modified and improved. The construction of the robot (at the school's facilities) was completed by February 2002 (and similarly in Feb. 2003, 2004).

New Horizons attended three competitive events each year: the NASA-VCU Regional competition in Richmond, Virginia during March 2002, 2003, 2004; a Regional Event in Philadelphia and/or Annapolis during March 2002, 2003, 2004; and the national competition, held at either Houston, TX or in Atlanta, GA sometime during March or April 2002 (and 2003, 2004).

### **4) Results**

The goals of this project were to allow students to work hand in hand with engineers to learn the engineering process, how to work as a team, to learn the importance of prototyping, and to discover that engineering and technician/fabrication and computer software development are exciting careers to consider.

We accomplished thirteen (13) distinct new tasks/outcomes during FIRST 2002, 2003, and 2004:

- Students demonstrated their robot and shared what FIRST is all about with Matthews High School, mentored a FIRST Lego-League team at Epes Elementary School in Newport News, and helped mentor a high school team from Landstown H.S. in Virginia Beach. We worked to aid teams with "engineering difficulties" in their PIT areas at the events, loaning tools or sharing wisdom.
- Our team won the Sportsmanship Award twice during these three years. We are most pleased with this Award.
- During FIRST 2002, our team won the "Leadership in Control" Award at the NASA Langley/VCU Regional.

- We were the Event Finalist at the Philadelphia Regional that same year. At Philadelphia we also won the GM Industrial Design Award.
- Team 122 won the Regional Competition at Columbia, South Carolina during FIRST 2004 with the great help of 2 alliance partners. Team 122 also won the Team Imagery Award at this Columbia Regional.
- During the FIRST 2002 competition season our team built a robot that could tip over by 90 degrees, allowing it to have a larger "footprint" moving on the competition playing field. We learned that such a tipping action created a lot of stress on the frame of the robot, leading to some broken frame elements. And though this larger footprint allowed us to pick up more soccer balls on the playing field sometimes the extra time it took to tip over helped us to lose critical time in a "tight" match. We decided never to build a "tip over" robot again.
- The students on our team nominated one of our engineers, Mr. Ansel Butterfield, for the Woodie Flower's Engineering Award (best engineer that aided the students/team). Mr. Butterfield (retired NASA) very deservedly won this award at the Richmond Regional during FIRST 2004.
- Our team submitted an entry for the Chairman's Award (to Richmond Regional) during each of the three years. Despite good compliments from the Chairman's Award Review Committee we did not win this award. It is an important award but it still eludes us. We will continue trying to win it.
- Success was achieved along several different lines. Overall, the students and engineers built a robot that functioned as it was designed to. Students learned the valuable lesson that pre-competition testing of the robot led to a consistent and reliable robot. Students and teachers observed how the engineers troubleshooted problems "right on the spot" in very tight time frames at the competitive events, including fixing broken frames and "popped" chains that controlled an onboard module/mechanism.
- Our team also learned the valuable lesson that an over designed robot did not often meet our needs. An over designed [or a too-complicated mechanism] often led to frustration as complicated components broke down and were difficult to fix. During FIRST 2003 a complicated robot design had to be taken apart between rounds on a playing field (and between Regionals) just like peeling back an onion, skin layer by skin layer. Only then could our vastly "stripped down" robot function well on the playing field.
- Students from various classes learned to communicate with one another more effectively, both orally and by email. Some learned that they had to overcome normal personality conflicts for the good of the team. Other students learned that they needed to listen and heed the advice that the engineers offered. Friendships developed between some of the students and the engineers that may last well into the student's college phase. Teachers-coaches learned to manage the engineers in a more effective manner than in previous years (from the school's perspective).

- New Horizons staff observed that the engineers from our community really enjoyed working with our students. The retired engineers from our community relished the opportunity to practice their skills again. Students appreciated being delegated fabrication and construction responsibilities after the engineers carefully (and patiently) explained their reasoning. Several girls (and a few guys) were thrilled that they learned how to use a drill press, a lathe, a band saw, or a dremel tool. The engineers had a collective wealth of knowledge to share and it was interesting to observe how they communicated their ideas with one another when it came to compromising on design ideas. It was an honor to watch the engineers enthusiastically support this educational project with their time and great efforts.
- Finally, the physics teacher continues to change his regular curriculum in some selected topics (e.g. rotational equilibrium, center of gravity, torque needed in a motor to rotate collection baskets on the robot, setting up Newton's 2nd law as a differential equation to calculate the tipping rate of a robot) Robotics examples were used in classroom lectures and homework assignments. Some special test problems were also created to reinforce what the students were learning in the design phase.

## 5) Conclusion

The New Horizons Regional Education Center deemed this robotics project a great success via participation in FIRST 2002, 2003, and 2004. All participants learned many "do's" and "don'ts" lessons and by October 2004 our team was re-gathering yet again to plan for FIRST 2005. Our school enjoys this competition very much!

Students and teachers alike came away from this project with an increased respect towards brainstorming, design work, fabrication techniques, and engineering in general. This project enhanced cooperation between science and non-science oriented students and also fostered better understanding and cooperation between teachers and mentors in different fields of expertise. Having the engineering community come together to impact education in such a special manner will be appreciated for many years to come.

  
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