ORIGINAL ARTICLE

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Smart home – digitally engineered domestic life

Abstract The purpose of the Smart Home Project is to devise a set of intelligent home appliances that can provide an awareness of the users' needs, providing them with a better home life experience without overpowering them with complex technologies and intuitive user interfaces. Our main aim for the project is to improve day-to-day home life with smart computer technologies while still keeping the home life as normal as possible – we refer to this as "digitally engineering analogue home life".

Keywords Automation · Digitally engineering analogue home life · Smart Home

1 Project overview

As the need increases for information and media technology to deviate from conventional desktop computing environments and fuse with daily household appliances, an interaction style that effectively compliments recent technology's innovations and applications is in great demand. The ubiquitous and pervasive computing systems that provide the user with adequate information at the desired moment must also provide a digital environment that is both natural and friendly. The continuing pursuit of discovering and exploring new possibilities and ideas, and the demonstration of prototypes for new design concepts, will be utilised in tomorrow's infrastructure to develop a wider vision and formation. The purpose of the Smart Home Project is to devise a set of home appliances with more intelligence and awareness of the users' contexts so that they can provide better home life experience to residents without overpowering them with complex technologies and intuitive user interfaces. Our main aim in this project is to improve people's home life with smart computer

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technologies whilst being as non-invasive as possible with regards to their home life. We like to refer to this process as "digitally engineering analogue home life".

Following are some key ideas for appliances and devices that came out of the Smart Home Project. Some of these innovations are now on their "working-prototype implementation" phases (meaning we are actually developing them), while others remain as on-screen, virtual prototypes.

For 1AD, we are submitting our on-screen prototypes to show our design concepts for these new appliances of the tomorrow.

2 Appliance design

Smart memories

The atmosphere transmission system has the capacity to record its own memories of living patterns and the residents' preferred lighting, sounds, images and smells. It can then access these memories in order to create the perfect and appropriate atmosphere in the smart house (Figs. 1 and 2).

Smart pen

Smart pen offers a way of finding a definition for any unknown vocabulary when people have problems reading books or documents, and can even save important phrases. This is especially useful for documents written in a foreign language. All you need to do is underline or write down the unknown word, press the translation key and then the pen automatically projects the translation onto the document in, for example, Korean to English and vice versa (Fig. 3).

Gate reminder (desk)

Forgetting an important item at home that you need for your day is something that happens to the best of us. But

Fig. 1 The house learns your favourite ambient settings

Fig. 2 The house's memory can be programmed to react to the residents

now, this innovative Gate reminder will remind you what you need before you leave the house, so you will never need to forget anything again (Fig. 4).

GIA

GIA is a new professional picture management device that controls every function in your photo album through interaction methods using simple hand gestures

Fig. 3 Read a document in a foreign language easier and faster

Fig. 4 You'll never leave important items at home again

(Fig. 5). Most people become lazy when it comes to putting their photographs in an album, and their pictures end up being lost and forgotten. GIA is easy to use in conjunction with a digital camera – even for people who are not confident at using computers – and with a simple hand gesture, you can access all your favourite memories.

Smart wardrobe

The smart wardrobe digitally looks up the weather forecast for the user so that they can comfortably and

Fig. 5 An interactive photo album functioning on hand gestures

Fig. 6 My fashion coordinator

Fig. 7 A comfortable environment to apply make-up

adequately coordinate what they wear with the outside environment before they leave the house. Once the user returns home, the clothes that they have worn can be easily deposited to go through the simple laundry function (Fig. 6).

Smart dressing table

The smart dressing table is the perfect accessory for women who are fed up with having to put their make-up on in the morning in a bad and dark environment. This dressing table has several innovative functions that work with the user to create a perfect and convenient atmosphere for putting up make-up on quickly and effectively (Fig. 7).

Smart bed

It can be difficult in this modern age for busy working people to feel good and peaceful when they must get up early in the morning, but with smart bed, you can turn a stressful morning into an enjoyable one. The unique system can be programmed to remember your preferred sound, smell, light and temperature settings to gently wake up all your senses and give you a good start to every morning (Fig. 8).

