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Voice-Controlled Home Lighting

Introducing the 5 Big Ideas in Artificial Intelligence using Internet of Things in STEM education

T2.4 IoT Projects Design & Resources Development

29.08.2023 | ECAM-EPMI
PROJECT NUMBER: 2022-1-FR01-KA220-SCH-000085611

AI4STEM IoT Projects Design & Resources Development Project: Voice-Controlled Home Lighting

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1.Introduction to the Project

The goal of this project is to control the lighting of a house or a classroom by voice or speech.

To achieve this, the following equipment is required:

- For the hard-ware:

- BBC micro:bit card

- Breadboard

- IO extender

- RGB Led Module

- Photoresistor module

- Sound detection sensor

- Connection wires

- For soft-ware:

- MakeCode

The aim of this project is to familiarise secondary school pupils aged between 12 and 16 with AI and make it easier for them to understand and above all to create and apply AI in project, in particular: the voice recognition.

In this document we show how to create an AI project based on the components: micro: bit card and sensors. The objective of the project to simplify the concept of AI by manipulating electronic components and programming through a computer, so that students can assimilate the added value of AI in a technological project.

1.1 The scope of the Project

The scope of the project is to use a micro:bit card, a sound detection sensor, a photoresistor module and an RGB LED module to create an Artificial Intelligence project.

1.2 The target groups

The project is targeted mainly to the direct involvement of educators, mainly of upper primary and secondary education.

1.3 The purpose of this document

The aim of this document is to use examples of activities and experiments to simplify pedagogically the concept of Artificial Intelligence for secondary school students, through the creation of their own project.

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2.Glossary of the Unit

Word	Definition
Micro:bit	The micro:bit is a pocket-sized, programmable computer board designed for education. It features an LED matrix, various sensors, and a microcontroller
Sensor:bit	The sensor: bit is an interface for sensors to link them with the micro:bit card.

3. Introduction to the "AI in Speech"

3.1 Description

The main aim is to get students involved in real-life applications to make everyday life easier. In addition, to encourage them to find solutions to problems encountered in their daily lives. They will be able to come up with several solutions and then choose the best one, and above all find the technical solution to their project.

This project involves using AI to control lights using voice commands.

3.2 Learning objectives & outcomes

The educational objective at the end of this project is that learners will understand the following:

- What is the principle of AI
- Data collection
- Role of the sensors
- Speech recognition
- Machine learning
- Interfacing
- Programming the micro:bit card
- How to apply AI in real projects
- Identify advantages and risks of implementing voice commands
- Explore programming commands applied to an artificial intelligence project using voice recognition

3.3 Estimated duration of the Unit

This is a rather extended project needing several hours to properly address all the included aspects. The following duration is indicative and might vary based on your students' age and level.

Activity 1: 60 minutes

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Activity 2: 30 minutes

Activity 3: 60 minutes

Activity 4: 45 minutes

Activity 5: 60 minutes

3.4 Activity 1 - Introducing the Big Idea of Perception:

3.4.1 Description

In this activity, students will take a hands-on look at the world of artificial intelligence and, in particular, speech recognition, in order to understand what perception is, thanks to sound sensors and their connection with the micro:bit card.

It is through this connection between the sound sensors and the micro:bit card, and by means of an appropriate programme, that the students will discover the role of technology in the exploitation of real-time data. Students observe first-hand the real-time ability of the system to respond and the interaction between humans and this advanced technology.

Using sensors such as the light sensor, noise sensor and rainbow led and the interface board with the micro:bit board, students discover the technological relationship between these different parts of the project. Live tracking not only demonstrates the real-time capabilities of the system, but also highlights the dynamic nature of technology as it reacts to its environment.

