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Product Introduction
The idea of having a robot to manage a human’s residence has already been conceived since the mid-20th century. As we are heading into the 22nd, means to achieve that end have materialized in various fronts. Companies such as Echelon Corp. have put out products that allow their customers to access Echelon’s intelligent devices remotely. This is far better than having a robot that needs to be smart enough to multitask. We wish to extend the idea of Echelon Corp. by offering an integrated software/hardware system that allows users to access their devices locally and remotely. So wherever a person might be, he/she is able to be connected with his/her place. In summary, the HomeWiz product is to provide remote controlling service while ensuring reliability and providing transparency of the underlying communication.

To further demonstrate the need of HomeWiz, we have proposed three practical but not limiting scenarios. In the first scenario, a housewife needs to know what she needs to stock for her refrigerator. Viewing the real-time video clip from the web, she can know what she needs to buy without taking notes of the needy supplies beforehand.

In the second scenario, a sports fan wishes to record all the sports on sports channel. Since sports are shown at different times, he cannot possibly capture all the sports without knowing their show times beforehand. However, with HomeWize, any sports can be captured within a second of obtaining show time information. It gives the user the predictability and controllability of obtaining daily sports and news shows.

In the third scenario, a burglar breaks into our user’s residence while the user is away. HomeWiz’s integrated surveillance system provides the user instant alert of the break-in and gives the police an opportunity to track down the criminal with the system’s recorded clip.

Our Product HomeWiz seeks to make people’s lives easier by taking away the home chores that occupy people. The extensibility of this product means more manageability of people’s lives. We certainly hope that by creating this product, we are one step closer to bringing the relationships of people and people, and people and machines together.
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**High-Level Requirements**

HomeWiz is a piece of integrated software system that allows people to control their home appliances at a remote location. Users access and control their home appliances with a user-friendly adaptable web interface. The high-level requirements of HomeWiz can be captured as follows:

**Remote Login**

Users need to be able to login from anywhere to configure their home appliances. By selecting one of the HomeWiz Control Centers associated with each location that the user has registered with us, the HomeWiz Control Center will bring up devices detected. The interface that models the looks of a remote will change depending on the functionalities each device supports. Currently, we wish to support only one device in our prototype as methods in standardizing an interface would take a long time.

**Simple Registration Procedure**

Customers who wish to use our product will register using our installation CDs. The installation software will guide customers through the installation in a simple step-by-step process and allows the users to control his/her devices and appliances immediately.

**Universal Plug-and-Play (UPnP)**

For users already registered with us, as long as their devices and appliances support UPnP protocol, our HomeWiz Control Center will recognize the devices and appliances and configure them automatically. Configuration of devices and appliances include registering exporting functions of devices and appliances to our central database.

**Real-Time Web Viewing and Camera Detection**

HomeWiz product would not be complete without a real-time rendering of a user’s place. A user is able to view his/her place and makes appropriate decisions interactively with HomeWiz. In addition, motion detection is also necessary if HomeWiz wishes to provide a fully functional surveillance system. For the prototype, our camera will detect simple motion movement and trigger an alert.
Security
To make sure the identity of HomeWiz Control Center so that duplicating another HomeWiz Control Center is impossible, authentication of our HomeWiz Control Center is required. Furthermore, the end-to-end communication between our Middle Servers and HomeWiz Control Center and our Middle Servers and our users needs to be encrypted to prevent malicious people from eavesdropping and alter tasks sent to our Middle Servers.

Load Balancing
As users grow, the servers’ load will increase. We wish to increase the performance of our services by providing load balancing. Specifically, we would like to have a DNS server that will direct tasks to our Middle Servers equally. Since a task is just an encapsulation of the actual command plus additional task-related information to either a device or an appliance, assuming each server has the same CPU processing speed, the CPU time to process each task is approximately the same across servers. Thus, distributing tasks among servers is reasonable in achieving load balancing.

