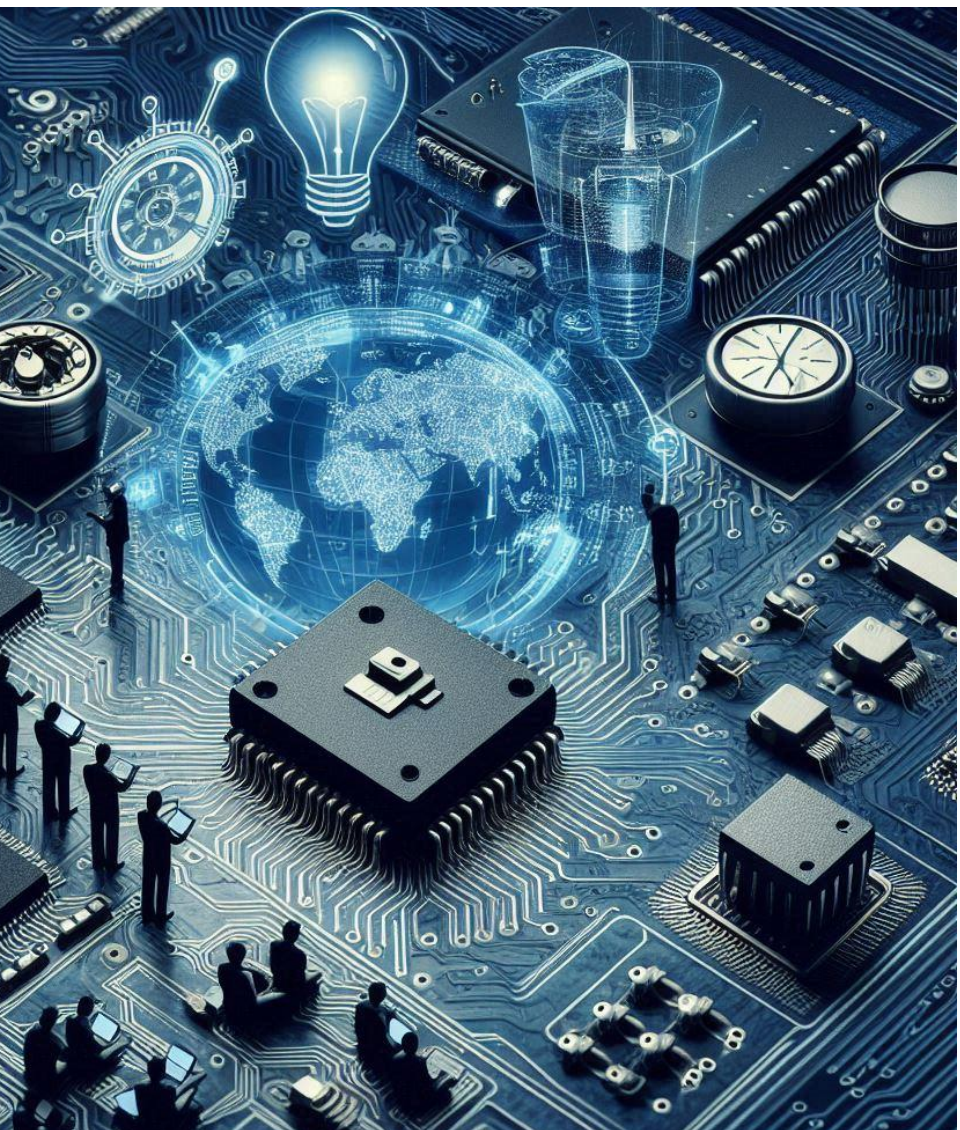




Toolkit Experiments

In order to further promote the introduction of microelectronics in schools, Hochschule Munich has developed two portable experiment suitcases as an additional educational resource. The concept behind these suitcases is to provide easily accessible, low-cost examples that can be utilised by any school, regardless of their existing equipment. The suitcases are presented and explained below.

LabKit - Image Recognition



The kit consists of:

- Raspberry Pi - Kamera, KI (AI), 12MP (has built-in neural network processor)
- RASPBERRY PI 5 B 4GB ALL-IN (TensorFlow)
- microphone
- cable and box

Approximate costs: 150€

This LabKit enables a range of interactive learning experiences, including three key demonstrations and projects. These include demonstration 1: Object and Gesture Recognition, which leverages the camera's pre-trained neural network to recognize specified images and detect key points for gesture recognition.

