Jose Ignacio Valero Cerdá

Escape Room for Robotics Academy

Industrial Electronics and Automation Engineering

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Satakunta University of Applied Sciences

Escape Room for Robotics Academy

Valero Cerdá, Jose Ignacio
Polytechnic University of Valencia
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ABSTRACT

This thesis reviews the first design of an Escape Room in the SAMK Robotics Academy. Different puzzles integrated in one room in order to make this possible were created by students from different parts of Europe.

In the first part of the document the main objective of the project is presented as well as the most important requirements since the beginning.

Secondly, all the different puzzles that constitute the Escape Room and all the characteristics about them are exposed. Also, all the specifications of the devices involved in the project and its limitations are presented.

Finally, the last part of the Escape Room, the Server is explained. It is the most complex part of the room and it makes everything possible.

CONTENT

1 INTRODUCTION

1.1 Background information and objectives

The Satakunta University of Applied Sciences is interested in making an Escape Room for sixth-grader students in Finland. It will be a dedicated room in which the objective is to be able to solve different questions, puzzles or even mathematic problems in order to win the game. This kind of games have become more famous in the last years since there are many ways to play it and infinite possibilities for designing.

The project was presented by Petteri Pulkkinen, the research director of the Technology faculty in SAMK and the main objective was to use machine vision and other technologies in order to create different puzzles related with the Robotics Academy in SAMK. Robotics Academy is a new way of studying where engineering students of the university accomplish incoming projects from the research projects or from companies in Finland.

In this project it was only required to design the actual puzzles, not to build the room. Even though, there is a place which could be used for this purpose, it was clear that the main objective was to design the complete puzzles with a duration of 30 to 60 minutes solution.

2 THE PUZZLES

2.1 The Maze

2.1.1 Story

The first part of the Escape Room is called “The Maze”. It is a simple covered labyrinth with one entrance and one way to go out. Also, the inside walls contain different letters from the alphabet in a concrete order.

The objective of this puzzle is to place the “Allbot” robot at the beginning of the maze and control it with the smartphone through the labyrinth. In order to make this possible, because the roof of the labyrinth won’t permit the location of the robot visually, there is a first-person view from the front camera of the robot implemented. This “FPV” allows the user to watch everything in front of the robot in real time.

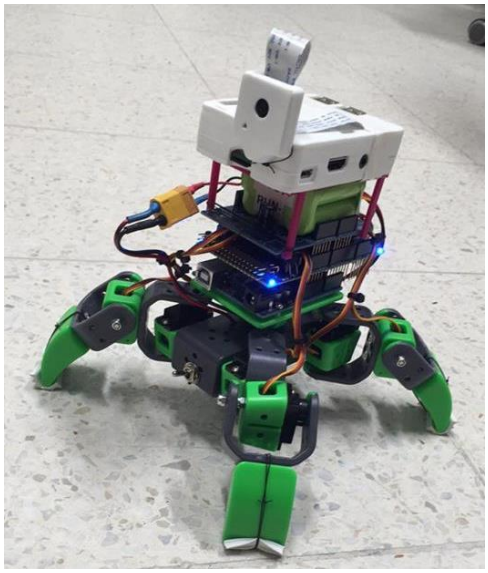
A monitor inside the room displays the real time vision to the user. This allows also to see the letters inside the maze. These letters are used in the next puzzle.

Picture 1. Example of the maze

2.1.2 About the Allbot

To make this part of the work, a robot named “**Allbot**” is used. This robot owns four legs with four knees and moves thanks to eight **servomotors**. Each leg can rotate horizontally for around 150° and each knee can rotate vertically for 180°. That means there are two servomotors for each leg for the two movements.

The robot can move in any direction due to infinite combinations of all the movements accomplished.



Picture 2. Allbot with Raspberry Pi

The user can take the control of the robot thanks to a mobile application that the company provides. It is called “ALLBOT” and it is available for every operative system (smartphone or tablet).

An external module is required in order to enable the communication via IR between a smartphone device and the ALLBOT. After connecting it to the device (the smartphone or the tablet), the user can send the instruction to the receiver of the robot via IR transmission. This app also provides predetermined settings in order to move the robot easily to the front, back and sides of itself. In addition, it is possible to increase or decrease the speed of these movements.

One of the best characteristics of this robot is that it provides a huge capacity of adaptation to the user and to the project itself. It is due to some factors of the 3D printed structure, which makes it incredibly easy to substitute any broken part and creates the possibility to make any modifications needed.

As it is shown in the previous picture (picture 2), a 3D printed structure is added on the top of the robot in order to add the Raspberry Pi 3B, which makes it possible to send the real time vision from the “Allbot” to the monitor in the room.

2.1.3 Allbot Robot

Picture 3. Allbot Robot

The main features of this robot are:

- Plastic structure (3D printable)
- 8 x 9G servo motors
- Servo motor connector shield (VRSSM)
- Battery shield (VRBS1)
- VR001 infrared transmitter with app for smartphone or tablet (Android® or iOS®)

The most important specifications of the Robot in this project are:

- Servo motor connector shield (VRSSM):
    - Compatible with ARDUINO-UNO-R3: ARDUINO® UNO REV.3 and ARD-A000067: ARDUINO® MEGA2560 REV3 (required but not included)
    - ARDUINO-UNO-R3: ARDUINO® UNO REV.3 can drive max. 12 servo motors
    - ARD-A000067: ARDUINO® MEGA2560 REV3 can drive max. 36 servo motors
    - IR receiver
    - Beeper
    - Power indicator LEDs

- Battery shield (VRBS1):

    - Power supply: 12 V booster for Arduino board (4 x AA batteries, alkaline or NiMH recommended but not incl.)
    - ON-OFF switch

2.1.4 Arduino Uno Rev.3

Picture 4. Arduino Uno Rev.3

The Arduino Uno board is one of the most famous microcontrollers in the world of electronics. It provides a huge versatility and programming possibilities to the project thanks to its open source community and the number of users that work with this board.

