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# Living Process Smart Home Use Case Implementation and Validation

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*Abstract*— The living process smart home is no longer concentrated on the control of energy usage and home environment automation, but the system must be designed to take care of the interaction of the people living in the smart home. The proposed smart home system will use context to provide a more precise service. The control system is extended to include alert and warning from info-sensors which are information related to the wellbeing of home owners. A central communication mechanism called Living Process Social Engagement Room is used by the member of the family to resolve abnormal events as monitored by the physical sensors and from the alert and warning from the info-sensor. In order to validate this system, a prototype was developed and a number of use-cases were used as the test cases in the experiment and a set of questionnaires are used to obtain the opinion of a sample group that participated in the experiments.

***Keywords - smart home, living process, engagement room, smart home use cases.***

## I. INTRODUCTION

It is a matter of fact as stated in the work by Allameh, E. (2016) that smart home technology is not still widely used used in the housing industry. Those implemented are simple control of appliances and management of energy usage. The advanced smart home concepts are still in the research laboratories and not ready for commercialization. Hence, most people do not really understand the advanced smart home concept.

In general, the introduction of living process with context-aware smart system to build a smart home would affect the way people live inside and outside of their home and shapes a new lifestyle with new types of activities, relations between activities, patterns of time allocations, and use of technology since the family members must always be aware of the engagement room that might have information waiting for the family members to resolve.

Accordingly, we aim to model this new type of smart homes. The model is based on the assumption that the family members prefer to behave in a unified manner in a smart home since even they can have various characteristics, lifestyles, and needs but they need to collaborate to resolve any problem as a family member. The chapter is organized as follows. First, we specify the use cases of the context-aware prototype that are implemented. Next, we organize a seminar to explain the concept of context-aware smart home supporting living processes by providing the family with a centralized mechanism to take care of the house and each other.

So, in designing this experiment, we base our presentation on the use case so most of respondents (samples) can understand the applications and benefits of the living process smart home.

## II. OVERVIEW OF THE LIVING PROCESS SMART HOME ARCHITECTURE

New smart home design based on the context aware processing of living processes was proposed by Charn et. al,., in [2] . The architecture of the Living Process Smart Home (LPSH) is shown in Figure 1 and Figure 2 [2]. For the sensor design, we define a new class of sensor signals derived from the monitoring of information on the internet as specified by the home owner. The info-sensors will provide alert-able-signal and warning for certain activities and events so that the family members can make decision on how to handle the event. A detailed classification of time context is also used to provide multiple level of context interpretations of a time slot. All information will be routed to LPER (Living Process Engagement Room [3]) is shown in Figure 3. so that the family members can make the final decision to take the right actions.

## III. PROTOTYPE AND USE CASES

To carry out the experiment, we create a prototype based on the six use cases to be presented below. The six use cases will be presented to the respondents so that they understand what they will be do or affected when living in a smart home as proposed by this dissertation.

The architecture presented in Section 2 and reported in [2] and [3] is implemented as a prototype with the configuration as follows:

- Environment Sensor: Fire and Motion
- Audio/Visual: CCTV
- On/Off: Air condition
- Physiological sensor: none

Control Array: Turn Off Master Electricity, Turn-on security lighting, Activate siren. The software functions implemented is a subset for proof-of-concept described as use cases as follows.

*A. Abbreviations and Acronyms*

Scenario: Mom plan a trip, on 25 July2019, to Japan boarding the flight from Suvarnabhumi Airport at 11.00 pm. This information is provided to the LPSH system on 21st of July 2019. The LPER system will issue a warning with checklist and weather information to the LPER on 22nd of July 2019, and another warning on 24th of July 2019 with updated weather information and uncompleted items on checklist.

*B. Physical sensor processing*

Scenario: It is a normal working day, nobody is at home, the sound sensor appears to detect. Some unusual noise in the living room. LPSH system then send an alert signal to the LPER. Mom is the first to get the alert, then she activates the CCTV in the living room to take a look.

*C. Info-sensor processing*

Scenario: The info-sensor system is set to track the direction of flooding approaching inner Bangkok, Info-sensor is set to alert for this natural hazard when it reaches Central Plaza, Lad Prow. LPSH will then report to LPER the location of the front of flood every 4 hours.

*D. Combination of Time and Physical sensor*

Scenario: The info-sensor is set to track the burglary in the vicinity of the smart home. The pattern emerges that burglaries happens on the weekend nighttime. On Saturday night at 2.00 am, the motion detection sends a signal to LPER indicating there are possible burglary event in progress. Normally, the all the light in the smart home will be turned on, but the time context that has a fixed-point event in which Mom will have a flight back from Japan arrival at Suvarnabhumi Airport at 12.30 am, and ETA home around 2.15 am. Under this circumstance Mom will see the motion sensor activation signal on engagement room at around 2.00 am while she is 15 minutes away to home. In which case, she will call Dad and consult the move to capture the intruder by deactivating the turning on the light and call 911 to report a crime in progress.

