"Smart" Housing for the Elderly: Understanding Perceptions and Biases of Rural America

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Abstract
It is commonly acknowledged that "smart" environments, interactive architecture and "smart" homes, will define the next cutting edge in architectural research. Most critics agree that one of the first problems that "smart" homes will help to address is that of spiraling costs of healthcare and aging-in-place. This may be true for urban settings where there is the financial feasibility for such technologies but what about rural America? It has been conclusively proven that rural America suffers from a lack of healthcare (delivery and access). Prior research (Mathew 2005) has also established that a rural home is different from an urban home. Will technologies designed for the urban home work in a rural setting? And do rural people carry the same attitudes and biases towards technology?

This paper continues our research in the design of "smart" rural environments. It summarizes findings from focus group studies conducted in rural communities that help us to understand attitudes of people towards "smart" technology. We will use these findings to examine the feasibility of ubiquitous computing and "smart" spaces in rural areas. In conclusion, we will present guidelines to help designers in the creation of technology to augment healthy aging in rural home settings.

1   Introduction

Aging in America is increasingly gaining the attention of policy makers, researchers, sociologists, economists and health care providers. Due to improved sanitation, better medical care and increased use of preventive health services, life expectancy has increased from 47 years for Americans born in 1900 to 77 years for those born in 2001 (AARP 2005). Not only are more Americans living longer, but the US population that is age 65 and above is growing. By 2012, nearly 10,000 Americans will turn 65 every day, and by 2030 20% of the population will have passed their 65th birthday. With this dramatic growth of the "old-old" population, about 43% of the United States will need health care or assistance in living at some point in their lives (Arno 2002).
With increase in age, old people face various chronic and temporary illnesses leading to severe limitation of activity in their daily life such as shopping, cooking, answering phone calls, opening doors, paying bills, taking medicine on time and so on. Assisted home living studies show that 50% of the over 70 population need assistance in their

daily activities, while 11.6% of the population over 65 years old has severe limitations in self-care (Dominick 2003).

Several authors make the claim that ubiquitous computing technologies can make a difference to the delivery of healthcare (Morris and Lundell 2003; Mathew 2005; Intille 2004). The development of "smart" or "intelligent" technologies may be many years in the future but before deploying or proposing designs for technology, a better understanding of its acceptance, both from the design and cognitive point of view is important. As technology becomes pervasive, its amalgamation into architecture is easier because it inevitably becomes a part of the design process. The problem is that computing is not yet pervasive and so it seldom finds integration within the design. Moreover, research into the integration of these technologies in natural home environments in *rural settings* is at best minimal. Rural areas differ from the urban in terms of scale (smaller), population density (lower), settlement pattern (dispersed), income (lower), outreach and access distance (greater), and transportation (lack of). Although several ethnographic research projects and surveys have been conducted in urban settings, little effort has been made towards understanding technology penetration in rural areas.

This leads us to the questions we asked: Can technologies bred in home labs and in urban centers be effective in rural centers? Will the rural population accept changes to their homes and lifestyles? Is the rural population ready to accept technology or are they unwilling to adjust to change?

2   The Study

In 2005, Anijo Mathew (Mathew 2005) presented a paper that described in detail challenges and opportunities associated with the design of rural "smart" homes; this paper is a continuation of that discussion. We decided to conduct a series of focus group studies to evaluate the claims made in the 2005 paper. The intention of the study was to ask important "first" questions to a quintessentially rural population. In the long term, we wish to understand the problem in context before we start designing solutions to these problems. The group discussions included care providers, care recipients and healthcare providers in an attempt to understand perception towards technology in different domains of the health care sector.

No study is complete without context; this means that this study is only relevant within the socio-cultural and economic context within which it took place. With this in mind, the authors would like to add a disclaimer: this is a study conducted in a rural state within the United States of America; to extrapolate the results to a larger (international) population is not recommended.