High Availability/Fault Tolerance
High availability and fault tolerance are necessary for system reliability. Since our servers are responsible for making sure that user’s tasks are sent to his/her devices and appliances successfully, failure in losing the task or in duplicating the task will be catastrophic in providing reliable services. We wish to satisfy this requirement by implementing a truly distributed system architecture for our servers. Within the cluster of servers, state transfer will ensure that peer servers will take on the responsibility readily. Furthermore, server notification among servers will ensure that duplicating tasks are not sent to our HomeWiz Control Center.
**System Design**
The HomeWiz Product is basically built by two major blocks. They are HomeWiz Server and HomeWiz Control Point. While HomeWiz Server provides the service that allows users to interact with their places remotely, HomeWiz Control Point gives users the control to all devices and appliances at home wirelessly. The detailed design is described in the following sections:

**HomeWiz Server**
To provide the functionality that allows user to remotely access their home via internet, we implemented the server architecture. The server actually comprises the following four daemons.

![HomeWiz Server Application Model](image)

**Figure 1: HomeWiz Server Application Model**
Database Server (MySQL):
Every scheduled task is kept in the database. In addition, user accounts and agent information are also stored in the database. Hence a database server is an essential part in our product. We chose MySQL as the underlying database server for its wide availability and nice integration with JBoss server.

Figure 2: HomeWiz Database Schema
**J2EE Server (JBoss):**

![Diagram of J2EE Server Application Model](image)

**Figure 3: J2EE Server Application Model**

In J2EE specification 1.4, a lot of services are defined and carried out by J2EE service provider. Several services become the critical foundation of HomeWiz server. They are:

- **Enterprise JavaBeans:**
  The database schema is instantiated by Enterprise Java Beans (EJB). Therefore, we can simply access the database by changing the property of java beans. This guarantees the consistency of our database schema and also reduces the complexity of writing SQL commands for each access function.

- **Java Message Service (JMS):**
  To actually dispatch incoming task from web service to HomeWiz service, we used JMS as the channel of inter-process communication. By doing so, no common API has to be defined between these two modules. This approach gives the flexibility to the whole system design.
- **Clustering Service:**
  This service provides a well defined infrastructure that allows us to build fault tolerance system on it. Detailed implementation of high availability system will be described in the following sections.

- **Management Specification (MBean)**
  This specification allows third-party companies to develop their own service to integrate with J2EE server, which means that the service could be automatically loaded by J2EE server and utilize the internal infrastructure provided by it.

  In HomeWiz Product, we integrated HomeWiz service into JBoss by following the specification defined by J2EE specification, so that we can access the clustering service and have our service be started when JBoss is launched without running a standalone process.

  Among J2EE server implementations available in the market, as an open source Product, JBoss outperforms other commercial products in the aspects of speed, ease to use, and completeness. It is the best choice for us to develop our service on it.

**Web Server (Tomcat):**
Web Service essentially provides a user interface that allows users to schedule their task. Users can also monitor the installed cameras via web service or access the recorded video clips. To provide this web service, we chose Java Server Pages as the web development technology because it could easily integrate with EJB architecture

Tomcat is shipped with JBoss distribution as a part of JBoss services. Being the most popular JSP server, it becomes the best choice for us to deploy our web service.
HomeWiz Service Server:
To relay users’ commands to their home appliances, the HomeWiz service server is the core component that actually bridges these two sides together. The main functions that carried by it are:

1. **Task Scheduling** — delivers tasks to users’ home when the time expires.
2. **Alert Processing** — accepts alerts from HomeWiz Control Center and notifies users by Email and/or Short Message Service (SMS) based on user’s preference.
3. **User Registration** — allows a user to create an account by HomeWiz Control Center.
4. **Device Registration** — accepts device registration request from an agent whenever a new device is discovered by agent’s device manager.
5. **Fault Tolerance** — transfers server state to other servers to ensure that tasks can always be delivered to whichever server an agent is connecting to.

