

# FORESIGHT SCIENCE & TECHNOLOGY

Technology Niche Analysis

Customer.com

On

Personal Wireless Thermostat

November 29, 2005

Developer's NAIC: 541330, Engineering Services

Science/Technology Fields: Engineering Technology: Engineering Thermostat

Arena NAIC: 34512, Automatic Environmental Control Manufacturing for Residential, Commercial, and  
Appliance Use

Library of Congress Subject Heading: Thermostat

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Supply Chain: Test, calibration, measurement, and monitoring

International Patent Classification: G 05 D 23/00 Controlling; Regulating; Systems For Controlling Or  
Regulating Non-Electric Variables Control of temperature

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## 1 Executive Summary

**NOTE: THIS REPORT IS BASED ON A MADE-UP, FAKE TECHNOLOGY. THE EXPERT AND END-USER INTERVIEWS ARE REAL, BUT THE RESPONDENTS WERE INFORMED THE TECHNOLOGY IS NOT REAL. THE DATA IN THE REPORT IS REAL DATA UNLESS OTHERWISE NOTED.**

The following is a non-proprietary description of this technology.

<i>Non-Proprietary Description of Technology</i>
The technology is a wearable thermostat that measures temperature uses to control the HVAC system. The technology is a system with one or more embedded sensors (enabling data from multiple users if the sensors are RFID based), a processing chip, and a low-power RF transmitter that sends a signal to a control unit to adjust the heating or air conditioning unit. The wearer can program the unit to provide the desired temperature, for example, and to change the temperature in accordance with times or the user's behavior (exercising, sleeping, etc.). The device is a battery-powered module that uses either replaceable or rechargeable batteries, can transmit its signal up to 2000 feet, and can be used as a stand-alone device or a component of a multi-functional control unit. The device's processor runs a Proportional-Integral-Derivative Controller algorithm and this control scheme permits a great deal of mass to be heated up or cooled down efficiently. A triangulation scheme using the base unit and two low cost transmitters enables the location of the user to be determined if the user is unable to provide that data. <sup>1</sup>

We anticipate that this technology will be useful not only for those who wish to have the most efficient use of their home environmental control system, but also for those who are disabled and need assistive technologies in order to effectively manipulate the controls of various appliances. The automation, or lack of dependence on input from the end-user, means that it could be used as an assistive technology.

What makes this technology a scientific/engineering innovation is:

<i>Non-Proprietary Description of the Key Innovation(s) Underlying the Technology</i>
The wearable capabilities of this technology combined with the wireless nature of the environmental control system appear to be the technology's major innovations. <sup>2</sup>

As we understand it, this technology combines the portability and convenience of a wireless thermostat (plus downstream other HVAC functionality) with the automated qualities of an assistive technology. So while a wireless thermostat appears to be generally desirable because it is a portable interface for controlling one's heating system, this technology takes that functionality and makes it so that, after the initial programming – which can be done by someone other than the ultimate end-user (i.e. a care-giver) – it requires no visual, tactile, or vocal input, making for a universally designed assistive environmental control technology.

CUSTOMER.com wishes to license this technology.

The end-user is defined as the person who ultimately uses the technology. Commercialization occurs when end-users buy your technology to utilize it in a practical application.

<sup>1</sup> FST0005TN Project Set-Up Form

<sup>2</sup> Ibid

### *End-User(s)*

End-users in this niche are characterized primarily by their need for assistive living devices such as this technology. End-users with disabilities – such vision or motor skill disabilities – would use this technology as a means to help them better control their living environment. The US Census estimates that approximately 9 million Americans have disabilities that require some form of assistive technology or care.<sup>3</sup> We anticipate that there would not be a high level of education needed for end-user to successfully adopt this technology, as it is an automated system. While there may be some training associated with the proper way to wear the device, we anticipate the lion's share of the education, that is, the programming of the system, would be a task performed by a third party such as an assisted living worker.

An application is a potential use for a technology that is based on end-user needs and could provide a feasible market opportunity for the technology. The following table presents our choice for an initial market entry application.

### *Recommended Application*

An assistive environmental control device for use in helping disabled end-users to better control their environment without manual use of thermostat or other HVAC controls.

Around 50 million Americans have disabilities. However, the actual market could be larger as non-handicapped people are also potential customers. As Patricia C. Sueltz, Executive Vice President and General Manager of Sun Microsystems' Software Systems Group notes:

“So, just as we design products with an eye toward internationalization in order to capitalize on worldwide opportunities, we need to think about the opportunity involved in enabling people with all levels of ability to interact with the system.... technologies developed to give access to people with disabilities often prove useful for the rest of us.... Solutions developed with accessibility in mind--whether an enlarged keyboard or an audible screen or a wireless handset to control the thermostat in your house--certainly help people with disabilities become more independent [and makes it easier for the rest of us].”<sup>4</sup>

### *Description of Use in Practice*

The device would be worn on the end-user's person whenever that end-user is physically in the environment that needs to be controlled. The device takes readings off the user, which are used to adjust the HVAC system to maintain comfortable temperature in this iteration of the technology. Downstream, R&D will add other parameters such as humidity. The technology can be in constant use, programmed to be in use at certain times, or overridden by the end-user if necessary or desired. The system provides for “smart” operation or operation which requires no user input. Thus for example, it can track the timing and magnitude of temperature adjustments in order to avoid wasting energy by too quickly turning off and on heating or cooling, leading to inefficient HVAC use. It also can

<sup>3</sup> “Disabilities Affect One-Fifth of All Americans” Census Brief, 1997, <http://www.census.gov/prod/3/97pubs/cenbr975.pdf> (accessed November 23, 2005).

<sup>4</sup> Sueltz “High-tech's disability mandate,” *CNET News.Com*, January 14, 2002, <http://news.com.com/2010-1072-812862.html?legacy=cnet> (accessed October 23, 2002). For example, comedian Valerie Harper jokes that if men had menopause “Every thermostat in America would be set to ‘cool,’ even in the winter. Men would control the thermostat the way they now control the TV remote.” [http://www.oxygen.com/sex/allsex/valerieharper\\_070301.html](http://www.oxygen.com/sex/allsex/valerieharper_070301.html). It may be that technology such as this would be attractive for people whose body temperature is varying.

be provided with adjustable presets to meet different preferences of its users. An option is to link sensors from multiple users to one controller and optimize given readings and preferences to make the environment as comfortable as possible for all the people in it.

As mentioned above, this device would basically be worn constantly or in proximity to the body to best control the living environment of the end-user. We anticipate that, after some set-up by someone such as an assisted living worker, care-giver, relative, or vendor, the technology would operate without input from the end-user.

These end-users work in a segment of the economy. Forces in the arena can support or threaten commercialization.

*Arena Dynamics*

The arena for assisted living technologies is made up largely by the populations of end-users, the manufacturers/vendors of assistive living technologies, and government forces and laws or organizations. These include the Americans with Disabilities Act, other federal legislation that seeks to ensure that these individuals have full access to the benefits of society, and the National Institute on Disability and Rehabilitation Research, who provides funding to advance assistive technology.

We anticipate that an assistive living technology may be in good position insofar as the federal government drives the advancement and adoption of such technologies via programs such as the National Institute on Disability and Rehabilitation Research. One major segment of the population of other potential end-users, the elderly, is anticipated to grow in size as the baby-boomer generation ages. This growth will also lead to more disabled people.

The reason end-users find this technology attractive is:

<i>Current Weaknesses and Improvements</i>		
<b><i>End-User Need</i></b>	<b><i>Weakness of Current Technology</i></b>	<b><i>Improvements Offered by This Technology</i></b>
Environmental controls, such as thermostats, which can be effectively and accurately used without dependence on accurate vision, dexterity, or other motor controls. Ideally minimum end-user input is also desired.	Current assistive living technology, such as thermostats with large, easy-to-read numbers and large dials, still require a certain level of ability on the part of the end-user. <sup>5</sup> Human error can result in the mismanagement of environmental controls. <sup>6</sup> Current technology is also not “personalized” in the sense that, like your house thermostat, it measures ambient air parameters as opposed to the actual comfort levels of the people,	This technology would remove the need for the end user to have to visually interpret the information on a thermostat and physically manipulate the controls. It adds multimodal capabilities as well as the ability to integrate readings from several people.

<sup>5</sup> “Wireless Thermostats” The Thermostat Shop, 2005, <http://www.thermostatshop.com/wireless-thermostats.shtml> (accessed November 23, 2005).

<sup>6</sup> Dr. Stephen Sprigle (Director, CATEA, Associate Professor, Industrial Design, Associate Professor, Applied Physiology, Center for Assistive Technology & Environmental Access (CATEA), Georgia Tech University, 404-894-4960, [stephen.sprigle@coa.gatech.edu](mailto:stephen.sprigle@coa.gatech.edu)), in a telephone interview, November 23, 2005.

We understand that one of the major innovations of this technology is its ability to effectively, efficiently, and accurately control the temperature of a living environment so that it is comfortable without any input - physical, vocal, or otherwise. Therefore, we anticipate that this technology would meet the basic needs of an environmental control system and would beat currently technology on the grounds that it cuts out human effort and error.

Based on our analysis to date, which is constrained by budget and time, we estimate the market to be:

<i>Market Size</i>			
<i>Market Size</i>	<i>Growth Rate</i>	<i>Base Year</i>	<i>Short version of Basis for Estimate</i>
\$36.25 million	5.9% <sup>7</sup>	2003	This market size and growth rate are based on the approximate number of self-care disabled Americans, <sup>8</sup> the price per unit of this technology, and the market for comparable technologies.
\$45.6 million		2007	

A preliminary estimate of the price for this technology is:

<i>Price</i>
We anticipate that the price for this technology would be largely influenced by comparable technologies, which are priced at approximately \$99 per unit. <sup>9</sup>

There is an old saying that goes “at what price comfort...” The goal here is to provide more comfort at the price of more traditional technology.

We also identified other potential applications for the technology.

<i>Other Applications Identified</i>	
<i>Application</i>	<i>Potential Competitive Advantages of Technology</i>
Energy Efficient Buildings and Homes	“For every degree you lower the thermostat, you save 3% on your heating bill.” <sup>10</sup> Thermostats are so important that many energy companies offer “smart thermostat programs” under which they will provide a free thermostat and install it at no cost. These savings are based on traditional one zone heating and cooling. In California, San

<sup>7</sup> “North American Temperature Sensors & Transmitters Markets – HVAC,” Frost & Sullivan, May 30, 2003, <http://www.frost.com/prod/servlet/report-document.pag?docid=A309-01-06-02-02>, (accessed November 20, 2005).

<sup>8</sup> “Detailed Tables” U.S. Census Bureau, 2005, [http://factfinder.census.gov/servlet/DTable?\\_bm=y&-geo\\_id=04000US03&-ds\\_name=ACS\\_2003\\_EST\\_G00\\_&-redoLog=false&-mt\\_name=ACS\\_2003\\_EST\\_G2000\\_P058](http://factfinder.census.gov/servlet/DTable?_bm=y&-geo_id=04000US03&-ds_name=ACS_2003_EST_G00_&-redoLog=false&-mt_name=ACS_2003_EST_G2000_P058) (accessed November 29, 2005).