2.1   Why focus groups?

This study was designed as a precursor to a larger quantitative (survey) instrument, which would then inform us of formal design solutions. Focus groups are *qualitative* instruments that allow a glimpse into attitudes. Focus groups are used before surveys because subjective discussions between participants can help to fine tune objective questions for the larger survey. Since this study is purely qualitative, readers will notice that the findings are presented as subjective statements rather than hard data or statistics. The analysis of these statements will provide the reader with not just the biases but also

perceptions of the rural "technology" user.

2.2 Study site

We chose a quasi-rural city in Mississippi, a rural state with a large population under the poverty line and with very little access to technology. The major center of our study, Meridian is located in east central Mississippi. It has a total population of over 39,000 with 10,026 families. The median age of the population is 35 with 14% population aged 65 and above living alone. According to the 2000 US census, the population of Meridian is 39,968 and the total population density is 342.0/sq.km giving it the status of a rural county. Defining a rural area is a very complicated task (primarily due to the large variation in definitions). The simplest definition is that which is provided by the US Census Bureau definition - rural areas comprise open country and settlements with fewer than 2,500 residents; Meridian falls within this category.

An important criterion for our selection of site was the fact that Meridian is a favorable place for retirement as there are no state income taxes on retirement income. Meridian is also home to three large general hospitals with a total number of beds over 1,150. These hospitals will prove fertile research grounds for any future development of technology in this area. The catchment area of Meridian goes far beyond the formal boundaries of the town and includes many rural villages. However, even though the US Census categorizes Meridian as a rural county, it is important to understand perceptual biases of local people. In our research, we refer to Meridian as "*quasi-rural*" primarily because of its unique location and perception within the state of Mississippi.

2.3 Focus Group Setup

Three sets of focus group studies were conducted with health care professionals, care providers and care recipients. The first set consisted of healthcare providers and therapists (for geriatric patients). The second set consisted of care providers with some experience in providing care for someone in their own family. The last set consisted of elderly people in the 65 and above age group. Each study had an average of 5 participants (per group). The criteria for selection were:

- Elderly aged 65 and above staying alone with or without disabilities.
- Healthcare providers who provide health care to elderly persons.
- Family or friends with care giving experience for someone aged 65 and above.

Sample recruitment was done through personal contact, through email and through phone. Shelter homes and assisted homes were contacted to recruit participants aged 65 and above. Approval from the concerned authorities and physicians was obtained in cases that required them.

3 Findings

The findings of our study are presented here in broad categories with sample comments from the participants, showing a flavor of what was discussed:

3.1 Rural America is getting older and living alone

There is a growing perception of the problem of aging among the people of rural areas. The participants in the study understood the problems associated with old age and recognized the importance of interventions that could enable them to counter these

problems.

- "I have an old grandmother of age 92 and half, who still lives in a two storied old farm house… she wants to live there as long as she is alive."
- "My grand father still lives independently. He is in his 80's."
- "Both my grandfather and mother are in their mid 90's, still they live independently; living alone in a home."
- "Especially in rural areas, where there is a geographical issue, transportation issue, cultural issue, where they don't want to go visit the physician…[technology] can work very well."

3.2 Awareness

Surprisingly some participants were already aware of healthcare technology solutions available in the market. However, it was evident that most people had not heard of "smart" or "intelligent" spaces. Some caregivers and elderly participants seemed to be comfortable with the idea of Internet healthcare models:

- "We have a lady in our church she goes to a doctor in New Orleans every three weeks. Now she has some kind of monitoring device on her and she plugs this monitor into her cell-phone and to her landline, and it gives her all the readings, everything they have been looking for last three weeks. So she is doing that now for almost a year. So technology is here and she is 80 years old now. She has a cell phone so it is easy for her to adapt and use it."
- "I have come across a few elderly who do use Internet to get health related information."

