Development of smart house system model based on colored Petri nets

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DEVELOPMENT OF SMART HOUSE SYSTEM MODEL BASED ON COLORED PETRI NETS

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In the article the smart house (SH) structural scheme, the general performance algorithm of the SH system, and the SH system model based on colored Petri nets, which enables exploring dynamics of the whole system as well as internal interaction of its main structural and functional subsystems at the system level design, have been developed.

Key words: smart house, automation, design, system, colored Petri nets.

Introduction

The energy saving issues becomes more and more argent in recent days all over the world [1]. One of the possible partial solution to this problem is a widespread use of the smart house technologies (SH) [2] that enables saving energy consumption up to 30%-40% and even more [1]. Nowadays there are a lot of companies, which offer ready modules for the implementation of this project [2, 3, 4] and there are many design solutions of smart houses and theirs components. Various systems for domestic appliances control via the Internet and mobile phones have been created and implemented [2]. Smart houses design as well as the majority of complex technical systems requires application of the block-hierarchical approach, which includes such hierarchical levels, namely: system level, subsystems and elements levels. For the analysis of smart house systems and subsystems performance models based on Petri theory [4 - 7], which enables integrating different functional components and investigate their joint work, are proposed to be used. The purpose of the research is the development of the SH system model that provides automation of the inner system processes and the relationship of its main subsystems on the system design level.

The main part

To ensure the maximum efficiency and functionality, the smart house system should include the following major subsystems: climate-control subsystem, lighting and domestic appliances subsystem, safety and security subsystems and number of other additional subsystems [2]. In order to ensure an effective synchronization mechanism among the main subsystems and components of the developed SH system as well as with the user, the SH system should also include the remote SH controls, the inner SH control module, the central management module and SH subsystems controllers. Taking into account the above requirements the structural SH system scheme, presented in Fig. 1 has been developed.

The developed structural scheme of the SH system (see fig. 1) includes several major subsystems, namely, climate-control subsystem, lighting and domestic appliances subsystems, safety and security subsystems as well as the monitoring subsystem. Each of the subsystems is responsible for the instant response to the sensors triggering, indicating the change of the corresponding input SH system parameter, with the aim of the further correction of the system in a given area (areas). Data exchange between the major functional components of the SH system is done through the internal network (see fig. 1). The system can operate in three modes – in automatic mode, user mode and in the standby mode.

