Virtual Window for Everyday Life

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Abstract

Within society we have many digital devices that have replaced their classical analog counterparts. Smart-phones have replaced our notepads, calculators, and pocket calendars. Tablets have started replacing sketchpads, paper-books, newspapers, and gaming systems. But what about the next size-up when it comes to media devices? This paper discusses the potentials for a home media device that goes beyond simply being a computer or a television and approaches the realm of being the homes central-control system, integrating multiple existing technologies and opening up the potentials in application creation that has been shown to exist within both the Android and iPhone app markets.

The Virtual Window takes existing technologies and shows how, if they were mass-produced to be cheaper, more-user friendly, and obtainable in the same realm as devices such as the iPhone or iPad, they could be combined to create a smarter home media system. Diagramming, group-discussion, and affinity wall testing were all used in creating the initial concepts.

Author Keywords

Virtual reality, user interfaces, smart home, 3D display, 3D gestures.

Figure 1. Michael Senkow (R) and An Yang (L) conducting interviews

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Motivation and Background

According to the US Census Bureau, the average household size was 2.58 people per household, which means lots of people did not live with their family member. And from the Skype's annual report, it also showed that there were over 30 millions users using Skype concurrently and the population keeps growing. Therefore, communication will become a very important issue inside the family. With the separation in families, thinking of ways to make the capabilities afforded to us via modern computing technology is key.

Virtual Window takes the logical next step of thinking about how computers can integrate information from their environment to create a smarter media connection. Smart phones have filled this niche in the small and medium size category of electronics, integrating more intelligent processes into the classic cell phone and e-book markets. Based on the Pew Internet Project, 35% of American adults own smart phones with the three largest platforms being Android, iPhones, and Blackberry phones [1]. By comparison, 11% own tablets, with 77% using their tablets daily [2].

Desktop computers or televisions fulfill the next niche in the size market for media devices, but neither realm really fulfill the potentials that exist. While individuals may modify their computers to work with web-cams better, take-in readings from their environment, or connect to various news/media feeds, these are on a computer-by-computer basis.

Contextual Inquiry

The first stage of the project was the problem discovery stage where contextual research was done to find limitations of existing technologies used at home. We randomly interviewed people around campus, most of which are graduate students, about their domestic experience and use of technology in everyday life, especially for communication, health and entertainment. Based on the information gathered from the interviews, we constructed an Affinity Diagram (or Affinity Wall). The diagram helped us identify relations between different findings and group them together based on context.

From our research, we found that all subjects face common constraints in communication within or outside their houses. These include lack of communication with family members who live far away form them, lack of technology for controlling and managing all electronic devices in their houses, and lack of technology for enhancing living experience.

We also found that people's needs differ according to their ages, background and personalities. Their opinions about whether an electronic device is good or not heavily depended on their own expectations. For our project, we have divided target users into three main categories: senior citizens living far away from other family members, young people studying at colleges far away from home, and people working and living alone in small apartment in big cities. These three groups of users share certain needs and meanwhile have diverse expectations of our product. For example, all subjects reported their needs of friendly user interface for long-distance communication, while senior citizens claimed the needs for health control and emergency report.

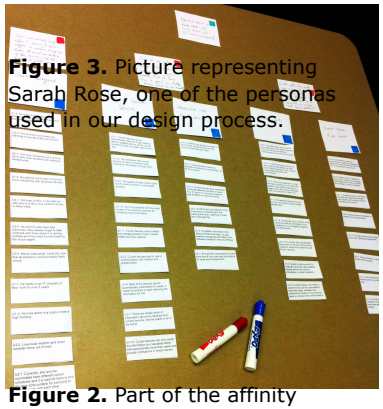


Figure 2. Part of the affinity diagram created during the project. Colored boxes were used instead of colored noted to identify different types of notes.

Figure 3. Picture representing Sarah Rose, one of the personas used in our design process.

Therefore, providing an easier way to monitor health status is another important issue. People are likely to know their health status; however, without enough medical knowledge and proper instruments, it's hard to get that information correctly.

Design Process

The second stage of the project was the brainstorming sessions and solution design. We defined three personas that would capture the requirements of different user group of our solution. The personas were created based on demographic research we did on use of technology in everyday life. Our concepts for design

Persona

Personas represent a group of people with similar interests and needs. For our project, we created three personas based on the contextual research we did previously. In brief, the personas used here are:

- Robert Griffin, 32 years old male, works as a manager of a retail store. He is single and lives in a one-bedroom apartment in Manhattan, New York City. Robert enjoys the view of the New York skyline. However, he does not have any window in his apartment. Moreover, he would not be able to afford an apartment, which could provide him a nice view of the city and fresh air.
- Sarah Rose, 19-year-old female. She is an undergraduate student of architecture and lives in the university dorm. Being away from her parents, she misses them in the dining table. Sarah is fond of playing video games and now planning to buy an Xbox360 with Kinect. She also likes to create 3D models and artwork.
- Andrew Thomas is 70 and retired. His sons, who visit him once in six months, live in different cities with their families. Andrew is on medication and he could get some assistance regarding health and medicine through technology.

