

**ROMAN D.**

**SMART HOUSE SYSTEMS**

**Thesis**

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| <b>Name of thesis</b><br>Smart House Systems                                                                                                                                                                                                                                                                                                                                                                                                     |                               |                                   |
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| <b>Supervisor</b><br>Hannu Puomio                                                                                                                                                                                                                                                                                                                                                                                                                |                               |                                   |
| <p>I have been thinking for long time about topic for my thesis project, and decided that “Smart Houses” would be a perfect one. This technology is new and rapidly developing, in addition it is very useful system for humans. It provides new level of security and safety, performs a number of everyday tasks and makes life easier. In my thesis, I outlined the most important, useful and interesting features of Smart-Home system.</p> |                               |                                   |

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## 1 INTRODUCTION

In my thesis project, I will show you and explain what is a new smart house system, how it works, positive and negative sides of usage, why it is becoming more popular nowadays. In addition, I am going to tell about few economical aspects.

Any building - an administrative, industrial or residential building consists of several subsystems responsible for the performance of certain functions. All these functions are installing with customer's needs. The costs of maintaining staff, repairs and maintenance of these subsystems are also growing rapidly. These problems arose during the operation of large administrative and industrial complexes.

A modern building of this type is a miniature city. In fact, it operates all the services that were previously indispensable conditions of urban economy. In such buildings, usually an administrative service or administrator use this system almost around the clock. Automation, ventilation, climate control, lighting, fire alarms, control of entry / exit, however the management and maintenance of all these systems requires the presence of administrative personnel. His responsibility is to monitor the operation of this subsystem. There are even situations where the actions of qualified personnel can be ineffective, such as global problems - fire, earthquake and other natural disasters. The reaction and adjustment of the actions of people in a critical situation may be insufficient.

Traditional systems of providing various aspects of life in the past were designed as automotive. Such systems were created separately for each function. The systems were created and installed only with possibilities and intelligence that were necessary at the current time of construction the building. Further expansion and modernization of these systems were due to various factors. These factors are costs of operating such systems separately, costs of training personnel, also costs of training personnel are as high as operators should be familiar with the operation of each autonomous system.

## 2 SMART HOUSES

### 2.1 History and definition

The Intellectual Building Institute in Washington formulated the concept of “smart home” in the 1970s: a building that provides a productive and efficient use of the workspace. The principle of the “Building Intelligent Building Management System” presupposes a completely new approach to organizing the life support of a building. With this organization due to the complex of software and hardware, the operating efficiency and reliability of management of all systems and executive devices of the building are significantly increased.

A “smart home” should be understood as a system that must be able to recognize specific situations occurring in a building and react accordingly to them: one of the systems can control the behavior of others according to previously developed algorithms. The main feature of an intelligent building is the combination of individual subsystems into a single managed complex. An important feature and property of “Smart Home” that distinguishes it from other ways of organizing living space is that it is the most progressive concept of human interaction with living space, when a person sets the desired environment with one team, and automation sets and in accordance with external and internal conditions and monitors the operation modes of all engineering systems and electrical appliances.

In this case, it eliminates the need to use several remotes when watching TV, many of switches, which control lighting, different units when controlling ventilation and heating systems, video surveillance and alarm systems, gates and more. In a house equipped with the Smart Home system, it is enough to select one of the scenarios with one click on the wall key (or remote control, touch panel, etc.). The house itself will adjust the operation of all systems in accordance with one’s wishes, time of day, owner’s position in the house, the weather, ambient light, etc., to ensure a comfortable state inside the house.

Internet website (BBC research April 11, 2018).

## 2.2 Concept of work

“Smart House” is another name of the term “intelligent building”. In this approach, intelligence means the ability to recognize certain situations and respond to them (naturally, the degree of this skill can be different, including very high). However, in accordance with a literal translation from English, “intelligent building” can be interpreted as “reasonably constructed”. This means that the building should be designed so that all services could be integrated with each other with minimal costs (in terms of finances, time and labor), and their maintenance would be organized in an optimal way.