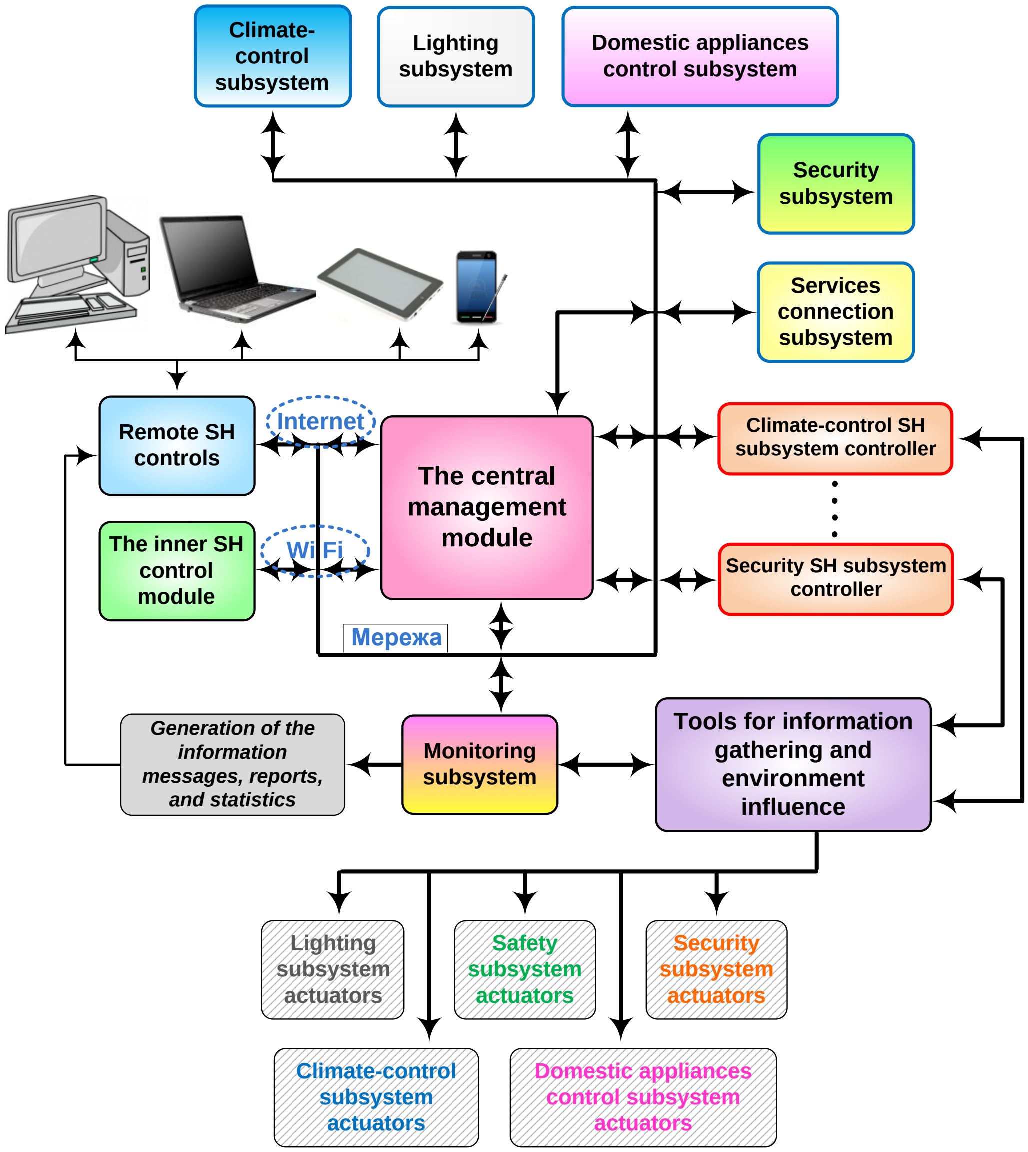

Fig. 1. **Structural scheme of the smart house system**

According to the developed structural scheme (see fig. 1), the general SH system algorithm is the following (see fig. 2). At the very beginning the system goes into the automatic mode. In case of any event (activation of one or more input parameters) the according associative link of the activated input parameters reference to their domain subsystems and launch of such subsystems are set. In the selected automatic mode the neurcontroler is run [8, 9], which activates the mechanism required for the according SH system parameters correction.