The features that make this board part of the project are:

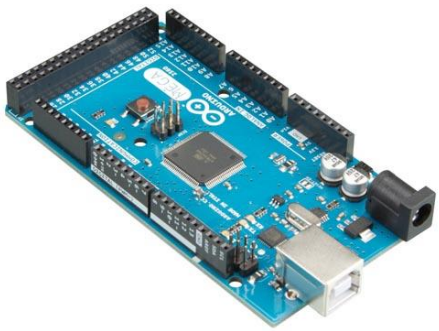
- Digital I/O pins: 14 (of which 6 provide PWM output)
- Analogue input pins: 6
- Contains: 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button

These are the specifications that make this board possible:

- Power supply: 6-20 V max. (adapter not included)
- Microcontroller: ATmega328
- Digital I/O pins: 14 (of which 6 provide PWM output)

- DC current per I/O pin: 40 mA
- DC current for 3.3 V pin: 50 mA
- Analogue input pins: 6
- Flash memory: 32 kB (ATmega328) of which 0.5 kB used by bootloader
- SRAM: 2 kB (ATmega328)
- EEPROM: 1 kB (ATmega328)
- Clock speed: 16 MHz

2.1.5 Arduino Mega2560 Rev3



Picture 5. Arduino mega2560 Rev3

Arduino Mega 2560 (picture 5) is a free hardware development card built with the Atmega 2560 microcontroller, which gives meaning to its name. It is a part of the Arduino project that involves an international community dedicated to the design and manufacture of hardware development boards.

Arduino achieved its objective of facilitating and relating, in a simple and didactic way, the programming of microcontrollers and electronics, two very complex areas of engineering, and therefore it was decided to incorporate it in the Allbot puzzle.

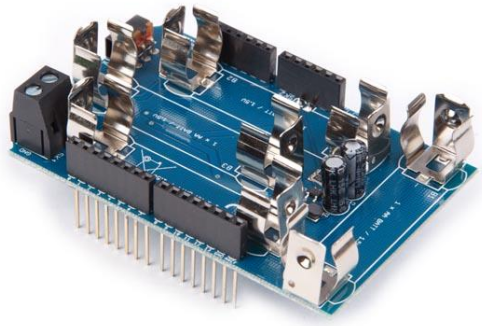
There are several different card designs, among them is the Arduino Mega 2560 that has a series of features, which can be utilised in the project.

The Mega 2560 is an update to the Arduino Mega, so the decision was to replace it.

Additional features coming with the R3 version are:

- It is a robust family development board, has a very powerful 8-bit microcontroller and is the one with the most pins of all possible options.
- It has a memory for high programming.

2.1.6 Allbot Battery Shield



Picture 6. Battery shield

The most important features that made the company implement this shield in the Allbot Robot are:

- Supply 5 – 6 V (servomotors) and 12V (Allbot)
- Possibility to connect to external power supply
- Power switch
- Spare part

And here are the specifications of the shield that is finally used in the project:

- External power supply: 5 - 6V (not incl.)
- Arduino® power supply: 12V - 200mA
- Battery power supply: 4 x AA batteries (not incl.)

2.1.7 Smartphone IR Transmitter

The IR transmitter (picture 7) is used in the project as a decision after trying to implement a wireless controlling mode from the website.

Finally, it was decided that this method could be easier for both, the user (who always will have a smartphone in his pocket) and the programmer.

Picture 7. IR Transmitter

The features that make this a part of the project are:

- Easy installation (plug in smartphone and open the app)
- Perfect communication with the predetermined app (ALLBOT)

And the specifications that the company provide are the following:

- Uses a CR2032 battery (which is included)
- 3 to 4 m distance range
- Audio to IR
- Transmit indication LED

2.1.8 Raspberry Pi 3B+

Picture 8. Raspberry Pi 3B+

The Raspberry Pi 3B+ is the most advanced product of the company. It is an interesting iteration of the previous model that comes with an "accelerated" CPU, dual band Wi-Fi support and also Gigabit Ethernet "capped" support. These improvements, whether they are capped or not, provide better benefits with the benefit of the still cheap price. The Raspberry Pi 3 Model B+ is the latest product in the Raspberry Pi 3 range. The improvements that the company has integrated in this product make it even more powerful than it was before. The size of the product kept as it was, so it was decided to implement this product in the project without any doubt.

These are the specifications that make this board part of the project and also, part of every puzzle:

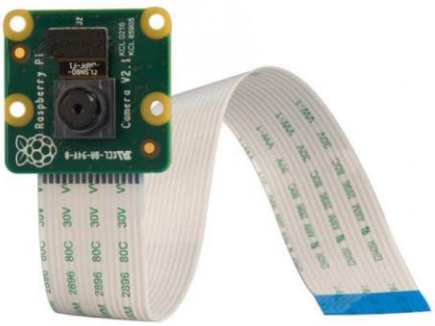
- Broadcom BCM2837B0, Cortex-A53 (ARMv8) 64-bit SoC @ 1.4GHz
- 1GB LPDDR2 SDRAM
- 2.4GHz and 5GHz IEEE 802.11.b/g/n/ac wireless LAN, Bluetooth 4.2, BLE
- Gigabit Ethernet over USB 2.0 (maximum throughput 300 Mbps)
- Extended 40-pin GPIO header
- Full-size HDMI
- 4 USB 2.0 ports
- CSI camera port for connecting a Raspberry Pi camera
- DSI display port for connecting a Raspberry Pi touchscreen display
- 4-pole stereo output and composite video port
- Micro SD port for loading your operating system and storing data

- 5V/2.5A DC power input
- Power-over-Ethernet (PoE) support (requires separate PoE HAT)

2.1.9 Raspberry Camera Module v2

The Raspberry Camera Module v2 of High-Quality Video (picture 9) is connected to any RPi in order to take pictures or record video. It integrates the image sensor IMX219PQ from Sony that provides video images of high speed and sensibility.