<sup>9</sup> “North American Temperature Sensors & Transmitters Markets – HVAC,” Frost & Sullivan, May 30, 2003, <http://www.frost.com/prod/servlet/report-document.pag?docid=A309-01-06-02-02>, (accessed November 20, 2005).

<sup>10</sup> “Tips for the home,” *Spots Interconnect*, <http://www.spots.ab.ca/~ics/hse.html> (accessed October 23, 2002).

	Diego Gas & Electric is also offering a \$100/yr cash rebate for installing smart thermostats. <sup>11</sup>
Clean room and other controlled settings	“To understand why chips require such extraordinary degrees of cleanliness, think of a chip in terms of the Manhattan metaphor. To wit: imagine a detailed map of Manhattan, with every street and every alley showing. Then reduce that map down to a piece of paper a quarter-inch by a quarter-inch. If you stuck a pin in the map now, it would create a pothole from Times Square practically to Harlem. One obvious result is that traffic would come to an everlasting halt. Even a mere flake of Godzilla skin would short out the entire city by lying across four or five north-south avenues. So how do clean rooms cope with us slovenly types? Clothes, they like to say, by Omar the Tentmaker. Or in other words, the ‘bunny suit.’” <sup>12</sup> In such settings, the ability to automatically keep workers comfortable is likely a plus.
Vehicles	The technology would be a nice adjunct to trends in the auto industry towards personalized environments. “The CCS system is the only system on the automotive market today that provides seat occupants individually controlled, active heating and cooling for year-round comfort. The environmentally friendly system is integrated into a vehicle seat and operates through a self-contained and solid-state electronic heating and cooling system based on Amerigon's proprietary thermoelectric device technology. ‘We are very proud that General Motors chose to highlight our CCS seat system as a technology for the future in its Cadillac STS demonstration vehicle, even though current models of that vehicle do not yet include CCS,’ said Amerigon Chief Executive Officer Daniel R. Coker.” <sup>13</sup>

The following material is available on this technology.

<i>Information on the Technology</i>	
<b>Material Available without a Non-Disclosure Agreement</b>	Fact sheet, photos
<b>Material Available with a Non-Disclosure Agreement</b>	Technical specifications
<b>Web site for Additional Information</b>	<a href="http://www.CUSTOMER.com">www.CUSTOMER.com</a>

The following individual has been designated as a point of contact in CUSTOMER.com.

<i>Point of Contact</i>			
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<sup>11</sup> “Residential Energy Solutions,” San Diego Gas & Electric, 2000, [http://www.sdge.com/efficiency/res\\_rebates.html#smart](http://www.sdge.com/efficiency/res_rebates.html#smart) (accessed November 19, 2005).

<sup>12</sup> Page, “How Chips Are Made,” *Smithsonian*, January 2000, <http://www.cs.fredonia.edu/~hansen/chipdup.htm>, (accessed November 20, 2005).

<sup>13</sup> “Amerigon Climate Control Seat System Featured in General Motors Technology Presentation at SAE 2005 World Congress,” April 12, 2005, <http://www.theautochannel.com/news/2005/04/12/036243.html>, (accessed November 20, 2005).

## 2 Methodology Used for this Study

Foresight uses a methodology called Technology Niche Analysis (TNA™). This method filters applications through a series of funnels. Funnels are decision gates in which we eliminate some options but allow those meeting the decision criteria to pass on for further analysis. Each step assesses potential applications in light of pre-determined criteria. Applications may be eliminated at any step. Eliminated applications are not considered further.

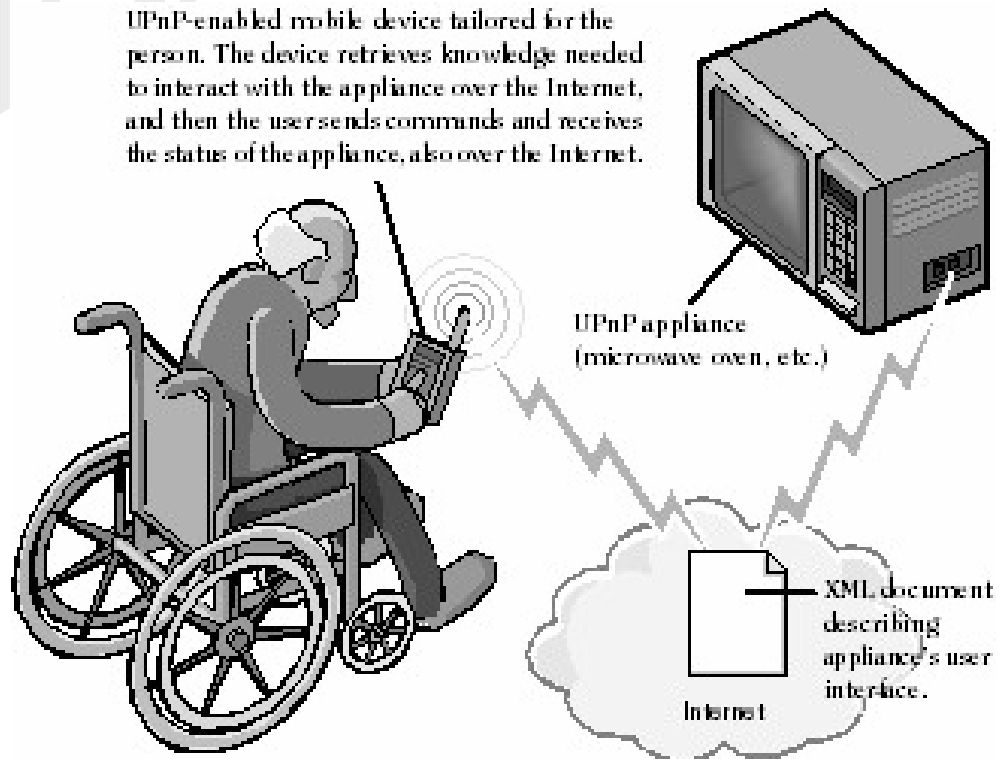
Foresight begins solving the commercialization puzzle by using the customer's definition of the technology's performance specifications and characteristics. These are used as guides when conducting on-line data searches and interviews with experts to identify applications and markets. We also collect our customer's preferences for commercializing the technology and use them as a secondary guide.

In today's rapidly changing global markets, it is unlikely that a single, "best possible" entry strategy exists. Even with the informational resources of the Internet, this remains true, especially for a study such as this that is constrained by budget and time. Of course, budget and time always constrains the data collected and analysis performed for any report. Thus, *the findings and recommendations presented here are preliminary*. Additional market research may lead to modifications or substantial revisions. Although we strive to describe trends that will be important over a five-year window, market and technology developments are dynamic. Events can overtake the data and analysis presented in this report.

## 3 Competitive Opening

End-users are likely to be interested in your technology because of the following advantages it can bring. The following advances are being sought according to our research. At the heart of these advances is a different approach to household activities which presumes a "network centric" home. (See

UPnP-enabled mobile device tailored for the person. The device retrieves knowledge needed to interact with the appliance over the Internet, and then the user sends commands and receives the status of the appliance, also over the Internet.



graphic.<sup>14</sup>) This technology fits into that trend and can be positioned as either a complementary technology for a central device or a stand alone unit.

<i>Technological Advances Being Sought by End-Users</i>	
<b><i>Technological Advances</i></b>	<b><i>Explanation</i></b>
<b><i>Lower Purchase Price</i></b>	Our research indicates that lower purchase prices are of general interest, both to the end-users that may buy assistive technology and to the entities, such as Medicare, that may help with the purchasing of such a technology. <sup>15</sup>
<b><i>Overall Simplicity - Less Complex, More Robust, Easier to Use</i></b>	User-friendliness, a blanket term of sorts, appears to be paramount for assistive technologies like this one. That is to say, if the impetus for the implementation of an assistive technology is the lack of abilities on the part of the end-user, then the assistive technology itself should be as simple, robust, and easy to use as possible. <sup>16</sup> While automated assistive environmental control technologies may make life easier and healthier for end-users, it appears that end-users require technologies that can be overridden, either manually or automatically, should either the end-user or the environmental control infrastructure require it. <sup>17</sup>
<b><i>No Special or Less Expensive Infrastructure Needed</i></b>	Ideally, assistive technologies like this one should be compatible with existing environmental control interfaces on the one hand and the emerging infrastructure for networked houses on the other. That is to say, if one buys a new way to control one's heating system, one should not have to replace the heating system too. <sup>18</sup>

The following improvements should be considered during future R&D for better aligning your technology with the needs of end-users.

<b><i>Design and Improvements that Might Increase Value for End-Users when Adopting the Technology</i></b>
The technology should be adapted to work as an input to “universal controllers” as well as a stand alone unit. Options for sensor placement (including whether they should be directly on the body or in proximity) should be explored through focus groups and available to address different kinds of needs. It should also be capable of control “smart clothes” and vehicle systems as well as building HVAC to maximize downstream market potential. We strongly endorse the R&D plans to add additional functionality, such as humidity control.

<sup>14</sup> “The Future of Accessible Technology” Microsoft Corporation, October 9, 2005,

<http://www.microsoft.com/enable/business/future.aspx> (accessed November 19, 2005).

<sup>15</sup> “Assistive Technology Glossary” AT Network, California Foundation for Independent Living Centers, 2005,

<http://www.atnet.org/resources/glossary.htm> (accessed November 19, 2005).

<sup>16</sup> “Environmental Control” Washington Assistive Technology Alliance, 2002, <http://wata.org/resource/e-control/> (accessed November 19, 2005).

<sup>17</sup> “April 2003 Vision Webletter” Vision World Wide, April 2003, <http://www.visionww.org/webletter-april03.htm#thermostat> (accessed November 19, 2005).

<sup>18</sup> “Assistive Technology in Extra Care Housing” Housing Learning & Improvement Network, February 20, 2004, [http://www.tunstall.co.uk/splash/downloads/5\\_5\\_3HousingLIN.pdf](http://www.tunstall.co.uk/splash/downloads/5_5_3HousingLIN.pdf) (accessed November 19, 2005).

An assistive technology, by definition, is “any item, piece of equipment, or product system, whether acquired commercially or off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities.”<sup>19</sup> For this technology to fit this definition and to be as valuable as possible to potential end-users, we anticipate that it will first have to be compatible with as many types of disabilities as possible. Second, we anticipate that it will have to meet and exceed the performance of traditional environmental control thermostats. Third, the price must be right. That is to say, it should be priced competitively with current assistive environmental control technologies. Finally, it appears as though the ability to override the technology is very important, as this will allow either the end-user or the system itself to adjust the controls in order to better serve the end-user, avoid damage to the environmental control infrastructure, or both.

The ability of advantages to be leveraged to accomplish market entry depends on how important they are for end-users and the people for whom they work. Market drivers are statistical tendencies that strengthen or weaken the importance of advantages. Practice level drivers are micro-economic; they affect the end-user directly. Arena level drivers affect the industrial sectors in which the end-users work.