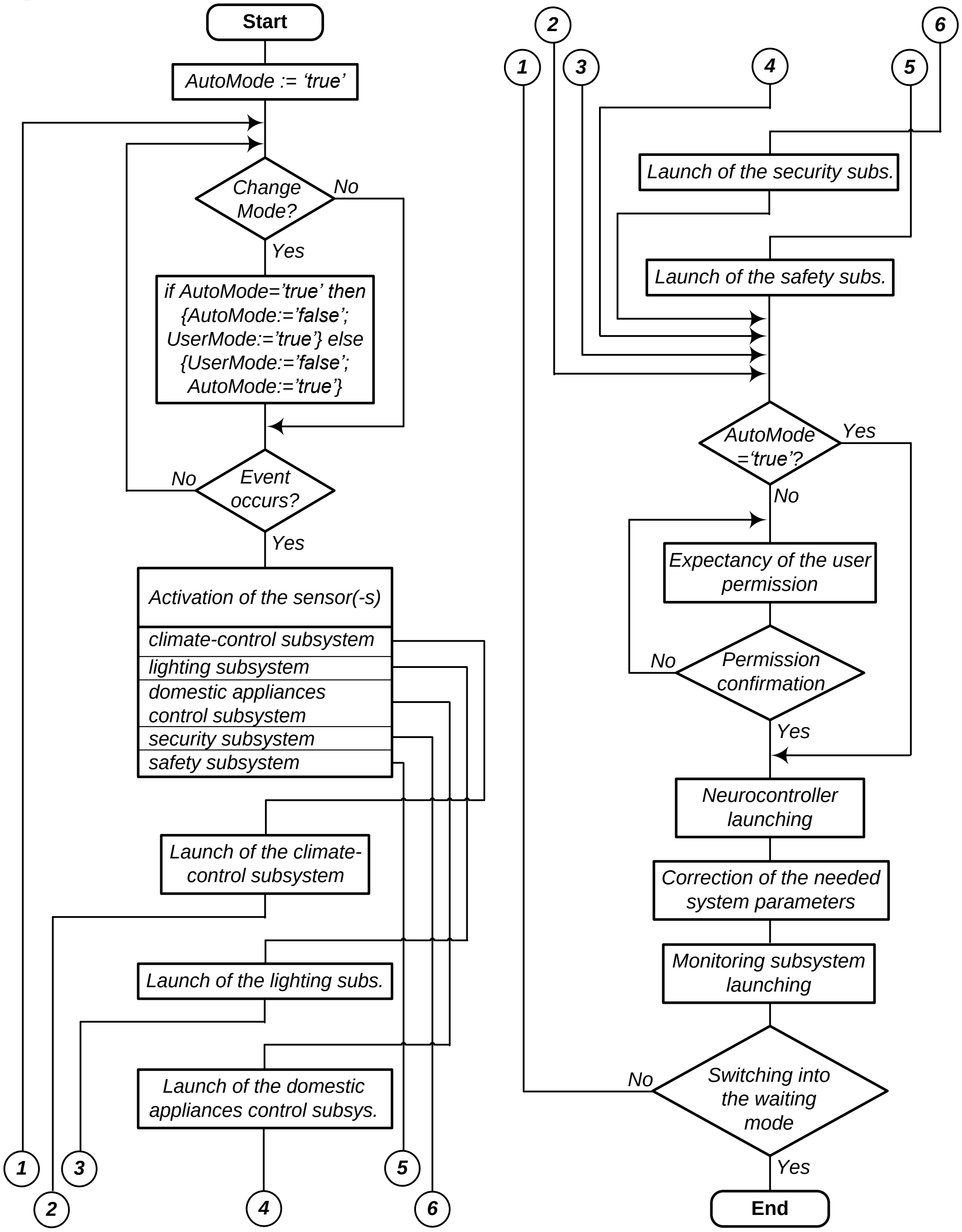

Fig. 2. **The general SH system algorithm**

In the user mode the system generates the appropriate request and pends the user permission confirmation to perform the required SH parameters correction, in case of confirmation the neurcontroller is run. After this the system switches to its start state expecting events, or goes into the standby mode and temporary suspension of the system operation. On the base of the proposed algorithm the SHsystem model based on colored Petri nets [5 - 7], presented below in Fig. 3, has been developed.

