The customized personal services for providing active action the variable Circumstance and Location on Homenetwork system

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Abstract User should monitor the home network environment periodically so to maintain his optimal conditions. User should also collect the information about the environments of electronic devices within home network, analyze them through learning algorithm and seize the disposition of user under the collected information. In addition, after seizing the disposition of user, home network should be controlled to provide optimal environment to user through continuous monitoring. And more enhanced services that can analyze users' pattern of behaviors and reflect individual tendency in the service should be offered so that users can obtain the information they want much faster. Thus, an intellectual control model will be discussed herein, which can offer active service based on a pattern of users' behaviors, in order to suggest a device that predicts users' activities and operates in a more intelligent way.

Keyword: active service, individual tendency, pattern of user's behaviors, intellectual control, predicts user's activity.

1. Introduction

Home networking technology refers to the key technology that enables individuals' living to be more convenient and safe by controlling various home devices and sharing each device's resources through connecting home electronics, PC, communication devices in network and making environment to exchange data. In other words, it, not seeing home as a simple residential space, aims to maintain environmental structuring safe, minimize operation cost by environmental optimization and maximize the convenience of home members through integrating high-end IT technologies at home. More recently, home networking services have adopted varied wired/wireless networking technologies to connect not only the home appliances in a house but a mobile device (e.g. a mobile phone, a PDA) with a network and this allows users to control their household appliances and take a proper measure in case of an emergency. Making our life more convenient and safer, home networking service is viewed as a technology of growing interest and expected to create enormous economic value in the future. In line with the distribution of home networking service, the market has called for individualized service, utilizing users' profiles or other similar information to meet their needs, and context-aware service that senses users' activities through various context information, sensors, and other environmental information in order to meet the demands of users. Individualized service is a service that "refines" superabundant information by filtering technology to provide the information fitting the need of users. By means of such service, miner technology can be realized, making possible self-learning of users' behavior patterns as well as repetitive sensors or environmental information. In terms of engineering, a filtering system is suggested for the self-learning function: collaborative filtering(CF) and content-based filtering(CBF). Many recommender systems are based on Content-based Filtering and Social Filtering. Both methods have their own advantages and disadvantage, and they are in the complement relation rather than competition. So incorporating of both methods can make the better system and combination technique controls the quality of the entire recommender system. CF system operates in a way that analyzes items to recommend with users' evaluation and then group users of a similar taste together so that they can recommend wanted items to each other. On the other hand, CBF system searches for items most likely to be favored by users based on users' preferences. And a sensor network means a technology of attaching a sensor or an electric tag to all objects needed for providing the service, collecting environmental(e.g. a temperature, humidity, illumination)/location information, and of transmitting the information to the network real-time. In this document, a user-oriented intellectual control model will be examined to provide individualized service through the filtering system.

2. Related Works

2.1 EPC(Electronic Product Code)

EPC is a series of code information for differentiation of each object in an RFID tag. Currently, the capacity of data is large enough to give every type of an object a unique consecutive numbers. This is quite similar to an IP of the Internet or UPC/EAN. EPC code structure consists of Class 0-5, and Class 1 is available at present. Class 0 is a 64-bit system, readable only while Class 1 is a 96-bit system, both readable/ writable. Class 2 will be a both 123-bit and 256-bit system, readable/writable also. Sensor function will be added to Class 3 and a technology of telecommunications among tags to Class 4. And a tag which has data-reader function will be applied to Class 5.

2.2 Context Conceptualization

Context conceptualization is a process of transforming data to context information needed for providing services, which aids decision-making, and is expressed by the environmental information collected by sensors. That is, it is crucial to processing the collected context data to optimize the service, and the process is defined as context conceptualization. The purpose of context conceptualization is to properly process collected context information so that it can be used for decision-making to perform a service..

2.3 Constitution technique for Recommendation System

CBF system, based on information retrieval (IR) technology, is a basic approach that provides information by consulting users' preferences. In this case, however, the service is limited to information already input and can not fully understand users' preferences. Meanwhile, CF system is more attractive in that high-quality service is possible without detailed information of users' preferences. Yet, in order for CF system to operate properly, users' evaluation of items must be accumulated to some measure, and if a new item is added, it can't be recommended to users until its evaluation is completed.

2.4 Home Network System based on the RFID

RFID technology, already commercialized in the distribution industry, has come to attention due to fast growing telecommunication industry.