<i>Drivers Identified as Important</i>		
<i>Level</i>	<i>Today</i>	<i>Trends</i>
<i>Practice Level</i>	<p>Price appears to be an important driver at this level. While there is a small population of early adopters whose purchasing decisions are based primarily on performance rather than price, vendors in this market tend to direct their products towards a wider market, including those with limited means and those that rely on Medicaid. Therefore, vendors price their products in the low hundreds of dollars.<sup>20</sup></p> <p>This technology will provide the handicapped access to functionalities already being provided to other users. “Lighting, HVAC, and home entertainment are the most common systems to be integrated in the automated home. While each part of the system can operate independently with its native controls (light switches, wall thermostats, stereo knobs and dials, and the old TV</p>	<p>As noted earlier in this report, there is a trend emerging towards “network centric” homes and appliances. These leads to a blending of traditional appliances and home infrastructure with information technology. “Appliance Design is the new discipline that will reach across historical and discipline boundaries, blending physical, functional, interactive, graphical, and information design for new information appliances.”<sup>22</sup> (See also beyond the connected home at <a href="http://www.beyondconnectedhome.com/products/beyondhome.html">http://www.beyondconnectedhome.com/products/beyondhome.html</a>, from Salton, Inc., a vendor.) We anticipate devices which are compatible with this trend will have longer product life cycles.</p>

<sup>19</sup> “Glossary” Buffalo State University Office of Disability Services, n/d, <http://www.buffalostate.edu/offices/disabilityservices/glossary.htm> (accessed November 19, 2005).

<sup>20</sup> Jamison, Nancy “Speech Technologies Impact the Accessibility Market” Speech Technology Magazine, May/June 2005, [http://www.speechtechmag.com/issues/9\\_9/cover/11848-1.html](http://www.speechtechmag.com/issues/9_9/cover/11848-1.html) (accessed November 19, 2005).

	<p>remote), the overlay control package integrates all of the individual systems into one "super system" that has a single control point. The homeowner can control all the systems through wireless devices, such as a Web tablet, a radio frequency (RF) controller, or a personal computer. By connecting the main control system (and the rest of the home) to the Internet (and if available a home's structured wiring network), the homeowner can also access and manipulate the home's controls from afar."<sup>21</sup></p>	
<p><b>Arena Level</b></p>	<p>The primary driver at this level appears to be the large population of disabled people in the US. According to the US Census, there are 77 million people with some form of disability, including 10.7 million with sensory disabilities, and 23.5 million with some form of physical disability.<sup>23</sup></p> <p>While disabilities are certainly not limited to the aging population, we have identified the aging of the population in markets such as the US and the UK as one of the major drivers for this market, as approximately 35% of those over the age of 65 have some sort of disability.<sup>24</sup></p>	<p>We anticipate that the price driver will continue to be important for this market. Additionally, there appears to be a trend towards the development of assistive technologies that are based on Universal Design principles – the design of products and services to be as usable as possible by as many people as possible<sup>25</sup> -- making for assistive technologies that are useful to people, regardless of what kind of disability they have.<sup>26</sup></p> <p>We anticipate that the rising population of aging people with disabilities will continue to be a driver for this market as the baby boomer generation moves past the age of 65.<sup>27</sup></p>

As we understand them, arena level drivers affect the number of end-users that will need a technology, and the practice level drivers are related to why an end-user would choose one technology over another. With that understanding, we anticipate that the aging of the population

<sup>21</sup> "Getting Connected: Controlling the Home," 2001,

<http://www.bobvila.com/ArticleLibrary/Subject/HVAC/Thermostats/ControllingTheHome.html>, (accessed November 20, 2005).

<sup>22</sup> "The Appliance Design Network," n.d., <http://www.appliancedesign.org/>, (accessed November 20, 2005).

<sup>23</sup> Jamison, Nancy "Speech Technologies Impact the Accessibility Market" *Speech Technology Magazine*, May/June 2005, [http://www.speechtechmag.com/issues/9\\_9/cover/11848-1.html](http://www.speechtechmag.com/issues/9_9/cover/11848-1.html) (accessed November 19, 2005).

<sup>24</sup> "SRS Technology Group plc, "Preliminary unaudited results for the year ended 30 June 2005" SRS Technology, October 28, 2005, <http://www.srstechology.co.uk/upload/pdfs/pressreleases/Prelims%202005.pdf> (accessed November 19, 2005).

<sup>25</sup> "Universal design" Wikipedia, October 26, 2005, [http://en.wikipedia.org/wiki/Universal\\_design](http://en.wikipedia.org/wiki/Universal_design) (accessed November 19, 2005).

<sup>26</sup> "Assistive Technology – Your Key to Independence" Massachusetts Assistive Technology Partnership, March 2005, [www.matp.org/news/MATP\\_Report\\_2005.doc](http://www.matp.org/news/MATP_Report_2005.doc) (accessed November 19, 2005).

<sup>27</sup> McClinton, Denise H. "Adapting to Challenges" *Home Care*, PRIMEDIA Business Magazines & Media Inc, 2005, [http://www.icopyright.com/user/tag.act?tag=3.5476%3Ficx\\_id%3Da178074](http://www.icopyright.com/user/tag.act?tag=3.5476%3Ficx_id%3Da178074) (accessed November 19, 2005).

in the U.S. and disabilities associated with an aging population will be the major driver for all assistive technologies in the future. The drivers of lowering prices and increasing the number of disabilities for an assistive technology is compatible with what will influence product choice, as will the timing when “network centric homes” become common. If this happens more rapidly than we currently anticipate, it would be a positive factor in adoption of your technology, especially if you have strong IP protection, an issue addressed below.

Your technology appears to be well-positioned vis-à-vis the universal design driver insofar as it is technology that does not require manual, visual, or vocal abilities on the part of the wearer and thus, does not appear to exclude segments of the disabled population.

In light of these drivers, we see the window of opportunity for market entry as follows.

<i>Likely Window of Opportunity</i>
We anticipate that the window of opportunity is currently open and will remain open for at least the next five years.

Our research and interviews indicate to us that there is an immediate need for such a technology. Additionally, our research leads us to believe that currently available technology does not compete directly with this product. In addition, our research did not turn up technology that will be available in the next few years that competes directly with this technology. That is not to say there are no competing technologies; however, we were unable to locate any that appear to compete directly, either now or within the next few years.

We have contacted three experts to gauge their views on your technology’s potential competitive opening. These findings are presented in the table below.

<i>Experts Contacted on Competitive Opening</i>			
<b>Name</b>	Edward Steinfeld, ArchD. <sup>28</sup>	Joseph P. Lane, MBPA <sup>29</sup>	Dr. Stephen Sprigle <sup>30</sup>
<b>Title</b>	Director, Center for Inclusive Design and Environmental Access (IDEA), Principal Investigator, RERC	Director, Center for Assistive Technology	Director, CATEA Associate Professor, Industrial Design Associate Professor, Applied Physiology
<b>Organization</b>	Rehabilitation Engineering and Research Center (RERC) on Universal Design and the Built Environment, SUNY Buffalo	RERC on Technology Transfer, SUNY Buffalo	Center for Assistive Technology & Environmental Access (CATEA), Georgia Tech University
<b>Phone</b>	716-829-3485 x 303	716-829-3141 x141	404-894-4960
<b>E-mail</b>	<a href="mailto:arced@ap.buffalo.edu">arced@ap.buffalo.edu</a>	<a href="mailto:joelane@buffalo.edu">joelane@buffalo.edu</a>	<a href="mailto:stephen.sprigle@coa.gatec">stephen.sprigle@coa.gatec</a>

<sup>28</sup> Edward Steinfeld in a telephone conversation with Toby Balch, November 22, 2005.

<sup>29</sup> Joseph Lane in an e-mail to Toby Balch, November 22, 2005.

<sup>30</sup> Stephen Sprigle in a telephone conversation with Toby Balch, November 22, 2005.

<p><b><i>Importance of Need(s) being Addressed</i></b></p>	<p>Mr. Steinfeld explained that, from a universal design standpoint, the technology appears to be quite useful insofar as its nature does not exclude a segment of users in terms of ability. He explained that he also saw an immediate need for this sort of technology with elderly living in cold cities such as Toronto. He explained that his center is currently working with a group in Toronto on this very subject.</p>	<p>Mr. Lane explained that while the technology does not appear to be very useful for the general market, there are a couple of diseases, such as multiple sclerosis and Raynaud’s disease, that effect the thermoregulatory abilities of the end-user and that people with these diseases have an immediate need for this type of technology.</p>	<p><a href="#">h.edu</a> Dr. Sprigle described the need for this sort of technology as high, especially in the case of end-users with major spinal cord injuries that result in thermoregulatory problems.</p>
<p><b><i>Key Specifications and Characteristics to Emphasize for this Niche</i></b></p>	<p>Mr. Steinfeld explained that one of the big things to keep in mind is how many people are wearing the device in any one area. He said if more than one person’s physiological information is affecting the ambient temperature, then there may need to some mechanism in place to mitigate any conflict of needs. Another factor mentioned by Mr. Steinfeld is the technology’s ability to be integrated into a piece of clothing, such a coat. He explained that he sees a need for technology such as this in “smart” clothing that can change its insulative properties in accordance with the needs of the wearer.</p>	<p>Mr. Lane identified the need to negotiate the needs of the person wearing the device with needs of other co-habitants as the biggest characteristic to pay attention to.</p>	<p>Dr. Sprigle identified and explained that user interface is important for assistive technologies like this one. That is to say, the level and type of input needed on the part of the wearer is crucial to consider when designing an assistive technology. Additionally, the way in which the thermostat senses the physiological information is especially important. That is to say, whether the device requires electrodes as opposed to another type of connectivity that would change the level of comfort and ease of use for the end-user. Other characteristics that Dr. Sprigle identified as important are the time lag between when the device senses a need in ambient temperature change and when the HVAC system can enact that change, and at what level of automation the device operates.</p>
<p><b><i>Price and Pricing Factors for this Niche</i></b></p>	<p>While Mr. Steinfeld did not identify a specific price or price range, he explained that if one</p>	<p>Mr. Lane did not identify specific prices, but he did confirm that any new technology would have to be</p>	<p>Dr. Sprigle explained that the pricing factors for this niche can vary, depending on the design of the</p>

	<p>thinks about the technology as an integral component in a larger system – say, a personalized HVAC system for individuals in a large office space – pricing would be the price of the system itself. In the case of the personal HVAC system, price is in the thousands per user, so this technology would probably need to be priced in order of magnitude below the price of the overall system.</p>	<p>priced competitively with comparable products and would have to be priced to fit into the pricing scheme of the overall system.</p>	<p>technology and how it will be used. He explained that if this technology will be competing with products from competitors such as Honeywell, the price would have to be in the low hundreds of dollars, whereas the price could jump one or even two orders of magnitude if the market shrinks to only those who would use it as a quasi-medical device.</p>
<p><b>Potential Competitiveness of Technology</b></p>	<p>Mr. Steinfeld explained that this technology appears to be competitive insofar as it appears to be unique in its combination of characteristics. He explained that if the technology can be configured such that it is compatible with systems such as the personalized HVAC or smart coat, those might be the areas in which it is the most competitive, as opposed to areas such as wireless thermostats proper.</p>	<p>Mr. Lane explained that the technology does not appear to be terribly competitive in either the assistive technology or universal design for smart homes markets. His reasoning is that if more than one person is living in the room/office/apartment/home, all inhabitants would be affected by the needs of the wearer. He explained that widely available technologies, such as zoned heating blankets or water beds for sleeping areas would appear to beat the technology, at least in terms of focus on the end-user and perhaps price.</p>	<p>Dr. Sprigle was reluctant to comment on the competitiveness of this technology given our limited description, but he did say that he was not aware of any competitors using physiological input to control ambient temperature, and in light of the apparent uniqueness of the technology, it would be quite competitive if it were indeed successful.</p>
<p><b>Who are the Key Competitors</b></p>	<p>Mr. Steinfeld explained that the uniqueness of this technology keeps him from identifying specific competitors. He did say that companies that focus on the monitoring of physiological factors such as heart rates and blood pressure could be seen as potential competitors.</p>	<p>Mr. Lane identified NASA’s work with a “cool suit” for astronauts and a similar technology that NASCAR drivers use for their suits as a possible competing technology.</p>	<p>Dr. Sprigle could not identify any direct competitors, saying only that current home automation technology, such as X-10 systems, could be seen as competition.</p>

To find experts, we looked research centers that focus on assistive technologies, environmental controls, and wireless systems. While not all of the experts agreed that the technology is immediately useful, our overall impression is that the technology is unique and there may be a

significant need for such a technology, especially for end-users with thermoregulatory problems, such as spinal cord patients. One of the things that came up across the board was the issue of how to negotiate one person's temperature needs with those of the people the end-user lives with. Another issue that came up was that the sensor capabilities of the technology may be useful in assistive technology areas other than environmental controls. Dr. Sprigle, for example, commented that his work with mobility technologies could use physiological information about the patient, and the sensor capabilities of the technology may be of use in that application.

