



Interreg  Co-funded by the European Union
Slovakia – Austria

ICE-R: Inclusive and Creative Educations with Robotics and AI

Empowering Teachers and Students through Robotics and AI

Bildungsdirektion Wien 



STU SLOVAK UNIVERSITY OF TECHNOLOGY

1

ICE-R 3 pillars

- 3D printing and technologies
- Robotics
- Artificial intelligence



2

Introduction: Robotics in Education

1. What is a robot?
2. Why robots for education?

3

What is a robot?



4

Robot Definitions

An agentive device in a broad sense, purposed to act in the physical world in order to accomplish one or more tasks. In some cases, the actions of a robot might be subordinated to actions of other agents, such as software agents (bots) or humans. A robot is composed of suitable mechanical and electronic parts. Robots might form social groups, where they interact to achieve a common goal. A robot (or a group of robots) can form robotic systems together with special environments geared to facilitate their work.

Standard IEEE 1872

A robot is defined as "a programmed actuated mechanism with a degree of autonomy to perform locomotion, manipulation or positioning".

Standard ISO 8373 Vocabulary

"I don't know how to define one, but I know one when I see one!"

Joseph Engelberger

5

Robot Laws

The Three Laws, presented to be from the fictional "Handbook of Robotics, 56th Edition, 2058 A.D.", are:

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.



6

What is a robot?

Even that not strictly robots, they use the **same technology**:

- Sensors + Actuators + Control
- Embedded Microcontrollers
- Visual systems,
- Automation,
- and AI



7

Why robots for education?

- Development of STEM / 21st Century Skills
- Enhanced Motivation and Engagement
- Improved Learning Outcomes
- Interdisciplinary Learning
- Real-World Application



8

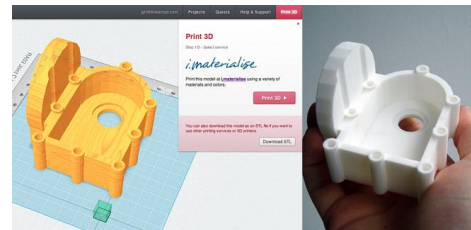
Why NOT robots for education?

- Distraction and Cognitive Load
- Dependence on Instructor Support
- Gender Issues
- Potential for Boredom
- Complexity and Cost (time + \$)



9

Part 1: Technologies for prototyping (3D print)



10

Part 2: Robot technologies (for education)

1. Simulators
2. micro:bit based robotics
3. mBot2
4. ...and AI

11

PRIA Hedgehog IDE Introduction



12

2.1 Simulator Hedgehog IDE <https://ide.pria.at>

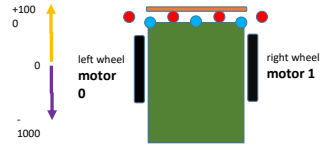


PRIA = Practical Robotics Institute in Austria
Hedgehog = r. Igel (AT), Ježko (SK)

13

Robot in the PRIA simulator - drives

Motors can use speeds between

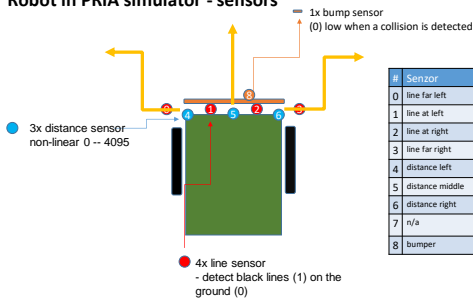


```
2D physical engine:
turn motors 0 and 1 off
brake motors 0 and 1
```

```
move motor 0 and 1 with speeds 1000 and 1000
move motor 0 and 1 with speeds 1000 and 1000 for 1 seconds
```

14

Robot in PRIA simulator - sensors



#	Senzor	Rozsah
0	line far left	0/1
1	line at left	0/1
2	line at right	0/1
3	line far right	0/1
4	distance left	0 - 4095
5	distance middle	0 - 4095
6	distance right	0 - 4095
7	n/a	
8	bumper	0/1

