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## MODERN TEHNOLOGIES AND THEIR APPLICATION IN "SMART HOUSES"

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### Abstract

The rapid development of information and communication technologies in the 21st century and their widespread increasingly affect people's daily lives. We are living in an era of application of artificial intelligence in most aspects of human life. Smart phones have long since become our indispensable everyday companion that helps us in the realization of numerous activities. We notice that smart systems have become an imperative of modern life. Surveillance cameras, door opening sensors, smart home appliances, are only part of the smart systems that are increasingly entering households. Recently, the terms "smart house", "smart building" and "smart city" have started to appear.

In an effort to gain insight into the interest of our fellow citizens in using smart devices in their household, we conducted a survey of a group of citizens. In the questionnaire, six questions were asked with the offered answers, which are correlated with the offer of smart devices on the domestic market. With the questions asked in the questionnaire along with the answers provided, we identified the needs and interests of the surveyed group of citizens in improving the comfort of living with the help of smart devices. The answers received were statistically processed. Based on the calculated statistical indicators, we analyzed the obtained statistical data and drew a conclusion about the amount of smart devices used in households, the interest of citizens in their use, as well as the reasons why they have not used them so far.

**Keywords:** *modern technologies, smart devices, smart house.*

### Introduction

Smart technologies are increasingly being used in many spheres of human life. Information and communication technologies embedded in consumer devices such as phones and smart home devices improve functionality, connectivity and manageability. Designers of energy devices and developers of technological innovations strive to extend smartness beyond smart

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devices to the smart home as a whole [1]. The essence of a smart home is to communicate information to users and feedback on user commands to manage the home environment.

Smart home technology provides users the numerous benefits such as home temperature monitoring, automatic light control, smoke detection, smart locks and more. In the modern period, smart homes have become a central topic in discussions about energy efficiency, climate change, sustainability of buildings, technology and politics. Along with the development of smart technology, there was the development of scientific and technological research on smart houses, as well as the improvement of applied knowledge in this area. Research has been conducted on the key challenges for the use of smart homes and their users [2]. Since the beginning of the implementation of smart devices, one of the key reasons for the disinterest of customers has been their high price. For this reason, research has been carried out on smart home automation [3] using smart devices and their implementation at a low cost. Research was also conducted on the amount of support that a smart home provides to its users, its further improvement, but also the security challenge. The authors of the paper [4] performed an extensive analysis of data collected in the United Kingdom, including expert interviews, visits to smart device stores and a comprehensive literature review, and provided a critical review of the benefits and risks of using smart home technology. They listed 13 different benefits that smart homes can offer and 17 potential risks and obstacles. In the paper [5], research was carried out on potential barriers to the adoption of smart home services. The authors of this paper cite financial risk, performance risk, privacy risk and psychological risk as identified obstacles that consumers express when familiarizing themselves with smart home services. The research also showed that these 4 types of risks are influenced by technological uncertainty and service intangibility. Analyzing the motivation, obstacles and risks of adopting the smart home concept, the authors of the paper [6] came to the conclusion that the primary motivations for adopting smart home technology services include efficient energy management, better home health services, potential financial savings and improved quality of life. The main obstacles to smart home adoption are limited perception of smart home, mistrust, concerns about financial issues, concerns about privacy and security. Recorded the main risks include threats to privacy and security, wasteful energy consumption, difficulties in adopting smart home technology and destructiveness of domestic life.

Proponents of the use of smart homes claim that in the coming period, technology will be oriented towards human-centered models in which interaction with devices will take place through implemented interfaces. The house will consist of networks of larger infrastructures that together with other smart buildings, services and transportation will form smart cities [7]. The key technology enabling smart homes is IoT (Internet of Things). The Internet of Things is a technology in which interconnected computer devices and sensors send data via the Internet with the aim of deciphering various problems and providing adequate services [8, 9]. However, this opens the door to the issue of security and privacy as it is possible to access users' private data, for example by taking control of surveillance devices or otherwise. Various possibilities of security attacks make smart homes weak and not acceptable for a large number of residents. The authors of the paper [10] were engaged in researching the security of smart homes, challenges, problems and solutions. A particularly interesting analysis of the application of IoT in smart homes, with reference to the prices of some smart devices that can be purchased online, is presented in the paper [11].



