2024

SmartHome4Seniors Guide

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Introductory information

This guide will give you a general insight into the topics of Smart Home and physical computing as a basis for a good understanding of the educational resources produced by the project SmartHome4SENIORS. In the second part of the document, practical information on the material, namely the learning motivation environment, the web application and the learning tutorials will be given and summarized in an overview.

1. About SmartHome4SENIORS

SmartHome4SENIORS (2021-1-DE02-KA220-ADU-000033587) is a project funded by the European Commission under the Erasmus+ Programme. The consortium consists of seven partner organizations across the EU. It is led by Innovation in Learning Institute of University Erlangen-Nuremberg (Germany) and further consists of following partner institutions: Dublin City University (Ireland), Asserted Knowledge (Greece), Atermon (Netherlands), E-Seniors (France), die Berater (Austria), and Komicha (Bulgaria).

The SmartHome4SENIORS project deals with Smart Home automation for older people using simple DIY solutions. It has three main outcomes:

1. State-of-Play Framework: Research of the current situation on existing smart home solutions/ applications for seniors available in the EU.
2. Kit & Guide: Design and development of a Kit based on a Raspberry Pi Pico microcontroller and a Learning Motivation Environment to guide older learners for their DIY smart home solutions.
3. Web Application: Design and development of a web application for seniors with personalised training paths, depending on a set of pre-defined criteria and preferences, to prepare their smart-home automation.

Please find more information on the project website. It is available under: https://sh4seniors.erasmusplus.website/

2. General information on Smart Home technologies

Smart home technology has rapidly transformed the way we live, offering a futuristic glimpse into the possibilities of our homes. In this chapter, we will delve into the world of smart homes, exploring what such a technology entails, how it can enrich our lives, and the challenges that accompany its use.

2.1 What is a Smart Home?

Smart home technology, often referred to as home automation, encapsulates a residential setting furnished with a high-tech network. This network interconnects a diverse array of sensors, domestic devices, appliances, and features, all of which can be remotely monitored, accessed, or controlled. These interconnected systems and devices collectively provide services that seamlessly respond to the specific needs of the inhabitants. This definition, as articulated by Chan et al. (2008), emphasizes the integration of technology into the very fabric of our homes. These technologies encompass an extensive range of applications, touching on key aspects of modern living, as follows.

I. Security

Security systems within smart homes have taken on a futuristic edge. High-resolution cameras capture every angle of your property, providing real-time video feeds directly to your smartphone. Smart locks eliminate the need for physical keys, allowing homeowners to grant access remotely or track who enters and exits their home. These advancements ensure peace of mind and enhance the security of our homes.

II. Entertainment

Entertainment in smart homes is an immersive experience. With voice assistants like Amazon's Alexa and Google Home, you can control your home's audio-visual systems with simple voice commands. Your television becomes a smart TV, granting access to a plethora of streaming services, all at your vocal behest. Home theatres are no longer reserved for the wealthy; smart technology has democratized entertainment.

III. Energy Efficiency

One of the most appealing aspects of smart homes is the significant impact on energy efficiency. Systems are designed to optimize electricity consumption, reducing waste and energy bills. Smart thermostats regulate your home's temperature intelligently, adapting to your habits and preferences. Lights are programmed to turn off automatically when you leave a room, conserving energy without a second thought.

IV. Comfort

Smart home technology extends to areas often overlooked, such as windows and blinds. These components can be managed automatically, adjusting to external conditions and your preferences. Imagine waking up to gently filtered sunlight as your blinds automatically rise and your coffee brews, all timed perfectly to start your day in the utmost comfort.

V. Health Support

Health monitoring devices in smart homes are becoming increasingly sophisticated. These devices track vital health parameters, offering a wealth of data that can be shared with healthcare professionals or family members. For the elderly and those with chronic illnesses, this technology can be life-saving. The essence of smart home technology is shown in the interconnectedness of its components. It's not merely about the devices; it's about the network that weaves them together, creating a cohesive, intelligent living environment.

VI. Internet of Things (IoT)

At the heart of smart home technology is the Internet of Things (IoT). IoT is an emerging paradigm that connects objects, including smart home devices, to each other, to the internet, and to users. The IoT ecosystem enables seamless communication and control, ushering in an era where your devices are always in tune with your needs.

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2.2 How can Smart Home Technologies improve our lives?

The integration of smart home technology goes beyond the mere convenience of remote control; it is now a central focus of various policies and initiatives across the globe. The European Union, in particular, places a strong emphasis on promoting smart home technology to achieve a digitally inclusive society. This emphasis is underscored by the wider context of strategic energy planning, climate change mitigation, sustainable architecture, and efficient building construction management.