3.4.2 Hardware

- BBC micro:bit card
- Breadboard
- IO extender
- RGB Led Module
- Photoresistor module
- Sound detection sensor
- Connection wires

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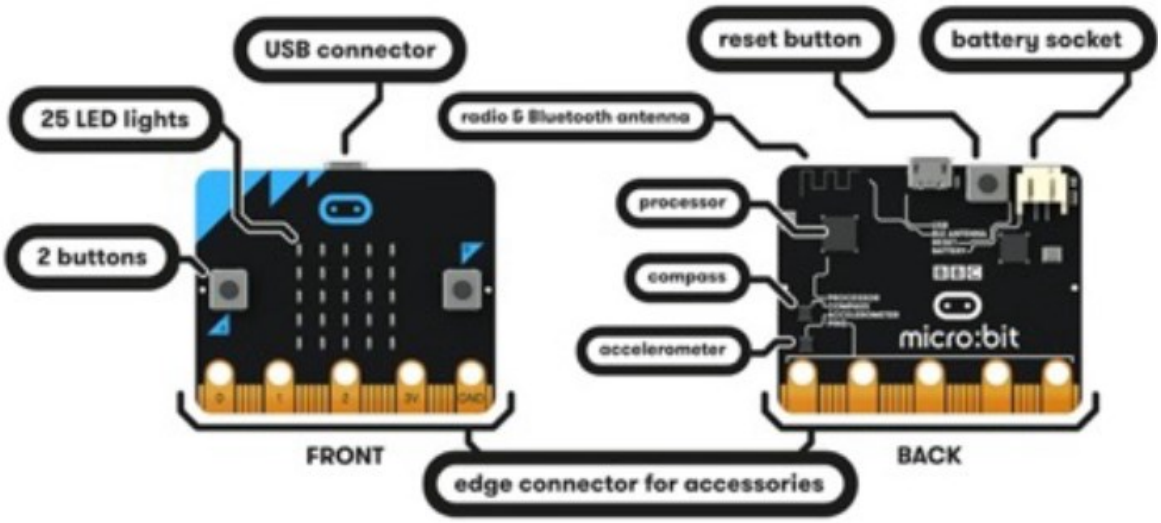

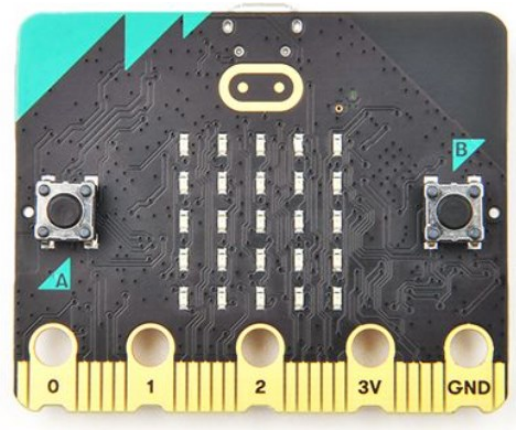

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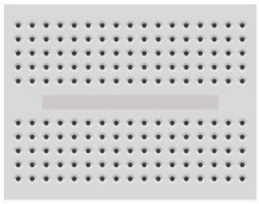
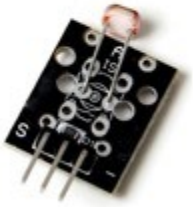
IO extender