The camera module provides also low image noise. This camera is used in this project since it is also possible to configurate parameters like the exposure, white balance and light detection automatically.



Picture 9. Raspicam

2.1.10 Servomotor

A servo motor is an electric device used for precise control of angular rotation. It is used in applications that demand precise control over motion, like in case of control of a robotic arm.

The rotation angle of the servo motor is controlled by applying a PWM signal to it. By varying the width of the PWM signal, it is possible to change the rotation angle and direction of the motor.

Picture 10. Servomotor

In this project, the Tower Pro SG90 servomotor is used. Its most important features are:

- ATmega328P microcontroller
- Input voltage – 7-12V
- 14 Digital I/O Pins (6 PWM outputs)
- 6 Analog Inputs
- 32k Flash Memory
- 16Mhz Clock Speed

Product dimensions

- Width 30 mm
- Height 30 mm
- Depth 10 mm

Power Source Details

- DC Voltage 3.5V-6V

It is important to note that, even if the decision was to integrate these servomotors in the robot, these motors are not powerful enough to handle with the whole system.

In the future, one possible improvement could be to integrate more powerful servomotors, with the consequences of less battery life.

2.1.11 Battery

Finally, in order to provide power to the Allbot, a 7.2 volts NiMH battery (picture 11) was integrated in the robot. This battery provided about 20 minutes life to the robot.

It was decided that around 15 to 20 minutes of life should be enough for the project since the complete duration of the Escape Room is about 30 min and user had to use the Allbot at the beginning of the game.

Picture 11. Battery

GPBM Security

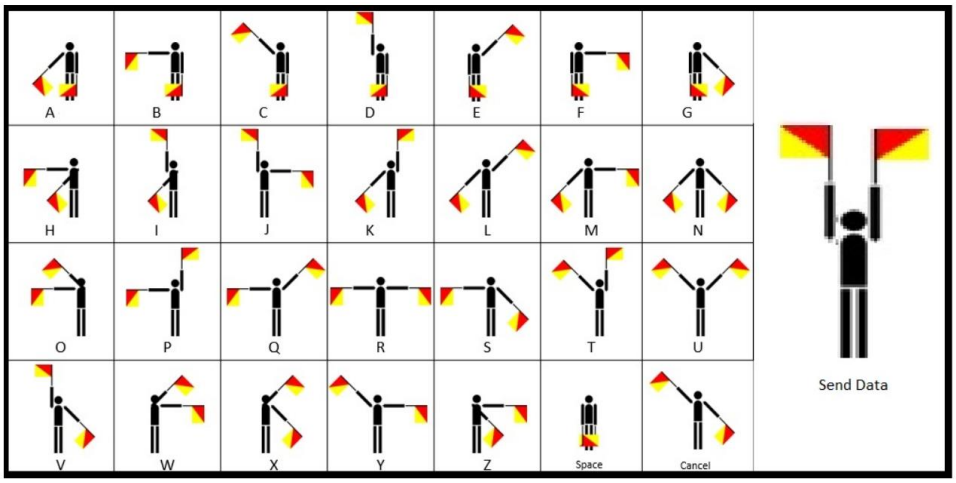
- GPP/N: GPRHC162N/GP160AAH6YMX
- Backup Battery: Powermax PM1
- NiMH 7.2V 1600mAh
- GPBM P/N: 300552
- Mfg date: SD

2.2 Kinect puzzle

2.2.1 Story

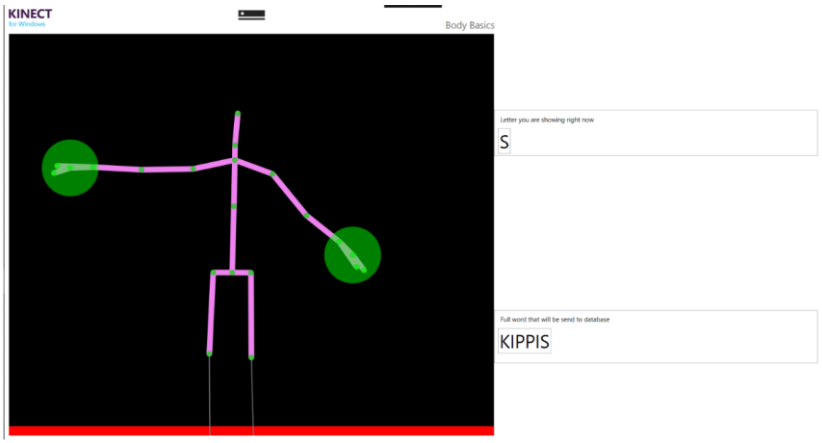
The main objective of this puzzle is to recreate the shape of different letters from the alphabet in front of the Kinect camera using only your body in order to build a known word. In order to transfer the information from your body to the actual device, the semaphore alphabet (picture 12) is used. It is a telegraphy system that uses visual signals with hand-held flags.

The decision of integrating this puzzle in the Escape Room was done because it was an easy way to make the user participate more intensively in the solution of the puzzle since it is needed to use movements of a body to solve it.