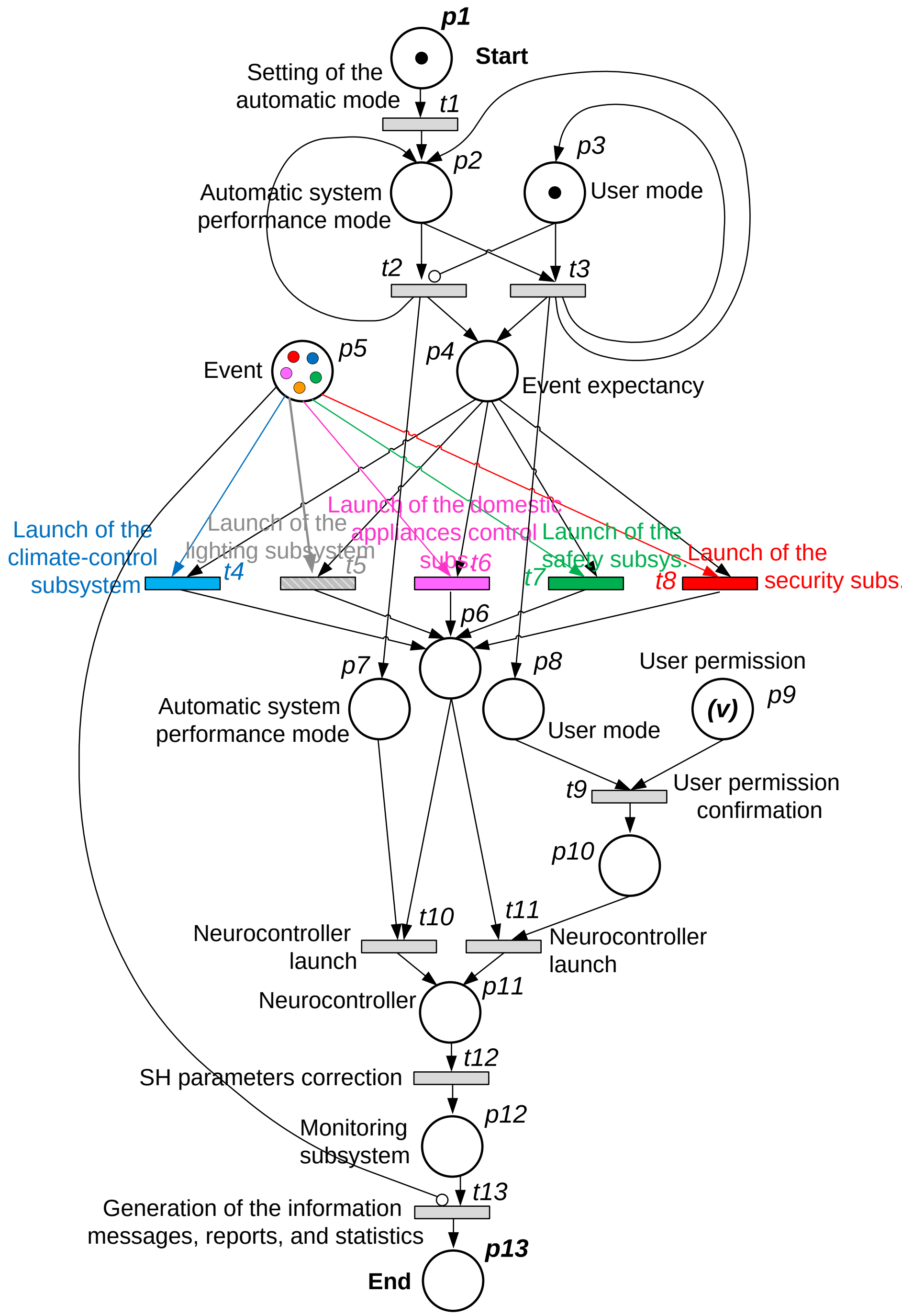

Fig. 3. **The SH system model based on colored Petri nets**

Conclusions

The work presents the structural scheme of the SH system, the general algorithm of the SH system and the SH system model based on colored Petri nets. The developed structural scheme of the SH system includes a number of key structural and functional subsystems that allow implementing automatic correction of the basic SH parameters for the most comfortable inner climate conditions and maximum energy savings, while providing protection against intruders penetration into the SH, as well as against probable property damage caused by emergency man-made situations (leak of the natural gas, water flowing, fire inside the SH premises, etc.) In order to avoid potential conflicts that may arise among the basic functional subsystems, there is a strict priority levels hierarchy in the SH system.

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