![HomeWiz Server Architecture](image)

**Figure 4: HomeWiz Server Architecture**
Fault Tolerance & High Availability Design

To guarantee the service to HomeWiz users, there are two requirements that have to be met in our system design:

1. **Failover**: The service has to be highly available to users and agents.
2. **Consistent**: Tasks pending in each server should be identical; therefore, no matter which server an agent is connected to, our server is able to deliver tasks that are scheduled for it.

To carry out these two requirements, a clustering architecture is brought up as the basic design of our HomeWiz service. HomeWiz servers and DNS server together comprise the topology of a cluster.

![Clustering Architecture](image)

**Figure 5:**
Clustering Architecture

Clustering design has the following advantages:

- **Automatic Topology Maintenance**: The topology of a cluster is automatically maintained by each server. No static configuration is required. Whenever a server joins or leaves the cluster, the other existing servers will detect the change and react correspondingly.

- **Global Function Invocation**: Any server in the cluster will be able to invoke a function implemented by all servers; therefore, every member in the cluster can be notified in this manner when an event occurs on one of the servers.

Detailed Implementation is described in “Implementation Section”.

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TAIYO Corp.
At the home side, there are lots of devices and appliances that can be controlled by the HomeWiz Control Center. For every device, we have to have a specialized software to control it. Our initial design was to put all software control modules in a centralized control point. However, there is a serious drawback. Whenever we want to add a new device, we need to re-program the control point. It seriously limits the scalability of our system and could be a fatal defect of our product. In order to create a more scalable system, we have come up with a cleaner interface between home appliances and the HomeWiz Control System. According to our need, we find the Universal Plug and Play protocol that meets our requirement most. Universal Plug and Play (UPnP) is a standard that uses Internet and Web protocols to enable devices such as PCs, peripherals, intelligent appliances, and wireless devices to be plugged into a network and automatically know about each other. With UPnP, when a customer plugs a device into the network, the device will configure itself, acquire a TCP/IP address, and use a discovery protocol based on the Internet's Hypertext Transfer Protocol (HTTP) to announce its presence on the network to other devices. For instance, if you had a camera and a printer connected to the network and needed to print out a photograph, you could press a button on the camera and have the camera send a "discover" request asking if there were any printers on the network. The printer
would identify itself and send its location in the form of a universal resource locator (URL). In our system, we classify the devices into two categories. They are controlled devices and control point respectively. Figure 6 shows the architecture of our home side system.

**Controlled Device:**
This is a home appliance with UPnP enabled. As mentioned above, when it is brought into a network, it will announce its presence and export its services to the control point. And from the Control Center, customers can see the services it provides and manipulate the device on the fly.

As every UPnP controlled device registers itself to the Control Center and, in the Control Center, one can see all the UPnP devices from the screen. Clicking on any device that shows on the screen, a web page will appear listing all the actions that one can do with the device.
Following the design philosophy of UPnP, the controlling software modules should be implemented for each device. The Control Center is just a display panel that shows available devices in the current environment. The main functionality of the Control Center is to bridge devices and customers. Therefore, whenever a customer wants to add a new home appliance, he will not have to change the setting of the Control Center. Just simply bring to device into his house, and the device will join the HomeWiz System automatically. This gives our system much more flexibility than the original design and brings customers the easiest way to use our system.

The way we implemented the UPnP module into home appliance is we wrote the UPnP module on laptops and think these laptops as the “processors” that are embedded in the home appliances. Our goal is to show that with UPnP support, our system can easily integrate any kind of home appliance and therefore, convince device manufacturers to embed UPnP modules in their product to make home automation come into reality.

For now, we have implemented two types of UPnP modules. One is for home appliances that can be controlled by infrared remote controller. The main functions of this module are to learn the infrared signals of different devices and play the learned signal back to the device. The other module is the webcam surveillance system. The main functions are to monitor, detect and record the happenings of a given place, and if anything wrong, this module will send alert to customers for them to take proper actions in time.
Implementation

1. HomeWiz Server

**Database / J2EE Application Model:**
Database access is implemented by J2EE server architecture. The database schema is instantiated by Enterprise Java Beans (EJB). Therefore, we can simply access the database by change the property of java beans. This guarantees the consistency of our database schema and also reduces the complexity of writing SQL commands for each access function.