Additionally, Project 2: Object Recognition and Project 3: Speech Recognition allow pupils to collect and train their own data using the camera and microphone, respectively, and install the software on the Raspberry Pi. By providing hands-on experiences in image and speech recognition. These demonstrations and projects showcase the potential of the LabKit to promote innovative and engaging learning.

What is in the Box, what are the costs

Own laptop, serves as terminal and keyboard

96€ Raspberry Pi – camera, AI, 12MP

has built-in neural network processor

(30€ Raspberry Pi – camera, 12MP)

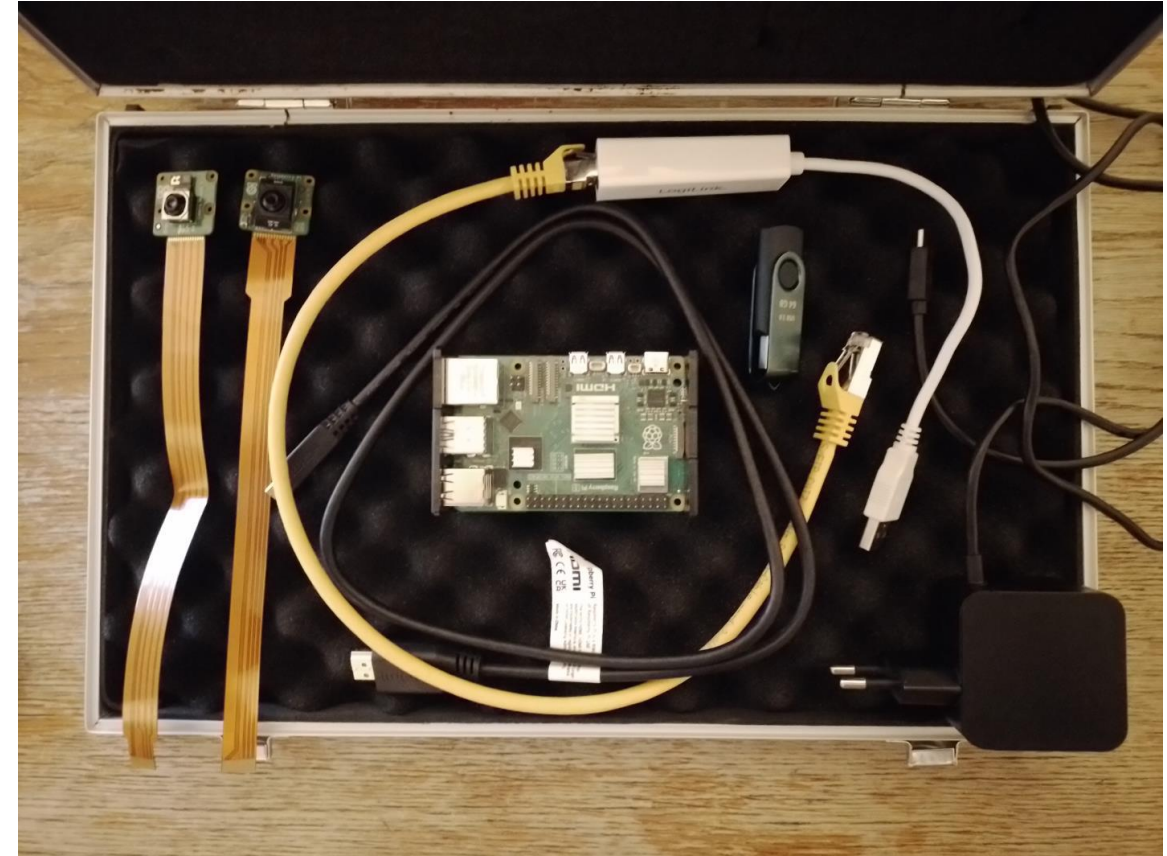
100€ RASPBERRY PI 5 B 4GB ALL-IN

TensorFlow

20€ microphone

30€ cable and box

Together ~ 150€



Setup of Demonstration 1

Demonstration 1: (small effort)

Object and gesture recognition with AI camera and a pretrained neural network (NN) installed in the camera firmware. Images to be recognized are specified. Raspberry Pi is used only for control.



*Problem: how to connect to the RPi5?
Is WLAN or cable easier?*



What else can be done



Leading idea: no software without hardware

Status: Demonstration 1 works

Demonstration 1: (small effort)

Object and gesture recognition with AI camera and pretrained neural network (NN) installed in the camera firmware. Images to recognize are specified. Raspberry Pi only for control.

Project 2: (larger effort)

Object recognition with camera, based on own collected data. Image collection with the camera, training on your own or an external computer, installation of the software on the Raspberry Pi (> 100 own images per label needed).

