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Creating Scenarios and Using for Smart Systems Generated with Wireless Sensor Networks

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Abstract

Smart homes can be identified as homes which can satisfy the needs of the residences with the help of the modules used, making their lives easier and offering safer, more comfortable and more economical living. Smart homes can be built with wirings or wirelessly. However, in our world where technology is rapidly advancing, with the wireless devices replacing wired devices the smart homes too are being developed wirelessly. The smart home systems allow the user to manage all electronic and electric devices in the house. None the less, one of the most significant features of the smart home homes is that even if the user does not run the system at all, scenario configurations with a small artificial intelligence in the background run. The scenarios are part of the system where the user defines cases that can occur in their homes once and then it gives necessary warnings when the cases defined do occur. In this study creating these scenarios for the smart systems and using of them in the wireless sensor networks is explained.

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Keywords:

1. Introduction

Nowadays, the developments in the technological area change the way people live and get beyond the luxury and take their place in the history of humanity as a need one can reach easily. In developing and expanding societies the concept of necessity constantly changes and navigates a route in parallel to the technology. While it was a major

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progress and an innovation that you could turn a lamp on with a click of a switch many years ago, now it is important that his lamp is turned on when the user goes into the room, when it gets dark or is controlled with commands. Individuals now expect breakthroughs in their living spaces; the fact that the factors that become banal and the control mechanisms do occur and end the way they wish constitutes a significant example for the changing concept of necessity. Wireless Sensor Networks are a new technology which has begun to be used in many fields. They are frameworks which collect data with the gateway nodes from the medium and convey these data wirelessly through the coordinating node. It is a technology without the cost and the mess of the wires and stands out with its ease of use. Wireless Sensor Networks have recently begun to be used in smart home systems. The smart homes generated in Wireless Sensor Networks can be monitored either on mobile platforms or on web-based platforms and the house is managed in this way. In this study creating a scenario in a smart home implementation that is managed with wireless sensor networks and managing of these scenarios is explained. The user is able to display the scenario they created on web-based as well as mobile platforms. It is a feature of the scenarios that allows your home to manage itself in terms of the times, conditions and incidents. The smart home technologies make the life easier by turning your homes into self-managed mechanisms. Due to smart home system, communications can be established with the electric devices in your home or office and they become easily manageable. Smart home scenarios make your home act on your behalf according to the circumstances such as weather, time, conditions and incidents. And this, too, will provide you with a solution domain and a chance to implement them in home and office automations. The user makes the desired adjustments once and creates a comfortable environment for him/her. For instance, the user is able to create scenarios containing below circumstances. Start and finish times of the incidents can be decided according to the time or condition.

- Temperature set-ups,
- Adjusting the music in the environment,
- Adjusting the lights in the environment,
- Running of your oven or coffee machines etc. in the kitchen,
- Garden watering operations,
- Turning on the desired channel on TV,
- Door locks,
- Activating Alarm System,
- Curtains

In literature, there are some studies made in smart home systems. These are generally Zigbee, Z-Wave etc. These studies are summarised as: Bai et al. (Bai, 2008) made a study on the remote control of power outlets found in houses using Zigbee communication. Lim et al. (Lim, 2011) designed smart home control systems using Xbee radio nodes. Wang et al. (Wang, 2010) conducted a study on usability and necessity of using Zigbee technology in smart home energy management. Tsang et al. (Tsang, 2007) designed remote Zigbee controller. The devices can be remotely turned on and off. Ajgaonkar (Ajgaonkar, 2010) made simulation studies in smart home automation. Rao (Rao, 2005), made different simulation studies of Zigbee/IEEE 802.15.4. Callaway (Callaway, 2002) mentioned the role of Zigbee/IEEE 802.15.4 protocol in smart home systems. Smart homes can be identified as homes which can be controlled in one origin, can communicate with each other and can satisfy the needs of the residences, making their lives easier and offering safer, more comfortable and more economical living because of these technologies. Smart home is the home, if it is to be spelled out, which is constantly in communication with the people living in it and fulfils its duties as per the commands given. The most important point in the concept of a smart home sums up as that the automation system implemented in your home is fully formed in a way that you wish. Contained in this study is a study about creating and using a scenario for a smart home system managed with wireless sensor networks. In the second part of the study smart home systems are mentioned and the study is discussed in more detail. In the last part however, the conclusions on the study is presented.