1 x Breadboard



RGB Led Module

Photoresistor



1 x Sound Detection Sensor

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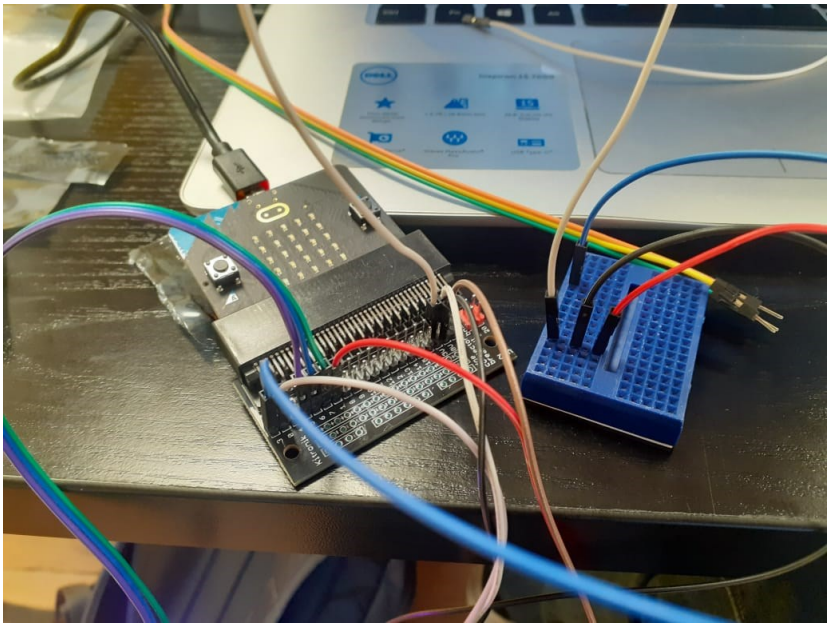
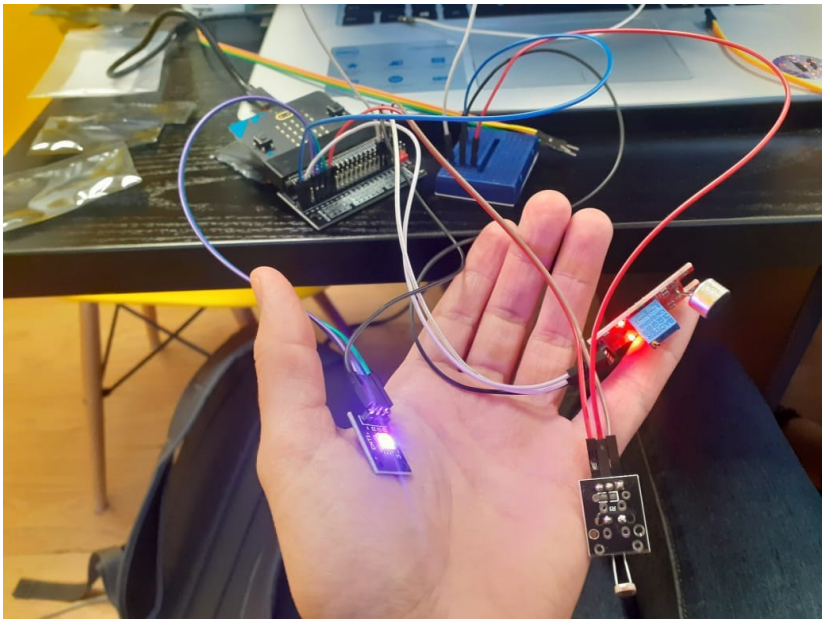
3.4.3 Setup

3.4.3.1 Wiring

Since the IO extender has only two pins and the other components have three or four pins, they must be connected through the Breadboard.

Here's how to wire the project:





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3.4.3.2 Get started

After setting up the wiring between the micro:bit and the interface card sensor-bit, the micro:bit must be connected with the PC through a cable. Once the connection is done, the programme can be loaded from the computer onto the card micro:bit.

3.4.3.3 Code

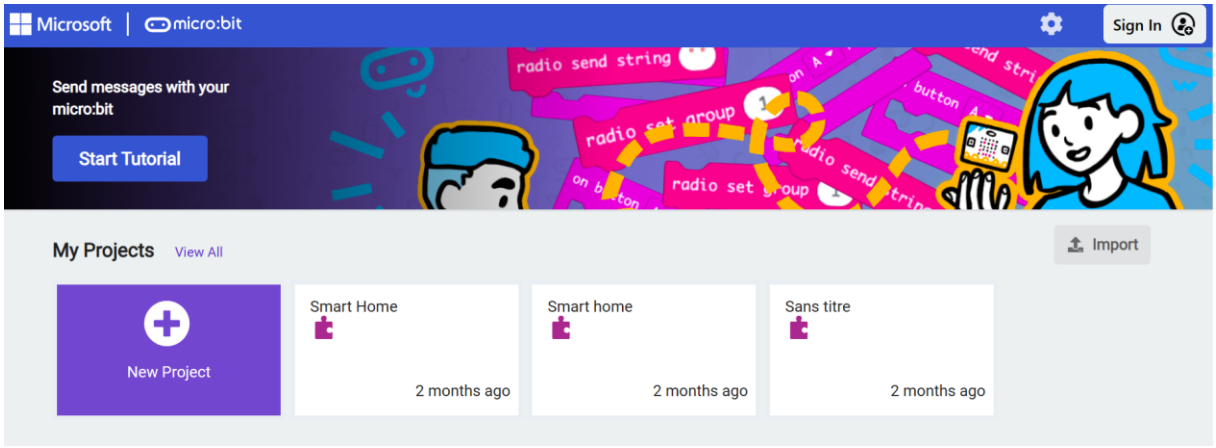
After setting up the wiring between the micro:bit and interface card, students should proceed to write code that provides instructions to the sensors enabling the creation of a voice recognition . This code will guide the sound and lighting sensors.