In recent years, the concept of a smart city with high-quality facilities has emerged that offer improvements in the daily life of citizens in the areas of health care, transportation, energy consumption and education. This concept is still being developed due to major security challenges. One of the proposals for solving the security issues of smart cities is presented in the paper [12]. Energy management at the city level is still a challenge due to the different types of buildings and complex infrastructure. Smart city researchers have been researching smart energy saving systems from smart houses to sustainable smart cities. The results of the research on obstacles to the advancement of smart houses towards sustainable smart cities show that it is necessary to build the infrastructure of advanced energy conservation systems and adopt a new strategy for energy trading in distributed energy systems [13].

### **Smart house as a phenomenon of modern life**

A smart house is a house or apartment in which all or most technical devices are controlled using modern technologies. In a smart house, automated control of heating, lighting, water supply, air conditioning, operation of various electrical devices, video surveillance, alarms is carried out. In order to achieve smart home control, it is necessary to install a large amount of equipment in the house. Experts for installing the necessary equipment will offer the buyer a sketch of a smart home that contains a detailed list of smart devices and equipment. It is not necessary to use all the equipment offered. The buyer will approve the part of the list in which he is interested. Then the preparation of the smart house project is started. In the preparation of the project, the participation of the architect and designer is desirable so that the installed equipment fits harmoniously into the interior and decorates the interior of the house. After the completion of the project, assembly work begins with the programmers who configure the technology necessary for the smart home system. The prices for installing smart home components are different. They depend on the technology used, on the planned level of automation and on the entire planned smart home system. The authors of the paper [11] compared the prices of some smart devices that can be purchased online in Bosnia and Herzegovina and other countries in the world. They stated that the prices of one group of devices in Bosnia and Herzegovina are a little more expensive, while the prices of individual devices are ten times more expensive than the prices on the world market.

It is not necessary to hire special experts for smart homes to install simpler home automation systems. With certain technical training, householders can install them independently.

With the aim of identifying the need for automating household processes and improving living comfort using smart devices and smart home systems, we conducted research among citizens in Novi Sad and Belgrade. The results of the research are presented in the next section.

### **Research methodology**

The methodology of the conducted research included data collection through surveys, statistical processing of the obtained data and interpretation of the results.

In order to conduct the research effectively, we chose Google Questionnaire as the platform for conducting the survey. This platform allows easy creation and distribution of surveys as well as analysis of the obtained results. The survey was anonymous. Respondents received



their questionnaire in online form, which eliminated the potential influence on the answers. The survey covered a total of 140 households in Novi Sad and Belgrade. In each household, only one member was interviewed who, as a representative of the household, presented the attitudes and opinions of his family.

The questionnaire is made up of 6 questions with the provided answers and the possibility to fill in an additional answer in the first three questions. The answers to the first two questions allowed us to determine the smart devices that are in use in households and that respondents consider useful. The third question showed us the reasons for not using smart devices in the house. The fourth and fifth questions showed which manufacturers and installers of smart devices are trusted by customers, while the sixth question answered the respondents' interest in personal space automation.

### **Results and analysis**

The first three questions in the questionnaire allowed the respondents to mark several offered answers, as well as to enter an additional answer that was not listed in the offered list of answers.

The first question in the questionnaire is: "Which smart home devices do you have at home?".

The following answers were offered:

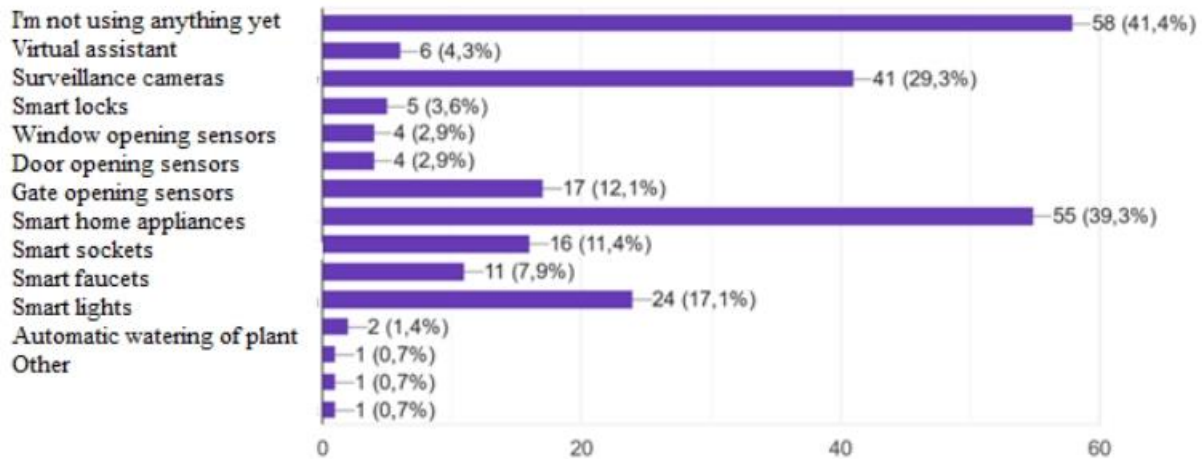
- I'm not using anything yet
- Virtual assistant
- Surveillance cameras
- Smart locks
- Window opening sensors
- Door opening sensors
- Gate opening sensors
- Smart home appliances
- Smart sockets
- Smart faucets
- Smart lights
- Automatic watering of plants