Since each table is represented by an EJB bean, to protect the bean from direct access by applications, we used several session beans to enforce the business rules. We have the following three session beans:

1. **AgentManager:** This object provides the function that helps java servlet to access the data that is related to agent, including agent list retrieval, agent creation, task management, as well as device management.

2. **UserManager:** This object provides the function that helps a java servlet manipulate user account database, including user account creation, user data update, and user authentication.

3. **HomeWizServiceDelegate:** This object provides functions exclusively for HomeWiz Service.

**HomeWiz Service:**
This is the primary component on the server side, providing services that is required by agent such as user registration, alert event, devices and cameras registration. It’s also responsible for task delivery. HomeWiz service has the following four modules:

1. **HomeWiz Service:** This is the parent component of all the following modules. It serves all the requests from its children modules and also coordinates their interactions.
2. **Connection Manager**: Connection manager accepts connection initiated from agents and populates the requests from agents.

3. **Scheduler**: When a task is scheduled by a user, it first will be stored in our database and sent as a message to HomeWiz service module, then finally reaches Scheduler and processed by it. When the scheduled time expires, Scheduler is responsible for delivery the task to the connection manager.

4. **Alert Notifier**: It processes all incoming alerts. It is also responsible to notify users by using email and SMS message. Furthermore, it designates the download location of video clips, so that clips can later be retrieved from the server.

**Web Service:**
Web Service is written by Java ServerPage (JSP) technology. To reduce the complexity of authoring JSP pages, a supporting Java bean is introduced in our application model. This bean delegates the entire database access request from JSP pages. Whenever a user logs on our web service, the authorization token will be kept in this supporting bean. Every action a user takes has to be accompanied by this token. This token is destroyed when the user session expires, which guarantees the security of our database server.

**Failover / High Availability:**
It was mentioned before that a cluster in our HomeWiz server is composed of these two core components:

**DNS Server / Load Balancer:**
Number of nodes: 1. Failover and load balance functions are carried out by our DNS server implementation. There are two service daemons running on the machine that serves DNS lookup request, *DynamicDNS* service and DNS server (*bind8*). The DNS server answers the name lookup request in a round-robin manner. Hence, the load balancing function is achieved. *DynamicDNS* service daemon dynamically manages the DNS host list, whenever a server dies or appears in the cluster, the host list will be changed in accordance to current topology. The DNS daemon will then be reloaded with the change that is made by *DynamicDNS*. 
**HomeWiz Server:**
Number of nodes: any. Whenever a server receives a task from user, it will pass it to every server in the cluster. This task is then scheduled by every server in the cluster. This ensures that an agent can always get the task. In addition, whenever a new member joins the cluster, all existing servers will be notified. One of these servers has to transfer its own pending tasks to the incoming server to guarantee the consistency. Every server will check if it is the one that has the lowest IP address in the cluster. If so, it will start to execute the state transfer. The event is ignored otherwise.

**Securities:**
The security between user and HomeWiz Web Service is done by using HTTPS protocol. Meanwhile, the communication between HomeWiz Server and agent daemon is also encrypted by using Secure Socket Layer (SSL). In addition, every distribution of our HomeWiz Control Center is shipped with a unique 128-bit key. The authentication of agent daemon has to be accompanied with this key. This prevents a false agent from connecting to our server.

**HomeWiz Control Center**
As mentioned above, there are 2 elements at home side system. First, the Control Center, which acts as a bridge between devices and users. Secondly, the controlled devices, which export services to control point. In this section, we will show the detailed building blocks of each of them.