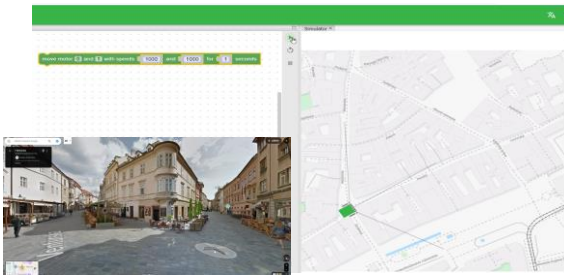
15

Task 1: city walk



16

Task 1: city walk



17

2.2 micro:bit & robotics + AI



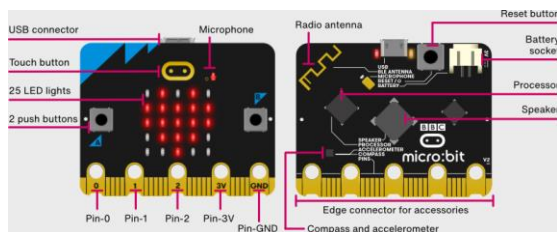
18

Robots for education



19

2.2 micro:bit



20



Kitronik :MOVE mini MK2 buggy kit

1+ 34,47 €
10+ 31,59 €

without micro:bit

Disassembled kit (repeatability?)
Differential drive
3x AA battery 1,5V
Opening for pen - can draw

<https://kitronik.co.uk/collections/accessories-for-the-bbc-micro-bit/products/5652-move-mini-mk2-buggy-kit-excl-microbit>

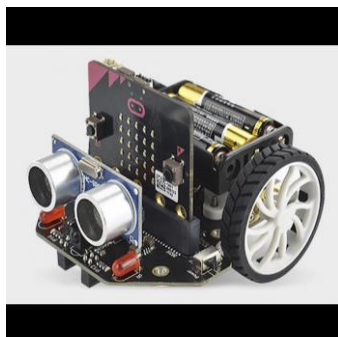
21

Microbit biped (OTTO)

<https://www.thingiverse.com/thing:2786066>



22



micro: Maqueen micro:bit Robot

partially assembled 1+ 39,48 €

Differential drive without micro:bit

3,5V (3x AAA or 3,6-3,7V LiPo)

Sensors:

2x Infrared (bottom)
1x Infrared Receiver (NEC decoder)
1x SR04 Ultrasonic

Actuators:

2x N20 dc motor with metal gear 1:150
2x LED red
4x RGB neopixel multicolor
1x I2C Interface (3.3V)

Dimensions: 81x 85 x 44 mm
Weight: 75,55 g

23



balenie obsahuje dosku micro:bit V2

ELECfreaks Ring:bit Car V2.0

1+ 47,88-52,90 €

incl. micro:bit

Assembled
Differential drive
3x AA battery 1,5V

<https://youtu.be/zGyO9VlCoSg>

<https://fx.sk/sk/microbit/8578-electreaks-ringbit-car-v20-for-microbit-obsahuje-microbit-v2-e08201v2.html>

24

Wukong based robot



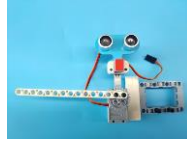
1+
47,88-52,90 €
without micro:bit

component, part of the kit
integrated battery

<https://www.elec freaks.com/wukong-board-with-lego-holder-for-micro-bit.html>

25

Wukong based robot



<https://www.elec freaks.com/blog/post/micro-bit-walking-robot.html>

26

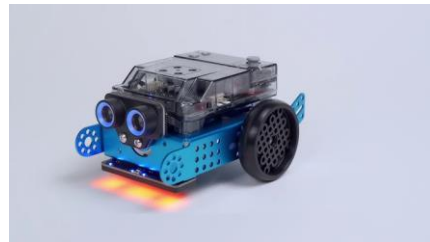
Cardboard robots



https://youtu.be/0Vpsrh_tS0A

27

2.3 Robot mBot2 - presentation by Michal Kocúr / FEI STU



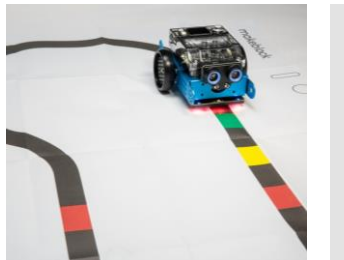
28

What is mBot2?

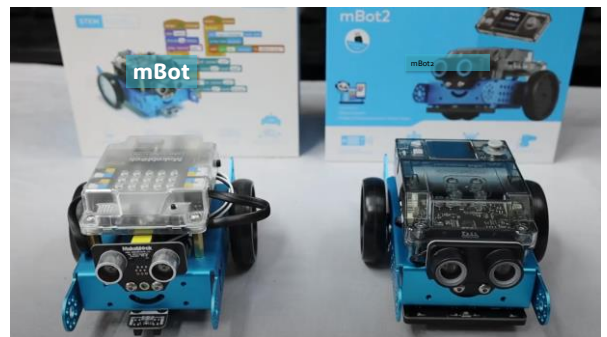
A programmable robot designed for STEM learning.