The concept of an intelligent building contains the following provisions:

1. Creating an integrated building management system - a system with the ability to ensure the integrated operation of all engineering systems of a building: lighting, heating, ventilation, air conditioning, water supply, access control and many others.
2. Elimination of all building attendants and transfer of control and decision-making functions to subsystems of the integrated building management system. These “subsystems” are precisely the “intelligence” of the building - the way it will respond to changes in the parameters of the system’s sensors and other events such as emergencies.
3. Implementation of the mechanism of an immediate shutdown and transmission, if necessary, to control a person of any subsystem of an intelligent building. Along with this, a person should be provided with quick access to the management and display of all subsystems and parts of the “Smart House”.
4. Ensuring the correct operation of individual subsystems in the event of a failure of the common control system or other parts of the system.
5. Minimization of the cost of maintenance and modernization of building systems, which should be ensured by the application of common standards in the construction of subsystems, automatic configuration and detection of new devices and modules when they are added to the system.
6. The presence in the building of a laid communication environment for connecting devices and system modules to it. Along with this, the possibility of using various types of physical channels as a communication medium in the control system: low-current lines, power lines, and a radio channel.

### 3 SMART HOUSES STRUCTURE

#### 3.1 Smart house capabilities

Intelligent building has many advantages. The management system allows owners to create arbitrarily complex and intelligent operating procedures, as all executive systems can work in concert and jointly. This implies the implementation of many resource-saving procedures:

- Access control and security
- Accounting and control of almost all system parameters and prompt response to their critical change.
- Remote control and building management, as all information and control communication channels in such a system are digital.

With one touch, owner can turn an empty house into a home, which is waiting for him to come back: the lighting will be turned on, a comfortable microclimate will be installed, curtains will drop, and the bathtub will fill. Customer can control the "home theater", as well as audio and video equipment using touch panels among the house. In addition, it is possible to create light scenarios from an unlimited number of light sources with different brightness.

Using special dimmers, operator cannot only change the brightness by which the lamp lights up when turned on, but also the time during which this brightness is reached. The function of constant monitoring of illumination, intended mainly for office premises, makes it possible to maintain a given illumination of the work surface whether the sun is shining or the sky is covered with clouds. The automatic inclusion of an external warning, depending on the time of day and the presence of people, will not only provide additional comfort, but also scare away uninvited guests. The system constantly measures the temperature individually in each room and maintains it at a given level, directly controlling the radiator valves or air conditioner dampers, and if necessary, automatically turns the ventilation on or off.

Each day helps to save money due to various modes of the system: comfortable mode, night mode, the mode of "no one in the house." In addition, operator can schedule different modes. It is enough only once to set the temperature on the touch panel display in the room for each of the modes. The heating / air conditioning system will turn off automatically to save energy if

the windows of the room are open for ventilation (a signal will send a frame contact). In summer, their lamellas automatically rotate at a certain angle and prevent excessive sunlight from entering the room without decreasing the luminous flux. Thus, they interfere with the heating of the room and help save energy consumed by the air conditioner.

A smart house will report to all the events that took place in it during the absence of the owners: who came and when, how much time was inside the house, outside cameras would inform about outside safety. Their faces and actions are recorded in SH memory. Uninvited guests are waiting for unpleasant surprises in the form of blinding light and a sound siren. In addition, owners and police will be informed by telephone if someone entry into the house illegally.

By installing a visualization program on your home computer and using a modem, owner can turn off the light left by someone from a laptop computer and let guests suddenly popping into the house. It provides reliable communication even when there is no computer at hand: download and install special app inside your phone. Enter the home control zone through tone dialing. Each device in the system has its own serial number. By calling it, various commands could be used: turn on the heating, warm up the sauna, fill the bath.

Fedorov. 1999. "How many floors does an intelligent building have?" - "Business: Organization, Strategy, Systems", No. 10.

### **3.2 Smart house technologies**

Smart Home projects have many different functions covering all areas of everyday life. Any "smart" house is characterized by the presence of a building automation system. This is a set of software for equipment management - monitoring, optimization and administration. The goal of building automation is the efficient and safe maintenance of all appliances in a residential building or other structure. Management is carried out using a system that is triggered when the conditions specified by the program occur.

Building automation is made possible thanks to modern devices, stations and control modules that can control (block, optimize) the operation of all equipment. The automation process allows a person to forget about the complexities of managing any communication systems. The peculiarity of building automation is the ability to simultaneously and accurately account for all the



most important factors: control of water, electricity, temperature, uninterruptible power supplies, etc. Installation of utility networks, ensuring the uninterrupted operation of systems in standalone mode is also going to save money.