In the context of older adults, smart home technology offers a unique opportunity to enhance digital skills, if associated with educational initiatives, and facilitate home care. This technology empowers users to become more independent, significantly contributing to their health and overall well-being. Older adults can age in place with enhanced support and reduced reliance on external assistance. Another key benefit of smart homes is their ability to mitigate social isolation. Smart environments can share user data with healthcare professionals, family members, or caregivers in the case of a health emergency, providing enhanced peace of mind and a sense of community even when living alone. In addition, smart home technology can be utilized in educational contexts, bringing people of all ages to learn together.

A consensus has emerged regarding the positive relationship between the use of smart home technology and the enhancement of quality of life. Numerous studies and research initiatives have supported this notion, underlining the transformative potential of smart homes.

- Chan et al. (2009) demonstrated how smart home technology can significantly enhance the quality of life for its users.
- Flores-Martin et al. (2019) explored the interconnection of IoT devices in improving the quality of life for elderly individuals.
- Kelly et al. (2009) delved into the affordability and efficiency of location-based smart home systems, highlighting their potential to enhance quality of life.
- Laver et al. (2011) delved into measuring technology self-efficacy and its role in clinical rehabilitation settings.

These studies collectively reinforce the positive impact of smart home technology on the quality of life across various demographic groups. Smart homes offer a holistic approach to living, addressing security, convenience, energy efficiency, and health support, as well as allowing for learning opportunities in formal and informal educational settings.

2.3 What are challenges in using Smart Home technologies

While the promises of smart home technology are enticing, its widespread adoption has encountered several challenges. A closer examination of expert perspectives and public attitudes has revealed several social barriers that must be addressed for the technology to reach its full potential, as follows.

I. Control

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One of the primary barriers to smart home adoption is the issue of control. Users often express concerns about the extent to which these systems can be controlled, both in terms of specific devices and the overarching network. The ability to fine-tune settings and preferences remains a key concern, particularly among individuals who value a high degree of control over their living environment.

II. Security

Data security and home security are paramount concerns for those considering smart home technology. As more data is collected and exchanged among IoT objects, questions arise regarding data privacy and security. Users are concerned about the potential for data breaches and unauthorized access to their homes. The need for robust security measures is an ongoing challenge that smart home providers must address.

III. Cost

The acquisition and maintenance costs associated with smart home technology can be prohibitive for some individuals and households. While the long-term cost savings through energy efficiency are evident, the initial investment in smart devices and systems can be a significant entry barrier.

IV. Older Adults and Digital Literacy

Older adults, in particular, face unique challenges in adopting smart home technology. They often have limited engagement with technological advancements and may lack the digital literacy required to navigate complex systems. Additionally, concerns about data security and privacy are more pronounced among this demographic.

V. Data Confidentiality and Integrity

As IoT objects continue to accumulate and exchange data, issues of data confidentiality, authenticity, and integrity have come to the forefront. Users want assurance that their data is secure and that it remains unaltered during transmission. Ensuring data integrity and confidentiality is an ongoing challenge in the development and implementation of smart home technology.

VI. Ethical Considerations

The integration of smart home technology raises ethical questions about the collection, storage, and use of personal data. Striking a balance between convenience and privacy is a critical consideration for both users and developers.

Addressing these challenges requires a multi-faceted approach, involving technological advancements, policy initiatives, and user education. It is essential to create an ecosystem where users feel empowered, informed, and secure in their adoption of smart home technology.

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3. Introduction to physical computing

Now let's take a look at physical computing as foundation for the next chapter in which we then turn our attention to the SmartHome4SENIORS educational resources.

3.1 What is physical computing?

Physical computing is the process where programming is combined with physical devices and sensors, allowing users to create interactive systems and applications in the real physical world.

In practical use, the term most often describes DIY projects that use sensors and microcontrollers or pocket computers to control electromechanical devices such as motors, servos, lighting, displays or some other hardware. The process of assembling and programming such devices can be a creative and educational experience for anyone, regardless of one's knowledge of computers, programs, and circuits.

Physical computing presents a captivating dimension as it compels us to engage in active construction rather than passive consumption. The skills acquired through physical computing are versatile, finding application across diverse fields such as engineering, art, and design. This realm bridges the gap between the digital and physical, fostering seamless integration.

The heightened awareness fostered by physical computing is noteworthy. Whether through a basic light sensor responding to changes in room illumination or a device signaling the presence of someone at the door, physical computing enhances the environment's responsiveness to our presence.