We have also contacted the following end-users to gauge their views on your technology and the marketplace. In some arenas, the population of end-users is such that these end-users are also the experts. In this case, they were asked to comment from both perspectives in order to gain the necessary information.

<i>End-Users on Competitive Opening</i>		
<b>Name</b>	John Satinsky, MD <sup>31</sup>	Ruth Fierman <sup>32</sup>
<b>Title</b>	Medical Doctor living with Multiple Sclerosis	Occupational Therapist, Assistive Technology Center
<b>Organization</b>	N/A	Shepard Center
<b>Phone</b>	601-664-2114	404-350-7716
<b>E-mail</b>	N/A	<a href="mailto:Ruth_fierman@shepherd.org">Ruth_fierman@shepherd.org</a>
<b>Importance of Need(s) being Addressed</b>	Dr. Satinsky explained that temperature regulation is a very big issue for him, as he has both MS and Raynaud's disease to deal with.	Ms. Fierman explained that the need for temperature regulation for her patients is very important, as their thermoregulatory systems are, as she puts it, "wacko."
<b>Key Specifications and Characteristics to Emphasize for this Niche</b>	Dr. Satinsky cited the ability of the system to be overridden and the ability of the technology to negotiate the differences in temperature needs of different people as key characteristics.	Ms. Fierman echoed that there is a definite need for the technology to somehow make the ambient temperature comfortable for the wearer and the non-wearer alike. She also explained that the technology may be useful outside of the environmental control application. She explained that if the device could also be used to alert end-users to unhealthy body temperatures when the end-user is out in elements, then it would be very useful.
<b>Price and Pricing Factors for this Niche</b>	Dr. Satinsky did not identify a specific price for this technology, but when asked, he said that a price of about \$100 – \$300 (the approximate price of comparable technologies) seems reasonable.	Ms. Fierman explained that the technology would have to be in the \$200 dollar range, but that if the technology was marketed specifically to a relatively small group of spinal cord and MS patients, that the price could go up one order of magnitude.
<b>Potential Competitiveness of Technology</b>	Dr. Satinsky explained that he had not heard of such a technology and that, if it works as it is supposed to, it would be quite competitive, largely because it is so unique.	Ms. Fierman said that technology would be competitive mainly because of its uniqueness.
<b>Who are the Key Competitors</b>	Dr. Satinsky explained that for his purposes, he relies on avoiding situations that may compromise the maintenance of optimal	Ms. Fierman could not identify any direct competitors, saying only that she currently uses current thermostat technologies as well as blankets

<sup>31</sup> John Satinsky in a telephone conversation with Toby Balch, November 22, 2005.

<sup>32</sup> Ruth Fierman in a telephone conversation with Toby Balch November 22, 2005.

	temperature, and if he does get cold, he wears mittens and thick socks.	and mittens to keep patients warm.
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The end-users we spoke with, a patient and an occupational therapist that takes care of patients, agreed that temperature management is a very important issue for patients such as those living with MS or a spinal cord injury. For example, Ms. Fierman explained that mismanagement of body temperature can put an MS patient in bed for two days with fatigue, and it can be fatal for spinal cord injury patients. Both end-users explained that the current technology consists mostly of traditional thermostat systems and heating elements such as blankets and mittens, reinforcing our design suggestion that these also be able to be controlled, possibly via Bluetooth connections.

Given our own research and the views of these experts, we anticipate the following parameters will be significant when this technology is evaluated by end-users:

- engineering performance:

<i>Our Current View of End-User Requirements</i>			
<b><i>Engineering Requirement</i></b>	<b><i>Units</i></b>	<b><i>Value Desired by User</i></b>	<b><i>Why Desired</i></b>
Vocal or tactile override capability	Yes/no	Yes	Some form of override appears to be necessary to ensure both the health of the end-user and the HVAC system. <sup>33</sup>
Universal Design	Yes/no	Yes	Universal design ensures that it will be useful for any end-user, regardless of ability. Additionally, universal design opens up the mass market and economies of scale. <sup>34</sup>
Number of sensors	N/A	5	Multiple sensors allow the device to take readings in different places, which helps to increase the accuracy of the temperature readings.
Size of the device	Cubic inches	4x3x1	Our interviews with experts indicate that if the device is much larger than a deck of cards, it will be uncomfortable for the end-user to wear. <sup>35</sup>

While the engineering requirements may seem fairly basic, we need to remember that this technology will be physically connected to the end-user, thus, certain basic engineering requirements, such as size, need to be taken into account. Another main feature that appears to be important is an override mechanism; this would allow the end-user to manipulate the system to meet their current needs, and the HVAC system could “save itself” should the temperatures become too hot or too cold to be healthy.

<sup>33</sup> Stephen Sprigle in a telephone conversation with Toby Balch, November 22, 2005.

<sup>34</sup> Ibid.

<sup>35</sup> Ibid.

Users' abilities to buy the technologies they want are constrained by relevant federal, state, and local government regulations and by relevant standards and certification requirements. These requirements indicate test and evaluation procedures that can speed market acceptance if incorporated into concurrent engineering.

<i>Examples of Regulations, Standards, and Certifications</i>		
<b>Identifier and Promulgator</b>	<b>Description</b>	<b>Comments</b>
US Federal Regulation (34 CFR 300.308)	This appears to be a federal government regulation under which, "each school district must ensure that assistive technology devices and/or services are made available to a preschool or school-age student with a disability as part of a student's special education, related services or supplementary aids or services as described in the individualized education program (IEP)." <sup>36</sup>	It appears as though many of the U.S. regulations and funding in terms of assistive technology come through the Department of Education. <sup>37</sup> We anticipate that regulations that help to ensure equal opportunities for education make up one segment of the group of regulations affecting technologies like this one.
Title XIX of the Social Security Act. 42 U.S.C. 1396 <i>et seq.</i> , US Federal Government, Social Security Administration, Health and Human Services	This appears to be section of the Social Security Act that allows for funding for assistive technologies through Medicaid. <sup>38</sup>	We anticipate that the money to purchase technologies such as this, especially in the case of elderly end-users living in private residences, will come from federally funded programs such as Medicaid.
Certification as a registered member of the National Registry of Rehabilitation Technology Suppliers	Assistive technology vendors that wish to be registered with the National Registry of Rehabilitation Technology Suppliers need to demonstrate that a standardized level of experience and services is available. <sup>39</sup>	We anticipate that if you intend to sell the technology yourself, you will have to be registered with bodies such as the National Registry of Rehabilitation Technology Suppliers. <sup>40</sup> If your intention is to work with a commercialization partner to sell this technology, then we anticipate that they will need to have certifications such as this.

The items listed above are examples of regulations and certifications that may affect your technology in terms of how it bought and sold. The above list is by no means exhaustive, and

<sup>36</sup> "Assistive Technology Devices and Services" University of the State of New York State Education Department, 2005, <http://www.vesid.nysed.gov/specialed/transition/atds.html> (accessed November 23, 2005).

<sup>37</sup> Jonathon Z. Schuch (M.Eng., P.E., University of Virginia), in a telephone conversation with Toby Balch, November 23, 2005.

<sup>38</sup> "Funding of Assistive Technology for Persons with Disabilities" Neighborhood Legal Services, Inc., 1997, <http://www.nls.org/atart.htm> (accessed November 23, 2005).

<sup>39</sup> "Requirements" National Registry of Rehabilitation Technology Suppliers, 2005, <http://www.nrrts.org/> (accessed November 23, 2005).

<sup>40</sup> "BSCIP: Vendor Registration" Florida Alliance for Assistive Services and Technology, n/d, [http://faast.org/bscip\\_vendor.cfm](http://faast.org/bscip_vendor.cfm) (accessed November 23, 2005).

because our research indicates that the assistive technology arena is highly regulated and certified, we recommend that you explore the regulatory landscape more in depth so as to best determine the obstacles and opportunities for your technology vis-à-vis regulation and certification.

- ease of use:

<i>Characteristics</i>	
<i>Technology Characteristic</i>	<i>Ease of Use Implications as Applied to This Technology</i>
<b><i>Maturity</i></b> – measures how close the technology is to commercial introduction.	This technology will be used as quasi-medical device that, in some cases, may be responsible for, at least in part, the health as well as comfort of disabled patients. Therefore, it would have to be a proven and highly mature solution. This health use may make it reimbursable from Medicare and insurance if doctor prescribed. (A topic for additional research. In this report we assume it is not as that is the bulk of the market.)
<b><i>Adaptability</i></b> – measures how easily the end-user can tweak the technology to meet their unique needs.	The end-user appears to need a fairly high level of adaptability in the technology; this is tied to the engineering requirement for an override mechanism. While the technology may be operated without interruption for long periods of time, adjusting it must be an option. <sup>41</sup> It also has to do with the various supplemental devices (blankets for example) that might want to be controlled.
<b><i>Packaging</i></b> – measures how much special infrastructure must be provided with the technology in order for the end-user to capture its utility.	Ideally, the technology will have a low level of packaging in terms of manuals or training that the end-user must receive before they can use it. A “plug-and-play” device with a very simple push button /r voice activated interface might be best. <sup>42</sup>
<b><i>Fragility</i></b> – measures the technology’s robustness outside the lab.	As mentioned above, because disabled people will depend on this technology for their health and comfort vis-à-vis the ambient temperature, the technology must be as rugged as possible. <sup>43</sup>

Our research indicates that ease of use characteristics are mostly related to the technology’s use by those with disabilities resulting from spinal cord injuries or diseases such as Multiple Sclerosis. For these end-users, technology characteristics such as simplicity, ruggedness, reliability, and comfort appear to be paramount. We anticipate that to best serve these end-users, this technology should be developed to be as reliable, rugged, simple, and comfortable as possible in order to avoid excluding any end-user segment from using it.