In recent years, a concept of mobile RFID, the convergence of RFID technology and a mobile phone has been introduced and research is being done. In home networking services based on RFID, the state of every electric home appliance is detected on a regular basis and the information is recorded while the home server analyze the data collected by the intelligent agent to provide users with the best environment by controlling the household appliances. In addition, users can directly monitor or control home networking status, using the home server or a mobile device via a wired/wireless network. Fig. 2 shows Architecture of the Home Network based on the RFID

3. Proposed System

3.1 Design of Profiling Agent

Fig. 1 shows the composition of system this paper suggests. In each device of user, RFID tag containing unique ID is mounted. In a series of code information saved in This ID and RFID tag are matched with user information. Code information read from reader call out user information and device information from HomeNetwork Server. Then two types will appear, one is for regular user behavior pattern and the other is for accidental behavior pattern. In case of the former, home information devices would be operated by user behavior pattern, and the latter needs to learn another behavior pattern. So, as questions would be given to user then event be created, it was certified that environmental factors (mounting of new devices, changes of temperature and whether inside and outside, condition and mind change of user, etc.) and location factors (position changes of electronics and furniture within home, etc.) can influence greatly on them.

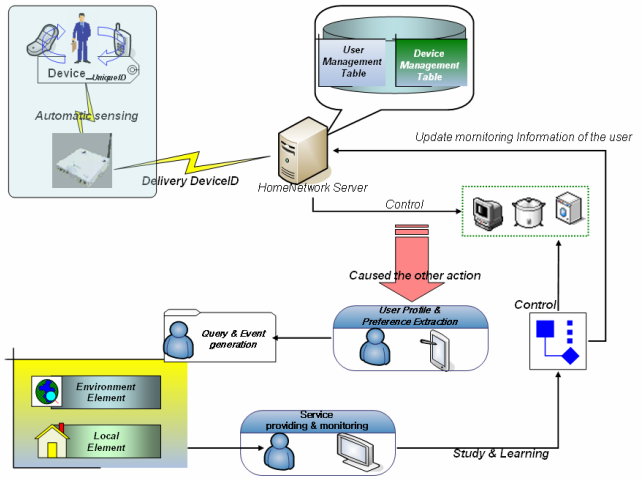

Fig. 1. Adaptability model for Activity service provide

User's new behavior pattern will control relevant information electronic devices after learning the relationship between environment and location variables and update the DB controlling user information and device information.

3.2 Pattern analyze agent of User behavior

The first action one should take to achieve adaptive monitor system is the comprehensive detection of user's behavior[6]. This action is performed by a monitor agent who comprehensively monitors the user using each device's information and device's action pattern representative user behavior.

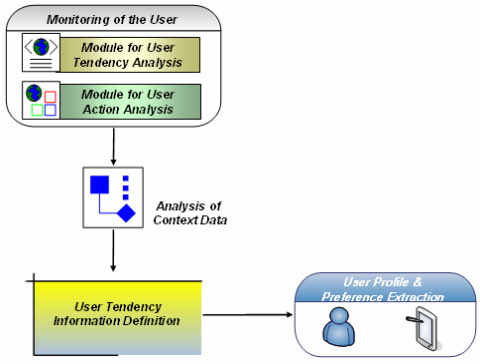

Fig. 2. Monitoring system on the User Preference Detection Process

In other words, the role of a context collector is to utilize monitored information of users and analyze the pattern of users' behaviors. The objective of the monitor agent, which monitors user behavior, is to use the behavioral pattern provided by analyzing currently updated user database of each devices's action pattern and the user's information and action pattern after a series of processing. Fig. 2 shows the Detection Process of User's Preference. Specifically, the collector analyzes the preference of users and their behaviors to define the information of their tendencies. By doing so, the action taken by users is detected comprehensively, and the data are used to find information preferred by the users and reused later to perform the service. Due to the data reused, the system can offer more active service without requiring users'

actions. The data monitored this way are first assigned to the relative users to derive each user's profile and device information.

3.3 Context modeling Agent

OWL, which constructs a context model using semantic language, defines a property of an object that shows its characteristics and expresses the relationship among objects. This also shows the complex relationships and characteristics of data with a structure of levels, helping to reason the data so that the system can extract undefined data too. In order for home networking server to offer intellectual service, it should be able to read ID information obtained from an RFID tag, properly understands the situations, and execute control commands.

```
<Device rdf : ID = "Unique_ID">
  <User>
    <Name rdf : ID = "User_ID">    // related of the user and the device
      <Temp_prof rdf:datatype="int">Temp</Temp_prof>
      <Hum_prof rdf:datatype="int">Hum</Hum_prof>
      <Chan_prof rdf:datatype="int">chan</Chan_prof>
      <Ho_day rdf:datatype="string">day:memo</Ho_day>
      <Au_De rdf:datatype="string">Auto_Dev</Au_De>
      <Ma_De rdf:datatype="string">Man_Dev</Ma_De>
    </Name>
    <Event rdf : ID = "Service_ID">
      <Env_Prof rdf:datatype="int">Env_Val</Env_Prof>
                          //related of Environment, Local and user
        <Home_In rdf:datatype="int">H_In</Home_In>
        <Home_out rdf:datatype="int">H_Out</Home_out>
      <Loc_Prof rdf:datatype="int">Loc_ID</Loc_prof>
        <Home_In_Loc rdf:datatype="int">L_In</Home_In_Loc>
        <Home_out_Loc rdf:datatype="int">L_Out</Home_out_Loc>
    </Event>
  </User>
</Device>
```

Fig. 3. Expressed and application of OWL on the suggest system

Fig. 3 depicts an example that a device ID transferred by the reader is expressed in a form of OWL. The application of the relationship among data including users' profiles, the preference, and an event produced is represented by classes and properties.

