Automatic TV Antenna Rotator Controller
Team 5
Homework 1
March 18, 2002

Responsible Engineers


# Table of Contents

1  Introduction:............................................................................................................................ 4  
2  Market Research ..................................................................................................................... 4  
   2.1  Methods.................................................................................................................... ....... 4  
   2.2  RESULTS ....................................................................................................................... 5  
3  Customer Requirements.......................................................................................................... 8  
4  Product Requirements............................................................................................................. 8  
5  Product Specifications .......................................................................................................... 10  
6  PRODUCT PARTS: ............................................................................................................. 11  
7  Conclusion ............................................................................................................................ 12  
Appendix A: Prospective Customer Survey Questions .......................................................... 13  
Appendix B: Survey Results......................................................................................................... 14  
Appendix C: System Block Diagram............................................................................................ 15  
# Table of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>Remote-Control Antenna Rotator (Cat # 930-0671)</td>
<td>6</td>
</tr>
<tr>
<td>Figure 2</td>
<td>Remote Rotator Control with Infrared Signal (Cat # 930-0670)</td>
<td>6</td>
</tr>
<tr>
<td>Figure 3</td>
<td>The Front View</td>
<td>11</td>
</tr>
<tr>
<td>Figure 4</td>
<td>The Back View</td>
<td>12</td>
</tr>
<tr>
<td>Figure 5</td>
<td>People Owning Television Receivers</td>
<td>14</td>
</tr>
<tr>
<td>Figure 6</td>
<td>Types of Channel Access</td>
<td>14</td>
</tr>
<tr>
<td>Figure 7</td>
<td>Cost of Channel Access</td>
<td>14</td>
</tr>
<tr>
<td>Figure 8</td>
<td>System Block Diagram</td>
<td>15</td>
</tr>
</tbody>
</table>
1 **INTRODUCTION:**
Our objective was to design a controller for a television antenna rotator that has the following prerequisites:

- sense the signal strength from a received television signal
- rotate the television antenna in such a way that the signal strength to the television is maximized
- have a read out/display indicating the direction that the antenna is pointing at all times
- small in size
- control a low-cost antenna rotator
- low cost – maximum price of $49.00

We first conducted initial background research to discover more information about the current available controllers. This information supplied us with a prospective market. More research and analysis provided insight into whether or not our product would appeal to this market. We expect our product to sell well because it assists a popular service at an economical price. Our controller is a desirable complement to the outdoor antenna.

2 **MARKET RESEARCH**

2.1 **Methods**

We made use of a myriad of resources for our research. First we browsed the World Wide Web with several popular search engines. These resulting web sites supplied the initial background information. Specific company web sites and online product manuals, however, showed us the current products on the market. The U.S. government patent site supplied similar designs that helped us figure out the block diagram.

More background information and figures came from statistical reference books. These resources included the *World Almanac, U.S. Census Bureau, and U.S. Industry Profiles*, all of which reside in Gordon Library.

We conducted the majority of our market research at the Radio Shack and Best Buy stores in Greendale Mall. There we looked at similar products and spoke the employees. Particularly helpful was Jodi Eastwood, the manager of Radio Shack. We asked her the following questions:
What is the demand like for TV antenna rotator controllers?  
What types of customers typically purchase this product?  
What kind of features and specifications does a customer usually look for?  
What range of prices appeal most to the customer?  
How durable are these devices?  
How often are they repaired?

The answers to these questions led to the development of a survey for prospective customers, found in Appendix A.

### 2.2 RESULTS

Our background information revealed that there are two types of antennas: indoor and outdoor. As for controllers for these antennas, we did not find any products with our identical prerequisites. We analyzed the alternative products on the market to discover the similar features that customers would also find appealing in our product.

At Best Buy we did not find any separate antenna rotator controllers, however, we did find various indoor antennas. These products ranged from $9.99 to $99.99 depending on their features. The features offered including UHF, VHF, and FM reception, programmable memory, manual or remote controlled adjustment of dipole antenna elements, amplification of weak signals, satellite compatibility, different size bandwidths, and different length warranties.

Figures 1 and 2 illustrate the remote-controlled antenna rotator that Radio Shack offers. The combined unit consists of a heavy-duty mast rotator, control box, and handheld remote, costs $99.99. The remote aims the antenna in up to 69 positions for accurate reception. Fig 2 shows the wireless controller by itself. Radio Shack’s product adds remote operation to the rotator and costs $54.99. An indicator on the remote displays the antenna direction. This product is the closest match to our proposed design which is available on the market.
According to Jodi Eastwood, this controller is very durable. Radio Shack does not offer a repair service as this product rarely breaks. As for the demand for this product, business is slow but profitable. Our interview with Eastwood resulted in two markets to consider: (1) rural areas without cable access and (2) people that wanted local channels without paying a monthly cable fee.