- and of course, price:

<sup>41</sup> John Satinsky in a telephone conversation with Toby Balch, November 22, 2005.

<sup>42</sup> Ruth Fierman in a telephone conversation with Toby Balch, November 22, 2005.

<sup>43</sup> John Satinsky in a telephone conversation with Toby Balch, November 22, 2005.

<i>Price per Unit</i>
We anticipate that the price for this technology would be largely influenced by comparable technologies, which are priced at approximately \$99 per unit.

As mentioned above, our research indicated that the prices of comparable technologies fall in range of approximately \$100 - \$300 dollars.<sup>44</sup> We anticipate that part of successful market entry will be the competitive pricing of this technology. To that end, we recommend pricing this technology at or below the price of comparable technologies.

Another important issue is the frequency of sales of a new product. If users have just completed a round of purchasing, they are less inclined to scrap that purchase until they have depreciated or expensed it. The notion of product life cycles reflects this economic reality.

<i>Frequency of Purchase</i>	
<b>Today</b>	<b>Trends</b>
The purchasing of this technology would track largely with the replacement of old HVAC systems in existing buildings and the with new HVAC systems for buildings such as assisted living communities, with replacement purchasing occurring every 10 - 30 years. <sup>45</sup>	We have not seen indications that the frequency of purchase will change in the next 5 years. <sup>46</sup>

We anticipate that frequency of purchase may affect this technology’s entry into this market, as we view this technology as both a replacement system in existing buildings and as an alternative for new buildings. While a frequency of 10 – 30 years may seem like a long time and perhaps not favorable for a new technology, we anticipate that as the baby boomers move into retirement age, the rate of retrofitting for existing buildings and construction of new buildings to meet the needs of an aging population will grow.

## 4 Competition

There is a range of competitive technologies to consider when comparing this technology to those on the market now, and those that may be available in a five-year window from the date of anticipated market entry. The products, services, and technology below demonstrate the range of potential substitutes from which customers will be able to choose.

We conducted a search for relevant products, patents, and projects using Google, RaDiUS and the Thomas Register, using the terms “wireless,” “thermostat,” “wireless thermostat,” “assistive technology,” and “environmental control.”

<sup>44</sup> Greg Epley “The High (and Low) Cost of Blindness Technology” Thinkzo Systems, August 2005, <http://www.thinkzo.com/resources/blindtech.htm> (accessed November 19, 2005).

<sup>45</sup> “North American HVAC Thermostat and Temperature Control Markets” Frost & Sullivan, April 19, 2000, <http://www.frost.com/prod/servlet/report-document.pag?docid=7249-01-06-02-02&ctxht=FcmCtx7>, subscription required (accessed November 22, 2005).

<sup>46</sup> Ibid

<i>Examples of Relevant Products/Services Identified</i>			
<b>Product Name</b>	<b>Manufacturer</b>	<b>Relevance</b>	<b>Web site/Phone</b>
Kelvin Talking Thermostat	Action Talking Products, LLC	This assistive technology thermostat can be operated both with both vocal and tactile input. <sup>47</sup>	<a href="http://www.actiontalkingproducts.com/">http://www.actiontalkingproducts.com/</a> , 800-537-2118
Wireless Thermostat	RCI Automation	As described on the manufacturer's Web site, this technology is, "a wireless thermostat and controller that can be placed in any room in your home to control your heating and cooling system." <sup>48</sup>	<a href="http://ourworld.compuserve.com/homepages/rciautomation/p1.htm">http://ourworld.compuserve.com/homepages/rciautomation/p1.htm</a> 619-857-4268
T8665A Chronotherm® IV Wireless Thermostat	Honeywell	This product appears to be a wireless thermostat manufactured by an industry leader. <sup>49</sup>	<a href="http://content.honeywell.com/yourhome/ptc-thermostats/t8665.htm">http://content.honeywell.com/yourhome/ptc-thermostats/t8665.htm</a> 800-852-Heat (vendor)
Smart Systems 5000	Smart Systems International	The vendor's Web site describes this product as follows. "The Smart Systems 5000 is the radical new design from Smart Systems. Unlike its predecessors, it has a user interface and buttons for various functions unavailable on the Smart Systems 1000. This is the full service model which accommodates users' sleep time requirements and allows for the adjustment of recovery time at any time. The icon system of buttons and large digit LCD have been tested extensively for simplicity, intuitiveness, and ease of use. All of the instructions in this non-programmable unit fit neatly inside the cover. An adapter allows it to control HVAC systems higher than 24 VAC (the standard for home thermostats), making it the ultimate solution for all HVAC systems: residential, commercial, and industrial. The 5000 communicates wirelessly with PCs." <sup>50</sup>	<a href="http://www.smartsystemsintl.com/products.html">http://www.smartsystemsintl.com/products.html</a> 702-734-0044

The thermostats sell for around \$150 to \$300, although there may be additional charges for the base stations, chargers, and other peripherals. Ranges are around 300 to 500 meters, which is sufficient for residential or most commercial applications. In addition, some high-end units for

<sup>47</sup> "Thermostats - Kelvin Talking Thermostat" Independent Living Aids, Inc, 2005, <http://www.independentliving.com/products.asp?dept=582&deptname=Thermostats> (accessed November 19, 2005).

<sup>48</sup> "Wireless Thermostat" RCI Automation, Inc., n/d, <http://ourworld.compuserve.com/homepages/rciautomation/p1.htm> (accessed November 19, 2005).

<sup>49</sup> "T8665 & W8665 Wireless Honeywell Thermostat System," n/d, <http://www.honeywell-thermostat.com/honeywell/t8665a-wireless-thermostat.htm> (accessed November 19, 2005).

<sup>50</sup> "Smart Systems International Products" Smart Systems International, n/d, <http://www.smartsystemsintl.com/products.html> (accessed November 19, 2005).

hotels and other institutions can incorporate IR or other sensors to determine if someone is in the room and whether the inhabitants are awake or sleeping.

<i>Examples of Relevant Patents and Patent Applications Identified</i>				
<b>Patent or Application #</b>	<b>Patent Title</b>	<b>Date</b>	<b>Relevance</b>	<b>Assignee</b>
6,394,359	Remote control thermostat	May 28, 2002	Abstract states: "This invention is a remote control device to control a thermostat. The remote control works using RF transceivers in a wall mounted base unit and a portable remote control unit, or optionally, using infrared signals much like a television remote control. The remote control has a keypad on it to allow one to select the desired temperature, or to select a temperature from one of several buttons on it corresponding to a specific temperature. This enables the user to set the temperature of a room without having to get up and manually change it." This patent appears to be close to the technology being assessed.	None
5,927,599	Wireless air conditioning control system	July 27, 1999	This patent appears to be even closer, as it includes ambient air temperature monitoring. The abstract states: "A thermostat assembly measures ambient temperature in an area to which an air conditioning system provides conditioned air. It compares the measured ambient temperature with a predetermined target temperature and wirelessly transmits air conditioning request signals to an air conditioning control assembly responsively to the comparison. The thermostat assembly and the air conditioning control assembly may be automatically mated with one another so that the air conditioning control assembly responds to air conditioning request signals only from a particular thermostat assembly. Where a plurality of transmitters are present, their transmissions are staggered to avoid data collision."	Marley Electric Heating (Bennettsville, SC)
5,839,654	Portable air comfort system thermostat enabling personal localized control of	November 24, 1998	Although this patent appears to be focused on portable heating and air conditioning units, it appears to be close to your technology in terms of intended use. The abstract states: "Wireless control of an air conditioner or space heater by a portable, easily relocated remote thermostat combined with a	Innova Patent Trust (Centerville, MA)

	room temperature		control signal transmitter which is placed on a table, desk or stand near an occupant of a room or office to set the operation of a cooling or heating source in order to maintain a more uniform level of air temperature comfort in the portion of the room where the thermostat is located. A wireless control receiver responsive to the transmitted control signal is included as a portion of a plug-in adapter module that plugs directly into an AC power wall receptacle.”	
5,833,134	Wireless remote temperature sensing thermostat with adjustable register	October 27, 1995	Abstract states: “A wireless remote temperature sensing and control thermostat system for regulating air ducted air conditioning systems incorporating a normal mode and a remote control mode, including a combination thermostat and radio-frequency receiver unit, a radio-frequency transmitter, and an adjustable register. In the normal mode, a reference temperature is set by the thermostat for the temperature throughout the entire air conditioned structure. In the remote control mode, the local temperature sensing and control functions of the thermostat are disabled and the transmitter unit will take over the temperature sensing at the remote site which, in turn, then will control the thermostat unit. As a result, the users will be able to more accurately control their own personal environment.” The notion of the personal environment is of particular interest here.	None
20020152298 AL (Application)	Small building automation control system	October 17, 2002	A plug and play device manager for control applications, including HVAC. Included because this is the kind of controller in which this technology might be an element. Alternatively it could supplant it if the body sensors are not incorporated.	None

What is striking is that there are few hits, which suggests the technology in this field is generally unprotected. A competitive advantage may be gained by patenting this technology. We recommend a thorough search of patent class 236/49.3 and consulting patent counsel concerning at least a provisional patent. However, note that prior published patents are a concern to be discussed with counsel.

Our research did turn up work at MIT which should be reviewed by patent counsel. The description below is from Steve Mann’s project as an MIT graduate student. It appears to be the most directly competing. A series of photos are found on the site that the following text describes.

“Smart underwear prototype: (a) Detail, showing ‘underwear’ with sensor sewn into waistband. (This version is not actually underwear; a Jansen bathing suit turned out to work better than underwear.) Transmitter at right has two cables entering it, one is to connect to the sensor, while the other is the transmitting antenna (hanging free). (b) Transmitter in use rests comfortably to left side of body. (c) Receiver, RF signal-strength meter, and bank of high-current (40 amp) relays, together with heater (operating off one of the relays).”<sup>51</sup>



(a)



(b)



(c)

Since Mann’s work does not appear to have been commercialized, we do not necessarily see it as a technology capable of swamping, which is the emergence of new technology that prevents riding out the product life cycle for this technology. It could be a real threat given the work going on at universities in assistive technology, but the technology may not be commercialized.

Others are researching and developing technology that may become a threat within the next five years.

<i>Examples of Relevant Projects Identified</i>			
<b>Project Title</b>	<b>Performing Institution</b>	<b>Performance Period</b>	<b>Relevance</b>
Angelo	Telecom Italia S.p.A	2001 and earlier	This project appears to be a basis for a direct competitor. “Angelo has two physiological stress tests. One measures heart beat rate using an instrument called an optical pulse oximeter that is placed on the ear like an earring. The other measures the sweatiness of the skin - related to how well the skin conducts electricity - using electrodes on two of the workers' fingers. Angelo also measures the temperature and gas concentrations in the room and regulates them to restore optimal environmental conditions by switching on ventilation or increasing air conditioning.” <sup>52</sup>

<sup>51</sup> Steve Mann, “Smart Underwear,” University of Toronto, [http://genesis.eecg.toronto.edu/smart\\_clothing/node4.html#SECTION00022000000000000000](http://genesis.eecg.toronto.edu/smart_clothing/node4.html#SECTION00022000000000000000) (accessed October 23, 2002).

<sup>52</sup> “A guardian angel for call centre workers,” Institute of Physics, August 28, 2001, <http://physics.iop.org/IOP/Press/PR4601.html> (accessed October 23, 2002).