**HomeWiz Control Center:**
There are two tasks for the Control Center. Besides collecting all the UPnP devices in the network and shows them to customers, it also takes the responsibility to communicate with the Middle Servers. Below are software block diagram and function description of each element.
- **Graphic User Interface:**
We provide a user friendly graphic user interface to access our system. We believe an excellent GUI is the one of the key to make our product successful. Here is the snap shot of the GUI.

![Figure 8: Graphic User Interface](image-url)
- **UPnP Module:**
  This module can passively listen to UPnP devices or it can actively search for the UPnP devices in a network. After it learns the UPnP devices, it will inform the GUI module and GUI module will create icons for customer to access the devices. This module is also responsible for the interactions between customers and devices. Customers’ commands are passed to the devices by this module.

- **Communication Module:**
  This module deals the two way communication between the home-side system and Middle Servers. The communications include the following
  1. Receive Command: Receive customers’ commands from the Middle Servers and pass them to UPnP devices.
  2. Send Alert: When the surveillance system detects an event, it will send an alert to the Control Center and the Control Center will relay the alert to the Middle Servers via this communication module.
  3. Live Monitoring: When customers want to monitor their places in real time, images are sent to customers’ web browser through this module.

**Controlled Device:**
We have implemented 2 types of devices and below are the software building blocks and functional descriptions of each of them.

- **Infrared Enabled Controlled Device:**

  Web Based Graphic User Interface

  - UPnP Module
  - Infrared Learning Module
  - Infrared Playback Module

  **Figure 9: Infrared Enabled Controlled Device**
- **Web Based Graphic User Interface:**
  Each device has a web page that is exported to the Control Center and when customers click the device icon on the Control Center, this page will appear for customers to control the device. Here is the snap shot of the GUI.

  ![GUI of Infrared Enabled Controlled Device](image)

  **Figure 10: GUI of Infrared Enabled Controlled Device**

- **UPnP Module:**
  When a device is brought into a network, this module will actively announce the presence of the device. It also takes the responsibility to communicate with the Control Center.

- **Infrared Learning Module:**
  In order for laptops to communicate with infrared enabled devices, we need to have a special piece of hardware that receives infrared signals and translates the signal into parallel port signals. The learning module is to record the control signals of the device and map the signals with commands for playing back when customers commit commands. This module has the same GUI as the web-based interface. By pressing right mouse button, it will show dialogs that will guide customers to finish the learning process. Here is the snap shot of the learning process.
Figure 11: Snap Shot of the learning process

- **Infrared Playback Module:**
  As described above, when customers send commands to the device, the commands are passed to this module and translated to corresponding signals to be sent to designated devices.

- **Surveillance Webcam Controlled Device**

![Surveillance Webcam Controlled Device](image)

**Figure 12: Surveillance Webcam Controlled Device**
- **Web Based Graphic User Interface:**
  Same as the infrared controlled device. This device also exports its controlling web page to the Control Center for customers to control the webcam.

![Web Based Graphic User Interface](image)

**Figure 13: webcam**

- UPnP Module: Again, this module will announce the presence of webcam device when it comes to a network and is responsible for transferring data between webcam and the Control Center.

- Motion Detection Module: When a webcam is started in a network, the motion detection module will also be initialized. This module will capture 2 frames per second and then compare the two frames to decide if there is motion within that second. Under a normal scenario, a motion means some usual event happens. When a motion is detected, this module will invoke the video capturing module to record the event.

- Video Capturing Module: This module is triggered by the motion detection module and it will start recording a 10-second video clip. After it finishes the capturing process, it will send an alert to the control point saying that an alert has been triggered and ask the Control Center to inform customers by means of E-mail and cell phone. The clip will be stored in the Middle Servers and customers can login into our system to see what has happened when the alert was triggered, it will send an event to inform Control Center saying that a alert has
User Sequence Demonstration
Following is the user sequence that shows how one would install our HomeWiz service and enjoy it in his life.

Home-Side Service:
1. Dashboard Installation:
   This is the starting point of our service.