According to Andrew Grant of Dover-Foxcroft, Maine, cable companies will only make cable accessible to regions the meet the required ratio of ten households per mile. Mr. Grant is a
Maine native that has not had the option of cable access until this year because of this requirement, and therefore a reliable source.

Anything pulled in by an antenna is free, and this is the characteristic that attracts the second market. There is no alternative to a rotator controller for an outdoor antenna unless you want to climb on the roof to move the antenna by hand. As for indoor antennas, they have the option of being remote controlled or possessing a manual switch. Either of these two features must be built into the design and therefore our product does not apply.

Executive Neil Terk, the president of Terk Technologies, stated

> Interest levels in antenna products have gone up significantly as retailers become more aware of the benefits of being able to provide customers a solution to local channel reception. Retailers are seeing that antennas contribute to the sales of satellite TV systems, and the importance of being able to provide the proper antenna with HDTV sets.¹

The validity of the statement could be considered questionable as Terk may have been presenting a biased view. *HDTV Magazine* conducted a survey on consumers, however, which supports this statement. Released in September of 2000, this survey reveals that 46% of HDTV users receive service through antennas and 83% of those use outdoor antennas.²

Of the surveyed people without TV or a TV without channel access, 100% said they lacked channel access because cable was too expensive. Basic cable costs under $30 dollars a month, but a increasing the variety of programs or adding premium channels quickly raises the price. The high price was also the most common complaint for satellite owners as well as cable access owners. Of the people with antennas, 56% lived in rural areas with an outdoor antenna as their only channel access. 33% lived in either suburbs or cities, had satellite television, and used indoor antennas for local channels. The remainder lived in a city with an indoor antenna in addition to cable access. Any channel an antenna can pull in is free.

The goal of the surveying the general public was to obtain consumer information about the market into which we planned to introduce our product. The results (some shown in Appendix B) provided insight into the size of our market and the places we should target. We concluded that rural New England (i.e.: Maine, Vermont, New Hampshire) should be our current target region. The results reveal enough interest by the population of these areas to ensure that our product will fare well. The most common complaint of antenna access was the lack of quality reception. Our product design maximizes signal reception and therefore handles this issue.

3 CUSTOMER REQUIREMENTS

The information from our market research and surveys allowed us to gain a precise idea of what the average consumer typically seeks in a TV antenna controller. The following are customer requirements that we have composed:

- Durable -- long life span
- Affordable -- low cost -- less than monthly cable access
- Low power consumption
- clear picture
- easy to use
- Display direction of antenna/rotation at all times
- Easy to connect to rotator
- Relatively small size, light weight
- works in conjunction with satellite television
- Remote control
- one time step-by-step easy set-up and installation
- low maintenance
- low noise level

4 PRODUCT REQUIREMENTS

From the customer requirements we derived the following product requirements.

Durable – Our interview with radio shack revealed that the antenna rotator controller they currently sell is very durable with a long life span. In fact they do not even offer repair for the
product because the cost of replacing is less than the cost of repair. They offer a 90 day warranty but the product very rarely needs to be replaced. (Jodi Eastwood) Our product must also be a one-time purchase only.

Affordable – Our survey results show that most people are economical in nature. If they want local channel access in addition to their current television channel access, they want the cost to be less than the monthly cable bill. Anything pulled in by an antenna is free and our controller will maximize reception of the channel signals providing better access. Also raised was the issue of HDTV through antenna access.

Accurate Reception – Our survey results showed that people were dissatisfied with fuzzy unclear pictures. Our controller must be able to rotate the antenna to the position that will maximize the signal reception.

Display – Our market research showed that people watch TV during the day and at night. Therefore our display must be large enough that the consumer can read the antenna direction without eyestrain. Also the display must be illuminated in order for the consumer can read the antenna direction regardless of the time of day.

Efficient – The general public wants something that will have low power consumption. Therefore the controller needs to be on only when the TV is in use.

Appearance – As this product will be used most often in everyday households, the physical characteristics must be pleasing as well. The controller must be small in size so that it will not attract attention and fit on a TV shelf. It must also be light weight so that an average individual can pick it up and move it around easily.

