Design Project Proposal

EECE 401 Senior Design I
Department of Electrical and Computer Engineering
Howard University

MEMORANDUM

10/31/02

TO: Dr. Charles Kim
Instructor

FROM: Paul Booker
Nia Bradley
Ebonie Davis
Pameshanand Mahase
Duane Smiley
Daniel Ward

SUBJECT: Design Project Proposal Submission

Enclosed is our group's design project proposal, Game Ball Tracker. This proposal is submitted for partial fulfillment of the Senior Design requirement outlining the plan for the project pursuit through the problem formulation with functional requirement, alternative solution generation with electrical and computer engineering approaches, project management and milestones, and task assignments and deliverables. We understand this proposal, in written report as attached and oral presentation upon scheduled, would undergo a rigorous Proposal Review Panel assessment, and we are willing to accept recommendations from the Panel Review and modify and resubmit for final approval.

Design Project Proposal

Game Ball Tracker

Submitted by

Paul Booker
Nia Bradley
Ebonie Davis
Pameshanand Mahase
Duane Smiley
Daniel Ward

Approved by

Proposal Review Panel Representative:

Name	Signature	Date

Senior Design I Instructor:

Name	Signature	Date

Game Ball Tracker

1. Introduction

Team GBT is really birthed from a customer point of view. Since its members are both customers and sports fans, they are aware of how easily the sight of a game ball can be lost on television amid the melee that often takes place on the ground in some arenas. (Add, if possible, even though it may anecdotal, the comments on viewers' or spectators' (who watch arena screen) on the problem and wishes for better technology to overcome the problem) Using a tracking system (this sounds like, the system is already out there, and GBT intends only to use it. Change the voice more active), Team GBT hopes to successfully reduce how often this loss occurs when viewing a game on television and therefore enrich the entertainment value of the customer by adding some clarity.

The purpose of this project is to create a method of tracking an object from a distance using one of the various types of tracking technology that are available. By implementing a feasible solution, Team GBT hopes to utilize this system in the gaming arena, where a game ball or similar object (e.g. a hockey puck) can be efficiently followed by an in-house camera, thus improving the television broadcasting experience of viewers everywhere.

2. Problem Definition

(Description, instead of itemization would be more proper in the proposal writing. This is more true since you will provide a design requirement in tabular format in the Appendix.)