The main task of specialists who develop automated solutions for residential facilities is the creation of engineering networks and their management. Engineering communications are being introduced in stages: first, a heating system, an air conditioning and ventilation system are created, then “smart” light and multimedia technologies. The use of these networks saves from 10 to 40% of electricity. Engineering communications are controlled by a computer using special programs - controllers. Coordination of work is done with touch panels, via the Internet or a cell phone, as well as using one-, two- or multi-button switches. The latter are able to provide control of the entire building system.

In addition to the centralized management of all communications of the building, it is proposed to establish a monitoring system that will allow controlling engineering networks thanks to special devices: light, motion, temperature sensors. Information on the state of communications allows timely prevention and replacement of faulty parts. The complex for the design of country houses equipped with "smart functions" includes:

- development of a project for a lighting control system
- the creation of the concept of multimedia systems (home theaters, music centers)
- installation of climate control
- management of ventilation, air conditioning, heating and water supply
- installation of a power electric system
- integration of the sewage system
- installation of security systems, scheduling
- Connection of any systems at the request of the customer (landscape irrigation system, anti-icing system for roofs, steps, paths and drains, etc.).

Individual designs of cottages, houses or apartments and the installation of security systems that perfect house needs are- security and fire alarms, fire extinguishing, access control, calling the security service, etc. The design of “smart” housing is accompanied by warranty and post-warranty maintenance of the installed system.

### **3.3 Economical aspects**

In all countries with developed market economies, both incomes and expenses of taxpayers are transparent. A clear control of income and expenses allows institutions such as mortgage lending (issuing loans for the construction and purchase of housing) to work effectively. This leads to the fact about the purchasing of smart house with credit would be perfect for the working population. Therefore, in many countries there is already the practice of a compulsory home insurance. Naturally, insurance companies are interested in the quality and reliability of the insured housing. However, since the occurrence of insured events unfortunately cannot be avoided, the insurance companies recover money from the organizations and people, that were guilty in insurance case, and often it is not ordinary people, but, for example, construction companies.

The “Smart House” is able to provide the experts with the all the information on hard disk by the content of which conclusions will be made. Therefore, the development and implementation of Smart Houses in countries with developed market economies is now proceeding rapidly. In addition, the future owners of such buildings themselves are interested in their intelligence, because it undoubtedly brings significant savings to its owner through accurate accounting and control of all building systems, as well as the rational use of resources such as electricity, water, heat. In addition, a smart home allows owner to save on payments made for utilities. Heating, electricity, water and operating costs in such houses are reduced by 30%. The intelligent system of the Smart House is configured in such a way that thanks to the built-in temperature, presence and light sensors, it independently monitors the operation of air conditioners, convectors, radiators, and lighting and is able to turn off these devices if they are idling.

### **3.4 Integrated Management System**

Such systems are necessary due to the need to maintain information technology environments, when multi-platform support at all levels - different computers (servers, workstations and personal computers), different operating systems, such as Linux, Mac OS, Windows, and network

equipment from different manufacturers and different levels of intelligence. Based on the services provided by the most companies, all aspects of building infrastructure management are combined into a single system that performs diverse functions, which has dozens of functions. There are some of them: fire alarm, environmental control, building access control, elevator control, television tracking, time recording, lighting control, control of the use of electrical energy, heating, ventilation and maintaining a microclimate. In addition to performing the target functions, it is also set with the functions of managing the information infrastructure. Information access control and security management, workload management, performance monitoring, event management, automated data storage management, problem management, data transport management, report distribution management, Web server and network management.

M.E. Soper. Practical tips and solutions for creating a "smart home".