2. Smart Home Technology

The formal logic of the smart homes is to provide building owners with more comfortable, safer and prestigious spaces. In order to provide this, scenarios created as per the wishes of the client, travel programs, astrological time

clock and remote control features are offered. For instance, with the touch of a button, the home owner, when leaving the house, can turn all blinds down, turn off power at certain power points, turn off the TV and the sound system, adjust the air conditioner and the heater to a certain degree, stop the water motor and activate the alarm system. Apart from such scenarios, some smart home systems can allow for little more security and comfort. In these systems features such as control of the blinds according to the Sun that rises and goes down at different times in every season, heating systems and the scenarios can be controlled. In cases where there is no one in the building, the running of the system as if people exist in the building can also be accomplished. The smart home system saves into its memory what the owner has done in the last week. Within this record are the operations such as at what times the owner turned on and off the lights, what time they listened to music and watched TV and what time the garden is watered etc. When they are leaving the house for a long period of time, the smart home system runs the applications as if the owner is at home. The capabilities and the capacities of the smart home systems depend on the sub systems working integrated with the main system. For more security and comfort, digital lock systems, power floor heating, snow and ice prevention systems, sound and display systems, CCTV, alarm systems and touch screens can be included in the smart homes. For every sub-system included, necessary modules are included in the main system and these devices need to be programmed. The digital lock systems which increase the security level are a new technology that has come up as an alternative to the conventional locks. This system offering wireless doors, easy installation, non-taking-up-room entrance control systems can be integrated into other external systems. In the system that can be integrated into furniture locks, safety doors, safes, lifts, shutters and alarm systems, time recording and permission programming is performed. With integration to the smart home system, controlling of the doors, monitoring of the entries and exits, intervention into permissions can easily be performed over the internet. Power floor heating systems, however increases the comfort features of the smart homes. The power floor heating systems which allows more homogenous and effective heating comparing to the conventional systems can be included in the smart home systems with no hassles. This system which is used, apart from its inner-building use, in roofs, eaves, walkways, vehicle ramps and garage entries and exits prevents the formation of snow and ice and offers a more comfortable and safer life. This system that can be used in smart homes runs by measuring the underground and ambient temperature. With this system that is capable of a 0.1 degree precision, programming can be made 24/7. In outdoor applications however, the system which measures the outside humidity, apart from the temperature, and steps in when the snow and ice forming conditions are formed steps out when these conditions disappear. The alarm systems are most significant sub-systems of the smart homes in terms of security. According to the signals to come from the fire, gas and water flood detectors and the movement detectors within the alarm systems, the smart home system can trigger certain scenarios and devices. In case of a water flood being detected, the smart home system can command the shut off of the electric water valve. In the same logic, the smart home system can command to shut off the power to prevent a fire and open the windows to aerate the atmosphere in case of gas leakage. While the signals coming from the alarm system can trigger the smart home system to turn on and off the lights in the building in case of fire as well as theft, it can call out to desired numbers through its telephone interface and make notifications. The smart homes which ease the lives and save time with all these features provide convenience for the elderly and the disabled. Leaving nothing on behind when leaving home with a single button, activating the lighting and the alarm system with a single button in case of an emergency and enabling to make an automatic phone call come to the forefront as vital factors. The smart homes bring security, comfort and prestige into the lives of the humans with their continuously increasing capabilities and capacities.

3. Management Of Scenarios In Smart Home Systems

The scenario of the smart home created is analysed in two stages. The first stage is to create scenario and the second stage is to display of the scenario.

- Creating a scenario
- Displaying the Scenario

3.1. Creating a Scenario

In this section, the scenario creating part used to add a new scenario in the smart home application generated is discussed. The user wanting to create a scenario needs to log on firstly to the smart home application with the user name and the password and run the application. Then they will need to go on to the scenarios section by entering into the section with the letter “S”. Then they will need to go in to the page where a scenario will be created. The scenario creation screen is shown in Figure-1.