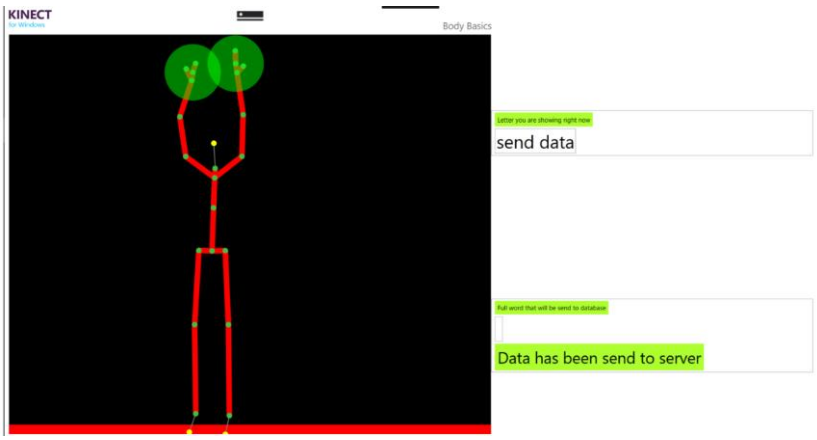


Picture 12. Alphabet

It was decided to add also the “Send data” sign in order to send the word once the player has finished it. This way it was also possible to communicate with the server, instead of sending data constantly.



Picture 13. Sending letter "S"



Picture 14. Sending all data

2.2.2 Kinect sensor

Kinect for Windows (picture 15) is one of the most versatile devices in its category. It can see people's full body movement as well as small hand gestures. Up to six people can be tracked as whole skeletons. The Kinect for Windows v2 Sensor has an RGB (red-green-blue) camera for color video, and an infrared emitter and camera that measure depth in millimeter resolutions. The Kinect for Windows v2 Sensor enables a wide variety of interactions, but any sensor has "sweet spots" and limitations.

Picture 15. Kinect sensor

This device provides the possibility for a person to act as a game controller. This way there is no need for an external controller device anymore. This is one of the most important reasons that made this product part of the project. It was decided to investigate on how it works and what possibilities of programing could it bring for the project.

The body limits that the device can work with are:

- 0.5 m to 4.5 m (default)
- Sweet spot: 0.8 m to 3.5 m
- The depth sensor can also see from 4.5 m to 8 m, but body detection does not work in this extended range

With an angle limit of:

- Horizontal: 70 degrees
- Vertical: 60 degrees

Software

The software is what makes the Kinect a breakthrough device. Developers for the Kinect gathered an incredible amount of data regarding motion-capture of actual moving

things in real-life scenarios. Processing all this data using a special artificial intelligence machine-learning algorithm allows the Kinect to map the visual data it collects to models representing people of different backgrounds (age, height, gender, body type, clothing and more). This is just one of the ways that developers were able to help the Kinect "learn" about its surroundings and what it is seeing.

The Kinect's brain is really the secret. Stored in the system there is enough intelligence to analyze what it sees and align that with stored collection of skeletal structures to interpret any movements. Once the brain has enough data of the body parts, it outputs this reference data into a simplified 3D avatar shape. Beyond gauging player movements, the Kinect must also judge the distances of different points on your body throughout the entire game. To do this it uses a host of sensors and analyzes all this data 30 times a second.

Hardware

The Kinect contains three vital pieces that work together to detect any motion and create a physical image of the human on the screen: an RGB color VGA video camera, a depth sensor, and a multi-array microphone.

The camera detects the red, green, and blue color components as well as body-type and facial features. It has a pixel resolution of 1920x1080 and a frame rate of 30 fps. This helps in facial recognition and body recognition.

The depth sensor contains a monochrome CMOS sensor and infrared projector that help create the 3D imagery throughout the room. It also measures the distance of each point of the player's body by transmitting invisible near-infrared light and measuring its "time of flight" after it reflects from the objects.

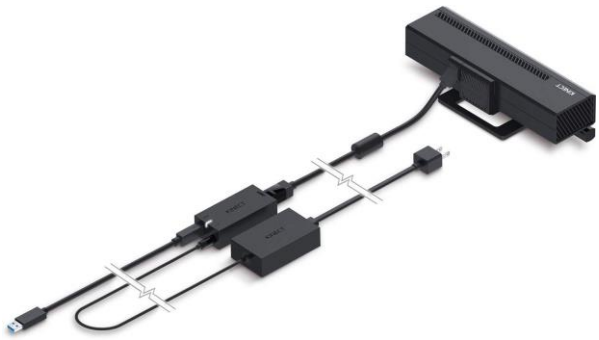
These components come together to detect and track 48 different points on each player's body and repeats 30 times every second.

2.2.3 Xbox Kinect Adapter for Xbox One S and Windows 10 PC

With the purpose of being able to work with the Kinect sensor, it was necessary to implement the use of the Adapter for Windows 10 PC.

This adapter is provided separately from Xbox Kinect and makes the user able to interact with the configuration of the Kinect sensor from a Windows 10 PC, It also makes it possible to program the sensor in a thousand different ways.

It is possible to find demo programs with applications from face detection to whole body lecture. In this project it was decided to make a completely new code program in order to detect the semaphore alphabet from the user body.



Picture 16. Adapter for PC

2.2.4 System requirements

- Windows 8 (64-bit) Windows 8.1 (64-bit), Windows Embedded Standard 8 (64-bit) Windows Embedded Standard 8.1 (64-bit).

2.2.5 Hardware requirements

- 64-bit (x64) processor Dual-core 3.2 GHz or faster processor Dedicated USB 3.0 bus 2 GB RAM A Kinect for Windows v2 sensor.

2.2.6 Software requirements

- Microsoft Visual Studio 2013 Express or any other Visual Studio 2013 edition, Microsoft Visual Studio 2012 Express or any other Visual Studio 2012 edition.
- NET Framework 4.0 Microsoft Speech Platform SDK v11 for developing speech-enabled applications for Kinect for Windows.

2.3 QR Reader

2.3.1 Story

This puzzle is composed by two main different parts. The first one is the QR code with the correct shape that contains the information about the solution of the puzzle. And the second part is the device that will check if the user is building the QR code correctly.

In the room, the user will find three different layers of the QR code (picture 18) that should be stacked one over the other in order to form the complete QR code (picture 17). Once the user has a possible combination of the code, the camera built on a Raspberry Pi 3B+, will check the shape and send the information to the server.