### **3.5 Smart house remote control**

A person can control an intelligent house or building using some controls located in the building or its surroundings, but included in the same communication environment as all other components of the system. However, there are many cases where it is necessary or desirable to remotely control the subsystems of an intelligent home. These is the list of main abilities:

- The ability to control the state of his home in a long absence and, if necessary, manage some systems
- in case of unforeseen situations (fire, flood, etc.), the house should be able to notify its owner and the relevant city services
- in case of malfunctions in some modules and subsystems, diagnostics and some repair or adjustment procedures can be carried out by specialists from service centers remotely without direct presence, which saves considerable money and contributes to the variety of available technical means

The concept of an intelligent home provides an opportunity to create a remote control subsystem as part of an integrated management system. This subsystem allows customer to receive information about the events and status of some parameters and remotely send control commands to the entire system or its individual components. Regarding the depth of the implementation of such an opportunity in an intelligent house, the following forms can be distinguished:

- Autonomous self-regulating and controllable object, which includes all kinds of automation, but has no communication with other parts of smart-house. This is the most primitive model of intelligence, which is advertised in the media, such as “press 1 button and the smart house will do everything for you”.
- When connecting an intelligent home to a network with individual objects into a single system, which will allow monitoring of the life support systems, energy saving of resources, security, etc. The solution of any issues related to the mentioned systems, as well as the delivery of various services over the network will become much simpler and more efficient.
- Another form of intellectual home: information is exchanged both inside the house and outside it using standard digital protocols. All system components are integrated into a single communication space. This is the most intelligent form of smart house.

## 4 CLOSED SYSTEM RESEARCH

### 4.1 Two types of systems

All smart-house automation systems divided into open and closed ones. There are dozens of different automation systems, and I will provide examples of some of them. Open systems are: BACnet, MODbus and LonWorks and others.

The customer, who is looking for an open system, receives a wide selection of equipment from various manufacturers, which can be correctly integrated into the common engineering complex (system) without any difficulties. In addition, the market for system integrator companies of open systems is already quite extensive, which gives the customer the opportunity to choose a manufacturer with different design, help with installation and commissioning stages of an automation system.

At the same time, closed systems are often cheaper and easier to install and set up, and therefore, their use is justified in cases where it is enough for the customer to solve a local problem without the need for further modernization and docking with automation from other manufacturers. Moreover closed systems often have their own OS and app for both Android and iOS, while open systems sometimes support only one system. For example, a person wants to have light control and water control systems, without any future modernizations. For this case, it is much better to purchase a closed system, as it is going to be cheaper and easier to control and install. Such systems include, for example: Domintel, Clipsall or AMX and others.

The choice of a system is determined by the tasks and objectives set by the customer. In addition, usual electrical equipment has recently become more and more “smart”, and often, many tasks of building automation can be solved without resorting to complex intelligent systems. For example, a modern remote controller (for example, Pronto Philips, controller from Samsung, etc.) allows owner to control the audio-video complex, climate technology and lighting, including programming of light scenes. In markets, such as “Prisma, K-Market, etc.” customer can already find and purchase “smart” lamps, which support different brightness, colors and, of course, reduce the usage of electricity.

## 4.2 "Domintell – smart living experience"

I chose Belgian company Domintell for my research, because this company has some advantages to other companies. Domintell manufactures an automated control system designed to control and manage lighting, heating, ventilation, water supply, security, audio / video equipment and other engineering systems at home. Domintell – a perfect example of a closed system. All devices are united by one cable, which significantly reduces cable management, makes the system flexible and makes it easy to expand its functions. The system can be configured and modified at the request of the owner. All functions of the system can be controlled distantly from the remote control or even from a mobile phone. Domintell allows integrating various subsystems, ensuring their coordinated and cooperated work and high functionality of the entire complex.

The entire concept of a smart home involves the coordinated work of various systems. This allows not only to exclude conflicts during their functioning, but also to ensure harmonious interaction. A classic example: an air conditioner will not cool a room while the heater is working, so two different modules (subsystems) cannot work at the same time, and this is the perfect example of coordinated work. Integration provides comfort inside the house. The smart home takes over the management of the entire complex. With the request, a smart home controls lighting, curtains, air conditioning, floor heating, audio / video systems, bath etc.

Internet website (Domintell 2019)

## 4.3 Functions

-Light control

Indoor lighting throughout the house, outdoor lighting, dynamic light scenes that allow to give different "moods" to the room, turn on when passing, smoothly turn on incandescent lamps, taking into account the power, turn off all devices by one command. Spotlights are now relevant, allowing to illuminate the room as required by what is happening in it, and the control of

the lighting system can be entrusted to an intelligent system. There are two ways to implement automatic light control. In the first of them, each room is equipped with a separate remote control. Several buttons on it are responsible for individual lighting fixtures. The light can be controlled without getting up from a chair or sofa with a special controller.