Smart pillow

Wouldn't it be great if, as an adult, you could still be read a bedtime story of your choice and have someone taking care of you and your needs when you went to bed each night? But what if you had a pillow that could look after your bedtime needs? Smart pillow can read any books of your choice to you at bedtime and can play your favourite music to drift off to when you start to get
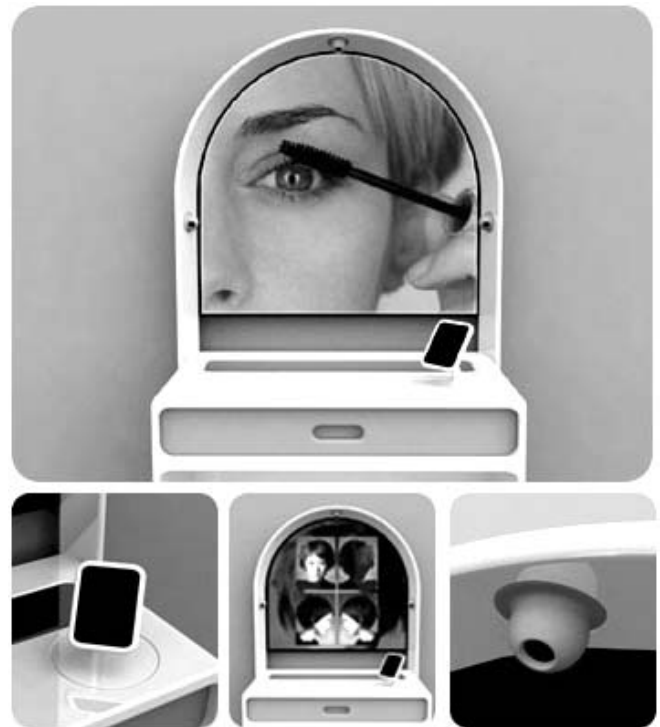

Fig. 8 The system that makes every morning a great morning

sleepy. Once your body goes into deep sleep, it will automatically check the condition and quality of your sleep, gradually reducing the volume of the music accordingly and, eventually, turning it off completely. As well as being ready for you when you wake up in the morning, it also checks the user's basic body information (such as respiration, pulse and body temperature) and in the case of any emergency or illness it will immediately report via the network through to the emergency system (Fig. 9).

Fig. 9 The pillow that monitors your sleep

Smart mat

There should be a mat at the entrance of every home, and for the Smart home, this is a particularly important place as it provides a vital connection between inside and outside the house. Simply by sensing the body weight and footprint of the user, the smart mat immediately recognises which user is stepping on the mat. It is easy to record who is at home and who is not – and even who is visiting – by using this device. Additionally, the display can give a message of choice to each user, whether it is 'hello' or an important message. The mat's analogue function can be programmed to automatically remove dust and bad odours, and it is just the right material and consistency for constant use – not too soft or slippery (Fig. 10).

Gate reminder (door)

As we discussed before, everyone has a day when they are forgetful or in a hurry and they leave something vital at home that they needed for their day. But with this second reminder at the door, there is no chance for you to make this mistake any more (Fig. 11).

Smart table

Tables are multi-functional pieces of furniture that are used for both work and leisure situations, but this smart table also works to make your life easier for you on every level. The smart table's surface incorporates an interactive touch screen which allows you access to all parts of the network at the touch of a finger and can be used in any situation to communicate messages and create tasks – even in an emergency (Figs. 12 and 19).

Smart picture frame

It is not always easy to access the information that we need, such as local news, weather information or the

Fig. 11 The house reminds you to take a special item from the house with you

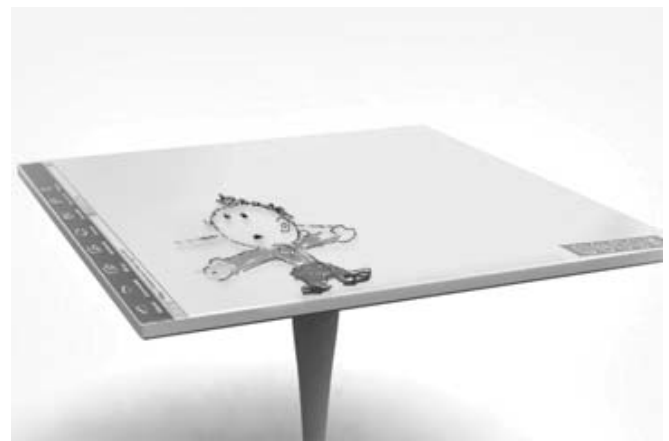**Fig. 10** A device that connects outdoors and indoors

Fig. 12 Smart furniture in the smart home

latest update on the stock market – especially if you live a busy life and are always on the move. Even with the explosion of the world wide web, it can be time consuming to access information, and once you have found what you want it can be hard to recognise, concealed in too much information, which also makes it difficult to remember. But smart picture frame is an interactive device that can simultaneously provide instant information and be aesthetically pleasing. Using phrases such as 'the traffic is bad today' or 'the stock market rose' it communicates quickly and effectively what you need to know before you go on your way, and by matching each information category with certain images inside the picture, the images can change as the information is updated. This provides the user with real-time information updates through easily recognised images, and by touching the designated image, additional in-depth information can be accessed easily (Fig. 13).