3.3 Coping with technology

Most participants felt that elderly people may not be able to cope with technology:

- "My mother cannot use a computer; I think she must be afraid that she may break it."
- "I really feel frustrated with computers. I have a laptop and I get frustrated using it… People, who have never been involved with this… they do have a problem…."
- "My parents are 79 and 76. If the power fails, I have to set the TV, set the microwave, reset all plugs because they cannot do it. They just say 'I cannot do it.'"

But baby boomers seemed to be more receptive:

- "The present day baby boomer generation in the next five years will have absolutely no problem with [technology]. They have grown up with [technology]…it is a part of their life. So it is moving very fast…like wait a minute [laugh] so it will really make a difference in the next five years."
- "I don't know how many will be willing to learn computers when they are sick and have to go to a nursing home, but people who have the computer knowledge and go to the nursing home could use the facility properly."
- "I am right now working with older adults and again I have to say that there is certain percentage of people who would use [technology] but there are certain percentage like my parents who would go to the doctor and do only what the

doctor told them. But when the baby boomers hit, they will go and look for the information."

3.4 Design of interfaces/places
The overall attitude of participants seemed to be "keep the design of interfaces simple:"
- "I think making new technology as close to the old technology will surely make a difference. For example, don't change the whole system just simplify it…make them feel more familiar, with some simple operation."
- "I don't know if there are too many who will be or could be willing to learn computer…one reason behind this is that computers are intimidating. An easy way to understand interface could solve the problem."
- "But the problem [with cell phones] is - they are not always friendly. The menu is sometimes so complicated with many selections and options."

3.5 Information Management
Information and how it was presented to both users and care providers was a critical concern for almost all the participants:
- "Elderly people get little bit obsessed while getting information about their health and when you talk about that a lot."
- "I won't like my sister watching me."

Most participants were concerned about *what type* of information was visible to *whom*. Few participants even mentioned that they were not sure if they wanted their children or relatives to be given access to their health information.
However many felt that the option of receiving "just-in-time" information in their homes will be helpful:
- "Sometimes we have to remember to get that information later but if we can give that information right there that will be wonderful."

3.6 Privacy and Security
As shown in other studies (Green et al. 2004), almost all the participants were worried about privacy and security:
- "My mother won't [even] use the ATM; she says 'somebody might take my money.'"
- "I go to a patient and ask him, 'Did you smoke today? You have cancer and the doctor has told you if you smoke you are going to die.'… he is dying anyway and you can smell cigarettes and see cigarettes all over his body. If you ask him if he smoked that day, he will say 'I have not smoked today' but yes he has already had five cigarettes. He does not want monitoring. We have lots of monitoring now but the people don't want to be [monitored]."
- "I think it is a good thing to have an interface where the health care provider or care-giver can go to the internet and check the health status if their patients. But privacy and security concerns should not be overlooked."

4 "Smart" Housing—a solution?
Our primary discussion in the focus groups revolved around "smart" technologies and its feasibility as an *age-in-place* solution. When "smart" technology was shown and

described, some participants were excited about the technology:

- "My husband is going to retire and we are looking forward to move. When we look at the housing market we found that most of the housings that have been built are not meant for senior adults. There are four to five bedroom apartment built in four to five floors. I want everything in one floor so that we don't have to go upstairs. So if you build this monitoring system into an existing house that might be expensive but if you build that into a new house that might be very helpful."
- On housing market or housing developers for older adults: "I went to a workshop that designed housing for older adults where this kind of technology could be used and they need not have to go to nursing home for a long term care…where you have retirement communities, this might be a selling point in the future… like to say 'here is a house that has been designed for elderly people and will help you to stay independently here' If you have all the monitoring system built into the house as actually part of the building…this will help in developing housing for senior adults in large communities."