   If a user uses our service the first time, we will ask the user to provide his information for further internet-based access and register his Home Control Center into internet accessing.
service list. In another case, we also allow the user to register to up to five Home Control Centers with one package purchase. Therefore, the user just enters his registered information to register another Home Control Center sit in other place.

2. Integrated Home Control service:
   - **Initialization setting:**
     Using smart infrared learning module allows a user to integrate easily any home appliance with infrared communication device into home Control Center. Following is the learning sequence:
     1. Execute the learning program,
     2. Click the power-on button on learning program
     3. Press the corresponding command button on real controller to input signal.
     4. Once finish device learning procedure, the appliance will be always ready to serve via user-friendly dashboard.
   
   - **Use sequence:**
     When a user wants to turn on his audio and lets say his dish washer to work by our dashboard, he first starts the HomeWiz Control Center program on dashboard, then click “Control My SMART Devices” link. (Figure 16)
Following is our HomeWiz integrated home appliance user interface (Figure 17)

![Figure 17](image)

The active device list indicates how many home appliances that are available to provide services. Remote controller templates provide the identical layout as the original controller one wishes to control.

When a user clicks on audio set icon on the active device list, our HomeWiz Control Center will start audio set controller template. Once the user clicks on the power-on button on the template, the music comes up. Afterward, the user clicks on the dishwasher icon and issues dishwasher to start washing all dishes. Easy life comes with our HomeWiz Control Center.
3. **Surveillance service:**

- **Initialization setting:**
  Because we employ Universal Plug and Play protocol, we bring a lot of convenient to out users. With the UPnP, whenever a user buys a new camera, the camera will auto configure itself and add into service list. Users do not need to have any device setting knowledge at all.

- **Use sequence:**
  When a user wants to survey his place, he starts our HomeWiz Control Center, and then clicks “See what’s happening around my place” category (Figure 18)

![HomeWiz Control Center](image-url)
Following is our HomeWiz integrated home surveillance system user interface (Figure 5)

The right-hand side is the simultaneous multiple monitor list. The left-hand side is the enlarged monitor screen.

When a user is checking the corners around his place by simultaneous multiple monitor lists, he finds something strange in his front door. He can just click on the small screen on left-hand side, a screen will then enlarge on the right-hand side for the user to check details.
Internet-Side Service:

1. Initialization:
   Firstly, a user account and password will be created when the user installs our HomeWiz service package. (Figure 20)
   Therefore, a user can access our internet-based service with this account.

Besides, we also allow a user to create extended accounts for his family. (Figure 7)
One HomeWiz serves the whole family and provide full control of the home remotely.
2. Remote Dashboard service:

   Use sequence:
Tonight NBA has Western Final Lakers v.s. Kings, a user has job to do so he would like to record the game. Then he can enjoy it later tonight. After he logins the HomeWiz service website, our server will start a customized webpage to present the active home appliance, alert status, and task schedule list. (Figure 8)

![Figure 22]

The place you are accessing
The alert list
The device active list in your place
The task arrangement list
Then all the user needs to do is click “create task” button which is circled in the red box. A identical controller template (Figure 9) will appear. Therefore, the user just enters when he would like to start recording and which channel he would like to record. After that, the user can go back to work without worrying about missing the game.

Figure 23
3. Surveillance service with internet support

- Use sequence:
  Steve can check out his place whenever he wants via our real-time multiple screens monitoring which is consistent to the style we maintain in HomeWiz Control Center. (Figure 24)

In addition, Steve can also turn on the alert system that allows our HomeWiz surveillance system to secure your place by sending SMS to your cell phone (Figure 11) or e-mail when HomeWiz detect intruder try to break into your place.

Meanwhile, HomeWiz also records a short video clip and sends it to our server. The user can review this video in alert list (Figure 8) on our HomeWiz Service Website.