*E. Combination of Time context, Info-sensor and Physical sensor*

Scenario: It is a long weekend; the family take a trip to Amphawa on Saturday and will return on Monday. They set the info-sensor to track their location throughout the trip. Then in the early afternoon, the LPSH detects that the air conditioner in the living room is still on after they left in the morning, now for 5 hours. LPSM's logic has not programmed to reason this event. But the logic about the long weekend stated that for long weekend with family members out of town, report any usual events. Hence, LPSH will send a warning signal to inform that the air conditioner is still on. Then the family has the consensus of turning the air conditioner off.

## IV. VALIDATION

In our experiment, the validation is done by finding a group of respondents who can be exposed to the LPSH prototype and answer several questions. In the case of our experiment, gathering large numbers of participants is quite challenging since the smart home technology is not widely applied in housing industry yet. Consequently, it is almost impossible to obtain useful result with a large sampling size. Hence, we conducted the experiment through a group seminar presentation to ensure that they understand the system. Then a simple questionnaire is handed out to the samples to solicit their opinion.

To simplify the process without losing the validity of the process, The UMT company is chosen since it is a technology company with 120 employees. We select only the persons who are home owner with diverse experience in information technology, engineering, sales and marketing of hi-tech products. There are 40 persons satisfying our requirements. This is our sampling size. From Yamane's sampling size with 95% confidence, 36 respondents will be chosen to answer the questionnaires. The questionnaires are given below.

The six use cases give me a better understanding of the Living Process Smart Homes.

- Strongly agree
- Disagree
- Neutral
- Agree
- Strongly agree

1) The LPER is useful as a tool for family member to be the real stakeholders of the smart home with power to make group decision regarding the safety and well-being of the family.

- Strongly agree
- Disagree
- Neutral
- Agree
- Strongly agree

2) The Living Process Smart Homes with context awareness are useful for future lifestyle.

- Strongly agree
- Disagree
- Neutral
- Agree
- Strongly agree

3) I would like to live in such a smart home.

- Strongly agree
- Disagree
- Neutral
- Agree
- Strongly agree

LPSH-LPER Questionnaires

After the respondents filled in the questionnaires, the results are tabulated as shown below. It is quite obvious that 94% of the respondents understand the operation of the LPSH, and almost all the respondent, 100%, agree with the usefulness of the LPSH, among which more than 94% strongly has the desire to live in a living process smart home with LPER.

TABLE I. The six use cases give me a better understanding of the Living Process Smart Homes.

| Strongly Disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|
| - | - | 2 | 14 | 20 |
| | | 6% | 38% | 56% |

TABLE II. The LPER is useful as a tool for family member to be the real stakeholders of the smart home with power to make group decision regarding the safety and well-being of the family.

| Strongly Disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|
| - | - | - | 2 | 34 |
| | | | 6% | 94% |

TABLE III. The Living Process Smart Homes with context awareness are useful for future lifestyle.

| Strongly Disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|
| - | - | - | - | 36 |
| | | | | 100% |

TABLE IV. I would like to live in such a smart home.

| Strongly Disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|
| - | - | - | 1 | 35 |
| | | | 3% | 97% |

## V. CONCLUSION

The living process smart home context-aware architecture and control system was described in [2]. The architecture uses the Living Process Engaging Room [3] for family members to communicate and capturing of events reported from home so that group decision to handle the unusual event is possible. In this papers, six use cases of the living process smart home system are described, and a prototype of the control system were developed to captures the events as simulated by each of the 6 use cases. The six use cases cover, the time context processing, the physical sensors processing, the info-sensor processing, the combination of time and physical sensors, the combination of time context and info-sensor, and the combination of time context, physical sensor, and info-sensor. Then the system is evaluated by 36 homeowners who are working in the technology area. 97% of the reconsents indicate the desire to live in the Ling Process Smart Home.

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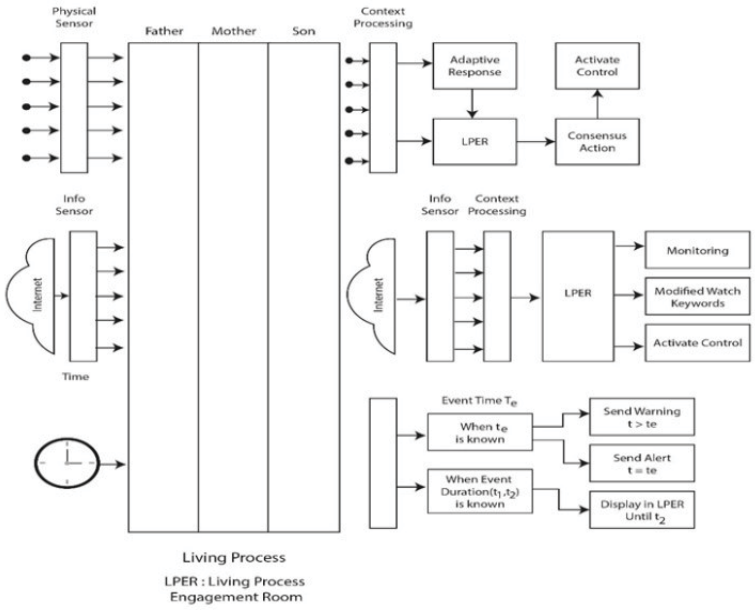


Figure 1. Signal and control structure of
the context-aware living process smart home [2].