4. Active Service Algorithm for User Action Prediction

In order to provide individually customized service, the recognition information about dynamic condition is used from user's profile, various similar information and status information, sensor and other environmental information. For these satisfactions, the grasping of user behavior pattern to each device should be addressed at first. Thus, the customized home network system should be established based on following algorithm.

Formula 1 considered the relationship between user's behavior and the devices that provide services according to the behavior.

$$P_{u,s} = Device_A(User_{ID}, Device_{U,T}) + weight_{(U\_action, D\_type)} \quad (1)$$

In order to provide individually customized service, services for devices should be influenced according to user's behavior patterns. At first, the kinds of devices user accesses are to be grasped and then the behavior pattern adapted for selected devices should be understood. That is, the services provided to user will be influenced by the kinds of devices and behavior patterns. $Device_A$ is the behavior taken by device and $User_{ID}$ is the unique ID of user. $Device_{U,T}$ is the kind of device user accesses and indicates the relationship between user and the device user wants to access. $Weight_{(u\_action,D\_type)}$ is the device same to the behavior pattern taken by user but it was made to influence differently according to time.

Formula 2 considered the fact that environment and location factors can have a significant influence on each device and user behavior.

$$weight_{(U\_action,\ D\_type)} = \frac{Action_{U,D\_type[j]}}{\sum_{i=0}^{n} Action_{U,D\_type[i]}} \otimes (Env_{(w,U\_action)}, User_{(D\_type,U\_action)}) \oplus (Loc_{(L,U\_action)}, User_{(D\_type,U\_action)}) \quad (2)$$

Very close relationship exists between each device and user behavior. However, among many variables that influence on user behavior, environment and location information are most important, because user's behavior pattern can be changed by changes of environment and location. $Weight_{(U\_action,\ D\_type)}$ is the variable to find the weight for the behavior taken through the device user uses. As various behavior patterns can be derived from same kind devices, it can be said that the weight is very important to derive user's behavior pattern. $Action_{U,D\_type[i]}$ is the derived behavior pattern from the devices user is using and $Action_{U,D\_type[j]}$ is the behavior pattern of the devices user is using currently. $Env_{(w,U\_action)}$ and $Loc_{(L,U\_action)}$ is to indicate the current environment and location information. It considered the fact that environment (W) and location(L) variables can be changed by user's behavior pattern. The portion of weight was made to be influenced along with the degree in which environment and location variables would influence on the relationship between user and device.

$$Index_{(U\_D,D\_A)} = weight_{(U\_action,D\_type)} \otimes \frac{now_{(U\_action,D\_type)}}{recent_{(U\_action,D\_type)}} \quad (3)$$

For customized individual service, focus should be placed on the close relationship between user and device. Formula 3 is suggested for such priority. It intended to determine the priority about the service would be generated after giving priority to the device user uses and the behavior of that device.

Among the records about recently used devices ($recent_{(U\_action,\ D\_type)}$), the importance of currently using device ($now_{(U\_action,\ D\_type)}$) was considered. By this, the service details recommended to user was made to be influenced by the behavior pattern that would be generated from now.

5. Simulation and the Test

5.1 Environment for Realization

The environment of development for the system we are suggesting is based on Pentium Ⅳ PC with 512MB for RAM and 2.4Ghz for CPU. It is also based on Window XP as an operating system and on Apache Web Server. It

uses Oracle as a database. JDK 1.4 is used for its environment of development, and JMF engine is used for providing multimedia. J2ME is used for an embedded device that can be used when equipped to a mobile device and the sensor(RFID Device). The system suggested in this thesis gets a user's activate pattern analysis data from the server through IP and Port which has already been established after being connected to the server on a connection mode and passing an identification test. Data from this communication process are managed in the XML text form, and each signal data input is controlled by the server.

5.2 Preferred Simulation

The test environment in Fig. 4(a) and (b) are to show a situation of the inside of the home on an observation mode to the user by using a each devices set up in the laboratory for testing the capacity of the system and by using the intelligent multimedia server. Regular monitoring for home networking services is necessary to maintain the optimal environment according to users' preferences. Thus, the home networking system is controlled based on the data of optimistic home networking environment and by figuring out users' tendencies consistently.