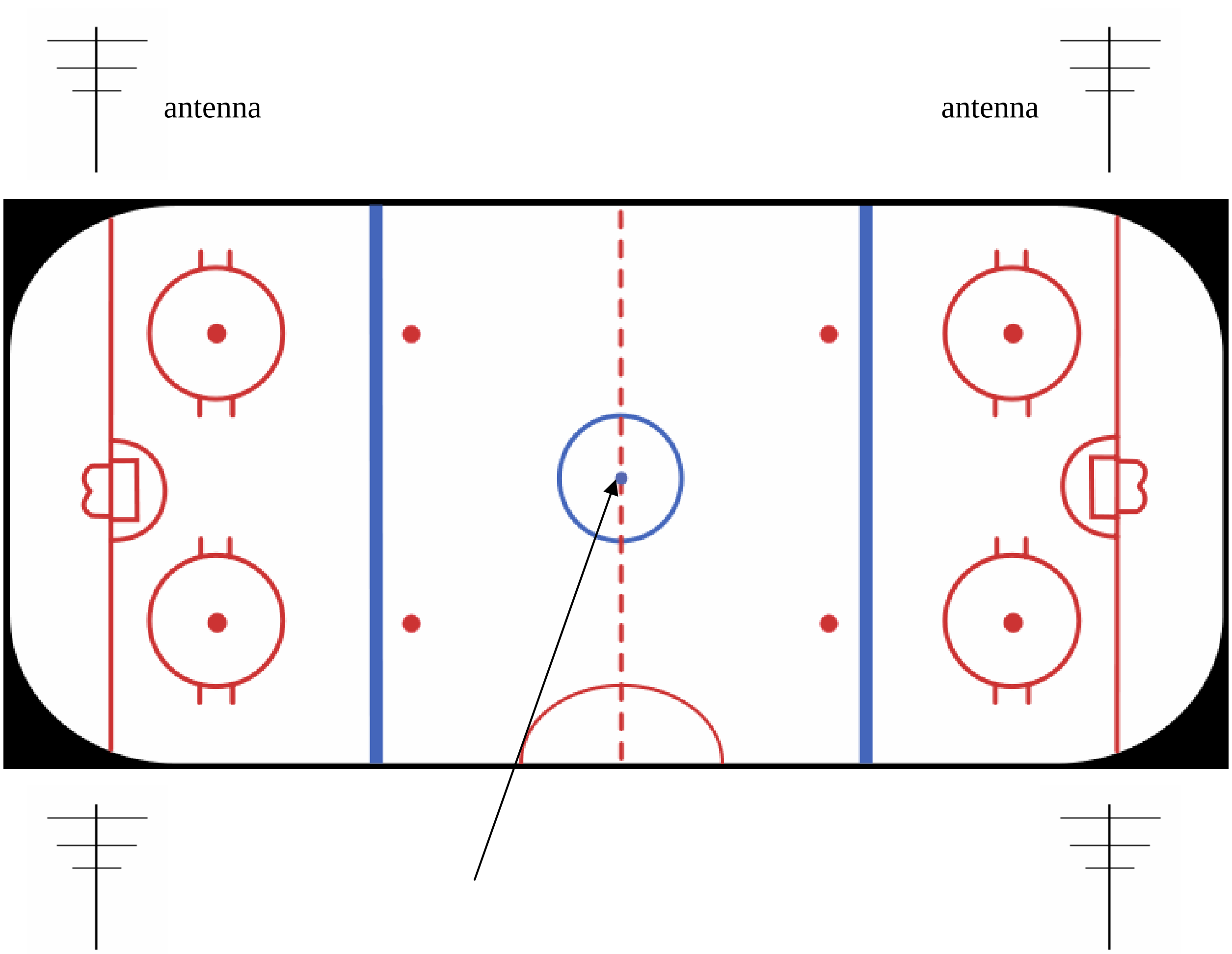
The successful completion of this project requires the following standards and regulations to be met:

1. The RFID system must contain an RFID tag (for the game ball), an RFID receiver, an RFID antenna, and a computer controlled motor.
2. Product production must not exceed a cost of $500.00.
3. Devices used must adhere to part 15 of the FCC guidelines regarding wireless devices.
4. The camera base motor must operate using 120 VAC or 240 VAC.
5. Wireless devices must not interfere with any other wireless devices within its operating area. (and compliance with such and such regulations. Put here the specific standard/regulation number.
6. The RFID tags must have a width no larger than 70 millimeters and have a length less than 70 millimeters.
7. RFID tags used must be placed within the game ball and be sturdy enough to operate in harsh environments.
8. The camera base must be able to support a weight of 80 lbs.
9. The camera base dimensions must at most have a width of twenty-two inches, a height of four inches, and a depth of twenty-two inches.
10. Any RFID antennas used must appear inconspicuous.

11. The RFID receiver must use 120 VAC or 240 VAC.

3. Engineering Approach (including solution alternatives)

There are a few solutions that could work when trying to design a tracking system for a game ball. Each of the solutions involves the use of some sort of RFID system. The system will involve the use of an RFID tag, 4-5 antennas, an RFID reader, and a motorized camera base. For the purposes of this project, we will experiment with a design that could be implemented in a hockey arena. The setup in the arena will look similar to what is on the diagram below:

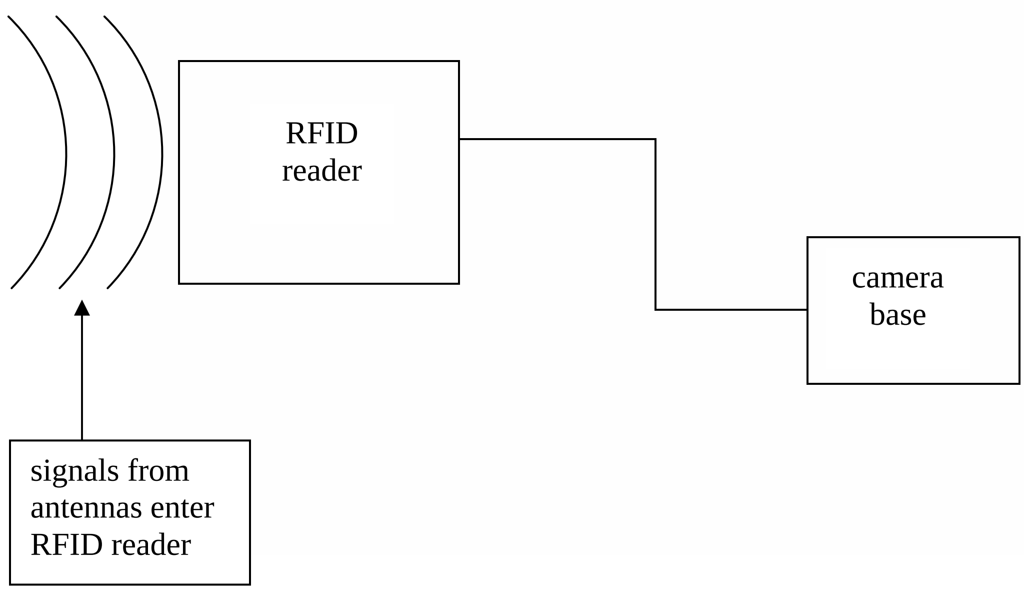


antenna

additional antenna will be placed on the bottom of the jumbotron

antenna

The system will function as such: as the puck travels along the ice, the antennas will track the RF signature emitted by an RFID tag that will be implanted within the puck. As the antennas track the movement of the puck, a signal will be sent to a reader that is connected to the camera base. That reader will communicate with the camera base to allow the camera to follow the position of the puck. A block diagram of the signal transmission can be seen below:



The ways in which the RFID tag could be implemented can vary one of three ways:

1. The tag could be "passive." In other words, the RF signal coming from the antennas could induce enough current in the tag to provide it with enough power to transmit an RF signal. No

internal power supply would be necessary. However, this setup would shorten the range of the tag and may result in the installation of additional antennas.

2. The tag could be “active.” In other words, the tag will have its own power supply. This will allow a stronger RF signal to be emitted, and the range would be exponentially greater than that of the “passive” configuration.

3. The tag could be “semi-active.” The tag would still have its own power source. However, it would only be enough to power the chip within the tag. Therefore, the tag would still depend on the RF signal generated by the antennas to provide power for an RF emission from the tag.

The ways in which the reader and antennas could be implemented may differ as well:

1. Low-frequency parameters could be used. The antennas would emit and pick up low frequency signals, and the reader would only respond to signals of such a low frequency. It is energy efficient, but it will shorten the range of the setup.

2. A high frequency configuration could be used. The antennas would emit RF signals of higher frequencies. This would increase the range of the antennas, but it may come at the cost of more power when implementing the RFID tag.

3. An Ultra High Frequency setup could be implemented. The range would be more than what is necessary, but a sufficient power supply is needed for the tag.

4. Tasks and Deliverables

<u>Tasks</u>

Phase 1 " Building a Foundation"

September

- Conduct Brainstorming Session for the following:
    - To identify needs
    - Determine possible topics

October

- Establish Team Contract by defining the following for the Team:
    - Needs
    - Vision
    - Goals
    - Individual Roles
    - Procedures and Policies
    - Expectations

Phase 2 "Taking The Next Step…"

October

- Perform Research
- Adjust Requirements using feedback from presentation of 1st Version
    - Identifying the problem
    - Alternative Designs
    - Possible Design Parameters (i.e. cost, weight, regulations…)

Phase 3 "I Propose…"

October

- Assign each member in group one of the following:
    - Introduction
    - Problem Definition
    - Engineering Approaches
    - Tasks and Deliverables
    - Project Management
    - Conclusion
- Call Meeting to make each subject cohesive with one another.
- Establish 1st Proposal Draft
- Discuss Low-level design specifications

November

- Meet with multiple professors to further discuss project specifications
- Submit Draft Proposal
- Obtain feedback from instructor
- Revise proposal based on feedback
- Generate Memo for Dr. C. J. Kim
- Complete Official proposal
- Begin construction of In-Class Presentation
- Present Presentation to panel
- Proceed accordingly based off panel feedback

Phase 4 “ Ready, Set, Go…”

November

- Meeting called to implement feedback provided by the panel
- Revise proposal as needed
- Refer back to high-level design specifications
- Make appropriate changes
- Finalize low-level design specifications