The second method is a complete automation of lighting using special sensors. As soon as a person enters the room, the light in it turns on, and turns off some time after leaving. Such an automation system is extremely convenient: this is especially noticeable if both hands are busy with something. The usual switches, however, are not canceled in this system: The lights can be turned off manually, while owner remains in the room.

#### -Power outlet control

Turning on and off groups or individual devices in each room. At the same time, you can control various household gadgets, for example, turn off the TV in the children's room, turn off the power of the iron after a specified interval of time, or set up function to turn off everything when leaving the house area.

#### -Security and alarm

Motion sensors and window or door closure sensors protect rooms from unauthorized entry. Safety functions also include protection against water flooding, fire alarms, power failure of electrical appliances when leaving. The ability to send SMS messages in emergencies, turning on sirens, simulating presence. In addition, the system allows organizing panic buttons, for example, in the children's room, by the patient's bed, etc.

#### -Micro-Engine Control

Micro Engine means curtains, blinds, shutters, automatic gates, barriers, garage doors, pumps, moreover, everything that has small engines inside.

#### -Notification

Notification for a mobile phone in case of emergency – such as fire, water flooding, unauthorized entry, etc. The notifications done by sending SMS messages from a mobile phone, or in-app notifications. If something is going wrong, householder will instantly know about it.

### -Multi-Room system

A multi-room is a system for transmitting an audio signal from several sound sources in different rooms. Multimedia allows you to listen to music not only in the room where the sound-reproducing equipment is installed, but also in any other house, or on the street, or even in rooms where these systems are rarely installed, for example, in a swimming pool, a bathroom, an open bathroom, terrace, etc.

### -Climate Control

Climate control involves the measurement and maintenance within the specified limits of indoor air parameters: temperature, humidity, composition. To ensure this, various systems are used: underfloor heating (electric and water), radiators, fan coil units, air conditioning and ventilation systems, humidifiers and dehumidifiers, ionizers, etc. Therefore, for an integrated climate control system, there is a need to ensure coordinated management of all these devices. In addition, in a modern house there is a task of supporting a different climate in different rooms. In addition, the ability to manage the climate on a schedule that can be flexibly changed for different days of the week or host preferences.

This also includes the ability to remotely control the climate via the Internet, or a mobile phone or from the administrator's computer, if we are talking about a hotel. the ability to automatically use various energy resources for heating, depending on daily changes in tariffing makes this system special. Finally, the optimization of equipment operation in order to save energy. Of course, energy conservation depends both on the country's climate and on other parameters. Sometimes it can be up to 50%. All this provides a smart home and gives the person the opportunity to enjoy comfort.

### -Automatic watering

This system includes: water control, pump control, scheduled control, weather accounting, everything to make your plants grow up, while you are not at home.

Internet website (Domintell 2019).



Elsenpiter, J. Welt. 2005. "Smart House building itself".

#### **4.4 Comfort**

A large number of remotes in the house, which have the habit of being lost, people are usually confused about which remote to pick up, in order to control the device. However, there is a solution - one intuitive remote that can control almost any device. House owner presses the "virtual" button with the caption in Russian "Watch a movie" on the touch screen. As a result of one click, the curtains close, the lights go out smoothly, the air conditioner turns on, the phone turns off (if necessary).

Entering the house and on the wall-mounted touch screen click on the button "I'm home" on the controller. The chandelier in the hallway smoothly turns on at half brightness, the mirror illumination is also smoothly. The soft lights in the toilet are turned on as soon as the door is opened (presence detector triggered).

Using a mobile phone, it will not be difficult to select and send an "I will be home in an hour" SMS message from a prepared list. Immediately the house "wakes up" from hibernation: the heating and ventilation system turns on and sets the necessary temperature and humidity, the paths melt from ice and snow on the way to the house, and upon arrival the facade of the house and paths will be lit, and the temperature in the garage and the house will reach a comfortable level.