By utlilizing programming expertise, a prevalent aspect of computer science, with electronic knowledge, physical computing emerges as a more inclusive computing form. It facilitates the integration of varied disciplines, broadening the scope of possibilities. It can be both an art and a science, offering numerous approaches and system creation possibilities.

This form of computing encourages project creativity, enabling the development of diverse creations, from robots adept at line-following or soccer playing to interactive art installations responsive to passersby. Embracing a hands-on methodology, participants immerse themselves in building circuits, soldering, programming, and overall crafting innovative solutions. This experiential learning, engaging multiple senses, proves highly effective in real-world problem-solving.

Computers possess the capability to perceive and react to their surroundings through the integration of various electronic components, either inherent or externally connected. These external electronic components can be categorized as either sensors or actuators.

Sensors are devices designed to identify changes in their environment, while actuators are devices engineered to induce alterations in their surroundings. Sensors convey information about specific physical aspects of the environment to the computing device, which can, in turn, command actuators to execute tangible actions in the real world.

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There is a wide variety of physical computing devices on the market, such as Arduino, Raspberry Pi, Circuit Playground, BBC micro:bit, ESP32, etc.

These devices are called microcontroller. They serve as compact, energy-efficient computers—capable of operating on batteries—that function as the central 'brain' in physical computing systems. Widely applied in diverse fields, from automotive systems to consumer electronics, microcontrollers boast a limited set of features yet demonstrate remarkable efficiency, making them suitable for a broad spectrum of tasks. Similar to conventional computers, microcontrollers require programming to enable interaction with connected sensors and actuators. Typically equipped with a constrained program, they are coded using a programming language. While this aspect might pose a challenge for beginners, with appropriate learning resources, microcontrollers offer an excellent avenue for delving into the realm of computing.

3.2 Programming

A typical computer science student is likely to encounter and master over 10 different computer languages throughout their academic journey. Notable examples include C, C++, Python, JavaScript, Visual Basic, and C#, among others. These languages, with a human-readable syntax, empower programmers to dictate the behavior of a computer. In the realm of modern PCs, where abundant resources like memory and graphics capabilities prevail, programmers can develop intricate programs without concerns about resource limitations.

However, the microcontroller domain presents a stark contrast, characterized by severe resource constraints. Microcontrollers exhibit significantly less memory, storage, processing power, and graphical capability compared to standard PCs or mobile phones. Due to these limitations, programmers must exercise meticulous control over resource usage. To optimize efficiency, microcontroller vendors often design programming languages as streamlined subsets of those originally intended for PCs.

Commonly used computer languages for various microcontrollers include:

- Arduino: C++
- Micro:bit: C, Scratch, and JavaScript (for the web)
- Raspberry Pi Pico: MicroPython, C/C++
- ESP32: MicroPython, C/C++

Programmers leverage software or development tools to craft microcontroller programs. These tools enable code writing, testing (referred to as debugging), and the conversion of the written code into a series of binary digits that the microcontroller can directly interpret—a process known as 'compiling.'

Typically running on PCs, these development tools facilitate the connection between the programmer's computer and the microcontroller development boards. This connection is established through interfaces such as USB or other relevant technologies. Once the programmer deems the code ready, it can be transferred to the microcontroller for execution

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3.3 Python programming

Raspberry Pi Pico is a small microcontroller developed by the Raspberry Pi Foundation. It was released in January 2021.

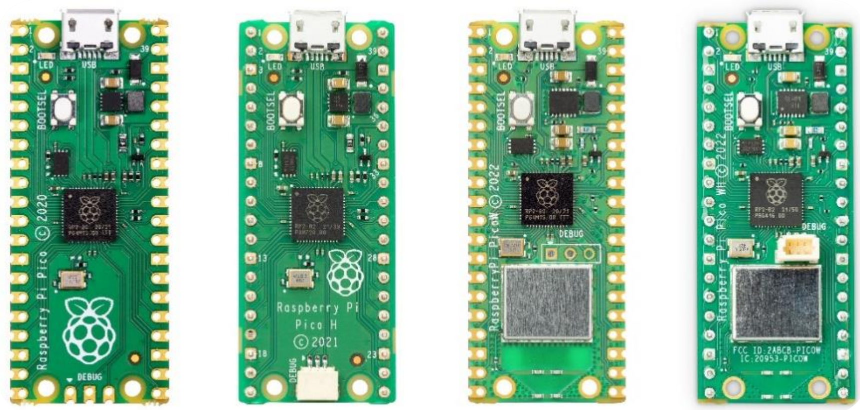

Figure 1 There are currenlty 4 variants of the Raspberry Pi Pico on the market. The two on the right have embedded WiFi, opening up its capabilities with IoT projects. Source: Raspberry Pi Foundation

It offers 40 GPIO (General Purpose Input/Output) pins and support for many different peripherals. The Raspberry Pi Pico is primarily designed for applications that require low power consumption, such as robotics projects, sensors, and other embedded applications. It can be programmed in MicroPython and C/C++.

