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ANALYSIS OF POSSIBLE PROBLEMS OF COMPATIBILITY OF COMPONENTS OF AUTOMATION SYSTEMS

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The creation of comfortable, technologically advanced intelligent and highly adaptive home automation and building automation systems is a multifaceted block of issues that are currently under special emphasis. In this paper, there is a review and analysis of existing automation systems, their relationship with parallel disciplines and proposed development paths. Creation of necessary and sufficient conditions for expanding the points of contact and interaction between a person and a computer. To resolve conflicts without the participation of a person (programs), a context-dependent system is needed, that will accumulate information about the form and content of the environment of its initial data, analyze ongoing conflict situations, as a result of which the environment is corrected, in order to resolve conflicting moments or inform about the impossibility of resolving the existing place of the problem. Within the framework of this article, a conflict taxonomy was carried out, covering various facets of the classification. In addition to the above, a systematization of the automatic approaches to the detection and resolution of conflicts existing in practice was carried out. At the same time, various methods for detecting and resolving conflicts were outlined, which should be implemented in automation systems in practice.

Keywords: highly adaptive systems, home automation, building automation, smart home, compatibility issues, conflict detection and resolution

The new age and the growing need for home automation and building automation systems contribute to their great distribution and mass. This requires efforts to make them usable, smart, easy to understand and able to meet the needs of users. The system must be logically understandable and meet the needs of the user. For comfortable use of this kind of system, it must have an extensive list of qualities, a high degree of adaptation.

Purpose of the study – analysis of possible compatibility problems of automation system components.

Materials and methods of research

Huge, sometimes redundant, functionality, poor Wi-Fi signal or poor-quality cable communications, the human factor are frequent causes of conflict situations during data transmission, exchange, changes in parameters and the functioning of the automation system as a whole.

The main working units of the environment interact with various objects and devices in a space equipped with various sensors and actuators. The automatic control system monitors these devices, pre-processes the environmental information collected by the sensors (sources of information), determining what actions to take, and prompting the leading agents to take appropriate action. Intelligent systems require planned sequential actions [1].

The basis of any automated system is a controller, a network of sensors and executive mechanisms, an actuator. Sensors can extract information from environmental parameters to the power supply of the control system, so, the sources can be: sound, movement, temperature, humidity, lighting, air consumption, energy, fuel and others [2].

Conceptually, the information read by the sensors is continuously aggregated to determine what actions are being taken at a given location at a given point in time, i.e., to determine situations applicable to each object.

Using this information, the intelligent control system coordinates all distributed devices, sending them command to ensure that the space corresponds to a set of predefined and pre-programmed scenarios, thereby based on the preferences and requirements of users [3].

Automatic doors and windows, electrically operated blinds and curtains, fixtures, heating, ventilation and air conditioning systems, multimedia and consumer electronics are examples and can used as actuators.

Conflicts occur when a user or application atypically changes parameters that cause an undesirable context. Context is an identified (named) point of view created within the information model and reflecting the features of the task being solved [1]. Usually, the system reacts to changes based on a set of previous, well-defined rules. Context detection refers to the collection and analysis of data from sensors, the identification of patterns of indicators from previous user actions and mathematical predictions.

In the event of a conflict situation, such as when two users simultaneously change the room temperature settings in a home automation system, the expected conditions conflict because two lighting scenarios cannot occur at the same time. The system has several possible actions:

- maintenance of the previous state;
- alignment to an intermediate value;
- informing about the failure to resolve the conflict.

The situation described, namely a conflict of preferences, is a very typical case of conflict. A topic aimed at conflict resolution must deal with the notion of user ownership and priority in order to adjust behavior accordingly.

In the field of home automation and building automation, there are three main ideas about the further development of these systems:

- evolution through user applications, i.e. so that intelligent systems evolve through the development of human-computer interactions, as well as increasing the capabilities of users of a portable system;
- evolution through user understanding;
- evolution through increased intelligence systems, through better profiling, machine learning and more efficient situation detection and communication, which minimizes interaction.

There are three main stages on the way to a conditional level of user orientation:

- context-sensitive shutdown of systems capable of receiving relatively accurate text input data;
- the ability to derive valuable information from the received contextual data;
- in fact, proven expected social value for users.

Definition of the situation, conflict

When applications interact in an intelligent environment, it also creates a space for conflicts. There are many types of conflicts, and systems must be able to resolve them on behalf of users or otherwise recognize their own limitations.

In multi-user scenarios, contextualization becomes even more difficult, raising questions about how to distinguish each user's preferences, how to resolve conflicts between different user preferences, and others.

When automation systems are synthesizing, some difficulties may arise during the switching of components. Let's take a look at some of them.

Incompatibility of systems

Buying incompatible components based on different standards of the "smart home" is another very common reason for the incorrect operation of the system. Assembled together parts from one set, a part of the components from another system combined with it are likely to lead to errors in the sensor-hub-actuator chain. A smart home has many different platforms that may not respond to each other.

In the process of choosing the right system for you, pay attention to the most efficient wireless technologies – Z-Wave, Zigbee, Thread, Bluetooth Low Energy and, directly, Wi-Fi.

When designing a system, it is important to purchase controllers, sensors and actuators of the same standard. It is equally important to pay attention to the compatibility of devices from different manufacturers.

One of the best technologies is the Z-Wave protocol, more than 700 manufacturers from different countries use it, and this is several thousand positions that are mutually compatible with all smart home devices. For friendly communication of Z-Wave products, there is a special service – Z-Wave Alliance. One of the variants of incompatibility is the incompatibility of devices connected to the system via radio frequency. The operating frequencies of devices and gadgets may differ even when working within a single standard. This may depend on the country of manufacture or manufacturer.