Smart Underwear	MIT	Pre 1996	A graduate student, Steve Mann, at MIT, developed what appears to be a direct competitor. (Ssee above.)
Assistive Technology Thermostat	SUNY Buffalo	Uncertain, Appears to have ended and licensing is being sought	This is a thermostat with auditory, tactile, and visual feedback to its users and high visibility controls. <sup>53</sup>
Wireless Thermostat Component	Georgia Tech	Uncertain – Appears On-Going	This is a component of a larger effort to develop wearable wireless control devices that utilize gestures to perform functions such as changing the temperature.

No hits were found on RaDiUS, a database of federally funded R&D for 1999-2004, the most recent years available. Only a few projects were found on the Web. Since we see a steady stream of new wireless thermostats hitting the market in the trade literature, we suspect this field is now comprised primarily of internal corporate incremental development efforts, and thus a lot of the R&D going on will not be picked up through literature searching.

<i>Competitive Landscape</i>
The competitive landscape appears to be made up of a handful of major manufacturers who account for the majority of the market share. These competitors, such as Honeywell, are also anticipated to be some of the major sources for patents, products, and R&D in the wireless thermostat market. In addition to being significant sources of competition, the competitors are very large and established and may have a fair amount of brand awareness and garner a fair amount of customer loyalty.

While a handful of major competitors may dominate the wireless thermostat market, we anticipate that the fact that this product can be marketed to the assistive technology end-user gives it access to a market that is not as well defined. That is to say, while there appears to be a dominant design in place for wireless thermostats and the market has a few established players, the assistive environmental control market appears to be in the process of developing a universal design for assistive environmental control technologies. We anticipate that because this technology appears to be well-positioned vis-à-vis the move towards universal design, it may be well-positioned to move into the assistive environmental control technology market.

More information on potential competitors may be found at:

<i>URL For Additional Competitive Intelligence</i>
Rehabilitation Engineering & Assistive Technology Society of North America: <a href="http://www.resna.org/">http://www.resna.org/</a>
Air Conditioning Contractors of America: <a href="http://www.acca.org/">http://www.acca.org/</a>
National Association of Home Builders: <a href="http://www.nahb.org/">http://www.nahb.org/</a>

<sup>53</sup> “Accessible Thermostat,” SUNY Buffalo, <http://cosmos.ot.buffalo.edu/t2rerc/programs/supplypush/devices/thermostat.htm> (accessed October 23, 2002).

## 5 Market

We estimate the total market size, at saturation and for U.S. and for all competitors, to be approximately:

<i>Basis for Market Size</i>			
<i>Market Size in Dollars</i>	<i>Growth Rate</i>	<i>Base Year</i>	<i>Detailed Basis for Estimate</i>
\$36.25 million \$45.6 million	5.9% <sup>54</sup>	2003 2007	We anticipate that size for this market will track largely with the population of self-care disabled people in the U.S. and the overall market for comparable technologies such wireless thermostats. The U.S. Census Bureau estimates that there were 366,171 self-care disabled Americans in 2003. If we assume that each self-care disabled person is possible end-user, and calculate the total potential market using a price of \$99 per unit, we arrive at a total estimated market size of approximately \$36.25 million. In terms of growth rate, we anticipate the market for this sort of technology will grow at the approximate rate of the overall temperature sensor and transmitter market – a rate of approximately 5.9% per year. <sup>55</sup>

The market size and growth rate is a function of the number of people in the market and the anticipated rate of buying. As markets transition between emerging, growth, shakeout, mature, and declining, the basis for competition and the number of competitors usually changes. The number of and growth rate for customers suggests how many units might be sold.

<i>Our Current View on the Phase of the Market</i>	
<i>Today</i>	<i>Trend</i>
Growth	Growth

We have characterized the market for assistive environmental control technology as a growth market, as we understand it be a sector of the market for assistive technologies. The wireless thermostat market’s growth tracks largely with the growth in the market for new buildings and building renovations, and the assistive technology market tracks largely with the growing number of disabled people. Both markets appear to be growing and it appears as though they will continue to grow.

Markets can also be described in terms of the basis for competition (best technological performance, best value or the price/performance tradeoff that best matches the end users’ preferences, lowest cost, and best availability or the ability to get the product quickly). This

<sup>54</sup> “North American Temperature Sensors & Transmitters Markets – HVAC,” Frost & Sullivan, May 30, 2003, <http://www.frost.com/prod/servlet/report-document.pag?docid=A309-01-06-02-02>, (accessed November 20, 2005).

<sup>55</sup> Ibid.

dimension helps to define the context in which you must develop your commercialization strategy

<i>Our Current View of the Basis for Competition in the Arena</i>	
<b>Today</b>	<b>Trend</b>
Best value	Best Value

Our research indicates that the three main criteria for competition in this market - performance, competitive price, and overall efficient operation of the environmental control system (i.e., a form of return on investment), added up to a focus on value for basis for competition. We anticipate that while price will continue to weigh heavily vis-à-vis purchasing decisions, there will also continue to be an emphasis on performance for the sake of the end user's health and the HVAC system.

Entry barriers are obstacles to be overcome when implementing market entry. Our work to date suggests the following entry barriers may be obstacles for this technology.

<i>Market Entry Barriers</i>	
<b>Name of Barrier</b>	<b>Description/Why</b>
<b><i>Cost of Product or Service too High</i></b>	The technology's current projected price (\$300) is higher than the price of comparable technologies. We anticipate that the developers of this product will need to put resources towards bringing the price of this technology down to the mid or lower side of the competitive range as it is a new entrant. That range is, as discussed, around \$100 - \$300 per unit.
<b><i>Currently Available Technologies Meet Needs</i></b>	Our research indicates that there is currently a large number of wireless thermostat products available. We anticipate that even though this technology appears to be innovative by nature of its universal design, unless universal design is required, there appear to be a number of satisfactory substitutes. Thus, our suggestion of positioning the sensor module as a stand-alone product as well as a component in your system.
<b><i>Competitor Goodwill (loyalty of customers or targets)</i></b>	Our research indicates that a significant portion of the wireless thermostat market is dominated by a few major players such as Honeywell that have both significant market share and brand awareness. <sup>56</sup>

## 6 Entry Strategy

A possible entry strategy is to focus on a narrow market, consisting of assistive environmental control technologies for disabled end-users. We feel this market should be approached with a cost leadership strategy, as there appears to be number of competitive products. By entering this

<sup>56</sup> "North American HVAC Thermostat Markets" Frost & Sullivan, August 7, 2003, <http://www.frost.com/prod/servlet/report-document.pag?docid=A355-01-05-04-04&ctxst=FcmCtx56&ctxht=FcmCtx57&ctxhl=FcmCtx58&ctxixpLink=FcmCtx59&ctxixpLabel=FcmCtx60>, subscription required (accessed November 20, 2005).

market as the cost leader, you may be able to gain the foothold necessary to grow your market share.

To help us analyze how these barriers can be avoided or overcome, we have conducted Strength, Weakness, Opportunities, and Threats (SWOT) Analysis. It suggests the following are among the key factors that should be addressed during commercialization.

<i>Factors for SWOT</i>		
<b>Factor</b>	<b>Category</b>	<b>Analysis</b>
Universal Design	Strength	Universal design, described as useful to an end-user regardless of their physical and/or mental abilities, is apparently a major strength, as it does not bar any segment of potential end-users from using this technology. There is general interest in environmental controls that allow the end-user to control a HVAC system with a high level of convenience and efficiency. We view the “personal physiological” as a strength as it is uniquely suited for both disabled and elderly people who cannot adjust the thermostat readily either for physical or mental capability reasons.
Develop Team	Strength	Ms. Smyth is considered one of the leading universal design experts in the country. This lends credibility to the technology.
High Price	Weakness	This technology is currently priced at the high side of the competitive range of prices for comparable products. We anticipate that competitive price – at or below the mid-point of the current price range – may be necessary for a successful entry into this market.
Dependence on targets to continue the commercialization of this technology	Weakness	The fact that your company requires partners for further product development as well as production, marketing, distribution, sales, and support, puts you in a poor bargaining and commercialization posture.
Changing demographics	Opportunity	As the population of the U.S. ages and more people require assistive technologies to perform daily tasks, technologies like this one may become more attractive to the growing population of end-users.
Trend towards network centric homes	Opportunity	As mentioned earlier in this report, there appears to be a trend towards more use of networking to control appliances and home infrastructure. This technology is compatible with that trend as well as the move towards more “universal design.”
Small number of potential targets	Threat	As mentioned early, because the market for wireless thermostats appears to be controlled by a few large competitors, unless you can partner with one of these players, you may be excluded from entering this market.
Large number of competitive products	Threat	Our research indicates that there is a large number of wireless thermostats already available. While this technology differs from the current technology in a number of ways, potential targets and end-users may view this technology as having the same essential functionality as products that are more readily available and lower priced.

We understand Strengths and Weaknesses to be internal to your company and under your control. We view Opportunities and Threats as factors outside of your control. That is to say, if

you throw enough money at a weakness, you may be able to overcome it, but Threats cannot necessarily be circumvented with more R&D. In the case of this technology, we see its greatest strengths as the technology itself and its potential to be a universally designed assistive technology. These strengths appear to align well with market drivers, such as the growing need for assistive technologies and the apparent trend towards assistive technologies that can be used by anyone, regardless of their type(s) of disability. When speaking with experts, they agreed that these strengths are, in fact, what may make this technology competitive. The weaknesses of the technology, as we understand them, come in the form of your company’s dependence on commercialization partners for certain crucial aspects of the commercialization of the technology, and the fact that you may have to focus some of the technology’s development on lowering the price so as to be competitive with comparable technologies.

Successfully implementing a market entry strategy means making sales. We use the SWOT analysis to focus on what should be sold to end-users and how to get them to buy it.

<i>SWOT Analysis Summary</i>		
	<b><i>Opportunities</i></b>	<b><i>Threats</i></b>
<b><i>Strengths</i></b>	We urge leveraging Ms. Smyth’s reputation to seed articles in key publications for disabled people and build pull-through. As part of this effort, seek out opportunities to win awards for “best technology” and “best design for the handicapped.”	Aggressively seek patent protection focused on general use of physiological parameters for controlling other items in conjunction with both wired and wireless. Get as broad a turf as possible in light of the fact that in the future network centric homes may increase the value of your technology for the general population and thus it may be a hedge technology for larger thermostat companies. Consider non-exclusive licensing with an emphasis on up front payments and smaller running royalties, although without more work, we cannot say if that is the best strategy. All we can do now is raise the option as an example of alternative ways of approaching deal-making. Note the threat of assertion licensing helps here. If you license at reasonable rates and initiation fees, they may find it cheaper to non-exclusively license from you than try to design around. This kind of approach may even be compatible with an exclusive license for the assistive technology market for some period of years, with some significant rate reduction if others start to sell for the general market.
<b><i>Weaknesses</i></b>	Just as pull through focused on the disabled is emphasized in the above cell, here we recommend building pull through for the elderly. This is a much larger customer segment. We suspect the emphasis here should be as much on baby boomers as on their parents, as they will be increasingly burdened with caring for the elderly. Again there is an “outside the box” exercise to be conducted to see if this kind of technology can be positioned as the ideal birthday or	The flip side of pull through is positioning this technology as the best solution for disabled people, thereby heading off competition. Functionality can differentiate your technology from others, justifying a price in the upper half of the price range. A design for manufacturability exercise may be able to bring the price down. If licensing does not readily occur, because this is a smaller market in which you are already known, consider contract manufacturing and selling it through associations and other entities focused on

	Christmas gift, for example. In this context, we also recommend considering a Bluetooth kind of transmission to the emerging “universal household controllers.”	servicing the disabled. If installation instructions can be provided to make it possible for most people to hook it up, then drop shipping via overnight mail is a good way to place it.
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The opportunities available for your technology (the growing population of end-users and a trend sympathetic to the universal nature of your technology) can be best taken advantage of by continuing to develop a truly universal design that can be used, regardless of ability, and by promoting your technology to a concentrated list of targets. By publishing articles in the appropriate trade publications, attending the right events, and meeting your targets, you may be able to partner with one or more of them to best take advantage of the growing pool of potential end-users.