The student must use the software on the following website to write the code: https://makecode.microbit.org/

Programming the project

Step1

Click on: New Project



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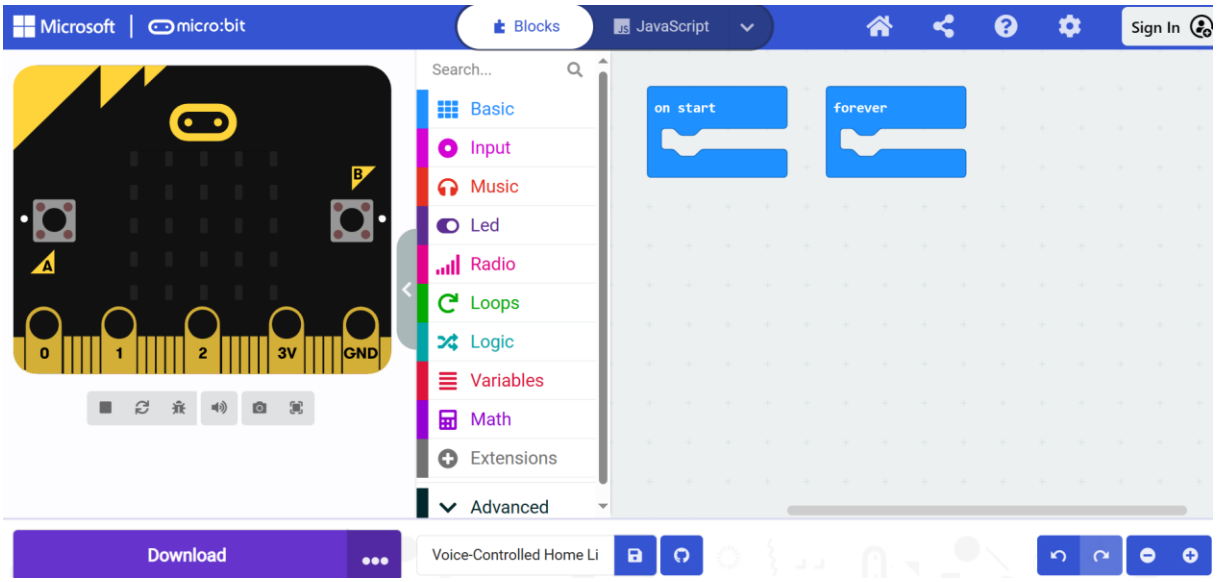
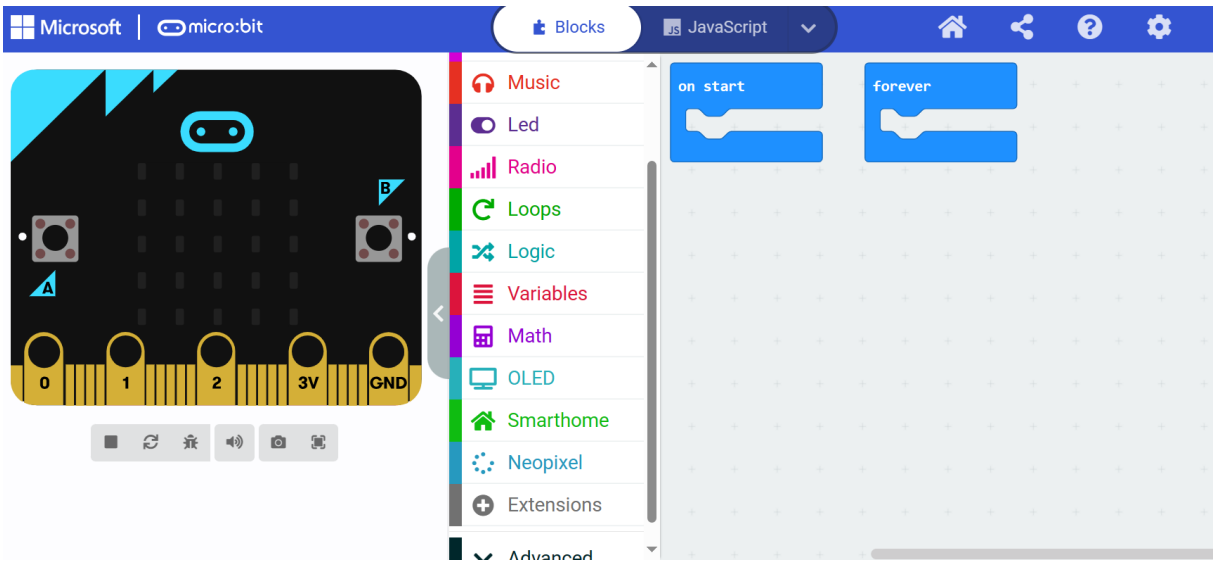