Powered by advanced electronics and sensors.

Can be programmed in Python or using block-based programming




29



30


Block-based programming

- very similar to the Scratch
- drag and drop blocks of code to create programs
- without worrying about typing or syntax



31

mBot2 components



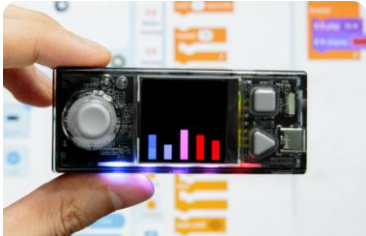
- CyberPi**
ESP-32 microprocessor for wireless communication. Compatibility with block-based and Python coding.
- mBot2 shield**
Compatible with a wide variety of external components, includes a built-in rechargeable battery.
- Ultrasonic sensor 2**
Object detection is accompanied with 5 programmable LEDs for an enhanced interaction.
- Encoder motors**
Measure rotation to 1-degree accuracy, distance travelled and precisely control speed up to 200RPM.
- Quad RGB sensor**
A sensor probes support color recognition, as well as basic and advanced line detection programs.

32

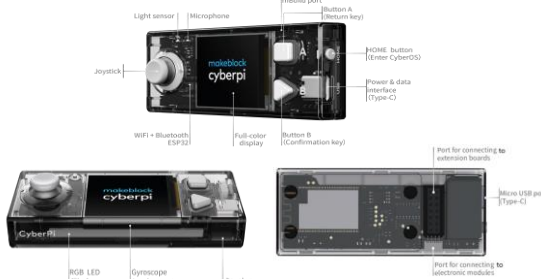
CyberPi

ESP32-WROVER-B

- WiFi
- Dual-mode Bluetooth
- Micro USB port (Type-C)
- Port for connecting to extension boards
- Port for connecting to electronic modules (serial communication)



33



- Light sensor
- Microphone
- mBuild port
- Joystick
- Button A (Enter key)
- Button B (Confirmation key)
- WIFI + Bluetooth (ESP32)
- Full color display
- Power & data interface (Type-C)
- Port for connecting to extension boards
- Micro USB port (Type-C)
- Port for connecting to electronic modules
- RGB LED (f/w)
- Gyroscope Accelerometer
- Speaker

34

Example 1: Noise detector

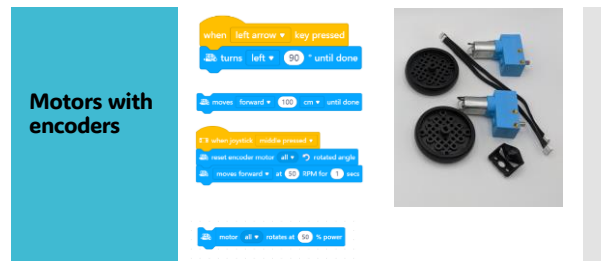


```

when CyberPi starts up
  sensor
  2.3 subtle input (microphone) of color 1 > volume 1 >
  2.3 subtle input (microphone) of color 2 > volume 1 >
  
```

35

Motors with encoders



```

when left arrow key pressed
  all turns left + 90° until done
  all moves forward + 100 cm until done
  if other joystick - middle pressed >
  all reset encoder motor all + → rotated angle
  all moves forward + at 90 RPM for 1 sec
  all motor all + rotate at 90° power
  
```

36

Example 2: Go forward 20 cm

```

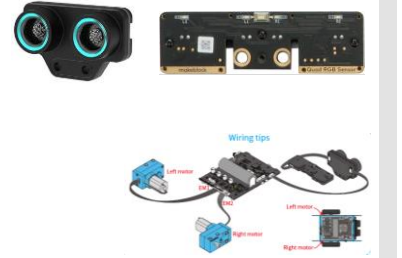
when button A pressed
  move forward 20 cm until done
  
```



37

Ultrasonic Sensor 2
Output range: 5-300 cm

Quad RGB Sensor
Detection range: 5-15 mm from the object to be detected



38

Example 3: Parking sensor

```

when button A pressed
  move forward 10 cm until sensor is triggered
  move backward 10 cm until sensor is triggered
  move forward 10 cm until sensor is triggered
  move backward 10 cm until sensor is triggered
  move forward 10 cm until sensor is triggered
  move backward 10 cm until sensor is triggered
  move forward 10 cm until sensor is triggered
  move backward 10 cm until sensor is triggered
  