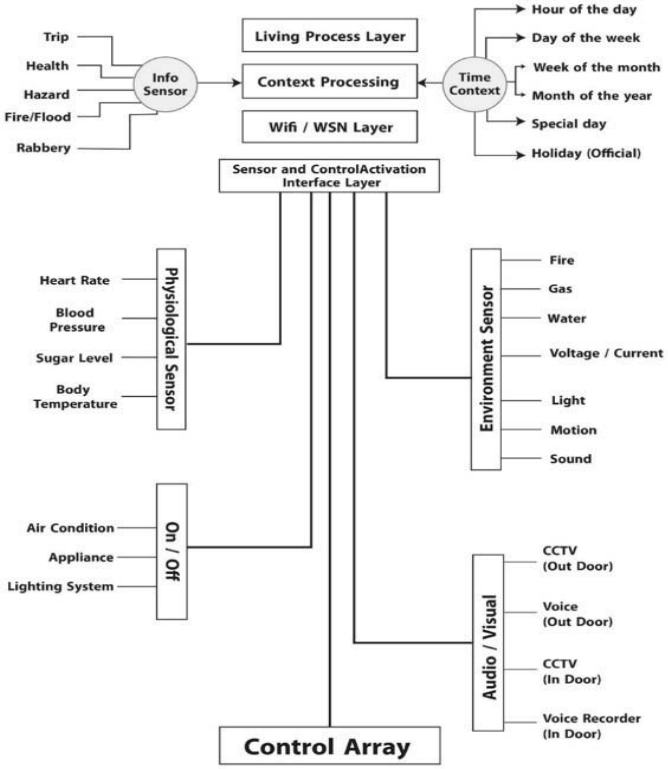


Figure 2. Control architecture of
context-aware living process smart home [2].

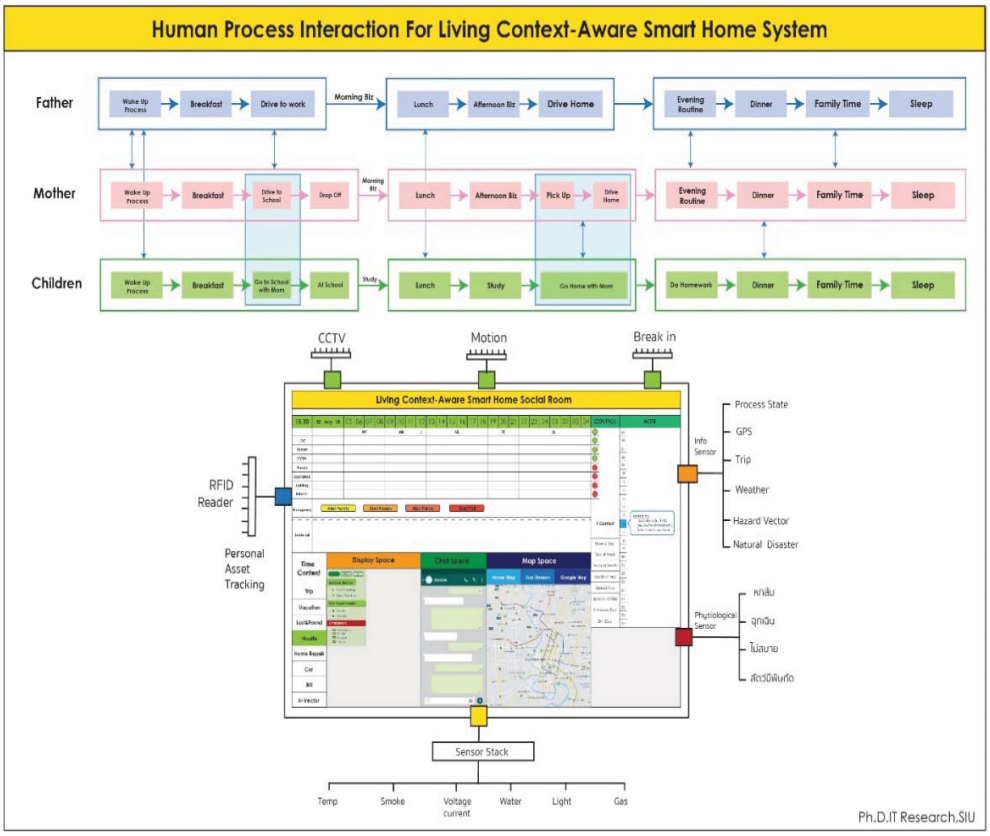


Figure 3. The living process interactions and the smart home physical sensors and info-sensors connected to the Living Process Engagement Room (LPER) [3].