## 5 SMART MODULES (CONSOLES)

### 5.1 Yandex control device

Here is a remote control from the TV, to perform any action just press the button of this remote control. However, there are no buttons in the Yandex smart console; the voice assistant Alice controls it. For example, there is a task to turn on the TV. It can either to find the remote control and press the button, or pronounce, "Alice, turn on the TV", or press the button on the device itself. All of them have the right to life, and the convenience of each depends on the specific situation. However, it is worth remembering that the smart home system should make everyday life more convenient, and the smart remote will allow to automate devices that are not included in this system.

Now, bullets can control only two types of devices: televisions and air conditioners. I hope that the list of possible devices (and control commands) will be expanded in the future.

TABLE 1. Control Device

|                       |                                |
|-----------------------|--------------------------------|
| Manufacturer          | Yandex                         |
| Model                 | Yandex. Remote(YNDX0006)       |
| Case material         | Glossy black and matte plastic |
| Range                 | Up to 18 m.                    |
| Communication Modules | Wi-Fi 802.11 b / g / n 2.4 GHz |
| Power                 | 220-240V, 50Hz                 |
| Dimensions            | Diameter 65mm, height 25mm     |
| Weight                | 62 gr.                         |

There are seven infrared transceivers at 38 kHz under the remote control case, the range of which should reach up to 18 meters. The device is made in Switzerland, while manufactured in China. The service life is only 2 years.

## 5.2 Examples of interesting modes

### **-August Smart Lock**

Smart lock allows avoiding usage of the usual physical keys, leaving them in the past. A virtual key, unlike a physical one, cannot be pulled out of jeans pocket or bag. In addition, such a key cannot be lost during a walk. The lock uses a Bluetooth connection, and can be controlled either directly or through a controller. The August Home application allows creating virtual keys that are individual for each user. Each visit is registered, which makes it possible to view statistics on the use of the house. Also in the application, you can enable the automatic unlock function of the lock when a smartphone approaches a certain distance. In this case, the phone does not even need to be pulled out of pocket; the main condition is the included Bluetooth. This is convenient in cases where the hands are busy with purchases or other voluminous things.

### **-Philips Hue White and Color**

Philips Hue is the perfect light for home lighting. The light bulb can be installed in your favorite sconce, desk lamp or ceiling lamp and control the brightness and intensity of the radiation, the shade of light, the on / off time from devices from Apple from anywhere in the world via the Internet. In addition, timer can be set up to turn on the light bulb in the morning and wake up, especially in autumn and winter; it will be much easier and more pleasant. The Philips Hue bulb not only provides pleasant lighting for the room, but also saves energy, because it is 80% more economical than conventional incandescent lamps.

Internet website (Apple 2019).

## 6 MARKET

### 6.1 Pricing

- 50-75 EUR /sq. m - basic options (lighting control)
- 75-100 EUR /sq. m - typical options (lighting and heating/window blind control)
- 100-150 EUR /sq. m - comfortable variant (lighting, heating, window blinds/air conditioning)
- 150 EUR /sq. m - luxury variant (lighting, heating, air conditioning, window blinds + extras)

The given prices cover the cost of the whole system (design, cabling, electric switch cabinets, system devices, outlets, system start-up) without actuators (lamps, radiators, window blinds, etc.). The often cited great price differences between systems in practice reach only up to a few per cent, because each system has to include cabling (which is often more expensive than the equipment itself), electric outlets, etc., so the price different in the system devices themselves does not greatly influence the cost of the whole installation.

The prices given for each system (net prices without VAT) were calculated for a sample house having an area of 200 sq. m, and cover the control of 40 light circuits (including 4 dimmed), 16 window blinds and 8 independent heating zones, as well as design, laying of the installation, equipment assembly and system configuration. If a system should not foresee heating control, then the price includes electronic programmable thermostats.

TABLE 2. Price Table

| Basic systems            |        | 'Middle-class' systems |        | Advanced systems |        |
|--------------------------|--------|------------------------|--------|------------------|--------|
| traditional installation | 10 896 | Dupline                | 16 727 |                  |        |
| Cardio                   | 16 312 | IDRA                   | 15 988 | Lonworks         | 17 090 |
| Hometronic               | 18 078 | IHC                    | 14 841 | Crestron         | 20 344 |
| Luxor                    | 14 533 | LCN                    | 16 866 | Lutron           | 21 085 |
| X10                      | 14 146 | Xcomfort               | 15611  | KNX/EIB          | 17 458 |

Of course, even a basic system configuration provides comfort that cannot be matched by traditional installations, and thanks to energy savings, the cost of the system pays itself back within a few years. “KNX” is one of the main systems in Europe and the US.