The threats to your technologies in the market, the small number of targets and the large number of competing products, may be best mitigated by working to keep the price of this technology as low as possible. A low price may not only make end-users more likely to adopt a new technology, it may also make this technology more attractive to targets. If a target views this technology as a blend of high performance and low price rather than as a high-tech, high-priced entry into a competitive market, the attractiveness may spark their interest in your technology.

One way to attain product advantages is to involve end-users in final design and test as concurrent engineering partners. If these partners like what they see, they will be helpful for spreading the word about the advantages of the technology, which is critical for early sales.

The following value proposition was used when cold calling potential lead customers to solicit their participation in concurrent engineering.

<i>Value Proposition</i>
This is a universally designed, assistive environmental control technology that enables the end-user to safely, comfortably, healthfully, and efficiently operate HVAC systems without the need for tactile, vocal, or visual input if they so choose.

The potential end-user for this assessment is defined as disabled, a group with many segments. That is to say, the term “disabled” encompasses the visually, mobility, vocally, and hearing impaired, among others. While other assistive technologies may address one or several of the needs of the range of disabled people, this technology serves the entire range of disabilities, as it does not require any sort of input from end-user. Instead, it relies on sensed information. We anticipate that this universal design feature, in addition to its nature as an environmental control device for health and safety, may make this technology valuable to end-users.

The following companies have agreed to appoint a representative to assist you with concurrent engineering at no cost to you.

<i>Potential Partners in Technology Development or Testing</i>			
<b>Company</b>	<b>Point of Contact</b>	<b>Participation in Design Discussions</b>	<b>Participation in Test and Evaluation</b>
Rehabilitation Engineering and Research Center (RERC) on Universal Design and the Built Environment at SUNY Buffalo	Edward Steinfeld, ArchD., 716 829 3485 x 303, <a href="mailto:arced@ap.buffalo.edu">arced@ap.buffalo.edu</a> <sup>57</sup>	Yes	Yes
RERC on Technology Transfer, SUNY Buffalo	Joseph P. Lane, MBPA, 716-829-3141 x141, <a href="mailto:joelane@buffalo.edu">joelane@buffalo.edu</a> <sup>58</sup>	Yes	No
Center for Assistive Technology & Environmental Access (CATEA), Georgia Tech University	Dr. Stephen Sprigle, 404-894-4960, <a href="mailto:stephen.sprigle@coa.gatech.edu">stephen.sprigle@coa.gatech.edu</a> <sup>59</sup>	Yes	Yes

A marketing mix is the tactics used to sell. The mix can be defined using the four P's – product, price, place, and promotion. We emphasize that this marketing mix is for the end-user. In the next section, we shall discuss what is being sold to targets.

<i>Suggestions for Four P's for Selling to End-Users/Buyers</i>	
<b>Product</b>	An assistive environmental control solution that is universally designed to be able to used by all end-users.
<b>Price</b>	\$99 per unit so as to be competitively priced.
<b>Place</b>	Placement will occur via your commercialization partners' existing distribution and delivery channels.
<b>Promotion</b>	Pull-through campaign focused on winning "best assistive technology" awards and advertising those combined with presentations and booths at meetings and trade shows of associations and groups representing the disabled. Articles in newsletters also should be written. We also recommend considering a Google campaign that pops you up with appropriate keywords.

As part of implementing this strategy, it is important to listen to advice from end-users and those they respect on how to improve the marketing mix and better address the competition. Contact with end-users also stimulates pull-through, that is, it encourages end-users to demand products and/or services based on your technology and opinion leaders to recommend purchase of those goods. The following venues provide communication channels for reaching customers.

<sup>57</sup> Edward Steinfeld in a telephone conversation with Toby Balch, November 22, 2005.

<sup>58</sup> Joseph Lane in an e-mail to Toby Balch, November 22, 2005.

<sup>59</sup> Stephen Sprigle in a telephone conversation with Toby Balch, November 22, 2005.

<i>Examples of Organizations, Meetings, and Publications to Use for Networking, Promotion, and Competitive Intelligence</i>			
<b>Organization</b>	<b>Utility</b>	<b>Point of Contact</b>	<b>Phone Number &amp; E-mail or URL</b>
The Assistive Technology Industry Association 2006 Conference & Exhibition January 18-21, 2006 Caribe Royale Resort Orlando, FL	“ATIA 2006 serves as a leading forum for the Assistive Technology community to participate in presentations and discussions about new technology, practical applications, and services. Segments of the Assistive Technology industry (Augmentative and Alternative Communication; Blindness; Computer Access; Curriculum Adaptations; Deaf and Hard of Hearing; Electronic Aids to Daily Living; Games and Recreation; Learning Disabilities/Study Aids/Literacy; Low Vision; and Mechanical Accessories and Mounting Devices) will be represented in various presentations, demonstrations and/or exhibits. In addition, a hands-on lab will provide an opportunity to experiment with and evaluate the latest assistive technology devices and software available.” <sup>60</sup>	Mr. Jeff Gardner, Director, Conference Chair for ATIA 2006	877-OUR-ATIA (687-2842), <a href="http://www.atia.org/conf_2006.html">http://www.atia.org/conf_2006.html</a>
Rehabilitation Engineering & Assistive Technology Society of North America (RESNA) 2006 June 22-26, 2006 Hyatt Regency Atlanta, GA	“RESNA 2006 will remain in Atlanta, GA for the second year, where assistive technology’s leading researchers, renowned clinicians, and policy experts will create a conference program with unmatched levels of knowledge and expertise. RESNA presenters and attendees will experience a surprisingly intimate conference environment where: <ul style="list-style-type: none"> <li>• information is contemporary and innovative</li> <li>• uncommon questions find in-depth answers</li> <li>• sharing knowledge, ideas, and experiences is easy, and</li> <li>• new connections last a lifetime.</li> </ul> RESNA will again offer a packed Exhibit Hall, Product Demonstrations and Training sessions, two days of Pre-Conference Instructional Courses, and 3 full days of Workshops, Interactive Poster Sessions, Themed Paper Sessions, and distinguished speakers. As always, the professional	Rosina Romano, Meetings and Membership Coordinator	703-524-6686 Ext. 306, <a href="mailto:rosina@resna.org">rosina@resna.org</a>

<sup>60</sup> “ATIA 2006 Conference and Exhibition - Purpose of the Conference,” Assistive Technology Industry Association, November 2005, [http://www.atia.org/conf\\_2006.html](http://www.atia.org/conf_2006.html) (access November 20, 2005).

<sup>61</sup> “Conference” Rehabilitation Engineering & Assistive Technology Society of North America, n/d, <http://www.resna.org/Conference/2005Conference/2005conf.php> (accessed November 20, 2005).

	networking will be intimate, easy and unparalleled. We want you to share your ideas and expertise at this year’s RESNA Conference and look forward to receiving your proposals for an Instructional Course, Workshop, or Paper for an Interactive Poster Presentation.” <sup>61</sup>		
Assistive Technology Outcomes and Benefits	“ATIA, in partnership with the Illinois State University SEAT Center, has produced this journal to further promote the outcomes and benefits of Assistive Technology. The ATOB Journal is free for download and available in multiple accessible formats.” <sup>62</sup>	Phil Parette, Ph.D., Kara Peters Endowed Chair Special Education Assistive Technology Center (SEAT)	309-438-8991, <a href="mailto:hpparet@ilstu.edu">hpparet@ilstu.edu</a> , <a href="http://www.atia.org/atob/ATOBWeb/ATOBV2N1/index.htm">http://www.atia.org/atob/ATOBWeb/ATOBV2N1/index.htm</a>

The organizations, meetings, and publications listed above are examples of the sorts of venues where one might promote a new assistive technology. We anticipate that by attending conferences like these and publishing articles in these publications or similar publications, your message would reach your potential commercialization partners and end-users.

Once you are clear that you have a good marketing mix, consider publishing articles on your technology in trade publications and making presentations or having a booth at relevant trade and professional meetings. Also, explore the benefit of having members of your company join relevant organizations in order to serve on committees that bring you in contact with end-users, opinion leaders, gatekeepers, and decision makers working for targets and customers.

Once interest is stimulated, there must be a way to take sales orders for the technology.

<i>Sales Channel</i>
Existing sales channels of your commercialization partners. In addition, a web site should be created and linked with sales outlets.

In light of the fact that licensing is the preferred commercialization vehicle for this technology, we anticipate that your technology would be sold via the channels of the target that licenses the technology.

## 7 Intellectual Property

The following is an example of an intellectual asset package. This package is what is being sold to the target, in distinction from the end-user.

<sup>62</sup> “Assistive Technology Outcomes and Benefits Journal (ATOB)” Assistive Technologies Industry Association, 2005, <http://www.atia.org/atob/ATOBWeb/index.htm> (accessed November 20, 2005).

<i>Intellectual Asset Package being Commercialized</i>		
<i>Intellectual Assets</i>	<i>Description</i>	<i>Method of Protection and Remaining Duration</i>
<i>Invention</i>	Personal Wireless Thermostat	Trade Secret, as long as the rules of trade secret are observed.
<i>Design Specification</i>	Configuration of necessary components	Trade Secret, as long as the rules of trade secret are observed.
<i>Patent</i>	Application being prepared	20 years once issued.

Our recommendation is that you continue to protect your technology via trade secret, but that you seek multiple patents for the invention and its design so that you can protect this technology as best as possible as you begin to commercialize it. Explore the possibility of patenting by field of use as well as generally (e.g. in vehicles, for clothing and blankets, for buildings)

We suggest patenting globally.

## 8 Targets

The target is the organization(s) that will partner with you to commercialize this technology. There are feasible and viable targets. Feasible targets have relevant product lines and appear to have an established presence in the market. In short, they are probably worth checking out to see if they make good candidates for partnering. Viable targets, unless otherwise noted, are those that still appear to be good candidates after we have spoken to them on the phone to confirm their potential interest in this technology. We seek viable targets that appear to be in good financial health, are established in the market with a relevant product line, can provide capabilities that are relevant for commercializing this technology, and possess good absorptive capacity.<sup>63</sup>

We cold called several targets to assess interest in this intellectual asset package. We presented this technology’s attractiveness as follows:

<i>Our Presentation used when Calling Targets</i>
This Personal Wireless Thermostat technology allows your company to provide end-users with a universally designed assistive environmental control solution. Adaptable to many situations and ranges of abilities, this technology will enable a growing elderly and disabled population to safely, comfortably, healthfully, and efficiently operate their HVAC systems.