Smart refrigerator

Along with its obvious basic food storing function, the smart refrigerator is equipped with a shopping and storage application that allows the user to keep track of the individual food items expiry dates as well as manage shopping lists. It also has a removable display panel that acts as an integrated kitchen product and can be used as an electronic memo board, housekeeping book and so on, providing a more pleasant and user-friendly kitchen environment (Fig. 14).

Smart greenhouse

The Smart Greenhouse is a natural air purifying system that utilises plants that have naturally powerful air purifying qualities in a mini greenhouse in the house, which provides fresh air and a pleasant natural scent. The greenhouse automatically controls the climate to adjust the plants' purifying abilities in order to provide

Fig. 14 The refrigerator that provides much more than food storage

adequate freshness according to the contamination level of the air in the house (Fig. 15).

Smart sofa

The smart sofa has many special functions that enhance your experience when watching the television, films or playing video games. Depending on the visuals and the sounds on the screen, it creates the ultimate watching experience in action scenes by using vibrating, the sense of touch and the sense of smell. Also, by reading signals from the user's body, it automatically adjusts to create the most comfortable and physically beneficial shape for the user's posture (Fig. 16).

DigiFlower

Wouldn't it be nice to know exactly who was approaching the house at any time of the day? The DigiFlower is a

Fig. 13 Delivering information via images from a picture frame

Fig. 15 The smart green house air purifying system

Fig. 16 The smart sofa gives you the ultimate viewing experience

cordless communication system that indicates whether or not any member of the family is approaching the home. As well as improving communication and general relationships within the family, it also provides general convenience and can also act as a safety device. The DigiFlower is composed of a portable transmitter and a receiver. This device indicates by bursting into bloom when a family member approaches the house. This innovation can act as a new communication interface for the people both inside and outside the house (Fig. 17).

Smart universal remote control

This is the perfect remote control. It does not require any additional set-ups and it is capable of recognising an object via an internal camera, promptly displaying an appropriate GUI for any system in the smart home. It is also possible to use to control the digital camera, as well

as to play back any desired images promptly at the display panel (Fig. 18).

Electronic paper

The days of paper books and newspapers are numbered. What they are going to be replaced with, according to some entrepreneurs, is "e-paper", which is basically a computer monitor that is so thin that you could roll it up and stick it in your pocket. The goal is to create an electronic paper that has the look, feel and flexibility of paper, but unlike paper, can be erased, updated and used over and over again (Fig. 20).

Smart projector

This is a product that is bound to be a favourite with all the family members, and being wireless, connected to a home digital device, there is never any trouble with the

Fig. 18 Universal remote control for the smart home

Fig. 17 The cordless flower blooms when a family member is approaching

Fig. 19 The interactive table

Fig. 20 An electronic paper

Fig. 21 Multifunctional projector

Fig. 22 UI display on the large screen

Fig. 23 One of the window's many displays

Fig. 24 The smart bathroom is a sanctuary for relaxation and health
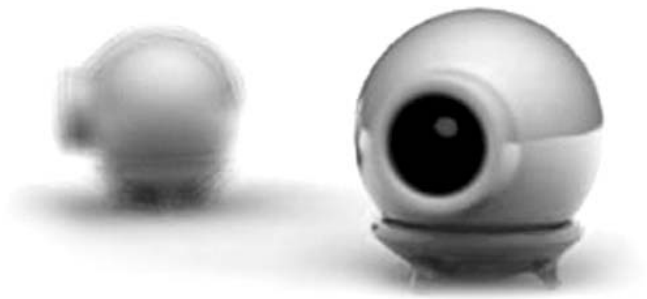
location when using this multi-functional projector. It formulates a new inflectional plan to existing projectors and is a wireless movable projector and home network system that can operate anywhere for ease of use. The main part of the lens can be detached and used to monitor any part of the house desired by using it in conjunction with the input camera (Fig. 21).

Smart wall

One of the problems when changing a display is the size. How can we utilise the size of a display effectively when it is constantly getting bigger? With the personal projector or the home PDP there are many window displays on one screen that can be controlled by the voice interface. This makes life even easier as you do not even have to use a remote control or type in any text commands to get results – all you need to do is talk to your applications (Fig. 22).

Smart window

This is an idea that was developed from human behaviour patterns of drawing on a frosted window in order to look outside and draw images. This system is developed on top of the normal function of the window, with connections both indoors and outdoors that have

allowed the elements of entertainment and sensitivity to be added to the window system (Fig. 23).

Smart bathroom

The bathroom is one place where every family member must spend a portion of their time every day of their lives. If we really get more enjoyment out of the time that we have to spend in this area of the house then both our lifestyle and our general well being will improve. The smart bathroom provides the user with a more pleasurable sanctuary that really makes use of the space and offers a wide range of multi-media options, including the control of atmospheric sounds, the temperature both inside and outside the bath and a variety of information relating to health and beauty issues (Fig. 24).