December

- Order parts
- Check with manufacturer as needed to check part delivery status
- Assign each member a focus area of project
- Over Christmas break start initial production of prototype

January

- Continue construction of prototype
- Troubleshooting any errors
- Testing each part individually
- Troubleshooting any errors

February

- Testing all parts together
- Troubleshooting any errors
- Group meeting called to finalize prototype

March

- Group meeting called to begin draft of presentation
- Each member is assigned a presentation section
- Group meeting called to make presentation cohesive
- Review draft presentation
- Make appropriate changes
- Submit presentation to Dr. Kim
- Review feedback
- Produce final presentation
- Prepare for presentation

<u>Deliverables</u>

Phase 1 “ Building a Foundation” (September/October, 2007)

September

- Needs Identified
- Topic is determined

October

- Contract is created

Phase 2 "Taking The Next Step…"

October

- 1st Version of Design Requirements is compiled
- Design Requirement presentation
- 2nd Version of Design Requirements is compiled
- High-level Design specifications produced

Phase 3 "I Propose…"

October

- Low-level design specifications produced

November

- Draft Proposal Submission
- Retrieve feedback from instructor
- Official Proposal
- In-class Proposal Presentation
- Receive feedback
- Revised Presentation
- Panel Proposal Presentation
- Receive feedback

Phase 4 "Ready, Set, Go…"

November

- Implementation of feedback
- High-level design produced
- Low-level design produced
- Finalized High/Low-level specifications

December

- All parts are ordered
- Log of part delivery dates
- Each member assigned focus area
- Christmas Break
    - Initial production of Prototype

January

- Continued production of Prototype

February

- Issues that occurred throughout construction addressed
- Continued production of Prototype

- Completed Prototype
- Tested Prototype

March

- Draft Presentation
- Final Presentation for EECE Day

5. Project Management

- Timelines and milestones
    - October 29, 2007 – Group Meeting
        - Discuss Draft Proposal
    - October 30, 2007 – Meeting with Dr. Zeng
        - To discuss specific about project
    - October 31, 2007 – Submit Draft Proposal
    - October 31, 2007 – Group Meeting
        - Discuss low-level design specifications
    - October 31, 2007 – Meeting with Dr. Harris
        - To discuss specific about project
    - November 2, 2007 – Initial Response from Professor
    - November 5, 2007 – Group Meeting
        - Consider Professor Response and make any appropriate adjustments
    - November 7, 2007 – Submit Official Proposal
    - November 14, 2007 – Official Proposal Presentation
    - November 19, 2007 – Group Meeting
        - Make appropriate changes based on suggestions from Official Proposal Presentation observers
    - November 21, 2007
    - November 28, 2007
    - December , 2007
    - March 2007 – Complete Game Ball Tracker
        - Produce prototype
        - Complete presentation

Thursday – Meeting with all professor
Friday – Meeting with all professors

- Resources and Budget
    - Internet
    - CEACS Faculty and Professors
    - NHL – National Hockey League
    - Tripod Motor - $300
    - RFID tag p $50
    - Antenna

    - RFID reader - $4000 (for installation)
    - Computer Software – Free
        - VHDL?
        - C++?
- Safety Issues
    - The Noise at Work Regulations 1989 require employers (operators of the camera) to carry out a noise assessment if their employees are likely to be exposed to noise levels above 85 dB(A). There are further requirements concerning reducing exposure, providing ear protection and so on.
    - Fixed camera positions should be placed
        - Behind recognized spectator barriers
        - Adjacent to permanent hazards such as dug-outs.
        - The camera should not protrude any more than is necessary for operation.
    - All fixed cameras should be protected to prevent injury in the event of a person or vehicle colliding into them.
        - Suitable protective barriers (eg buffer bags) should be placed to the height of the top of the mounting.
    - The assessments should consider whether access routes are:
        - Free from obstruction and debris; of sound construction
        - Securely fixed and fitted with handrails (1.1 m high)
        - Sufficiently illuminated even under emergency conditions.
        - Any obvious defects should be brought to the attention of the management of the stadium.
    - Access for equipment should also be considered. Spectators and others should be protected from the possibility of anything falling as a result of defective materials or inadequate handling arrangements.
    - Consider safety of human expose to radio frequency energies.
        - Biological effects that result from heating of tissue by RF energy are often referred to as "thermal" effects.
        - At relatively low levels of exposure to RF radiation
            - Levels lower than those that would produce significant heating, the evidence for production of harmful biological effects is ambiguous and unproven.
            - Such effects have sometimes been referred to as "non-thermal" effects.
            - Studies have shown that environmental levels of RF energy routinely encountered by the general public are typically far below levels necessary to produce significant heating and increased body temperature.
- Engineering ethics issues
    - In accordance with many engineering ethics, the group will avoid
        - Fabrication: making up data and results and recording or reporting them
        - Falsification: Manipulating research materials, equipment, or processes; or changing or omitting data or result such that the research is not accurately presented in the research record