Convenience – Our product must be easy to use in order to appeal to a greater market. It must be able to control a low cost antenna, and the complexity level involved in connecting the device should be low enough for the average television viewer. The controller must work in conjunction with other channel access options such as satellite television.
5  **PRODUCT SPECIFICATIONS**

The following are the product specifications that were derived form the product requirements and the customer requirements:

- ON/OFF button
- AC power supply input
- TV signal input from antenna
- Position input from antenna/rotator
- Output to turn on/off rotator
- 360° directional display of antenna position (NSEW)
- Rheostat
- AC/DC converter + transformer
- High signal input impedance
- Low distortion demodulator
- Noise filter
- Low power comparator circuit
- LED output when rotator is on
- Strong black plastic casing

Durability and appearance considerations are mostly covered by the outward casing that will be used. The casing is lightweight and not easily broken, with the color and small size being unobtrusive in most settings. Durability of the function of the controller should be covered by the design and choice of reliable components by the designers.

The controller should be convenient. All that the user needs to do when looking for a signal, is push the ON button on the controller. Once the controller determines the strongest signal, it automatically shuts down with the antenna in the appropriate position. The user is also able to see the position of the antenna, even while it rotates, because this might provide useful information.

The rest of the specifications are derived from the function of the controller. Basically, the controller needs to read the TV signal received by the antenna and turn the rotator on. When the strongest signal position has been determined, the rotator will stop the antenna in that position.
An AC/DC converter will convert the AC power source into DC to power the components of the controller. When the controller is turned on, it starts reading signals from the antenna and rotating the antenna. A demodulator takes the received signal from the antenna and processes it into approximately the original broadcast. A filter eliminates unwanted noise in the signal. The comparator circuit will be designed to determine the power of the incoming signal (while the antenna rotates slowly), and set a threshold, which will be the value of the strongest signal. The antenna then keeps on rotating until it returns to the position where that signal is found. At this point, the rotator and controller are automatically triggered to shut off.

This process can be visualized in the block diagram found in Appendix C. It shows a block diagram as well as a flow of functions that the controller goes through when the power is turned on.

6 PRODUCT PARTS:

Fig 1 and Fig 2 show two basic drawings of the product and its parts. Some of these parts might be changed during the course of the design as some changes could be introduced.

The front view shown, in Figure 3, shows the basic parts that were listed in the product specifications. These parts are the On/Off button, a display of direction, and the LED that indicates that the rotator is moving.

![Figure 3: The Front View](image-url)
The back view, shown in Figure 4, contains three input connectors. One connector is use for the AC power supply, one for the TV input signal from antenna, one for position input from rotator/antenna and a final one to turn the rotator on or off.

![Figure 4: The Back View](image)

7 CONCLUSION

From the previous studies and statistics, we can see that the consumption of antennas is rising because it provides a cheap alternative to cable. If HDTV is the future of television broadcasting, then the demand for antennas will continue to grow. Currently antennas are the only television option for people in rural areas. The most common complaint by this rural market is the quality of reception. Our product is designed to provide the most accurate reception possible providing a solution to this problem. For the surveyed sample from the rural region, the amount of money they would be willing to pay for a controller depends mainly on how well it worked. For a product that moderately improved reception $40 was the suggested price, and for something that worked excellently up to $120. Our $49 price limit fits well with in this range suggesting our product will be highly desired. Hence, we can conclude that our product will have good market appeal.
Appendix A: Prospective Customer Survey Questions

1. Where do you live?

2. Do you own a television?

3. What kind of channel access do you have (if more than one applies please mark all)
   a. antenna
   b. cable
   c. satellite
   d. other (please specify)

4. What features do you like about your channel access?

5. What features do you dislike about your channel access?

6. In what price range does your monthly access fall?
   a. Under $20
   b. $20-30
   c. $30-40
   d. $40-50
   e. $50+

7. If you answered (c) to question 3: How important is receiving the local channels (not accessible by satellite) to you?
   a. very
   b. if its not too expensive
   c. not worth paying anymore

If you answered (a) to question 3 or would like to express your opinion on antennas

8. Is your antenna indoors or outdoors?

9. Would you be interested in a controller for automatic rotation on your antenna?

10. How much money would you be willing to pay for such a controller?

11. Are there any special features/requirements you would like on such a controller?
Appendix B: Survey Results

Do You Own A TV?

Figure 5: People Owning Television Receivers

What types of Channel Access?

Figure 6: Types of Channel Access

Monthly Costs for Channel Access

Figure 7: Cost of Channel Access
Appendix C: System Block Diagram

This is a bad example of a block diagram.

A block diagram should contain blocks that represent physical parts of your system (ie. NOUNS).

A Flow Chart is a diagram containing blocks indicating your decision making strategy (ie. VERBS).

Don't confuse the two!

Figure 8: System Block Diagram