Picture 17. Complete QR code

Picture 18. QR code parts

2.3.2 About

A QR code is a square two-dimensional bar code that can store the encoded data. Most of the time the data is a link to a website (URL).

Nowadays, QR codes can be seen in brochures, posters, magazines, etc. It is easy to detect these two-dimensional bar codes around. QR codes allow to interact with the world through any smartphone.

Specifically, a QR Code extends the data available to any physical object and creates a digital measure for marketing operations. This technology allows and accelerates the use of web services for mobile phones. It is a very creative digital tool.

By scanning a QR code by using a smartphone, it gives an immediate access to its content. The QR code reader can then perform an action, such as opening the web browser for a specific URL. Other actions can be triggered, such as storing a business card in the contact list of your smartphone or connecting to a wireless network.

2.3.3 Raspberry Pi 3B

Picture 19. Raspberry Pi 3B

The Raspberry Pi 3B+ is the main brain of this puzzle. It is used in order to be able to run the camera and program it with the purpose of continuously read QR codes and send any read information to the server.

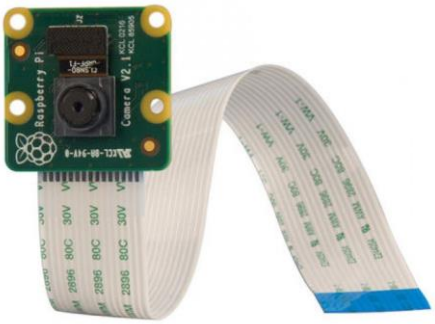
For more information about specifications read point 2.1.8 of this document.

2.3.4 Raspberry Camera Module v2

The camera used is this puzzle is the Camera Module v2 from Raspberry, the exact same one used in the previous puzzles.

It was decided to continue using it due to its versatility, easy programming and small size. In this case, it was decided to integrate a 3D printed case for the Raspberry and the camera in order to set the camera in the same exact position and to keep it safe from any collision.

For more information about specifications read point 2.1.9 of this document.



Picture 20. Raspicam

2.4 RFID cards

2.4.1 Story

Since the beginning of the project, one of the main ideas was to implement RFID cards and induction charging in one of the puzzles of the project. Since the induction charging was not an easy implementation, it was decided to implement only RFID cards.

The use of the RFID cards in the project is not in a concrete puzzle, but in the whole game. The player may find different cards around the room that will give different tips to get through the solution.

In order to check the information inside every card, there will be an RFID reader connected to another Raspberry Pi 3B+ that will read the card and send the information to the server. Once the information is received in the server, the tip is shown in the main screen.

2.4.2 RFID Reader

An RFID reader is also known as an interrogator.

The main objective of an RFID reader is to transmit and receive signals, converting the radio waves of the tags into a readable format for computers.

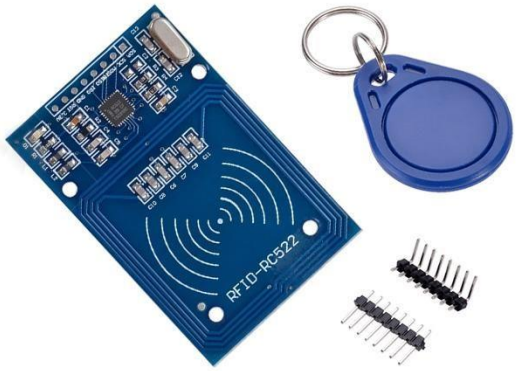
RFID readers can supply power to passive RFID tags. The readers can be autonomous units connected to antennas, portable units with integrated antennas, in miniature boards mounted inside printers, or integrated into large devices.

It is necessary for the reader to transmit energy to the tag, to receive the data corresponding to the communications from the tag, and to separate these two types of signals.

Most readers are able to read and write to a tag. The reading function reads data stored in the chip of the tag. In the same way, the write function writes the pertinent data on the chip of the tag.

The reader-tag communication can use any of the four frequency bands: low, high, ultra-high, and microwave.

Another function of an interrogator is to handle the situation that arises when more than one tag responds simultaneously to his interrogation. This is called anti-collision processing and is done through the interrogator's electronics using its software. A reader has to be connected through antenna cables to perform signal transmission and reception. Portable readers can have built-in antennas or connect with external reading modules. Readers use standard communication protocols to communicate.



Picture 219. RFID sensor and key

After deciding that the RFID Reader was going to be part of the project, it was decided to implement the RFID-RC522 due to the following features:

- Operating Current :13-26mA/DC 3.3V
- Idle Current :10-13mA/DC 3.3V
- Sleep Current: <80uA
- Peak Current: <30mA
- Operating Frequency: 13.56MHz
- Supported card types: mifare1 S50, mifare1 S70 MIFARE Ultralight, mifare Pro, MIFARE DESFire
- Environmental Operating Temperature: -20-80 degrees Celsius
- Environmental Storage Temperature: -40-85 degrees Celsius
- Relative humidity: relative humidity 5% -95%
- Reader Distance: ≥50mm/1.95"(mifare 1)
- Module Size: 40mm×60mm/1.57*2.34"
- Data transfer rate: maximum 10Mbit/s

2.4.3 Raspberry Pi 3B+

Picture 22. Raspberry Pi 3B+

One more time, a Raspberry Pi 3B+ is running the program of the RFID Reader, in this case, it facilitates the possibility of continuously read RFID card and send the text contained to the server.

For more information about specifications read point 2.1.8 of this document.

2.5 Machine Vision Puzzle

2.5.1 Story

The machine vision puzzle was the main requirement of this project. A puzzle in which the gamer could place different shapes under the Cognex smart camera with the objective of solving any question.

Since the beginning of the project, it was very important to understand perfectly how the camera worked and what functionalities were possible for the device.

In the game, once the user is in this puzzle, different questions appear on the main screen. The answer of these questions are objects hidden in the same room. In order to solve the puzzle, the gamer has to, not only to guess the correct answer, but also to find the actual object inside the room and place it behind the camera setup.