- Plagiarism: Appropriation of another person's ideas, processes, results, or words without giving appropriate credit.

6. Conclusion

The primary problem in hockey is that the puck moves very quickly, sometimes in unexpected directions. To add to this problem, the puck itself is so small that people watching the game on television have problems keeping track of where the puck is at any given time. NHL regulation pucks are 3 inches in diameter, 1 inch thick and weigh no more than six ounces. This makes it very difficult to track. The purpose of this project was to find a way to make it easier to for the audience to track the puck, and for hockey officials to know when goals are scored.

New pucks have been presented before, but there have always been problems. Players have complained that pucks with wireless infrared equipment do not perform as well as regular pucks made from solid vulcanized rubber. Officials have also complained that they go through pucks too quickly, because the infrared pucks have to be replaced every ten minutes of a game, at a cost of $400 per puck. Also, other tracking pucks that derived much of their weight from substances other than rubber, did not handle cold temperatures as well, and they bounced too much when hit.

The redesigned puck presented here brings a new element to hockey: the ability to track the puck over the course of the game without the use of overly expensive equipment and time-consuming practices. The use of RFID tags solves all of the problems with traditional hockey. The miniscule nature of RFID tags in general means that the puck itself can still be almost entirely made of rubber, which means that it will absorb cold as well as a traditional puck. This puck also will not have to be replaced every ten minutes because it does not consume as much power as a puck with infrared devices. Also, they will not cost as much, and the audience as well as NHL officials will be able to more effectively know where the puck is at all times when in play. Thus, the final deliverable of this project is an RFID enhanced hockey puck superior in all ways in to the original.

<table>
<tr><td rowspan="2">GBT Team

Pameshanand Mahase, Akil Booker, Duane Smiley Daniel Ward, Ebonie Davis, Nia Bradley</td><td rowspan="2">Requirement Form for Game-Ball Tracker</td><td>3rd Version: 10/30/2007</td></tr>
<tr><td>Modified from 2nd Version 10/23/2007</td></tr>
<tr><td>Date Update</td><td>Requirements</td><td>Sources</td></tr>
<tr><td></td><td>Overall Function: Follow hockey puck during a broadcasted game.</td><td></td></tr>
<tr><td>10/30/2007</td><td>RFID Tag
• Installed in middle of puck during manufacturing period (one-time installation)
• As thin as a sheet of paper</td><td>Internet
Dr. Zeng
Dr. Kim</td></tr>
<tr><td>10/30/2007</td><td>RFID Antenna/Reader
• Reader contains RFID receiver
• Antenna locates RFID tag in puck</td><td>Internet
PASDEN</td></tr>
<tr><td>10/30/2007</td><td>Camera Motor Base Operation
• Built in computer to calculate position of ball
• Manual user override
• Custom fittings for various cameras
• Smooth rotational motion</td><td>PASDEN</td></tr>
<tr><td>10/30/2007</td><td>Cost and Schedule
• All equipment will cost as much as $3,500 per unit (camera motor base, RFID tag, base unit)
• Limited 5 year transferable warranty
• Design must be built and ready for testing by March of 2008</td><td>Internet
PASDEN</td></tr>
<tr><td>10/30/2007</td><td>Regulations
• Complies with part 15 of the FCC rules. Operation is subject to the following two conditions:
  o (1) This device may not cause harmful interference, and (2) this device must</td><td>Internet</td></tr>
</table>

	accept any interference received, including interference that may cause undesired operation	