New Horizons Regional Education Center
2001 FIRST Robotics Competition

Final Summary of Research for Cooperative Agreement NCC1-01-025

1) Introduction

The New Horizons Regional Education Center (NHREC) in Hampton, VA sought and received NASA funding to support its participation in the 2001 FIRST Robotics competition. 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 3' X 5' robot which in turn competed in regional and national events. Thirty students participated on the New Horizons FIRST team along with and two New Horizons instructors and a new instructor from Crittenden Middle School in Newport News. Approximately ten currently employed and retired NASA Langley engineers assisted with the more technical aspects of the robot design. We also had 3 engineers from private industry on our team. The students came from a variety of educational programs at New Horizons: Governor's school science students and several electronics students from the career and technical program. Non-New Horizons students, from two different school divisions, also participated on our team, including 5 middle school students. Our team also had access to the welding, carpentry, automotive technology, and auto body shops at New Horizons.

New Horizons has an Peninsula-wide commitment to inspire the minds of our students to pursue technological careers. Getting students excited about learning and applying 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 these two student populations can learn and work together side-by-side on a team project, a valuable skill for future employment.

3.) Approach

During early Fall, 2000, New Horizons personnel 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 2001. An organizational chart was also constructed outlining tasks of different team members. During October-December, students broke up into small teams and each team spent two months building (or learning about) different sub-components of the robot. One team worked on measuring the friction characteristics of different materials used on our wheels. Another team worked on a wheel/transmission assembly for a prototype mobile platform. Another group learned how to program a Stamp II processor. Finally, four students tried to utilize the

animation software produced by AutoDesk, though the students had difficulty becoming proficient with the software. By mid-December 2000 a prototype platform was constructed. On January 6, 2001 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. Our initial target was to have the design complete by Jan. 19 but in reality it came almost two weeks later. Our team still seems to struggle with finalizing a design that all participants can agree on and also struggles with managing the time between the final design and the beginning of construction. However, by February a cart on which to place the robot was completed. The construction of the robot (at the school's facilities) was completed by February 20, 2001.

New Horizons attended three competitive events: a regional competition in Richmond, Virginia during March 8-10, 2001; a regional event in Philadelphia during March 21-24; and the national competition, held at Epcot Center in Orlando, Florida on April 5- 7 , 2001.

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 ten (10) distinct new tasks/outcomes this year compared to our participation in past years:

1. Students were much more involved in "sharing the story of FIRST" within our community than in year's past. This year's [and last year's] robot(s) were demonstrated to both public and private middle school groups; at the Virginia State Fair; for a group of 100 Peninsula-wide students who took the NTA math contest on May 12, 2001; at NASA Langley during its Open House in May; and at the Virginia Air and Space Center in late May. The robot construction process was also examined by a group of machine technology students as part of a curriculum exercise.

2. For the first time we used Palm-Pilot technology to collect data about other teams' robots at the competitive events. A student developed a database questionnaire our team members could use to catalog the characteristics of other robots (drive train mechanism?, how fast?, could robot pick up a ball?, go under the playing field bar?, etc.)

3. For the first time we had middle school students participate on our team, five of them from the Newport News school system. They helped in the initial brainstorming, and they actively used the Palm Pilots to collect data at the events. The middle schoolers also had a great team "spirit", enthusiastically rooting for our team and for our alliance partners at the competitions. They also "worked the crowd", giving out spirit items like buttons and candy, to let others

know about their/our own team. It was a delight to have the middle schoolers participate.

4. Students were also more actively engaged in fund raising activities this year. Students composed a brochure that was sent out to over 40 businesses explaining our team's involvement with FIRST. Students also sold pizza, candy, and Tupperware™ to raise some monies. Students shared our participation in FIRST at an evening meeting of the Electrical Contractors Council, which in turn then generously donated some monies to our team.

5. Our team submitted a much better "scrapbook" for the Chairman's Award. Feedback from FIRST describing our 2001 entry included: "a visually interesting and delightful submission...presents a great documentation of your team's journey...loved your comments about building bridges between divisions in your own school..."

6. We had more students this year [who put in many hours] trying to learn how to use the AutoDesk animation software. This was the first year that the students actually completed a 30 second animation. However, we did not submit an entry into the FIRST animation category in the competition due to last moment logistical and hardware difficulties. The AutoDesk software "learning curve" is still quite steep for students (and adults).

7. We won the Delphi "Driving Tomorrow's Technology" Award in Philadelphia which acknowledged a good quality engineering design of our robot's operational functions.

8. Our team made it into the quarter finals round in Richmond and in Philadelphia (4th places). We went on to win our Division at Nationals which allowed us into the semifinals round at Epcot. This has been the best year ever at Nationals, competition-wise, for our team.

9. We had much more parent involvement on our team. Parents gave of their time to assist with fabrication, fund raising, encouraging team spirit, making costumes, and attending the competition events in Richmond, Philadelphia, and at Epcot. Their input and support were welcomed by all.

10. Our team demonstrated our robot to the public at a local Peninsula Pilots baseball game which generated much interest not only in FIRST but also in the FIRST Lego League Competition for middle school students.

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 more testing of our control system would lead to a more consistent and reliable robot. Team members observed how the engineers and some of the students troubleshooted problems "right on the spot" at the competitive events, including the modification of software code to make our control system better.

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.

New Horizons staff observed that the engineers from our community really enjoyed working with our students. Both the retired and non-retired engineers from our community relished the opportunity to practice their hands-on skills again. Students appreciated being delegated fabrication and construction responsibility after the engineers carefully (and patiently) explained their reasoning. 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 effort.

5.) Conclusion

The New Horizons Regional Education Center deemed this robotics project a great success in our 4th year of participation in FIRST. Many "do's" and "don'ts" lessons were learned by all. The summer of 2001 will see our team regathering to plan summer and early Fall activities to include more "show and tell" demonstrations of our team and its robot along with more fund raising events to raise money for 2002 FIRST.

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 in different subject fields. The addition of the 5 middle schoolers added a new educational and valuable dimension to the project. Having the engineering community come together to impact education in such a special manner will be appreciated for many years to come.