Finally, when the question is answered correctly, a Raspberry Pi 3B+ sends the information to the server in order to show the next step of the puzzle.

2.5.2 About

The image reader is a vision system that combines a camera, software and processor into one compact unit.

Picture 23. Cognex Corporation

Cognex Corporation is an American manufacturer of machine vision systems, software and sensors used in automated manufacturing to inspect and identify parts, detect defects, verify product assembly, and guide assembly robots. Cognex is headquartered in Natick, Massachusetts, USA and has offices in more than 20 countries.

2.5.3 Raspberry Pi 3B+

Picture 24. Raspberry Pi 3B+

As in every puzzle, a Raspberry Pi 3B+ is used as communicator between the device and the Backend of the project. In this case, the brain of the situation is still the camera, with its own code programming, but it was necessary to implement the Raspberry Pi 3B+ in order to send the information to the server.

For more information about specifications read point 2.1.8 of this document.

2.5.4 In-Sight 5100C Vision System

"The In-Sight vision system is a compact, network-ready, stand-alone machine vision system used for automated inspection, measurement, identification and robot guidance applications on the factory floor. All models can be easily configured remotely over a network using an intuitive user interface." (Cognex support 2019)

- In-Sight version 4.4.3
- 128MB non-volatile flash memory; unlimited storage via remote network device.
- 256MB SDRAM
- 1/3-inch CCD
- 5.92mm diagonal, 7.4 x 7.4µm sq. pixels
- 640 x 480 (Max resolution)

- Shutter speed 16µs to 1000ms
- Rapid reset, progressive scan, full-frame integration
- 60 full frames per second.
- Clear plastic with an abrasion-resistant coating on the exterior side.
- 1 opto-isolated, acquisition trigger input. Remote software commands via Ethernet and RS-232C.
- 2 built-in, high-speed outputs. Additional outputs available using a compatible I/O module. Unlimited outputs when using an Ethernet, I/O system.
- 1 Ethernet port, 10/100 BaseT, TCP/IP protocol. Supports DHCP (factory default), static and link-local IP address configuration.

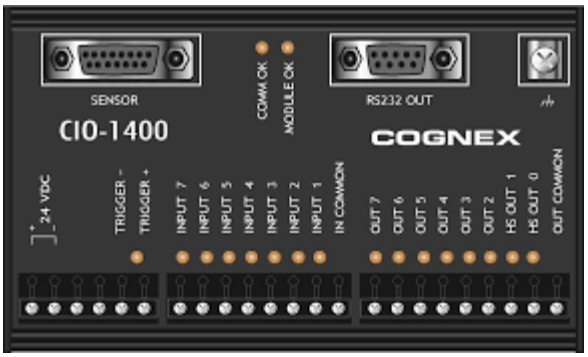
Picture 25. Cognex 5100C Camera

2.5.5 In-Sight Model 1400 I/O Expansion Module

"The In-Sight® Model 1400 I/O Expansion Module provides a convenient way to access the power, serial, trigger and high-speed output connections of the In-Sight 3400 and 5000 series sensors. The expansion module also extends the capabilities of these sensors by adding discrete inputs/outputs and hardware handshaking for serial communications." (HVS system 2019)

The main features that made this expansion module part of the project in addition of that it was the only way to work with any input or output from the camera are that it has a detachable terminal block, also LED status indicators and DIN-Rail mountable.

An I/O cable is needed to connect the used In-Sight camera to the 1400 I/O Expansion Module. The I/O cable has a DB15 connector on one end, and an M12 connector on the other.



Picture 26. In-Sight 1400 I/O

3 THE SERVER

3.1 Backend

3.1.1 About

Node.js is an open-source, cross-platform JavaScript run-time environment that executes JavaScript code outside of a browser. JavaScript is used primarily for client-side scripting, in which scripts written in JavaScript are embedded in a webpage's HTML and run client-side by a JavaScript engine in the user's web browser. Node.js lets developers use JavaScript to write command line tools and for server-side scripting—running scripts server-side to produce dynamic web page content before the page is sent to the user's web browser. Consequently, Node.js represents a "JavaScript everywhere" paradigm, unifying web application development around a single programming language, rather than different languages for server side and client-side scripts.

Picture 27. Node .js

3.1.2 Mongoose Database

- MongoDB stores data in flexible, JSON-like documents, meaning fields can vary from document to document and data structure can be changed over time. The document model maps to the objects in your application code, making data easy to work with.
- Ad hoc queries, indexing, and real time aggregation provide powerful ways to access and analyse your data.
- MongoDB is a distributed database at its core, so high availability, horizontal scaling, and geographic distribution are built in and easy to use.

- MongoDB is free and open-source. Versions released prior to October 16, 2018 are published under the AGPL. All versions released after October 16, 2018, including patch fixes for prior versions, are published under the Server Side Public.