These ready-made Smart Home systems differ in price and full functionality. Basic is suitable for those who do not need a large set of equipment due to the limited budget and area. Advanced systems allows equipping customer’s home with modern automation and security technologies, but to implement this option requires a large budget. Medium budget offers the opportunity to get wide functionality at a more affordable price. However, in the pricing table shown, that sometimes basic systems cost more than middle-class ones, so the customer has to choose carefully.

The increasing importance of combating security issues is expected to fuel the growth in demand over the forecast period for smart and connected homes. In addition, it is expected that the implementation of advanced wireless technologies, including HVAC (Heating, ventilations, and air conditioning) controllers, safety and access regulators and entertainment monitors, would stimulate market growth. Moreover, the recent Internet of Things (IoT) developments that resulted in price drops of sensors and processors are expected to push manufacturers to adopt domestic automation.

## **6.2 Smart Homes in Finland**

The smart-home ecosystem continues to expand rapidly, but market growth levels are directly associated with 5 G deployment speed. Recent IoT acquisitions by Google, Apple, Amazon and Alibaba have dramatically changed the landscape, providing opportunities for all kinds of businesses, but also forcing industry consolidation. Considering the current moderate consumer needs, long periods of product replacement and increasing accessibility of phones, adoption will increase gradually in the coming years. Below there are a few main stats:

- In 2019, revenue on the Smart Home market in Finland was EUR € 275 m.
- Revenue is expected to show a 14.3 percent annual growth rate (CAGR 2019-2023), resulting in a EUR € 518 m market volume by 2023.

- The penetration of households is 17.6% in 2019 and is expected to hit 34.6% by 2023.
- Currently, the average revenue per built Smart Home is EU € 613.52.
- A global comparison reveals that most revenue is generated in the United States (EUR€ 22 m in 2019).

Internet website (Statista 2017. Finnish Market Analysis).

## 7 CONCLUSION

The smart home is a relatively new technology, which is just beginning to develop actively. Thanks to various researches of such magazines as Forbes, Times, independent analyzes, etc., we can conclude that the bright future is predicted for smart homes. I believe that the smart home system is a great start as a business project, because the success of involving this technology depends primarily on people who are able to convey to customers all the advantages and disadvantages of this system. People who will let new technologies into their home in the near future will be able to greatly ease their everyday life, make it more comfortable and enjoyable.

In order to predict the direction of technology development, we analyze the facts available to us. The concept of “smart home” is interesting and promising. At the moment, a large number of companies, offer services to create such smart houses. The technology itself is implemented cheaply (wirelessly or using existing power cables), but setting up such a system, especially if it is controlled by software from a computer, is rather a complicated thing for the average person, as well as any new technologies that people get used to for a long time, and will cost a lot to its owners. In addition, the presence of a number of such decisions must be taken into account when developing the design of the premises. An ideal place to apply such technologies is private houses and cottages, as well as large offices. In principle, given that the owners of country houses spend much on their maintenance, the cost of such a decision will be relatively small.

In a smart home, all electronics and household appliances - from climate systems to televisions - are controlled by extremely complex computer systems. “Smart Home” turns on light and music when guests and loved ones enter the house and move through the rooms. At the same time, there is light and musical accompaniment as the visitor moves through the “smart” apartments. Changes are done according to the wishes of the owner, which are stored in the settings. A person does not need to set the temperature regime in the rooms or adjust the lighting - the installed “intelligent” system recognizes by the state of the owner what temperature and lighting he needs at the moment for complete comfort. To ensure convenience in the apartment, a variety of technologies can be used, from homemade devices to highly intelligent computer systems.

There was a time when people refused touch phones, saying that they could never replace push buttons, but now everyone has a phone with a touch panel. This technologies until recently seemed impossible. They provide the highest level of security and safety, bring an incredible



level of comfort and convenience, make everyday life easier, and help to cope with simple and routine tasks. All this is a smart home system.

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