However, there were many who thought such technologies might be helpful but not without personal interventions:

- "I think it will help definitely but nothing can replace another person being there."
- "I don't think technology can take the place of a phone call where you can hear the voice of the person that they are alright…this you can't know from a data screen. My mom stays alone and when I talk with her over phone I know if she is having a good day or not…"

Also there were participants who felt that these technologies would not work at all and had concerns:

- "My parents would say nothing to do with that, they don't want someone to watch them."
- "…technology could be great to handle it and do it, but they want that one-to-one relation… some will go to consult someone and have a talk with that person. I have friends who are doctors, they tell me that some people come to them 'just to have a talk'…."

5   Summary of Findings

Our findings from the study are more or less consistent with other studies and research conducted in urban centers (Edwards 2001; Green et al. 2004; Rodden and Benford 2003). In many ways, it was not surprising to find that rural users echoed the concerns of urban users; only biases and perception of technology differed.

The following is a summary of the findings:

- Rural America is aging and there is recognition within the rural community of this problem.
- Aging elders almost always want to age-in-place. Nursing and retirement homes are last resorts, especially for the baby boomer generation.
- Rural users are aware of current trends in computing and healthcare monitoring

technology and are willing to experiment.
- Old elderly people may not be able to cope with new technology as much as baby boomers who have grown up with this kind of technology.
- Adoption of new technology may still be a challenge because of perceptual biases inherent in rural populations.
- Rural users (like their urban counterparts) prefer interfaces that are simple and easy to use.
- Users are concerned about their personal information: who has access to it, what will be available and how much information is provided.
- Users are concerned about privacy and safety. They want proper safeguards set in place to ensure the highest level of privacy.
- Rural users are generally receptive of new "smart" and "intelligent" technology yet were concerned about the lack of human intervention and greater distances from loved ones.

6   Guidelines derived from the study

The primary intention behind this part of the paper is to provide guidelines for designers and researchers to help in the design of better technology for rural areas. In order to design these guidelines, we evaluated the results of the focus group and, in light of prior research and ethnographic studies, we drew conclusions (guidelines).

6.1   Technology

1) One notable aspect of technology that rural users complained about was the complexity of artifacts. People tend to reject complex designs especially those they cannot use or which do not make sense to them.
   Make design as simple as possible. Give the user exactly what she wants.
2) Decision-making should always be left to the user and be based on past experiences and studied user behavior.
   Technology should only guide the user in decision-making process, not make it for them. Moreover, technology must not just be unobtrusive but also calm and intelligent.
3) People feel frustrated with new technologies because they cannot associate new technology with their past experiences.
   In short, existing user experiences and media semblance should be used in the development of future technology, wherever possible.

6.2   Interfaces

1) Any attempt to bring in a new interface, however good, will lead to an immediate rejection of that change. This is especially true of rural users because of their limited exposure to new technologies. A better way of working is to introduce the change within existing technology and slowly work upwards.
   Don't try to reinvent the wheel, use interfaces that people are familiar with. Use a bottom up approach instead of a top down.
2) In order to make the front end interface as simple as possible, it is important that the device is functional, simple and repairable. Traditional appliances like

televisions, radios and telephones are commonly accepted because the intelligence of the system lies on the network and not in the interface. In rural settings it may be more economically feasible to develop complex networks and let the front end system be a simple interface (Edwards 2001).
Shift the intelligence from device to the network, in turn creating simple usable front-end interfaces.

3) Mobile computing will be the key to establishing "smartness" in villages, especially those that are disconnected due to large distances. Many companies are trying to accomplish multiple tasks that aid cognitively impaired and elderly people with activity limitation. But increasing the number of features and changing the interface to add new features can leave people frustrated. Younger generations may be more attuned to such innovations and may be able to adopt it; elderly people however find such interfaces cumbersome and very difficult to use. Therefore keep the interface as simple as possible and/or use device intelligence to work with context cues anticipating user needs.
Design customizable options into interfaces that allow users to choose only those options that they feel a need for.