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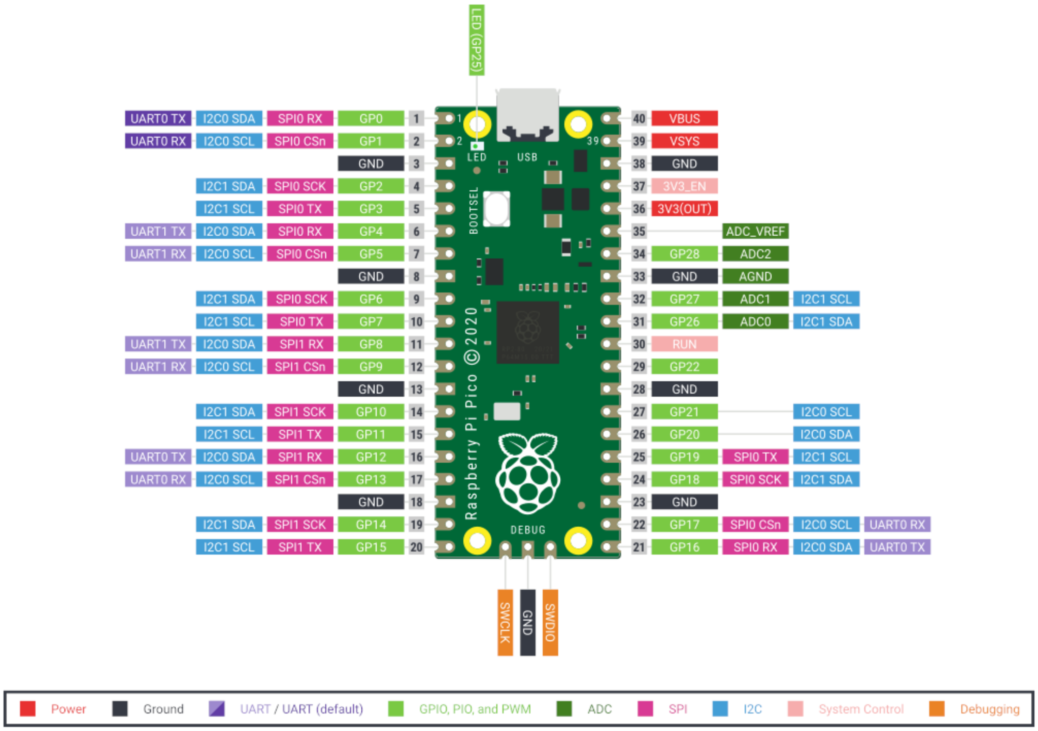

In SmartHome4SENIORS we will program the Raspberry Pi Pico using the MicroPython programming language.

MicroPython stands as a comprehensive implementation of the Python 3 programming language, specifically tailored to operate directly on embedded hardware, such as the Raspberry Pi Pico. It offers an interactive prompt known as the REPL (Read-Eval-Print Loop), allowing users to execute commands promptly through USB Serial communication. Additionally, it incorporates a built-in filesystem. The Pico variant of MicroPython encompasses modules designed for interfacing with the hardware at a low level, catering to the specifics of the chip.

To program your Raspberry Pi Pico, you can establish a connection to a computer via USB. Subsequently, you can install the required firmware using either the Thonny Python application directly or by downloading the firmware file (UF2 file) and transferring it to the Pico's filesystem. This process enables users to seamlessly engage in programming and harness the capabilities of the MicroPython environment on the Raspberry Pi Pico.

For more information about the Raspberry Pi Pico, its capabilities and its documentation you can visit raspberrypi.com. To get started with the SmartHome4SENIORS Kit you can also read the user manual found in the package or online on the project's website.

The Raspberry Pi Foundation has also prepared an online tutorial for complete beginners. You can access it for free in the following link: Getting started with Raspberry Pi Pico.

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4. How to use the SmartHome4SENIORS educational materials

After general introductory information on Smart Home technologies and physical computing we will in this chapter present the educational resources of the SmartHome4SENIORS project, namely the learning environment, the web application and the hands-on tutorials.