We begin with examples of viable targets and then provide a way to find other likely feasible targets. The following table summarizes key information on viable targets. **[Note: the following is a make-believe interview as this is not a real technology. We normally do three targets, assuming the technology creates sufficient interest to obtain them. In this case, in addition**

<sup>63</sup> Absorptive capacity measures the degree to which the potential partner’s staff has the scientific and engineering education and know-how to help commercialize this technology without having to “come up to speed” on generic technical issues.

**to a specialty player, such as the one below, we would go after the major market share holders: Honeywell Control Products, White-Rodgers (Emerson Electric), and Siebe Environmental (Invensys Building Systems Inc.). ]**

<i>Target Profile</i>	
<b>Name of Target and Relevant Unit</b>	Assistive Technology
<b>Address of Unit</b>	333 Elm Street, Dedham, MA 02026
<b>Point of Contact in Target with Position</b>	John Doe, Business Development, HVAC Technologies <sup>64</sup>
<b>Phone of Point of Contact</b>	XXX-XXX-XXXX ext. XXX
<b>E-Mail of Point of Contact</b>	<a href="mailto:john.doe@assistivetech.com">john.doe@assistivetech.com</a>
<b>Current Customer Base</b>	Assistive Technology currently serves the assistive market with communications technology sold to educators, clinicians, and those with disabilities. <sup>65</sup>
<b>Target's Reason for Interest</b>	Mr. Doe acknowledged the company was looking to diversify into IT related other product families.
<b>Our Reason for Recommending</b>	We selected the company because they are credible (started in the 1980s as a division of Boston Children's Hospital), have an international presence, and are growing. <sup>66</sup> We also liked the fact they emphasize helping customers obtain health insurance funding for the products on their website.
<b>Example of Prior Acquisition of Technology from the Outside, if Relevant</b>	Mr. Doe explained that, due to confidentially agreements, he could not discuss AssisTech's prior acquisitions of technologies in detail, but he did say that his company had, in the past, sought out and acquired assistive technologies.
<b>Criteria Likely to be Used to Evaluate This Technology</b>	Mr. Doe explained that the evaluation would likely focus on determining how easily the technology can be made compatible with the other types of HVAC-related technologies they currently offer, the technology's level of durability & reliability, and an evaluation of what sort of return on investment AssisTech might expect from this technology.
<b>Likely Information Desired</b>	Mr. Doe cited a more detailed description of the technology, a fact sheet, and performance data as the next pieces of information that he would need to see. He said that AssisTech is willing to sign a non-disclosure agreement in order to see this information.
<b>Anticipated Time to Decision from Initial Expression of Serious Interest</b>	Mr. Doe estimated that an evaluation process would likely take about 90 – 120 days. After which, a licensing deal could happen quickly as they are small and nimble.
<b>Name, Title, Phone, and E-mail of Likely Champion for Technology in Target if One can be Suggested</b>	Mr. Doe explained that while he would be the best point of contact to begin the process, the likely head of the evaluation would be: Bill Johnson, Research Engineer, XXX-XXX-XXXX ext. XXX, <a href="mailto:bill.johnson@ssistivetech.com">bill.johnson@ssistivetech.com</a>
<b>Likely Preferred Legal Structure for Deal</b>	Mr. Doe explained that some sort of licensing agreement would probably be best.

<sup>64</sup> John Doe in a telephone conversation with Toby Balch, November 26, 2005.

<sup>65</sup> Ibid

<sup>66</sup> Cf. <http://www.assistivetech.com/company.htm>, (accessed November 22, 2005).

<b><i>At What Stage in Maturity does the Target Prefer to Obtain Technology</i></b>	Mr. Doe explained that while AssisTech prefers to work with more mature technologies, they would be willing to work with a less mature technology, provided that it appears to represent a good opportunity for them.
<b><i>What Kinds of Assets or Capabilities will the Target Contribute to the Commercialization Effort, Both Before and After a Formal Deal is Signed</i></b>	Mr. Doe explained that, they would test it with several groups of end-users as part of their evaluation process and share that data. Once a deal is signed, they would of course handle manufacturing, marketing, sales, distribution, and customer support/repair.
<b><i>Who is the Ultimate Decision-Maker(s)</i></b>	Mr. Doe explained that while the decision would be heavily informed by the consensus opinion coming from Mr. Johnson and himself, the ultimate decision maker would most likely be AssisTech's President & CEO, Mary Smith.

We would characterize our conversation with Mr. Doe as very positive, as he was quick to respond to our initial voicemail message, he was happy to answer our questions, and expressed interest in hearing more from you about the technology. He explained that they are currently looking to develop universally designed assistive technologies and that he views this technology as good opportunity to do so. We recommend that you contact Mr. Doe as soon as possible to begin the process of answering his questions and more accurately determining the level of interest. Sublicensing to other vendors should be addressed as part of downstream negotiations if an exclusive is sought as if the technology takes off, better to have the big guys license from you than develop their own competing products.

We have also contacted the following companies. [**Normally several companies would be listed here too.**]

<b><i>Name of Company or Unit</i></b>	<b><i>Address, Web site</i></b>	<b><i>Reason for Recommending</i></b>	<b><i>Name, Title, Phone, and E-mail of Point of Contact</i></b>	<b><i>Reply, if Available</i></b>
Themotronics	1000 Vendor Row Springfield, USA	Themotronics appears to be a second tier thermostat manufacturer that may be looking to enter the assistive technology market.	Trent Rockwell, Product Line Manager, Wireless Thermostats	Mr. Rockwell is assigning an assistant to this technology and requested we address our question to him. We should hear within the next week who that will be and will forward a target table to you at that time as a supplement to this report.

The potential targets listed above appear to be suitable commercialization partners insofar as they appear to have the capacity to help you to develop this technology into a product, and then manufacture, market, sell, distribute, and support that product. The contact listed above appears to be the person with whom to speak about the possibility of working with you to commercialize the technology. We recommend that you contact the company listed above in order to better determine their capabilities and their levels of interest in your technology.

Names of other feasible targets may be found at the following Web sites.

<i>Internet Sites Linking to Other Feasible Targets</i>	
<i>Web site</i>	<i>Reason for Listing</i>
<a href="http://www.atia.org">http://www.atia.org</a>	The Assistive Technology Industry Association is, “a not-for-profit membership organization of manufacturers, sellers or providers of technology-based assistive devices and/or services.” <sup>67</sup>
<a href="http://www.inwhvac.org/">http://www.inwhvac.org/</a>	“The Northwest HVAC/R Association was formed and operates for the advancement of the HVAC/R industry through training and information sharing. Through the activities of the Association, we gain a broader perspective on issues that affect us all. By addressing and improving industry standards, together we become more effective in serving the public.” <sup>68</sup>

We recommend you develop a preliminary plan for deal-making before meeting with targets. This plan should be openly discussed with the target and a consensus one developed if they are interested in exploring being an investor/partner/licensee after meeting with you.

## 9 Revenue Projection

Potential investors/partners/licensees will want to know how much money they can make with your technology. Given the analysis to date, we can make a very preliminary projection of gross revenues the technology could generate.

<i>Revenue Goals</i>					
	<i>2007</i>	<i>2008</i>	<i>2009</i>	<i>2010</i>	<i>2011</i>
<i>Price per Unit</i>	\$99	\$99	\$99	\$99	\$99
<i>Number of Units</i>	4,606	14,636	51,666	109,434	292,424
<i>Revenues</i>	\$456,000	\$1,449,000	\$5,115,000	\$10,834,000	\$28,950,000

As mentioned earlier this report, we suggest a price of \$99. We think this will allow you to enter the market as a competitively priced, high performance technology for the assistive customer segment. Assuming you add on complete environmental controls and the ability to control devices beyond just the HVAC (e.g. electric blankets), we feel it could have strong market potential. The question is how much per share? We base our revenue goals on an eventual market share of 50%, the approximate market share of Honeywell, who dominates the mainstream market. Since there is not a dominant player in this customer segment /niche, we think your strategy has to be to focus on grabbing market share as quickly as possible, whether

<sup>67</sup> “About the ATIA” The Assistive Technology Industry Association, 2005, <http://www.atia.org/about.html> (accessed November 20, 2005).

<sup>68</sup> “Home” The Norwest HVAC/R Association, 2005, <http://www.inwhvac.org/> (accessed November 20, 2005).

alone or with a specialty (general assistive technology) partner in order to become an acquisition/buyout/licensing target for one of the big boys in the business.

You can calculate a discounted cash flow by using an inflation rate of 2.8% and a discount rate of 30% - 40%, which represents our preliminary assessment of the equivalent rate of return required by venture capitalists for an investment of equivalent risk.<sup>69</sup>

By taking the total market gross revenues and each year's preliminary revenue estimate, we can derive a preliminary market share goal.

<i>Gross Revenues</i>					
	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
<b>Market Size</b>	\$45.6 million	\$48.3 million	\$51.15 million	\$54.17 million	\$57.9 million
<b>Revenue Goal</b>	\$456,000	\$1,449,000	\$5,115,000	\$10,834,000	\$28,950,000
<b>Market Share Goal</b>	1%	3%	10%	20%	50%

As noted, your revenue stream will come from licensing this technology to a commercialization partner. In order to realize these revenues, the technology has to be transitioned into practical use and sold. Given our work to date, the following division of labor is a starting point for negotiations with investors/licensees/partners.

<i>Distribution of Activities for Commercialization</i>		
<b>Value Chain Activity</b>	<b>Customer</b>	<b>Partners</b>
<b>Research and Development</b>	75%	25%
<b>Design</b>	50%	50%
<b>Functional Implementation and Production Engineering</b>	25%	75%
<b>Test and Evaluation</b>	15%	85%
<b>Production/Production Processes</b>	5%	95%
<b>Facilities and Equipment</b>	0%	100%
<b>Marketing and Sales</b>	10%	90%
<b>Distribution</b>	0%	100%
<b>Customer Support and Training</b>	0%	100%

<sup>69</sup> The inflation rate is based on the US Government's Producer's Price Index (PPI), which measures the average change over time in the selling prices received by domestic producers for their output. The prices included in the PPI are from the first commercial transaction for many products and some services. A five-year average would give us a rate of 1.06%. This seems low if the economy bounces back, so we use the one year unadjusted average for finished goods. See <http://www.bls.gov/news.release/ppi.t01.htm>. This way of selecting a discount rate is recommended by the American Institute of CPA's Practice Aid, *Assets Acquired in a Business Combination to be used in Research and Development Activities*, and the discount rate is from that document as reported in Terry Allen, Jim Rigby, and Rizvana Zameeruddin, "New Guidelines for Valuing 'In Process' R&D," *les Nouvelles*, Vol. XXXVII, No. 4, December, 2002, p. 141.

In light of the preferred commercialization vehicle – licensing for purposes of manufacturing and other factors in the commercialization process – we anticipate that after some sharing of the R&D efforts, the lion’s share of the responsibilities in terms of production, marketing, sales, and distribution, would fall on the shoulders of a potential target.

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