Today, in Russia, the Z-Wave protocol operates at a dedicated frequency of 869 MHz, while in China – 868.42 MHz. The second most common Zigbee protocol in most civilized countries operates in the frequency range of 2.4 GHz. Although, some Zigbee devices in China use a frequency of 784 MHz, in the US and EU countries 868 MHz and 915 MHz, respectively. Such a difference in the frequency range within which the protocol is supported can lead to incorrect operation of devices.

Therefore, for example, an imported sensor purchased from an online store may refuse to connect to your main computer or activator. The "brain" of the system simply does not recognize it [4].

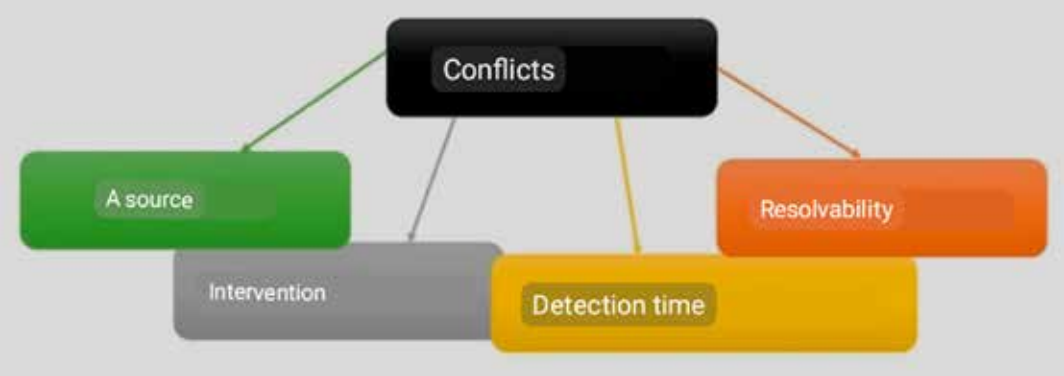
Excess equipment

Excessive equipment, that is, an overabundance of excess components, affects the efficiency of work and the spent budget of the project. To avoid buying unnecessary components, should be remembered that the basic automation of processes requires one main controller, a pair of sensors and actuators. If you have such a starter kit, you can create the necessary scripts to manage, for example, home processes.

Contextual Awareness

In a conventional system, users can interact directly over the radio. However, there are other ways to manage the system.

Essentially, the concept of a smart or intelligent environment, detection and conflict resolution in home automation and building automation systems has to do with the ability of a system to autonomously act to request and apply knowledge about the environment, as well as to adapt to its inhabitants.



Types of conflicts by measurement

These preferences depend on aspects such as needs, mood, goals, and motives. This kind of information is impermanent and subjective, and each act can affect the environment of the system, thereby affecting the context. This creates several problems when it comes to contextual output.

Thus, there are two main causes of inadequate system behavior based on context:

- the system draws a conclusion and acts in accordance with the erroneously accepted context;
- the system does not detect context and does not take action.

Users can provide information with or without direct control of input devices. Interaction through manipulation of the device can divided depending on the type of information provided:

- text, through physical or virtual keyboards;
- spatial information through pointing devices, such as mice, trackers and others;
- audio, through microphones, telephones, MIDI keyboards or other digital musical instruments;
- images and videos using digital cameras, scanners and other imaging equipment.

The smart environment itself has a set of applications that have their own goals, such as saving energy by providing a path to increased conflict.

Conflicts are classified into four different dimensions: source, intervention, detection time, resolvability, as shown in Figure 1[5].

Regarding the source, there may be a conflict when multiple users use a given resource, for example, one user prefers light at full power to the ability to read and another user prefers them at half power to watch TV.

Conflict can be detected through the system context, depending on the possibility of awareness, or through feedback from the user. In the latter case, conflict is detected when the possibility of reasonable resolution has passed, most likely due to limitations of contextual awareness or delays in time and perception.

Finally, conflicts can be distinguished by their resolution, where detection occurs before it occurs and the conflict is resolved before it actually occurs. Or the conflict is detected at the time of its actual occurrence, otherwise, the system may admit its inability to resolve it.

Another possibility is that the system, by not detecting a conflict quickly enough to resolve it, for example, due to a delay in sensor information, can inform users or system administrators of the conflict situation.

Thus, conflicts can be different, they require different detection and resolution mechanisms.

To resolve conflicts without human participation (programs), a context-dependent system is needed that will accumulate information about the form and content of the environment of its initial data, analyze the ongoing conflict situations, as a result of which the environment is corrected in order to resolve conflicting moments or inform about the impossibility of solving the existing problems. In other words, the goal of automatic conflict resolution is achieved through the development of a number of actions aimed at achieving consistent new actions performed by actuators. The automatic mode of adaptation also has a considerable number of unresolved issues, including such as the use of effective mechanisms for detecting and resolving conflicts, automatically adaptive to all kinds of scenarios, with corresponding solutions. The decision is made as a result of the analysis of information coming from the sensors and the application of gradation and machine processing methods for this data. In the case when the user or application adjusts the state of the environment, then as a result, a conflict arises, which in turn generates a problem situation. Conflict detection is based on the resulting findings.

Conclusion

Within the framework of this article, a conflict taxonomy was conducted, covering various facets of classification. In addition to the above, the existing in practice automatic approaches to the detection and resolution of conflicts were systematized.

The creation of comfortable, technologically advanced intelligent and highly adaptive home automation and building automation systems is a multifaceted set of issues that are currently under special emphasis. Increased intelligence, thanks to better profiling, machine learning, and more efficient situation and communication detection, which minimizes interaction.

Creating the necessary and sufficient conditions for expanding the points of contact and interaction of a person with a computer is one of the most urgent tasks of our time.

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