Under such well-guarded system, the user need never be worried about any security issue in his place.
Product Status
Currently, we have demonstrated very well that the system is able to control the devices under a set of normal sequences. The user will be able to issue a command and expect his/her device or appliance that supports UPnP to carry out the task. In addition, motion detection and alarm notification are successful as the video clip is stored and viewed by our user. As far as support for high availability and fault tolerance, the technology on which we implement state transfer behaves erratically and unreliably. We wish to continue seeking other underlying technologies that will make the system more robust and reliable.

Product Summary
HomeWiz is a home control system available anywhere. This product has three special features. First, HomeWiz allows customers to control their home appliances anywhere: customers can control home appliances and devices, schedule tasks, and monitor their house remotely. Second, HomeWiz is a dashboard for customers’ digital home: customers can control everything using their HomeWiz Control Center everywhere. Third and finally, HomeWiz is an intelligent surveillance system: customers can monitor their house everywhere with HomeWiz digital video camera.

Future Works
There are 2 main points of our future works: one, to make HomeWiz System a real customer-oriented product, two, to make HomeWiz a real business system.

1) Make HomeWiz System a real customer-oriented product.
   • HomeWiz can be more like a physical digital dashboard for control home appliances and devices, and can support more appliances and devices. Now our product only has a web interface as a user’s interface, however, if mobile phone or PDA have a popular standard of interface as a remote controller, and HomeWiz support this standard, customers can use HomeWiz more easily and conveniently. Because 3G technology of mobile phone appears, mobile phone is going to be not only telephone terminal but also remote controller very soon. Actually, various services by mobile phone have been already experimented. For example, mobile phone will become digital wallet, and then user can buy pops at a vending machine or
go through the automatic ticket gate only by mobile phone using wireless
and solid security technologies. In this century, people will feel that it is
very normal to control home appliances and devices by mobile phone or
PDA. In this case, mass-market will be much larger than business market,
because of characteristic of HomeWiz. Therefore, user-interface would be
critical and we need a mechanism to make HomeWiz more like a physical
digital dashboard.

- We could make a standard so that every home appliance and device
  manufacturer can easily develop their product and can integrate with our
  product seamlessly by collaboration with home appliances and devices
  manufactures. If this standard is succeeded to establish, many home
  appliances and devices could be integrated with HomeWiz. This might be
  a challenging task because of cost issue; however, information application
  computing is very hot topic in some countries such as Japan. Therefore,
  we could achieve this task. At least, we believe we could convince
  appliance and device manufacturers to build devices that support UPnP
  with help with Microsoft.

2) Make HomeWiz a real business system.
- To make HomeWiz a real business system, we need to develop and
  integrate with billing system. Paying method would be a big consideration.
  For example, customers pay some dollars per month or customer pay
  some cents per task.

- Beyond billing system, we need to think about a solid business model. We
  assumed that customers will be users who will register to use our services.
  However, we are not sure that they really pay money for our product.
  Even if they pay money, it would be matter that how much they would pay.
  Therefore, we should establish business model very carefully. For example,
  we consider ideas on what to charge our customers: services or hardware,
  or something else? Another example, we could tie-up with a supermarket
  company and this supermarket can provide housewives a service, which is,
  if some foods in refrigerator become less than certain amount,
  supermarket will deliver those foods. A Supermarket can recognize this
  customer information, which we provide by using webcam installed in
customer’s refrigerator and image recognition technology with customer database. And then, our company can get money from the supermarket. Making solid business model is probably the most important task we have to consider.

- We need to consider how we can avoid surrounding threat, such as rivals. Once our product succeeds, soon, many rivals could enter our business domain. Potential strong rival would be home appliance companies, and Microsoft, which provides UPnP and, of course, has big share in PC world. To avoid this, we might need to do something make a high barrier to enter our business domain, such as we create special technology to make our product very unique. This is also very important.

- Finally, we need to be creative: We need to ask ourselves what application/services will attract more customers. We have got ideas of applications such as remote controller, dashboard, and intelligent surveillance system. However, HomeWiz needs to provide outside-the-box services to stay ahead of the technology.