```



39

Example 4: Avoiding obstacles

```

when button A pressed
  move forward 10 cm until sensor is triggered
  turn right 90 degrees
  move forward 10 cm until done
  
```



40

Example 5: Color detector

```

when button A pressed
  move forward 10 cm until sensor is triggered
  move backward 10 cm until sensor is triggered
  move forward 10 cm until sensor is triggered
  move backward 10 cm until sensor is triggered
  move forward 10 cm until sensor is triggered
  move backward 10 cm until sensor is triggered
  move forward 10 cm until sensor is triggered
  move backward 10 cm until sensor is triggered
  
```



41

Example 6: Line Follower

```

when button A pressed
  move until sensor is triggered
  set base power to 50
  set left motor to 50
  set right motor to 50
  set left power to base power
  set right power to base power
  quad rgb sensor 1 detection (100-100)
  quad rgb sensor 1 detection (100-100)
  if sensor 1 is triggered
    set left power to 0
    set right power to 0
  
```



42

Where can I find more information?

- Makeblock official website
<https://www.makeblock.com/pages/mbotz-coding-robot>
- Makeblock help center
<https://support.makeblock.com/hc/en-us/articles/500006383023-What-is-mBot-Nano-mBotz>
- Makeblock STEM center
https://www.makeblock.com/collections/stem-classes?sort_by=manual&filter.p.m.custom.filter_by_product=mBotz

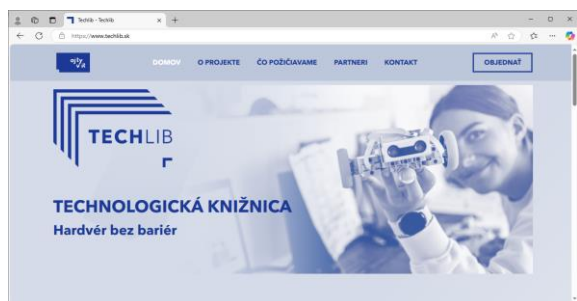
I don't have a robot... :(

Use a simulator!

OR...

43

44



<https://www.techlib.sk/>

45

Zdieľané vybavenie SmartLabu

Zdieľané vybavenie SmartLabu je **zdelené medzi knižnicami** v rámci programového kraja, knižnice nim preto nemusia disponovať podrobne určené obdoby. Ak máte záujem o konkrétne vybavenie, kontaktujte prosím **veľko miestnu knižnicu**, ktorá vám poskytne bližšie informácie.

Ozobot
Ozobot je malý programovateľný robot, ktorý je určený na učenie programovania a tých najmenších s Ozobotom je možné vytvoriť a programovať rôzne trasy alebo si sazy pomocou farebných značiek a fareb. Tento interaktívny robot umožňuje deťom vytvoriť vlastné cesty a programy, ktoré ovplyvňujú jeho pohyb a správanie.

mBot
mBot je programovateľný robot určený pre vysokoškolské učatý, najmä pre začiatníkov v oblasti robotiky a programovania. Tento robot je vybavený rôznymi senzorami a generovanými mechanizmami, ako sú motory a kolesá. Čo umožňuje simulátorom vytvoriť a ovládať rôzne typy robotických projektov.

Viac o Ozobotoch [testujeme zábera](#) a [Ozobotom v knižnici](#)

<https://smartlab.cvtisr.sk/>

46

Part 4 Artificial Intelligence

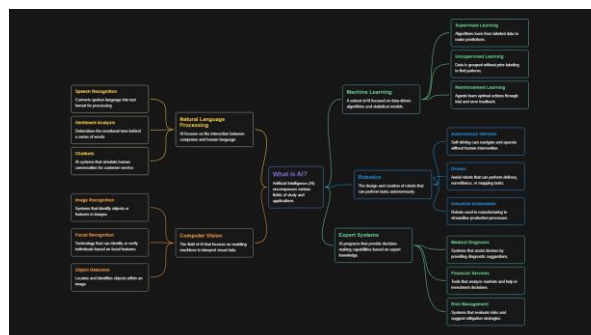
Non-exhaustive list

- Classical AI**
 - Rule-Based Systems, Search Algorithms, Depth First, Breadth First, A* algorithm, Propositional Calculus, Predicate Calculus Logic.
- Machine Learning**
 - Support Vector Machine, Decision Trees, Gradient Boosting, Principal Component Analysis, Logistic Regression, Linear Regression, K-means Clustering.
- Deep Learning**
 - Recurrent Neural Networks, Convolutional Neural Networks, Deep Reinforcement Learning with Deep-Q Learning, Capsules & GANs.