Hot Ideas Brainstorming Sessions

The question "Who is using the product?" was answered by the personas. In the brainstorming sessions, we tried to find answers to the question "What are they going to do?" During one of our discussion sessions we simply researched various existing technologies that connect and support our final idea. We made several sketches of technological solutions that could improve the domestic experience of a user. Some of the sketches were based on previous ideas while others were completely new. Initially we did not consider the feasibility of the solution as we encouraged the members to express creatively. Later, we narrowed down our ideas that could be implementable within at least two years time.

Use of Existing Technologies

Part of our design process involved considering as a group what potential technologies could be integrated and expanded upon in a home computing system that followed the same route that smart-phone and tablets

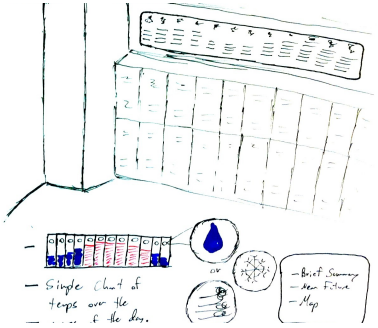


Figure 4. Sketch done in one of the early stages of the design process showing how walls (of the student lounge) could display weather information.

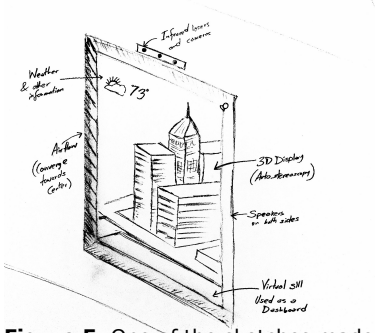


Figure 5. One of the sketches made during our brainstorming sessions showing the 3D display mounted in the wall with different sensors.

have taken. We considered the potential usages of these different technologies via diagramming and group affinity diagrams, and interviewing our classmates on what they would expect in a system.

Sensors - Accelerometer
Generally an accelerometer would be of less use in a static object, but there are some potential. Our general design concept has the computer situated in a vertical form, but an accelerometer could have use in allowing the device to be rotated for both vertical and horizontal use, protecting the system in the event of a fall (to stop the hard-drive), and on the more extreme end, there are some interesting potentials in having a wide net of computers that have accelerometers on them throughout the city. During our interview process, the idea came up that with many of these devices set statically throughout a city, they could be used do early detection of seismic activity. While one device shaking could just be a local event, if all the devices in the city moved it would show signs of the location of the activity.

Sensors - Temperature, Pressure
Either individually or combined, both of these sensors have a myriad of uses within the home. Currently, technology such as the 'nest', http://www.nest.com/ [5], are starting to exploit the potentials of making easy to use, smart thermostats for the home. The Virtual Window can expand upon this, with the central unit fulfilling the same purposes and potentially connecting to other peripheral units throughout the home. A similar process to the accelerometer could also be used depending on the exact way in which temperature and pressure readings are taken. If these devices exist in multiple locations throughout a city they can start taking location, by location points of data about the local temperature and air pressure, which could be of benefit to weather readings.

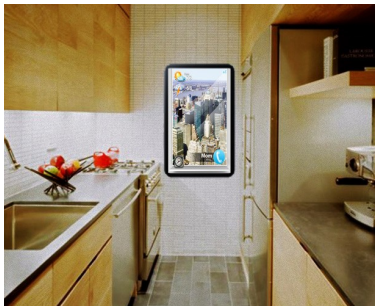
If there is not an easy way to monitor outdoor temperature and air-pressure, there is still numerous other ways in which knowing your homes internal temperature and sharing it could be of interest. Within a neighborhood, extreme rises in temperature could be warnings that a nearby house is on fire, and could be used as an alarm to the nearby users of the same device of the potential danger.

Sensor - Sound
While smartphones and tablets have started to integrate voice control intelligently, persona computers still tend to rely on keyboards and mouse/touchpad interfaces. By combining the best examples of voice control found in smartphones currently, with motion sensors or a camera to allow for movement on the screen, the Virtual Window would take the next step in creating a better interface. We found through our interviews that people often end up relying on the keyboards and mouse inputs, even if there is some potential for other controls of a system, due to the overall set-up of the system being directed at these two input methods. If, from the start of the system, it was designed for both camera feedback (as in existing systems such as the Kinect) and auditory control (as in the system Apple uses with Siri), using these input methods to control the device would much more comfortable for the end user.