Other \_\_\_\_\_

The following results were obtained:



140 answers

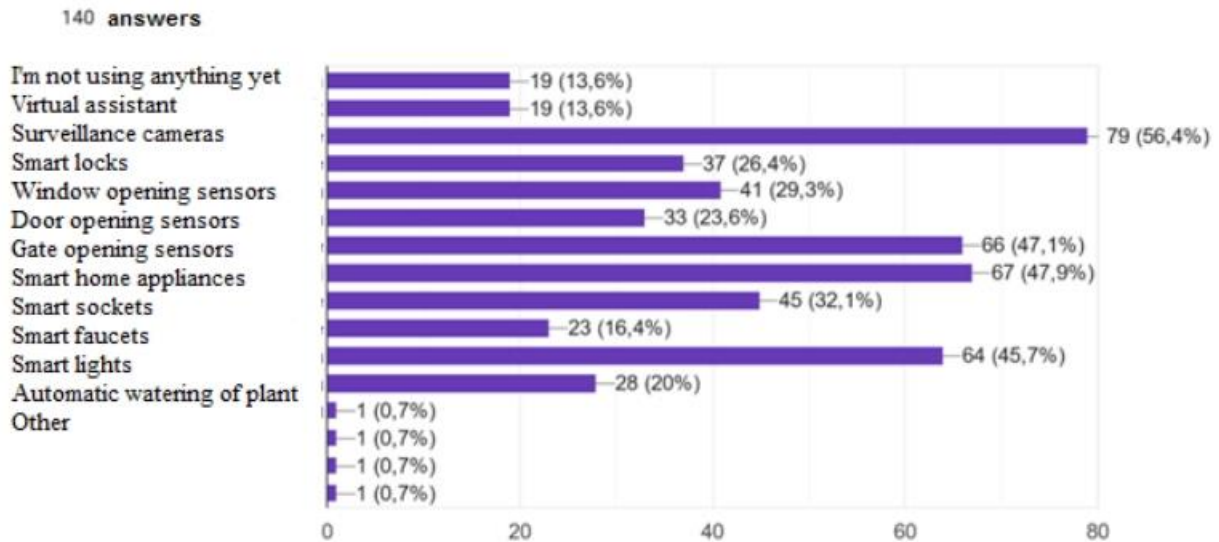


To the first question, the largest number of respondents answered that they do not yet use any smart home devices, as much as 41.4%. Social status, social norms and some other dominant factors probably dictate this type of result, or no longer being informed about the field of possibilities of smart home devices. Considering that this does not amount to half of the answers, it is important to emphasize that the second place is the choice of answers for smart home appliances. That answer received 55 votes, which is 39.3% of the total number of respondents. In third place are surveillance cameras (29.3%), followed by smart lights (17.1%), sensors for opening the gate (12.1%), smart sockets (11.4%). Other answers were recorded in a much smaller number. In addition to the answers provided, respondents entered smart fuses, smart TVs, smart phones, water heater thermometers with hygrometers, and smart vacuum cleaners.

For the second question: "Which smart devices do you find useful (from those available or those you would like to have)?" the answers were offered:

- I'm not using anything yet
- Virtual assistant
- Surveillance cameras
- Smart locks
- Window opening sensors
- Door opening sensors
- Gate opening sensors
- Smart home appliances
- Smart sockets
- Smart faucets
- Smart lights
- Automatic watering of plants
- Other \_\_\_\_\_

The following results were obtained:



It can be seen that surveillance cameras are considered the most useful, followed by smart home appliances, gate opening sensors, and smart lights. As with the previous question, the number of responses in the other field is negligible, probably due to respondents' lack of familiarity with all types of smart devices. Almost all the answers received 20 or more marks, so we can conclude that in this case the response was more significant than in the first question. There are 10 answers on the relationship between surveillance cameras and automatic watering of plants, which were recorded by a large number of respondents, in percentages from 16.4% to 56.4%.