6.3 Redundancy

1) One of the problems designers will face when designing for rural areas is the repair of technology. Participants in the study seemed to think that the best technology is the one that lasts longer, for example the radio or a battery operated clock. They work for years without complication (only requirement is change of battery once every few months). In case of complex technology like computing, the failure of one technology should not lead to complete failure of the system (Edwards 2001).
Design robust technology: If one technology fails, another one should take control of the task until it gets fixed.

6.4 Information

1) Most rural elderly have children in larger urban centers. Monitoring systems always look to care providers to forward information to. In the design of information systems, our studies show that designers should be concerned about the kind of information that is presented to the elderly care recipient and the care provider. What is essential is to provide summarized data—describing the status as "good", "bad" or "need for concern." Additional information should be available only as an optional feature for those want (or are comfortable with) detailed information.
Data visualization afforded to the elderly care recipient and/or care provider should be designed so that they only see the minimal layer of information required to inform them of their health status.

6.5 Privacy and Security

1) While designing ubiquitous technology for the home healthcare domain, designers must understand that privacy and security concerns are no different for the rural person. Participants seemed to prefer the idea of contextual clues in determining position or activities of a person in lieu of video monitoring. For example the heat

of the stove could tell us they are cooking; the running water of the bathroom tab could tell us they are taking a bath etc. Such cues can also be translated into relational data—whether they have taken their breakfast or not; or if they have taken a shower or not.

Use of contextual cues instead of direct monitoring may find greater acceptance with the care recipient, allowing in depth use monitoring

6.6 Adoption
1) The wide use of congruent technology by the current baby boomer consumer will lead to a more widespread acceptance of technology for healthcare in rural areas.

6.7 Barriers to Technology
From the study, we were able to also derive what we consider barriers to the penetration of technology in rural areas:

1) Design: Designers of technology solutions assume that the users will use the technology in a particular manner; they do not. They will almost always reject technologies which do not fit into their space and life style. They will find novel ways to circumvent conventional thinking of the designer and carve out new uses for the solution. Predicting these circumventions may be difficult, but it is important that we pay attention to the use of these systems by actual (rural) users to understand not only the working but also the scope of use afforded by the solution. In case of elderly homes, a further dilemma is created by the fact that although the end users of such technology may be the elderly, the actual running of it may be done by younger stakeholders (children, grandchildren, caregivers etc.). Thus, designs have to not only account for front end interfaces but also back end interfaces that are easy to understand and fix.

2) Perception: Perception towards technology varies widely from place, gender, geographical location and culture. Therefore, it is very difficult to understand and design a single technology that will be accepted by all segments of the society. Designers must eventually design spaces that will not end up as islands of functionality but connect seamlessly as a whole. One way to ensure such a design is to draw on the way people use spaces and designs currently; another is to study the behavior of people in natural settings informing us of the best configuration of space and technology. These technologies must not only accommodate differences across individuals but also differences across households. If "smart" technologies have to be accepted by the larger rural community, it must eventually be designed for them and with them. Without the involvement of the end-user, these technologies may never find use off the store shelf.

7 Rural "Smart" Homes – a Reality Check
With little access to technicians or system administrators, integrating "smart" technologies within homes in remote places like Meridian is almost impossible. "Mass smart housing" within retirement communities may be the more viable solution to the problem. We are currently looking at several such "non-smart" schemes in Mississippi. We hope to establish relationships with these housing communities wherein we can test and evaluate the above ideas. However, as mentioned in earlier research (Mathew 2005),

involvement of government agencies is key to ultimate acceptance of such technologies. One way that these technologies can reach the rural poor is if the government mandates legislation to include them as part of the medical insurance system or subsidizes the technology to enable initial penetration. Similar subsidies were available to the rural public with new technologies like the telephone and electricity. Initial subsidies allowed the rural owner to purchase these technologies, driving the price down and thus making the technology an essential commodity. Such initiatives may begin with population centers and finally trickle down to the rural poor.