All information on the kit and its structure can be found in the Manual (https://sh4seniors.erasmusplus.website/DE/data/files/sh4smanual_de.pdf).

4.1 About the Learning Motivation Environment

All digital learning resources are delivered under a learning motivation environment (LME) which engages the learners in the learning process. The portal functions as a knowledge dissemination platform and facilitates collaboration between learners and trainers. It is designed to motivate users to achieve goals and share their experiences. All participants can go through the content at their own time and pace. Some content is presented in the form of interactive learning objects. Additional collaboration features such as notifications, marking possibilities, and voting is also provided. The main motivational mechanisms are based on the Open Badges specifications (openbadges.org). The Skills & Achievements Framework is created for this purpose in the context of the SmartHome4SENIORS Guide and integrated into the portal so that badges can be awarded to users that successfully complete lessons and activities by achieving a predefined score.

The theoretical part (Theory) of the SmartHome4SENIORS Portal is presented in the LME in the form of activities. There are 3 modules and 21 topics in total, followed by an assessment quiz. The quiz's purpose is to validate knowledge and offer feedback. Learners can try the quiz as many times as they want. Topics can be marked as read once learners have completed them.

4.2 Introduction to the Web Application

The web application includes the practical part of the training course and covers activities in the form of text, videos and quizzes that learners can access anytime they want to try a smart home solution in their house.

The Web App (Practice) has the following features:

- Filters: Several filters are integrated to help the learners search among a pool of activities and select those relevant to their needs. These refer to the difficulty level and to the electronics and sensors that are included in the tutorials. For example, learners may choose "Intermediate Level" tutorials which include a "Buzzer", and a "Servo Motor". Then the Tutorial list will be filtered out, showing you all tutorials that fall into your parameters.
- Rating functionality: The users are able to evaluate the activities using voting widgets (star rating).

- "Favourite button" feature: The learners are able to mark the activities they enjoyed as "favourites". This kind of information is available in the activities but also in the user´s profile.
- Completion of an activity: Learners are able to mark an activity as completed. Doing this they receive a completion badge. All acquired badges can be found by clicking on "My Achievements" at the top of the page.
- User profile: The information that the user indicated on the registration phase will form the user's profile. The user's interaction with the different activities (mark activities as completed/favourites) is visible on the activities page, but they also appears in the user's profile. In this way, learners have a complete view of the completed activities while easily accessing their favourites.

The web application (practical part) of the SmartHome4SENIORS Portal contains 12 tutorials that guide learners to create and control several Smart Home systems such as automatic doors, smart lights, smart security systems, etc. To implement the tutorials, participants will need all the knowledge they acquired in the theoretical part, plus the SmartHome Kit and their computer.

The tutorials are described in 7 steps, so by following each step learners will be getting closer to the creation of a fully functional DIY smart home automation system. Some of the more "advanced" tutorials include also instructional videos to help learners understand and implement them.

4.3 Table overview of hands-on tutorials

As part of the SmartHome4SENIORS project eleven tutorials were developed which show possible Smart Home applications using the SmartHome4SENIORS house model. The learning content has been designed to meet the special needs of older learners and no advanced prior knowledge is required. Still, if you are interested in practical implementation of the instructions basic physical skills are required to make the connections on the breadboard and house model. For example, you should be able to count the holes on the breadboard and connect cables.

The learning content covers a wide range of topics. Starting with a basic tutorial, which is intended for every participant to work on as foundation for all following learning content, ten further scenarios follow, each dealing with specific topics and applications in the smart home sector. As a participant, you are free to work on or skip the learning content at your own choice and interest. You are also free to choose the type of learning – the tutorials can be used independently as self-study material online or as part of a classroom training.

To put the presented applications into practice, you will need the SmartHome4SENIORS house model. You will receive this as part of a face-to-face event or can borrow it from your national partner.

The learning time for each tutorial ranges between 1-3 hours - depending on whether you just read through the instructions or carry them out practically on the house model. Self-assessment tasks are available at the end of each tutorial. Completion of the questions is voluntary and is not monitored by anyone.

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Once you have completed a tutorial you will be awarded with a badge. The badge is used for informal recognition and validation of your acquired skill and / or knowledge. Once you have received the badges from all tutorials, you will achieve a badge that covers the content of the whole training program.

Below you will find an overview of all tutorials, their learning content, learning objectives, required material for practical implementation on the house model and the badge you will receive after successfully completing the module.