The third question in the questionnaire is: "What reasons prevent you from using such devices?". The following answers were offered:

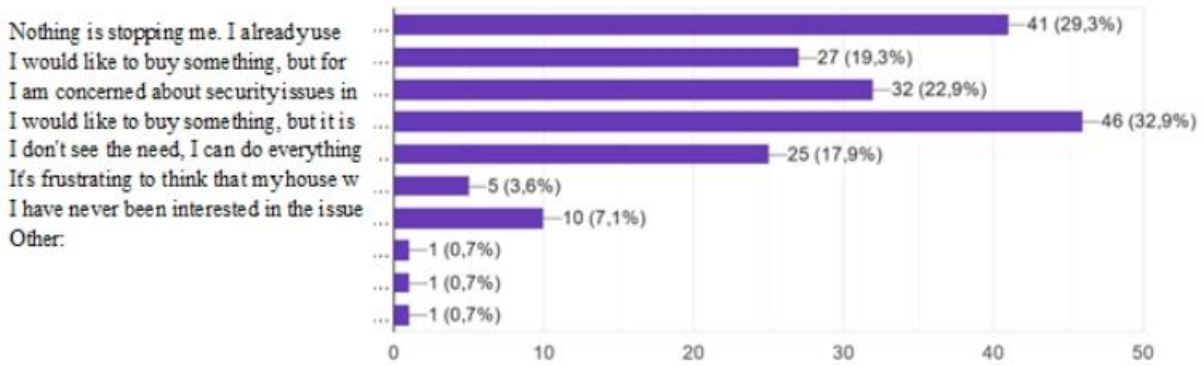
- Nothing is stopping me. I already use smart home devices
- I would like to buy something, but for now I have little information on this topic
- I am concerned about security issues in the use of smart devices
- I would like to buy something, but it is financially unavailable for now
- I don't see the need, I can do everything myself in my house
- It's frustrating to think that my house will be managed by a robot and not me
- I have never been interested in the issue of smart devices

Other: \_\_\_\_\_

The following results were obtained:



140 answers



The third question did not give many possibilities for additional answers. Apparently, the answers offered covered almost all the reasons for preventing the use of smart devices. The most common reason for not using smart devices in this group of respondents is financial (32.9%). This is followed by the question of the safety of using smart devices (22.9%) and insufficient information (19.3%). A significant number of respondents stated that they do not see the need for smart devices in the home (17.9%) and that they were never interested in the issue of smart devices (7.1%). It is interesting to note that a small number of respondents (3.6%) answered that it is frustrating to think that their house will be managed by a robot.

The next three questions in the questionnaire did not allow filling in the list of offered answers, but respondents could choose only one of the offered answers.

The fourth question in the questionnaire is: "Which manufacturer's devices would you use in your apartment (house)?"

The following answers were offered:

- Only well-known, proven manufacturers regardless of price
- Devices in online stores, in known markets and based on feedback
- I would not trust anyone regarding the safety of my apartment (house)

The following responses were received:

140 answers



The largest number of respondents (55%) trust only well-known and proven manufacturers. We can connect the answers to the third and fourth questions through a financial connection. A large number of respondents (32.9%) stated that financially they cannot fulfill their wishes in the direction of smart devices, and it is known that the prices of well-known and verified manufacturers are significantly higher than the prices of other manufacturers with the



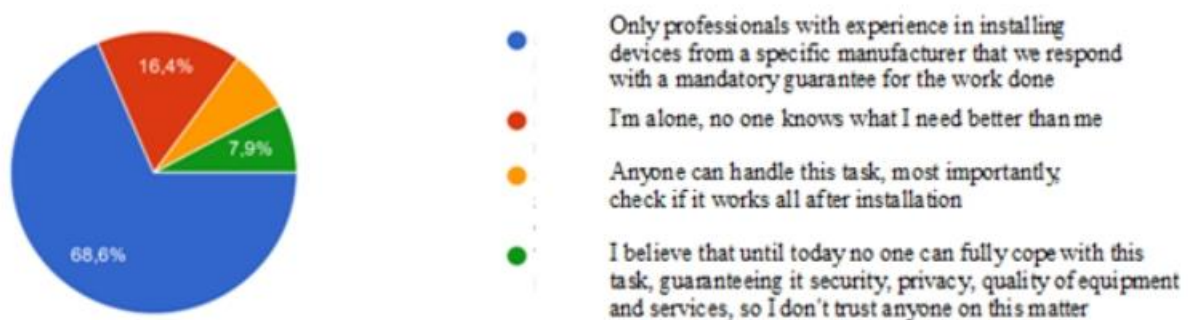
assumption of lower quality. A little more than a third of the respondents (34.3%) would use devices from manufacturers in known markets in online stores and based on feedback, while 10.7% of respondents would not trust any of the manufacturers of smart devices.