Step2

Click on: Extensions and after smart home



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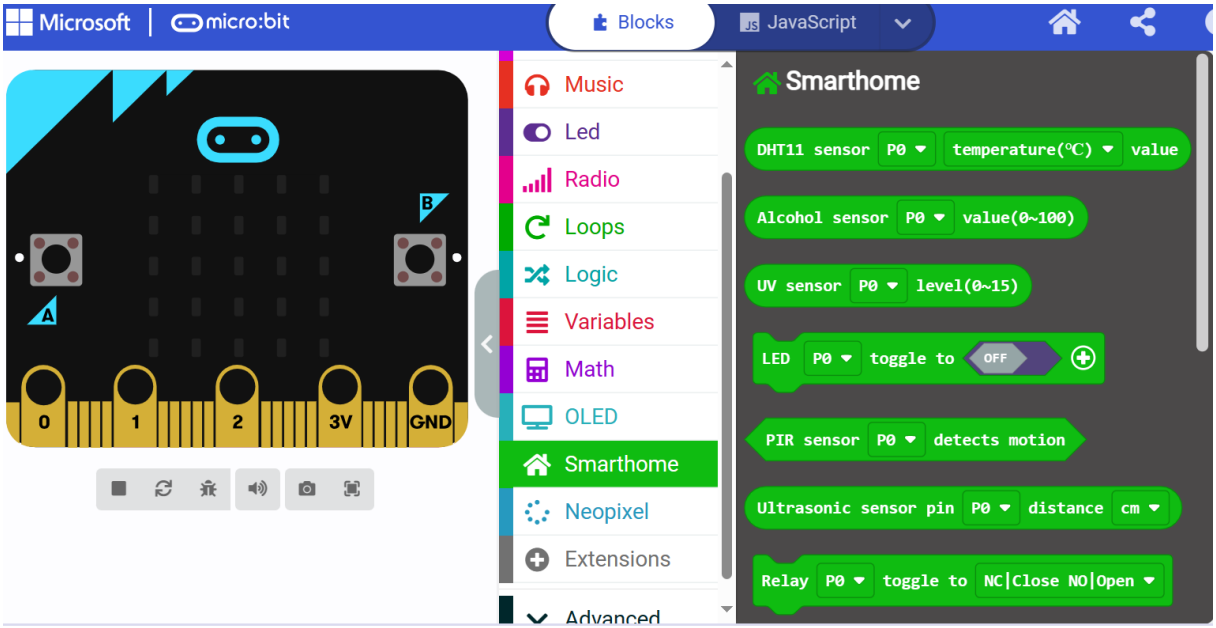