EDIT SCENARIOS	
NAME OF SCENARIO	My Scenario1
NAME OF SECTION	Hall
NAME OF CATEGORIES	Temperature
NAME OF SUB-CATEGORIES	Combi
CONDITION	☐ Smaller ☐ Larger ☐ Equal 50
MESSAGE TRANSMISSION METHOD	☐ Send SMS ☐ Send E-Mail ☐ Make a Call
Update	

Fig.1. Creating a New Scenario

As seen in Figure-1, the scenario creation section consists of 6 sub-sections. In order for the scenario to be active these 6 sub-sections need not be left blank. These are:

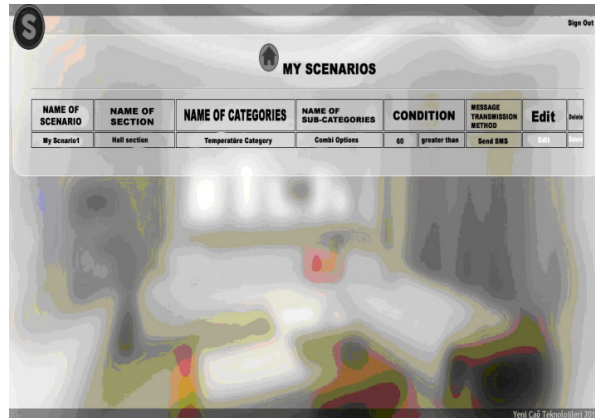
- **Name of Scenario:** A name is requested to be entered here for the scenario to be newly created. The user can enter a user name familiar to him/her.
- **Name of Division:** There is a drop down list here. In this list are the divisions/rooms of the smart home created earlier for the user. The user needs to select the division in which the scenario will be run.
- **Name of Category:** In this name of category section, too, there is a drop down list as in the Name of Division section. Listed here are the features available in the division/room previously selected (In Name of Division). For instance: A user who selected the Living Room in Name of Division section would see the features in the Living Room in this list (Temperature, Lighting etc.). For the scenario to be created one of these features needs to be selected.
- **Name of Sub-category:** In this section however, the devices belonging to the category (Temperature, lighting etc.) selected previously. In fact, this is the section where the scenario to be created will be monitored. Because the scenario will be created as per the data to come from the devices to be selected here.
- **Condition:** The Condition section aims to control the values coming from the devices or the features selected in the Sub-Category section. There are 3 different criteria here. These are Smaller, Larger and Equal. And there are empty text boxes next to these criteria. Meaning of the values entered into these boxes and the criteria selected is: check whether or not the data coming from the device selected in sub-category section is smaller or larger than or equal to the value in these boxes. For instance: A scenario can be created saying “if the value of the air conditioner in the Temperature category is smaller/larger than or equal to 40 Degrees Celsius, do this”.
- **Message Transmission Method:** In the last section of Message Transmission Method, there are 3 options. These are: “Send SMS / Send E-Mail / Make a Call”. The meaning of these options however, is to tell the system what to do when the defined conditions of the scenario do really occur. As per the option selected here, the system is able to automatically send SMS / Email or make a phone call.

When all these fields are filled in and the save button on the bottom is pressed, the smart home user will have created a scenario for his/her home. Therefore, the user will be able to be informed of what is happening in his/her house even though they are not home or not running the system because of the wireless sensor networks running in

the background. Thus the user, even when not home, will be informed about the hitches that can occur such as theft, fire as well as attack on the house. It is also a fact that even being aware of the existence of these scenarios is a deterrent factor for malicious people.

3.2. Displaying the Scenario

The user who has created a scenario is able to display these scenarios created through web-based or mobile devices whenever and wherever they wish and to re-configure. In Figure-2 the screen on which the scenarios of the smart home application are displayed on web-based platform is shown.