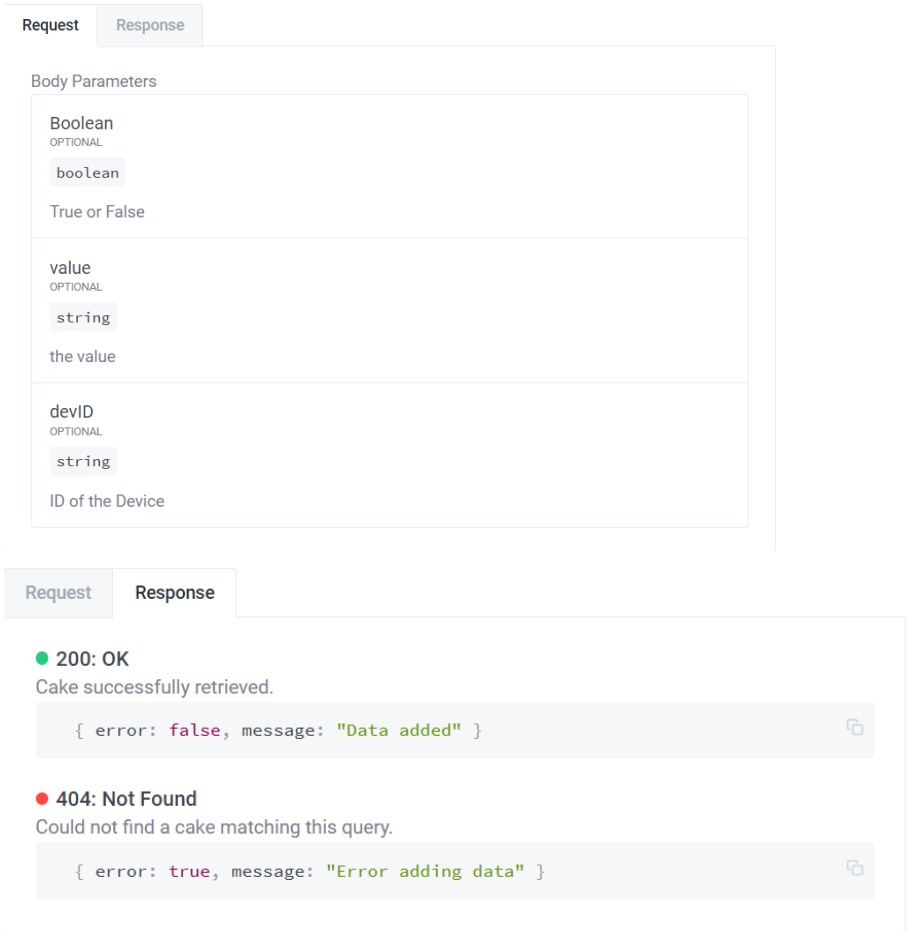
3.1.3 API

In order to communicate with all the devices in the room once they had sent all the needed information to the server, it was decided to use the API protocol.

In this case, here is all the configuration used to detect variables sent from all the Raspberry Pi 3B+ set in the room.