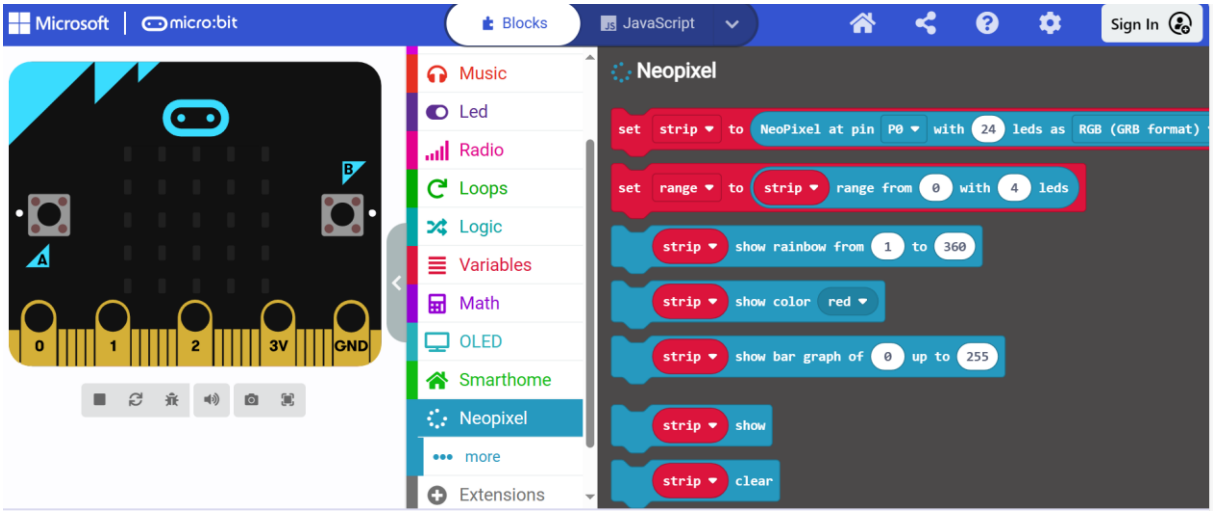

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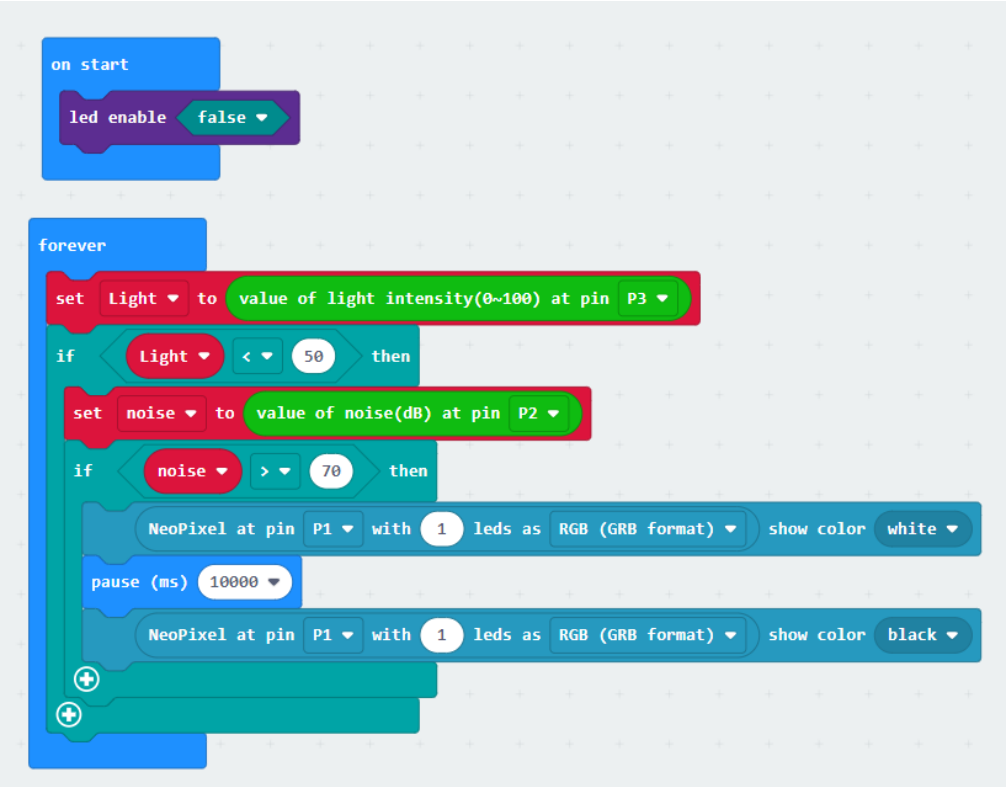
Voice-activated lights principle:

The LEDs are controlled by voice and the temperature by a sound sensor and a light sensor.