1. Understanding Smart Home

Learning content	In this tutorial, you will learn about the SmartHome Kit, how to assemble it, what the Raspberry Pi Pico is and how the programming interface works.
Learning objectives	✓ Understand the concept of Smart Home and assembly the SmartHome Kit. ✓ Understand the Raspberry Pi Pico microcontroller and its programming environment. ✓ Use the print function.
Required components	• 6x Plywood pieces • 1x Full size breadboard • 1x Raspberry Pi Pico • MB-102 power supply unit • Jumper wires
Badge	

2. Smart Electric Garage Door

Learning content	In this tutorial you will get to know one opportunity how to control your garage door using the method of distance measurement. The tutorial is built on the scenario in which a car approaches a garage and based on the distance between the car and the garage, the garage is opening automatically. The setup consists of three installation steps which will be presented to you.
Learning objectives	✓ Understand the concept of Smart Home and assembly the SmartHome Kit. ✓ Understand the Raspberry Pi Pico microcontroller and its programming environment. ✓ Use the print function.
Required components	• 1x Raspberry Pi Pico

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	• 1x Full size breadboard • 1x Micro-USB cable • 11x male-to-male jumper wires • 1x LED traffic lights module • 1x HC-SR04 ultrasonic sensor • 1x SG-90 servo motor
Badge	

3. Automatic Entrance Door

	In this tutorial you will learn how an automatic entrance door, triggered by an electronic key card or fob, can be installed as an entrance door in a home. Additionally, you will also learn how to install a motion sensor which will instruct you to present your fob to open the entrance door.
Learning objectives	After you have completed this tutorial, you will be able to ✓ Install and use a PIR motion sensor to detect an oncoming person and instruct them to present a fob to open an entrance door. ✓ Install and use an SG-90 Servo Motor to automatically open an entrance door. ✓ program an RFID Reader and fob to work as a verification system to operate other mechanisms (such as using a fob as an electric key card to open a door). ✓ Install, program, and use a RFID Reader to trigger a SG-90 Servo Motor to automatically open an entrance door. ✓ demonstrate an automatic entrance door system on the SmartHome4Senior wooden house model.
Required components	• 1 x Raspberry Pi Pico • 1 x Full sized breadboard • 1 X micro-USB cable • 1 x MB-102 power module • 6 x AA Batteries • 1 x SG-90 Servo Motor • 1 x PIR Motion sensor • 1 x RFID RC522 module • 1 x RFID tag • 10 x Male-to-male jumper wires • 11 x Male-to-female jumper wires

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Badge	

4. Music Doorbell

Learning content	In this tutorial, you will learn how to create a music doorbell for your Smart Home using a buzzer and a tactile push button. The scenario can be seen as the basis for further installations. I.e you can then connect the system with other sensors and electronics, such as the OLED display and the servo motor on the door, to offer a more interactive experience.
Learning objectives	✓ Understand the characteristics and principles of a passive buzzer. ✓ Understand the use of a tactile push button and a resistor. ✓ Be able to create a music doorbell that notifies you about guests at your doorstep.
Required components	• 1x Raspberry Pi Pico • 1x Full size breadboard • 1x Micro-USB cable • 2x male-to-male jumper wires (20 cm) • 2x Male-to-female jumper cables (10 cm) • 1x Micro-USB cable • 1x Buzzer • 1x 220 Ohm resistor • 1x Push button
Badge	

5. Smart Lights

Learning content	In this tutorial you will get to know one opportunity how to control your lightning using a motion sensor combined with a potentiometer. The tutorial is based on the scenario that the

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	presence of a person is registered and the light turns on and off automatically based on predefined settings.
Learning objectives	After you have completed the tutorial you will ✓ be able to connect and control a LED light ✓ be able to connect and control the PIR motion sensor ✓ be able to set a potentiometer
Required components	• 1x Raspberry Pi Pico • 1x Full size breadboard • 1x Micro-USB cable • 14x male-to-male jumper wires • 4x LEDs (any colours) • 1x PIR motion sensor • 1x Potentiometer • 1x 220 Ohm resistor
Badge	

6. Automatic Thermostat System

Learning content	In this tutorial you will get to know one opportunity to temperature control using a smart thermostat system.
Learning objectives	✓ Understand the DHT sensor and its characteristics. ✓ Work with a DC motor, TIP-120 module, and diode for fan control. ✓ Create an automatic temperature control system. ✓ Integrate the thermostat system into the SmartHome4SENIORS house model.
Required components	• 1x Raspberry Pi Pico • 1x Full size breadboard • 1x Micro-USB cable • several male-to-male jumper wires • 1x DHT11 sensor • 1x Fan (DC motor) • 1x Diode • 1x TIP-120 transitor