8   Future Work
As mentioned earlier, this focus group study, being a qualitative instrument, was designed only to understand perception and attitudes. The study provides us with a broad understanding of the situation. In order to be detailed, a quantitative instrument that asks specific questions is required. We are in the process of developing a larger scale quantitative survey (approximately 1500 data set) that will look at the rural areas of southeastern United States region (Tennessee, Arkansas, Louisiana, Mississippi). The survey is being designed to ask specific questions derived from the broader study described in this paper. It will also analyze the prevalence of healthcare technology and technology penetration in homes, and will be deployed in early 2007.

9   Conclusion
In short, this paper presents the problems of rural healthcare and how ubiquitous computing might be a solution to the problem. The paper then describes a focus group study that was designed to look at attitudes and biases of rural people towards the implementation of "smart" technology in their homes. Our results show a trend of thought in rural populations similar to their urban counterparts. Moreover, rural populations seemed to be receptive of "smart" technology as a viable alternative to traditional healthcare models, albeit with concerns.

In the end, researchers must remember that the problems of rural America are not the problems of urban America and strategies developed for urban citizens may not work for rural citizens. It is our hope that the above discussion will help us initiate a dialogue—to understand both the problems and the opportunities of designing rural homes of the future and to work together to find a common solution or set of solutions.

Biography
Lalatendu Satpathy completed a Master of Human-Computer Interaction degree from Carnegie Mellon University and a Master of Science in Architecture degree from Mississippi State University. Research from his thesis at Mississippi State University,"Smart Housing: Technology to aid aging in place – New Opportunities and Challenges" is currently under review for publication as a book.

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References
AARP. 2005. *The State of 50+ America.* 2006 Research Report, published by Public Policy Institute in AARP's Policy and Strategy Group, Washington DC.

Arno, Peter S. 2002. Economic Value of Informal Caregiving: 2000. Paper read at The American Association of Geriatric Psychiatry, February 24, 2002, at Orlando, Florida.

Dominick, K. L., F. M. Ahern, C. H. Gold, D. A. Heller. 2003. Health-related quality of life among older adults with activity-limiting health conditions. *Journal of Mental Health and Aging* 9(1):43-53.

Edwards, W. K, R. E. Grinter. 2001. At Home with Ubiquitous Computing: Seven Challenges. In *Proceedings of Ubiquitous Computing International Conference, UBICOMP. Atlanta, GA.* Berlin: Springer Verlag, pp. 256-272.

Green, William, Diane Gyi, Roy Kalawsky, and David Atkins. 2004. Capturing user requirements for an integrated home environment. In *Proceedings of the 2004 Biannual Nordic conference on Human-Computer interaction (Nordic CHI '04), October 23-24, at Tampere, Finland,* ACM Press, New York, NY, pp. 255 - 258.

Intille, S. S. 2004. A New Research Challenge: Persuasive Technology to Motivate Healthy Aging. *IEEE Transactions on Information Technology in Biomedicine* 8(3):235-237.

Mathew, Anijo. 2005. Smart Homes for the Rural Population: New Challenges and Opportunities. In *Smart Architecture: Integration of Digital and Building Technologies; Proceedings of the 2005 Annual Conference of the Association for Computer Aided Design In Architecture.* Savannah, GA, ed. Ataman, Osman, pp. 24-35.

Morris, Margaret, and Jay Lundell. 2003. *Ubiquitous Computing for Cognitive Decline: Findings from Intel's Proactive Health Research.* www.alz.org/Research/Care/Intel_UbiquitousComputing.pdf

Rodden, Tom, and Steve Benford. 2003. The evolution of buildings and implications for the design of ubiquitous domestic environment. In *Proceedings of the 2003 SIGCHI conference on Human factors in computing systems (CHI 2003), April 5-10, at Ft. Lauderdale, Florida, USA,* ACM Press, New York, NY, pp. 9 - 16.