- The LED will not light up even if the sound sensor receives a voice during the day because the light sensor is locked during the day.
- The light sensor goes into standby mode in the evening, and the LED will light up when it picks up a voice. It will automatically switch off after a certain time, 10 seconds for example. Voice-activated light lasts six times longer than ordinary light. This helps the user to avoid looking for the switch and to save energy.

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Step 1

Go to the MakeCode page, click on Advanced in the code block and click on Extensions.

We need to add a new code base for programming the smart home. Look for "Add a package" at the bottom of the code block and click on it. Next, a message box will appear, search for "smart home" and download this new code base.

Step 2

Drag the forever block from Basic, drag the display number block and it latches forever.

Drag the LED activation block from LED, choose false to deactivate the LED array.

Step 3

Activate "set light to light intensity value (0 - 100) on pin P3" in the permanent block and change the number after light to 50.

If the light intensity value is greater than 50, it is during the day. If the light intensity value is less than 50, it is during the night.

Step 4

Snap "Set noise value (dB) to pin P2" while the light intensity value is below 50. Change the number after the noise to 70.

Voice sensor judging the noise value higher than 70.

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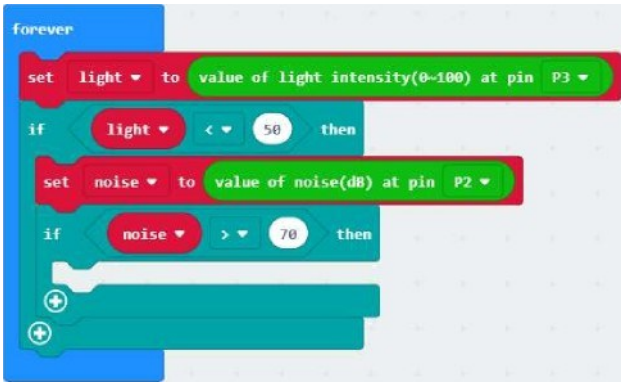
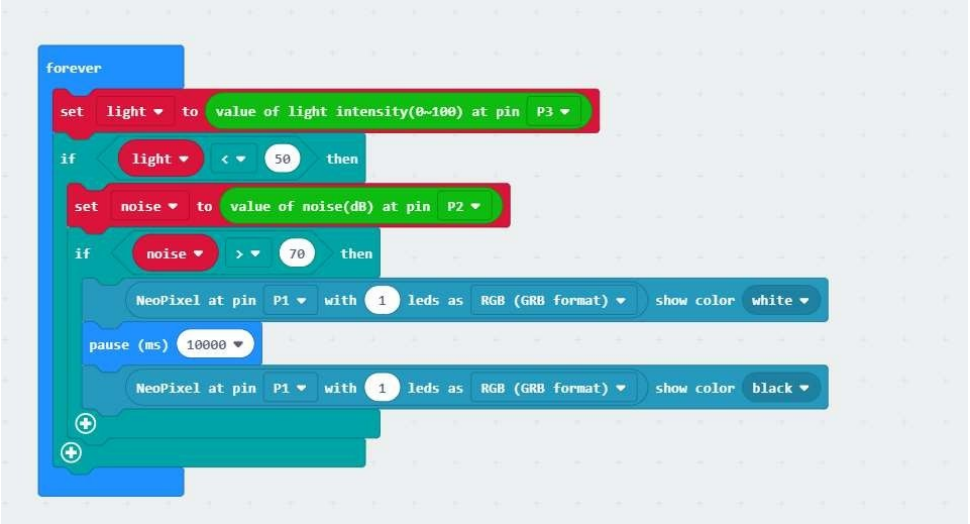


Step 5

The rainbow LED displays a white light when it detects a noise value above 70 and goes out after 10 seconds.



Activity 1 - Introducing the Big Idea of Perception

In this activity, students will take a hands-on look at the world of artificial intelligence and, in particular, speech in order to understand what perception is, thanks to sound sensors and their connection with the micro:bit card.