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Badge	

7. Smart Fire Alarm System

Learning content	In this tutorial, you will learn how to create a smart fire alarm system utilizing electronics and sensors, namely a flame sensor, a 5V passive buzzer, and a servo motor. This smart fire alarm system will notify the user if there is a fire inside the SmartHome. If the flame sensor detects fire, the buzzer will go off and the servo motors will be enabled, opening the entrance and garage doors.
Learning objectives	✓ Understand the use and characteristics of the flame sensor. ✓ Understand the use and characteristics of a passive buzzer. ✓ Understand the use and characteristics of servo motors. ✓ Be able to create an automatic fire alarm system.
Required components	• 1 x Raspberry Pi Pico • 2 x Servo motor • 1 x Full-size breadboard • 1 x Buzzer • 1 x Micro-USB cable • 6 x male-to-male jumper cables (20cm) • 2 x male-to-female jumper cables (20 cm) • 3 x male-to-female jumper cables (10 cm) • 1 x Flame sensor
Badge	

8. Smart Rain Detection System

Learning content	In this tutorial, you will delve into the implementation of a rain detection system using sensors and actuators. The scenario revolves around detecting rain and automatically initiating actions, such as closing garage doors or windows.

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Learning objectives	✓ Understand the functionality of rain detection sensor. ✓ Familiarize yourself with the integration of actuators for automated responses. ✓ Create a practical rain detection system for enhanced safety and convenience in your SmartHome environment.
Required components	• 1x Raspberry Pi Pico • 1x Full size breadboard • 1x Micro-USB cable • 1x Raindrop sensor • 2x female-to-female jumper cables (20 cm) • 4x male-to-male jumper cables (10 cm) • 3x male-to-female jumper cables (10 cm)
Badge	

9. Smart Air Quality Detection System

Learning content	In this tutorial, you will explore the implementation of a gas detection system using sensors and alarms. The scenario is based on the detection of gas within a specific environment, where the buzzer is activated upon sensing the presence of gas.
Learning objectives	✓ Understand the functionality of gas detection sensors ✓ Familiarize yourself with buzzer alarms ✓ Create an automated gas detection system

Required components	• 1x Raspberry Pi Pico
	• 1x Full size breadboard
	• 1x Micro-USB cable
	• 1x MQ-135 Air Quality Sensor
	• 1x Buzzer
	• 5 x male-to-female jumper cables (20 cm)
	    ○ 3 to connect gas detector
	    ○ 2 to connect buzzer
	• 11 x male-to- male jumper cables (10 cm)

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Badge	

10. Smart Security System

Learning content	In this tutorial you will get to know one opportunity how to connect home solutions for an increase in home security. The tutorial is based on a multiple-entry scenario: Detection and alert of an arrival, whether it's a guest or the owner. The devices detect a presence, authenticate the person with a connected badge system and manage whether or not to authorize entry.
Learning objectives	✓ Understand the use and characteristics of PIR motion sensor; ✓ Understand the use and characteristics of a passive buzzer; ✓ Understand the use and characteristics of the OLED I2C; ✓ Understand the use and characteristics of the RFID module; ✓ Be able to create a smart home security system.
Required components	• 1x Raspberry Pi Pico • 1x Full size breadboard • 16 x Male-to-female jumper wires • 1x PIR motion sensor • 1x Micro-USB cable • 1x Buzzer • 1 x OLED I2C SSD1306 display • 1x RFID RC522 module • 1x RFID Tag
Badge	

11. Smart Monitoring System

Learning content	In this tutorial, you will use the sensors and components that you used in the previous tutorials in order to create a smart

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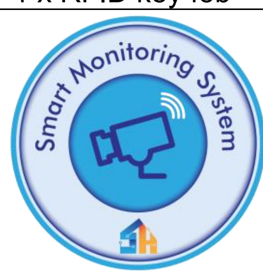
	monitoring system for your house model. You will need to use the knowledge acquired since the first tutorial and put it into practice. The goal is to utilize the OLED display in order to display information on all connected sensors and electronics.
Learning objectives	✓ Understand the use and characteristics of the OLED display. ✓ Create a smart monitoring system that provides information on all connected electronics and sensors.
Required components	• 1 x Raspberry Pi Pico • 1 x Full-size breadboard • 1 x Micro-USB cable • 5 x 220 Ohm resistor • 2 x 1k Ohm resistor • 1 x LDR photoresistor • 1 x 100nF Capacitor • 4 x LEDs • 1 x Traffic lights LED • 1 x Fan • 1 x TIP-120 control module • 1 x Diode 1N40007 • 1 x Rotary potentiometer • Jumper wires as needed • 1 x Buzzer • 1 x Push button • 2 x SG90 servo motor • 1 x OLED SSD1306 display • 1 x HC-SR04 ultrasonic sensor • 1 x PIR motion detector sensor • 1 x DHT11 sensor • 1 x MQ-135 air quality sensor • 1 x Flame detection sensor • 1 x Raindrop sensor • 1 x RFID reader RC522 • 1 x RFID key fob
Badge	