Deep Learning refers to the field of neural networks with several hidden layers.

www.dfs.ltd @deplearn007

47



48

4. Artificial intelligence in robotics

- + ChatGPT as a code generator
- + micro:bit AI or Teachable Machine
- + smart camera for robots

49

4.1 Code with AI

Can you give me a short program for random walking the room with an ultrasonic obstacle sensor for avoiding walls?

Here's a simple Python program for random walking with an ultrasonic sensor to avoid walls. This program uses the micro:bit's CyberPi microcontroller, the ultrasonic sensor, and the motors.

Requirements:

- micro:bit with an ultrasonic sensor connected to port 1.
- mBlock software to upload or run the code.

```
python
from cyberpi import *
import random
import time

# Set constants
SAFE_DISTANCE = 25 # Safe distance in cm to avoid walls

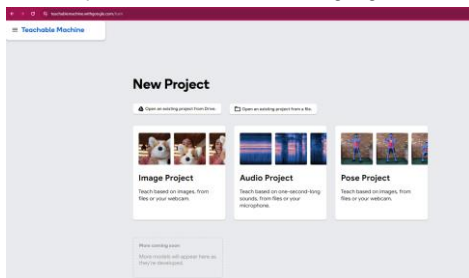
def random_walk():
    while True:
        # Set distance from the ultrasonic sensor
        distance = mBlockUltrasonicSensor.get(1)

        if distance < SAFE_DISTANCE:
            # Distance detected, turn randomly
            motor.rotate()
```

chatGPT 4o:

50

4.2 TM <https://teachablemachine.withgoogle.com>



51

4.3 Smart cameras for robots



52

4.3.1 Smart AI lens

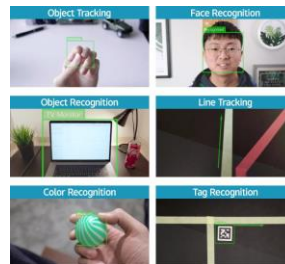


53



micro:bit AI Smart Lens Kit
ELECFREAKS
Shenzhen, China, € 50-65

4.3.2 Huskylens




54



Gravity: Huskylens
DF Robot
Chengdu, China, € 60-75

4.3.2 Huskylens

Arduino, micro:bit, Raspberry Pi and LatticePanda



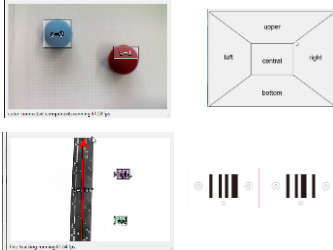
```

// Huskylens
Huskylens initialize the serial console
Huskylens switch algorithm to: Face Recognition
Huskylens request data and save into the result
Huskylens get a total number of detected face from the result
Huskylens check if found * 10 is screen from the result
Huskylens get * 10 * of area (located in the center of screen from the result)
Huskylens get * 10 * of area (located in the center of screen from the result)
Huskylens check if * 10 * is learned from the result
Huskylens check if * 10 * is screen from the result
Huskylens get * 10 center * of * 10 * from the result
Huskylens get * 10 * of * 10 * show that the result

// Face
Huskylens request data and save into the result
if * 10 * is learned from the result * 10 *
Huskylens show custom block * 10 * Huskylens get * 10 center * of * 10 * from the result to * 10 * at position * 10 * at screen
Huskylens show custom block * 10 * Huskylens get * 10 center * of * 10 * from the result to * 10 * at position * 10 * at screen
    
```

55

4.3.3 Smart camera for mBot2

Smart Camera Add-on Pack € 90-150
MakeBlock
Shenzhen, China / Irwindale USA / Netherlands

56

4.3.3 Smart camera for mBot2




57

Summary

During the bootcamps, students will work with:

- 3D printing,
- Robots and
- AI

If you are interested, we can provide more detailed information about any of topics presented today, just let us know...

58

Contact

Any questions? Problems?
Advice with educational robotics?
Don't hesitate to contact me:



Richard Balogh
Slovak University of Technology
richard.balogh@stuba.sk



59