For the fifth question in the questionnaire: "Who do you trust (or would you trust) in realizing the idea of a smart house for your home?" the following answers were offered:

- Only professionals with experience in installing devices from a specific manufacturer that we respond with a mandatory guarantee for the work done
- I'm alone, no one knows what I need better than me
- Anyone can handle this task, most importantly, check if it works all after installation
- I believe that until today no one can fully cope with this task, guaranteeing it security, privacy, quality of equipment and services, so I don't trust anyone on this matter

Respondents' answers are shown in the following graph:

**140 answers**



The largest number of respondents, 68.6%, trust only professionals with experience. The answer "I am my own master" is in second place with 16.4% representation. Then follows the answer that there is nothing in today's time that is safe enough (7.9%) and with the lowest percentage of representation (7.1%) is the answer where it is claimed that everyone can independently realize the idea of a smart home.

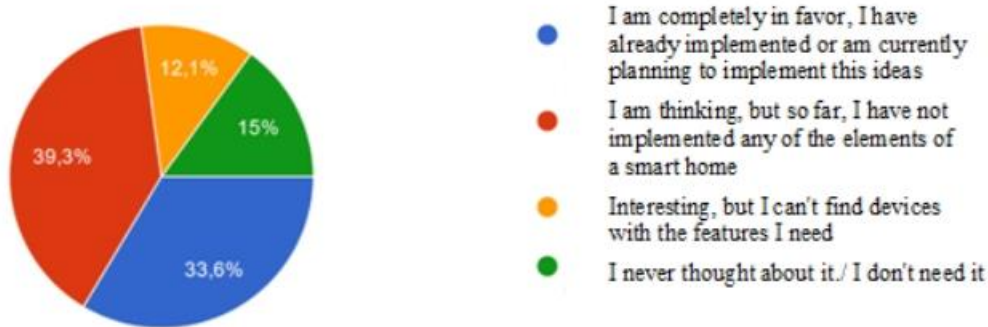
The last, sixth question in the questionnaire was "How do you feel about the idea of furnishing your home with a smart home system?". The following answers were offered:

- I am completely in favor, I have already implemented or am currently planning to implement this ideas
- I am thinking, but so far, I have not implemented any of the elements of a smart home
- Interesting, but I can't find devices with the features I need
- I never thought about it./ I don't need it

On this question, the following results were obtained:



140 answers



The largest number of respondents (39.3%) are considering but have not yet implemented any of the elements of a smart home. About a third of respondents (33.6%) have already implemented or are in the process of implementing the idea of a smart home. A total of 21 respondents (or 15%) have so far not thought about the idea of a smart home or are of the opinion that it is not necessary. The remaining respondents (12.1%) are of the opinion that the idea of a smart home is interesting, but they do not find devices with the functions that their households need.

### Conclusion

Based on the answers received in the conducted survey, we can conclude that the majority of surveyed citizens do not use any of the smart home devices. Among citizens who use them, the largest number use smart home appliances, surveillance cameras and smart lights. We can also conclude that the surveyed citizens consider most of the offered devices to be useful, with surveillance cameras in first place, followed by smart home appliances, gate opening sensors and smart lights.

As a reason for not using smart home devices, the majority of surveyed citizens cite a financial reason. Then comes the issue of security, lack of information and the feeling of no less need for such devices.

When buying smart devices, most surveyed citizens would trust only well-known, proven manufacturers, regardless of the price of the device. When realizing the idea of a smart home, the majority of citizens would trust only professionals with experience in installing devices from the selected manufacturer with a mandatory guarantee for the work done.

Based on a sample of 140 respondents, it is not realistic to draw a general conclusion about the disposition of our citizens to realize the idea of a smart home. In order to obtain more reliable indicators, we plan to expand the research by introducing additional survey questions and increasing the sample.

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