When the system begins to operate, data of devices are checked first and users' information is called for from an ID database, and then indoor/outdoor temperatures, humidity, as well as status of devices registered in the server. Users can check if a heater is off or on through a monitoring screen as well as its conditions. Figure 6(a) is the screen checking the conditions of basic devices. Fig. 4(b) is a monitoring screen that controls/verifies users' information with the preference information (e.g. temperatures, humidity, TV channels). To provide active services, some devices are separately managed to operate after inquiring of users. This document deals with information of users' favorite TV channels according to days of the week and time as well as maintenance of the most suitable temperatures and humidity.

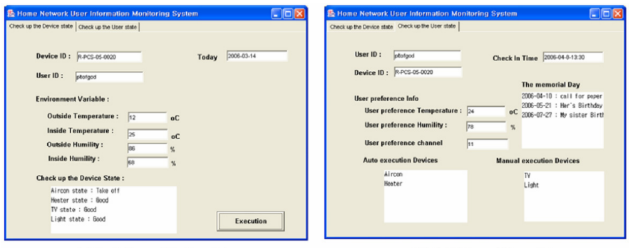

Fig. 4. Definition of Device state and the User state

This system has achieved its goal to make people's comfortable life by observing situations of the inside of the house through device using sensor by using the wired and wireless transmission module by remote control, checking records of intruding the houses or areas around the house in the user's absence, sensing an emergency automatically, notifying the user of the emergency, and turning out to solve the problem. In addition, it includes Environment entity(temperature, humidity, weather etc) and Local entity(user's present spot, user's present action etc) etc.

6. Analysis Evaluation

This test was conducted based on four cases. Firstly, with the cases having and not having the option of environment and location variables, measurements were recorded through 30 times data inputs, 30 times virtual simulations (a) and 100 times data inputs, 30times virtual simulations (b).

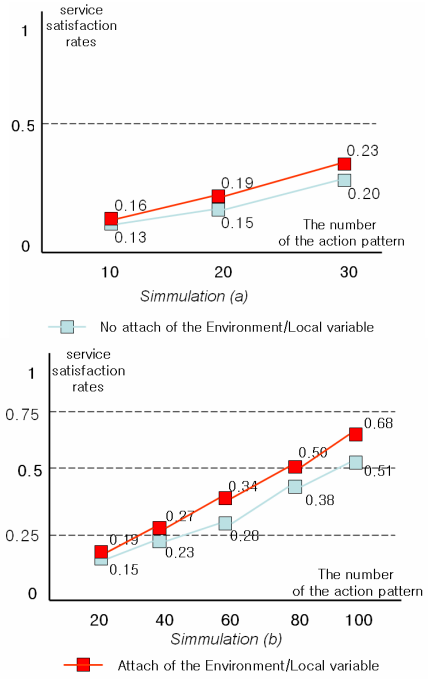

Fig. 5 Analysis evaluation according to the user's learning rates

From this result, the fact that learning rate has great influence on the exactness and the fact that environment and location variables has great influence on user's behavior pattern were certified. In other words, the result revealed that environment & location factors and user's behavior pattern according to learning rate have great influence on preference and service result. However, when new behavior pattern is input, new behavior pattern will be created, but many problems will likely occur as the structure based on such data is not formed yet. The reason is that human being do not behavior like a machine. Therefore, in order to apply to the system that controls even minute parts, ML (machine learning) technique and NL (Nerves network) technique should be applied together and more behavior pattern and data on various patterns also should be kept.

7. Conclusion and further study

Next generation ubiquitous home service scenario is required to provide proper information through multi-modal method according to the taste, interest and situation of users. Also, in order to maximize the sensory amenity, it needs the quality management reflecting the change of energy consumption pattern, the reflection of operation policy by space and intelligent in-room environment control system via temperature/humidity sensor for energy efficiency enhancement. In Nest generation ubiquitous home service scenario, devices collect information from various sensors then, summary, analyze, process and work on the information, and report to user in voice, text and graphic. From these contexts, user-centered service can be provided. To develop these services, service management technology should be continued.

User should monitor the home network environment

periodically so to maintain his optimal conditions. User should also collect the information about the environments of electronic devices within home network, analyze them through learning algorithm and seize the disposition of user under the collected information. In addition, after seizing the disposition of user, home network should be controlled to provide optimal environment to user through continuous monitoring.

In this document a user-friendly intellectual space control system was introduced, and the system offers a human-oriented interface and intellectual services by analyzing a pattern of users' behaviors. In the future, more research should be done on relevant home network servers, development of middleware, and telecommunications standardization of household appliances as well as security systems for their use.

Therefore, techniques that can support this system such as sensor networks, embedded techniques, reasoning and judging skills, and more accurate analysis technique for user's activate pattern will be essential in the future. In addition, if user's data stored in the system are used as data for providing personalized service, more effective intelligent home network system will be established.

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