It is through this connection between the sound sensors and the micro:bit card, and by means of an appropriate programme, that the students will discover the role of technology in the exploitation of real-time data. Students observe first-hand the real-time ability of the system to respond and the interaction between humans and this advanced technology.

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Using sensors such as the light sensor, noise sensor and rainbow led and the interface board with the micro:bit board, students discover the technological relationship between these different parts of the project. Live tracking not only demonstrates the real-time capabilities of the system, but also highlights the dynamic nature of technology as it reacts to its environment.

Experiment 1

In this activity, students will have the opportunity to apply sound and light sensor technology and the micro:bit card to recognize different types of voices based on their intensities. This activity aims to understand voice recognition and allows them to explore the practical applications of this technology.

The main goal of this activity is for students to create a program that uses these sensors to identify and distinguish different types of voices.

Depending on the intensity of the voice, the LED lights up or not.

Activity 2: Presentation of the idea of representation and reasoning

Description

In this experience, students will explore the world of Artificial Intelligence and voice to explore the voice recognition method. This activity aims to build an Artificial Intelligence model to perform specific tasks or make intelligent decisions. The study phase is important to build this AI model because through this study the model understands and can do this task or solve a problem. Teaching and reasoning in relation to the AI model by confronting it with different information and data will allow this model to recognize its environment and thus react.

In this experiment, a sound sensor is connected to the micro:bit board and allows the AI model to collect data directly.

The micro:bit card, representing the brain of the application, becomes the interface through which students can observe and interact with the trained AI model. This activity allows students to not only understand the theoretical foundations of machine learning, but also appreciate the practical implications of deploying such technology in real-world scenarios. By the end of this experience, students understand the fundamentals of speech recognition and AI training. They also learn how to integrate AI into everyday life.

Exercise: Test the AI model with your voice

In this exercise, students will have the opportunity to apply sound sensor and light sensor technology with the micro:bit card to recognize the voice and especially its intensity. The goal of this exercise is to understand the AI model.

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Activity 3: Introducing the idea of Learning by training a model for voice Recognition

Description

In this activity, students focus on the learning phase. This phase applies the knowledge acquired by the model and tests its performance in providing correct results in real-time scenarios, particularly in the context of speech recognition.

The training phase involves testing the trained AI model, evaluating its ability to deliver good results, and ensuring that it can identify the intensity of the voice it was trained on. The goal is to know if the model is capable of producing a correct result to ensure that the AI model is working as it should.

The micro:bit board serves as an interface through which students interact with the AI model. Students are responsible for checking whether the model correctly recognizes the voice through the sound sensor.

The process involves intercepting the sound using the sound sensor and allowing the AI model to analyze and identify the voice based on the intensity of the model's voice. The role of the micro:bit card is then to make the link with the light sensor. If the AI model manages to light the LED, this indicates that the learning phase was effective and that the model is working correctly.

Through this activity, students acquire technological principles related to voice recognition and AI. This exercise is important when validating or not the model thanks to real tests carried out on the AI system.

Exercise

Test if the AI model recognizes voice intensity

Use the sound sensor and light sensor and micro:bit board to test the AI model with multiple voice intensities to see at what intensities the light sensor light turns on.

Through this exercise, the user can train and test the AI model.

Activity 4: Introducing the idea of Natural Interaction by integrating a trained model to an AI application

Description

In this activity, students will learn how to integrate the trained model, which they completed in the previous activity, into the system they previously created. The goal is for them to observe how the performance of “Voice-controlled home lighting” can be affected when a trained model is integrated into the application. In this way, they will become aware of how

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AI systems can be made to make errors due to the limitations of AI to interact in a natural way.

Activity 5: Introducing the idea of Societal Impact

Description

This activity aims to introduce students to the societal impact of AI, by analysing the experience acquired during the implementation of other activities. In particular, they will be asked to explore the advantages and disadvantages as well as the risks associated with the use of AI technologies. In addition, they must be made to think about data monitoring and information security as well as making decisions based on this data and information. Students will realize the importance of ethical decisions, along with technological decisions, when designing a product that is based on AI services.

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