Sensor - Visual
With current technology it would be easy to implement movement detection systems into this device. The

Figure 7. How the device would look if placed on the kitchen wall.

Figure 6. Screenshot of the hi-fi prototype of the user interface.



Kinect has become an example of how 3D motion capture has become a cheap and easy system to integrate. The initial thoughts on having an integral part of the system, is that it could be used as the primary data input. But depending on the strength of the sensors, it could be expanded upon much further by application developers. With a central unit that has this power of detection, concepts such as pest-control apps that run at night and detect small movements akin to rodents or cockroaches could be created, or more pleasantly, an application that turns on various electronics in the household based upon the size of the user present. Making sure that the entire person can be detected would be a key part of the system.

3D Display

The recently developed Autostereoscopic displays could provide a very good quality image as well as 3D depth perception without making viewers wear glasses or headgear. The displays usually use a device called parallax barrier in front of the LCD or LED image source to allow stereoscopic image or 3D depth perception. Recently we have seen improvement in the image quality and viewing angle as more research is being done in this field. The costs of such displays were very high even a few years ago [3]. Now that the technology is being produced in mass scale for mobile phones [4], it is very likely that it will soon become available and affordable for everyday use. Using this technology will enable viewers to get almost 180-degree view out of the window.

As part of our design process, we have also created user interfaces for the display and how users interact with different components of the interface.

Networking

A point that has been mentioned previously is the idea of having these similar systems in multiple homes. While of course currently computers can talk to each other over the net and certain games share information with each other, there are not nearly as many programs that dynamically have the goal of working concurrently with each other. This is still primarily the realm of smartphones and tablets.

Our Solution

Our solution is straightforward. Design an object that carries similar functions to smartphones and tablets but integrates it into a more powerful, static device. There are a few key features:

User Interaction: User will be able to interact with the device by different gestures using different parts of the body. The system would allow users add different items to the screen. These items or components could be something that displays information, like clock, or just a piece of art. Using interfaces like in figure 6, users could easily add/remove virtual items to/from the screen using gestures.

Vertical format: While the classic computer screen and television generally uses a horizontal form, a vertical one is more conducive to documents or using multiple applications at the same time.

Use of the cameras and 3D display to allow improved webcam viewing: The end goal would be to turn the webcam usage with the Virtual Window into a more comfortable experience. Viewing angles could be created so that the experience is more 3-dimensional and may also be opened up to turn the

Figure 8. The device placed on the wall beside dining table.

device into a 'window', in which it is passively on, opening up a viewing between different users with the same device.

Use of sensors more appropriate for a static environment: Temperature, pressure, motion, and accelerometer sensors would all be obvious choices. The system would already come integrated with visual and auditory capabilities that could be exploited (both for direct visual viewing along with 3D mapping of the environment). More expensive sensors could also be explored, such as infrared sensors, or the beginning of air quality detectors.

Providing a better window experience: Take the step to pushing this system to use the classic 'computer-as-window' concept, used in many science-fiction stories and movies. We are at the point with technology that a proper combination of a high quality input camera with a high-definition screen and a strong Internet connection (or stored recordings) could easily create the illusion of a window.

Many virtual reality simulations [7] now provide passive haptic experience to users, which include ambient temperature and wind [6]. One of our design ideas includes blowing air towards the viewer from all four directions of the display. This would provide the user an experience of standing in front of an open window.

Specifically integrating health related applications: Smart phones and tablets have the potential of monitoring some aspects of your every day activity, but the Virtual Window would have the benefit of seeing your entire body every day. It could take images, discretely, and compare changes in skin tone, eye color, etc. to keep track of various health attributes over time.

Better integration with peripheral devices: There are some devices in the home that are meant to work with desktop/laptop computers, but they generally do not join as properly as devices made for smartphones/tablets.

Conclusion

Our concept is a fairly logical next step in the integration of smarter technology into our every day electronics. While personal computers and televisions are already a common object in people's homes, our system takes these to the next level. By integrating many of the different sensor systems that exist into a massively produced system, some of the higher end technologies that exist currently can be integrated into a common home system.

Placing this into a massively produced form opens up potentials that arise from more complex pieces of technology becoming cheaper due to mass production. Additionally, by pushing the system to a more simplified but efficient form, like those used by smartphones and tablets, the quick innovation found on these devices but not as well found on laptops and desktops could be approached. By combining a higher end number of technical utilities into an easily modifiable package, while our concept has a few key ideas to begin with, its meant more to be a platform that could be expanded upon, to become the computer core for the home.

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