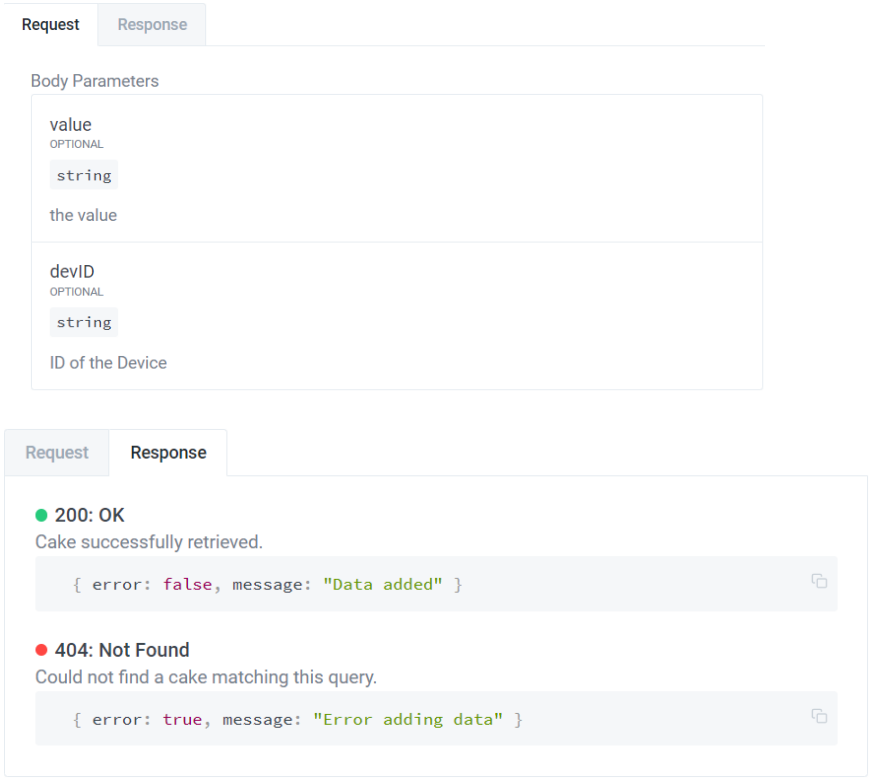
QR Reader

https://172.17.2.10/api/qrReader



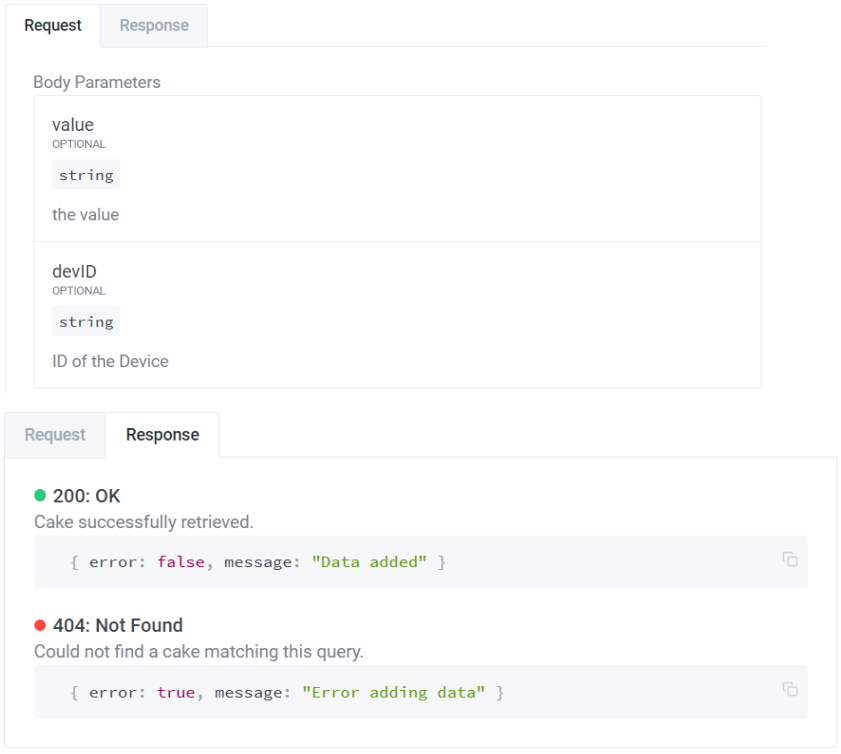
Kinect Sensor

https://172.17.2.10/api/motionsensor



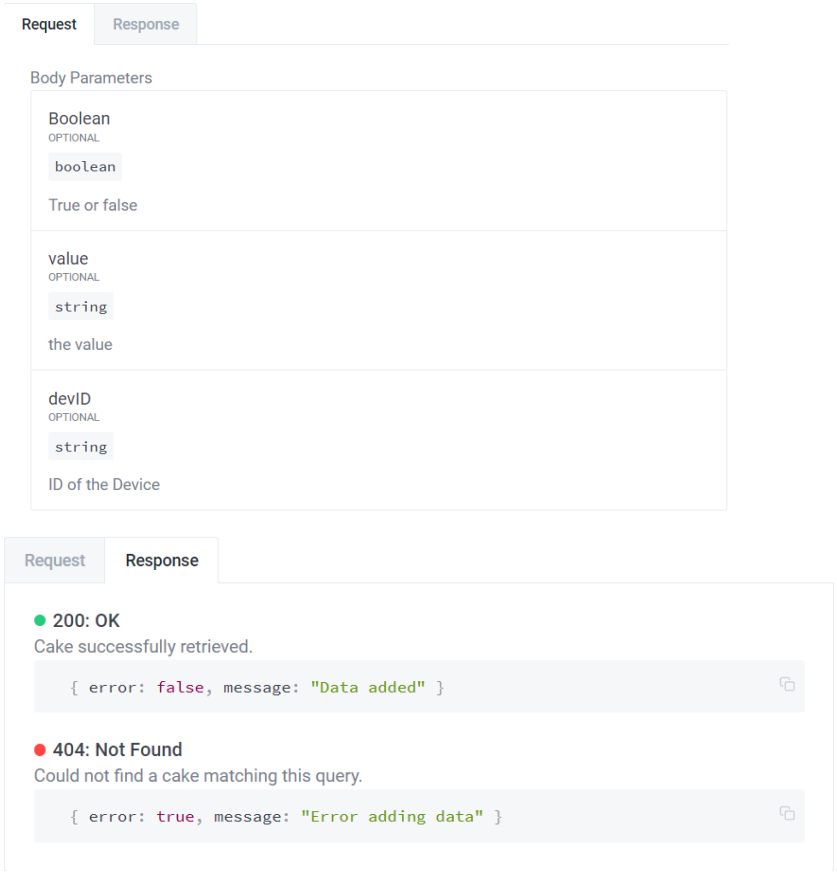
RFID Sensor

https://172.17.2.10/api/rfidReader



Machine vision sensor

https://172.17.2.10/api/imageReader



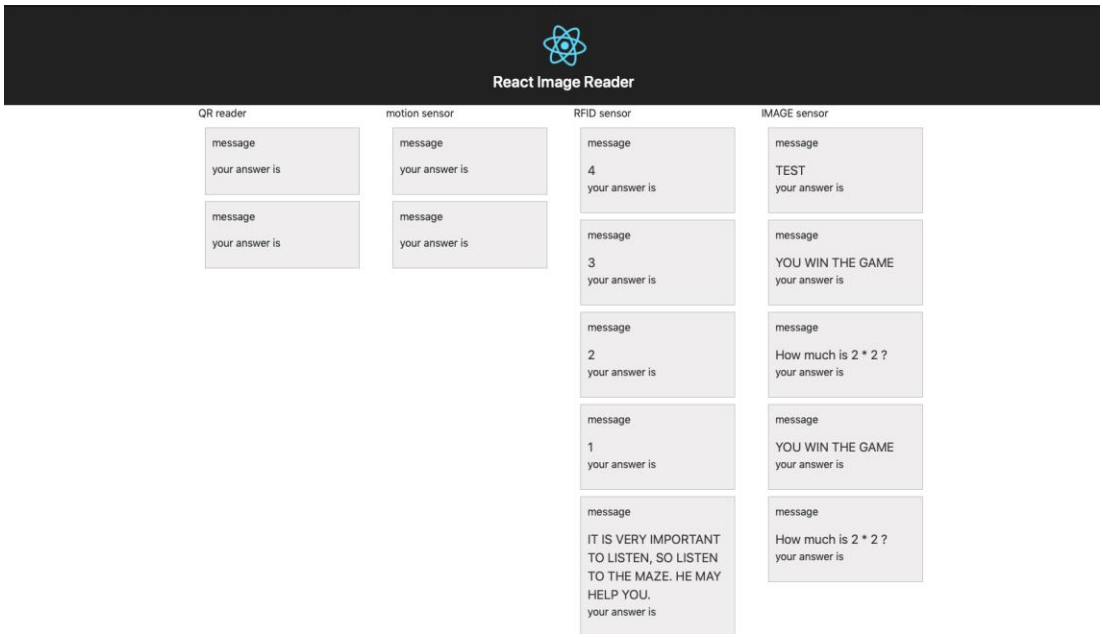
3.2 Frontend

3.2.1 About

React makes it painless to create interactive UIs. Design simple views for each state in the application and React will efficiently update and render just the right components when your data changes.

Declarative views make the code more predictable and easier to debug.

Finally, here is how the website looked like at the end. It was an easy way to represent the whole system to the user and also to check if every part of the Escape Room was working smoothly.



Picture 28. Frontend interface

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