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References

Ali, B., & Awad, A. I. (2018). Cyber and physical security vulnerability assessment for IoT-based smart homes. Sensors (Switzerland), 18(3), 1–18.

Balta-Ozkan, N., Davidson, R., Bicket, M., & Whitmarsh, L. (2013). Social barriers to the adoption of smart homes. Energy Policy, 63, 363–374

Boud, D., Keogh, R., & Walker, D. (1985). Promoting reflection in learning: A model. In Reflection: Turning experience into learning (pp. 18-40). Routledge.

Chan, M., Campo, E., Estève, D., & Fourniols, J. Y. (2009). Smart homes - current features and future perspectives. Maturitas, 64(2), 90–97.

Corrigan,T., McNamara, G. & O'Hara, J. (2013). Intergenerational learning: A valuable learning experience for higher education students, Eurasian Journal of Educational Research, 52, 117-136

Dewey, J. (1933). How we think: A restatement of the relation of reflective thinking to the educative process. Houghton Mifflin.

EC (2015). Communication from the Commission C(2015) 6317 final. Towards an integrated strategic energy technology (SET) plan: accelerating the European energy system transformation. European Commission, Brussels, Belgium, (EC). https://ec.europa.eu/energy/sites/ener/files/publication/Complete-A4-setplan.pdf

Flores-Martin, D., Pérez-Vereda, A., Berrocal, J., Canal, C., & Murillo, J. M. (2019). Interconnecting IoT devices to improve the QoL of elderly people. Communications in Computer and Information Science, 1016, 83–93.

Gibbs, G. (1988). Learning by Doing. Oxford Brooks University.

Kaplan, M.S, Kusano, Tsuji, I.& Hisamichi,S. (1998). Intergenerational Programs. Support for children, youth and elders in Japan.New York: State University of New York Press.

Kelly, D., McLoone, S., & Dishongh, T. (2009). Enabling affordable and efficiently deployed location based smart home systems. Technology and Health Care. 17, 221–235

Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development. Prentice Hall.

Laver, K., George, S., Ratcliffe, J., & Crotty, M. (2011). Measuring technology self efficacy: reliability and construct validity of a modified computer self efficacy scale in a clinical rehabilitation setting. Disability and Rehabilitation, 34(3), 220–227.

Mezirow, J. (1991). Transformative dimensions of adult learning. Jossey-Bass.

Moon, J. A. (1999). Reflection in learning and professional development: Theory and practice. Routledge.

Ohsako, T. (2002). German pupils and Jewish seniors: intergenerational dialogue as a framework for healing history. In Kaplan, M.S., Henkin, N.Z., & Kusano, T.K. (Eds.) ,Linking Lifetimes: A Global View of Intergenerational Exchange (pp. 209-219). Maryland: University of America Press.

Salomão Filho, A., Corrigan, T., Tillmanns, T. (2021). Digital Inclusion in Europe: Designing a course on smart home technology for older adults. The Online Journal of New Horizons in Education. 11(1).

Schön, D. A. (1983). The reflective practitioner: How professionals think in action. Basic Books.

Schön, D. A. (1987). Educating the reflective practitioner: Toward a new design for teaching and learning in the professions. Jossey-Bass.

Sovacool, B. K., & Furszyfer Del Rio, D. D. (2020). Smart home technologies in Europe: a critical review of concepts, benefits, risks and policies. Renewable and Sustainable Energy Reviews, 120(May 2019), 1–20.

UNESCO (2000) The Right to Education. Towards Education for all throughout life. World Education Report. New York.

Wilson, C., Hargreaves, T., & Hauxwell-Baldwin, R. (2015). Smart homes and their users: a systematic analysis and key challenges. Personal and Ubiquitous Computing, 19(2), 463–476.

Wilson, C., Hargreaves, T., & Hauxwell-Baldwin, R. (2017). Benefits and risks of smart home technologies. Energy Policy, 103(January), 72–83.

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