NAME OF SCENARIO	NAME OF SECTION	NAME OF CATEGORIES	NAME OF SUB-CATEGORIES	CONDITION	MESSAGE TRANSMISSION METHOD	Edit	Save
My Scenario1	Hall section	Temperature Category	Control Options	00 greater than	Send SMS	edit	save

Fig.2. All scenarios Smart Home Web-based Application

As seen in the figure, the scenario created in the previous section is shown. The user, if desires, can increase these scenarios re-applying the incidents explained in the previous section. All scenarios created can be displayed in the section shown in figure-2. If the smart home user wants to configure a scenario created earlier, they can do so by clicking on the configure button on the right of the desired scenario – shown in Figure-2. The next screen to come up is the same screen as the one in Figure-1. When s/he re-configures the desired parts in this section and hits the save button, s/he will have updated his/her scenario. When the user wants to delete a previously created scenario however, s/he will need to hit the delete button on the right of the scenario to be deleted. The scenario management of the smart home application can only be made through the web-based platform. That is, configuration, creation and deletion operations can only be made on the web-based environment and on the mobile platform only the scenarios can be displayed. Below are the screens on displaying of scenarios on mobile platforms.

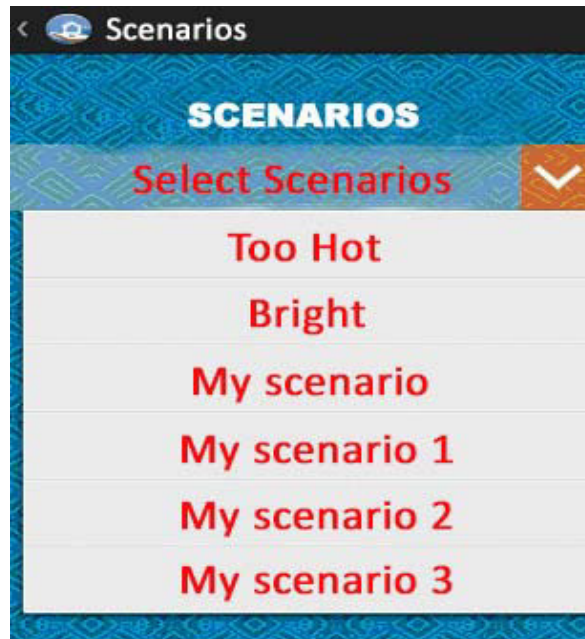


Fig.3. All scenarios Smart Home Mobile Application

In Figure-3, the scenarios created in the smart home application are displayed. As seen, it is also possible to add more than one scenario to the system. In Figure-4 however, the features of the scenario selected in the previous figure are shown. The “Oda” represents the Name of Division in the web-based platform. The section looking different YAE (HLE) represents the Condition section selected when creating the scenario. The value “Y” (H) means “higher than”. That means “if it is higher than the value entered in “Value”.

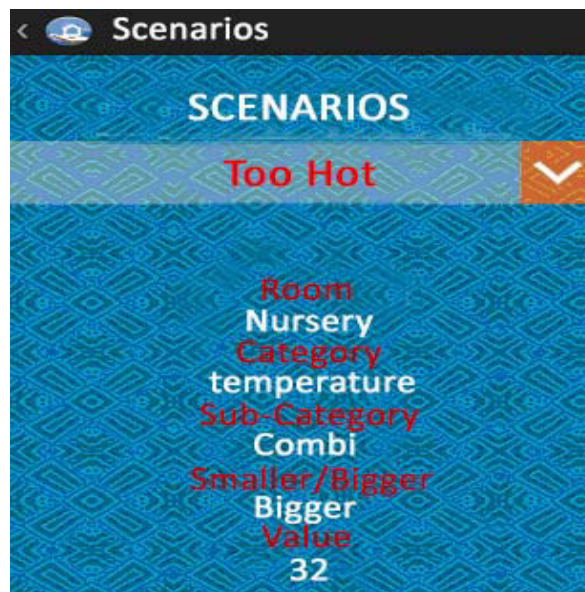


Fig.4. Smart Home Mobile Platform – Display Scenario

4. Conclusion

Ensured in this study are creating scenarios for the smart systems and using of them in the wireless sensor networks. Thus, it is ensured that the user is informed about what is happening in the house even when they are not home. In the study, it has been explained that the scenarios created can easily be displayed on web-based and mobile platforms. It has been mentioned that the management and creation of the scenarios can only be made on web-based platforms, and through the mobile platforms only the displaying of the scenarios can be made. It is also anticipated that the study would be useful in subjects of Wireless Sensor Networks and Management of Smart Environments.

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