Picture recognition: (how does face recognition at the airport work?)

Images from trained classes are given: apple, banana, human, dog, ...

Gesture recognition: (how does autonomous driving work?)

Only keypoints are detected; gesture recognition requires further software.

Project 3: (larger effort)

Speech recognition with microphone, based on own collected data. Speech fragment collection with the microphone, training on your own or an external computer, installation of the software on the Raspberry Pi (> 100 own fragments per label needed).

Effort of presenting the portable experiments: LabKits



The kits can be presented during a school class visit to the university or during a visit by the lecturer to the school. Which is more efficient?

School class visit to the university:

20+ pupils, teacher travels to the university and back
At the university: planning of the visit, usually several labs/people involved

Advantage: pupils see the labs in addition to the portable experiments

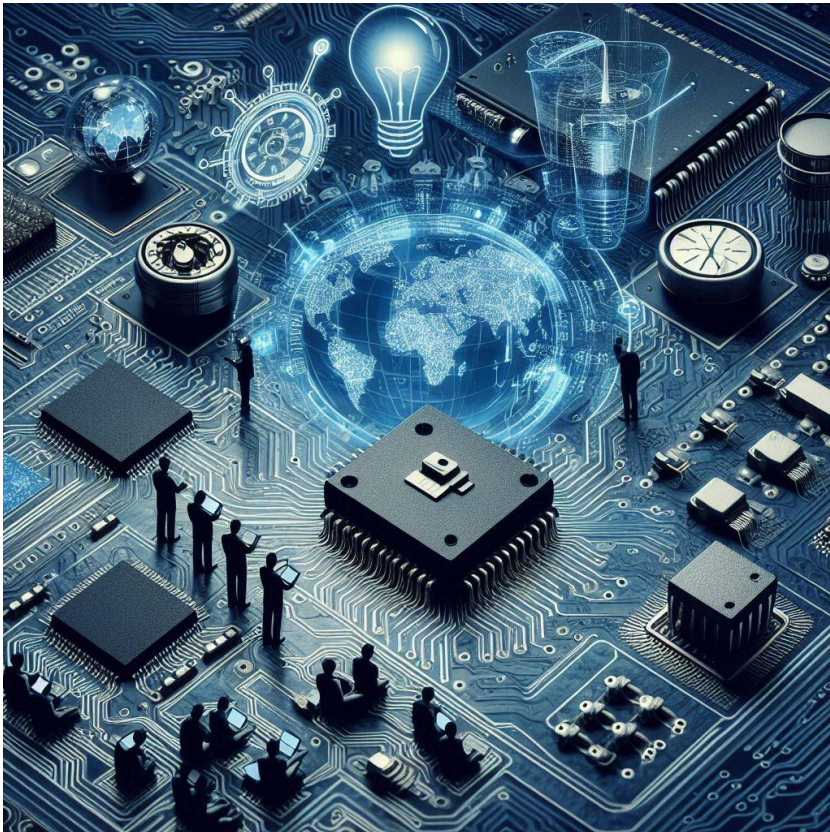
Disadvantage: a lot of effort for the university

Lecturer visit to the school:

Only the lecturer travels to the school
At school: only planning of the presentation in a classroom needed

Advantage: less effort for the university, because...

Disadvantage: not much further information about the university



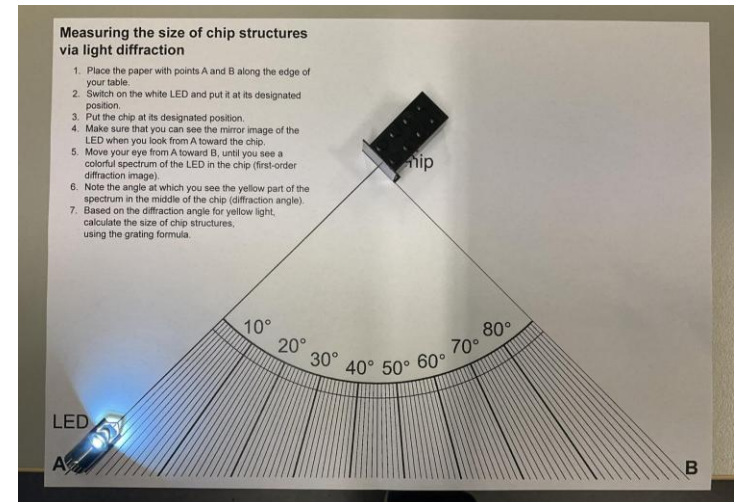
LabKit: Measuring chip structures

LabKit – Measuring chip structures

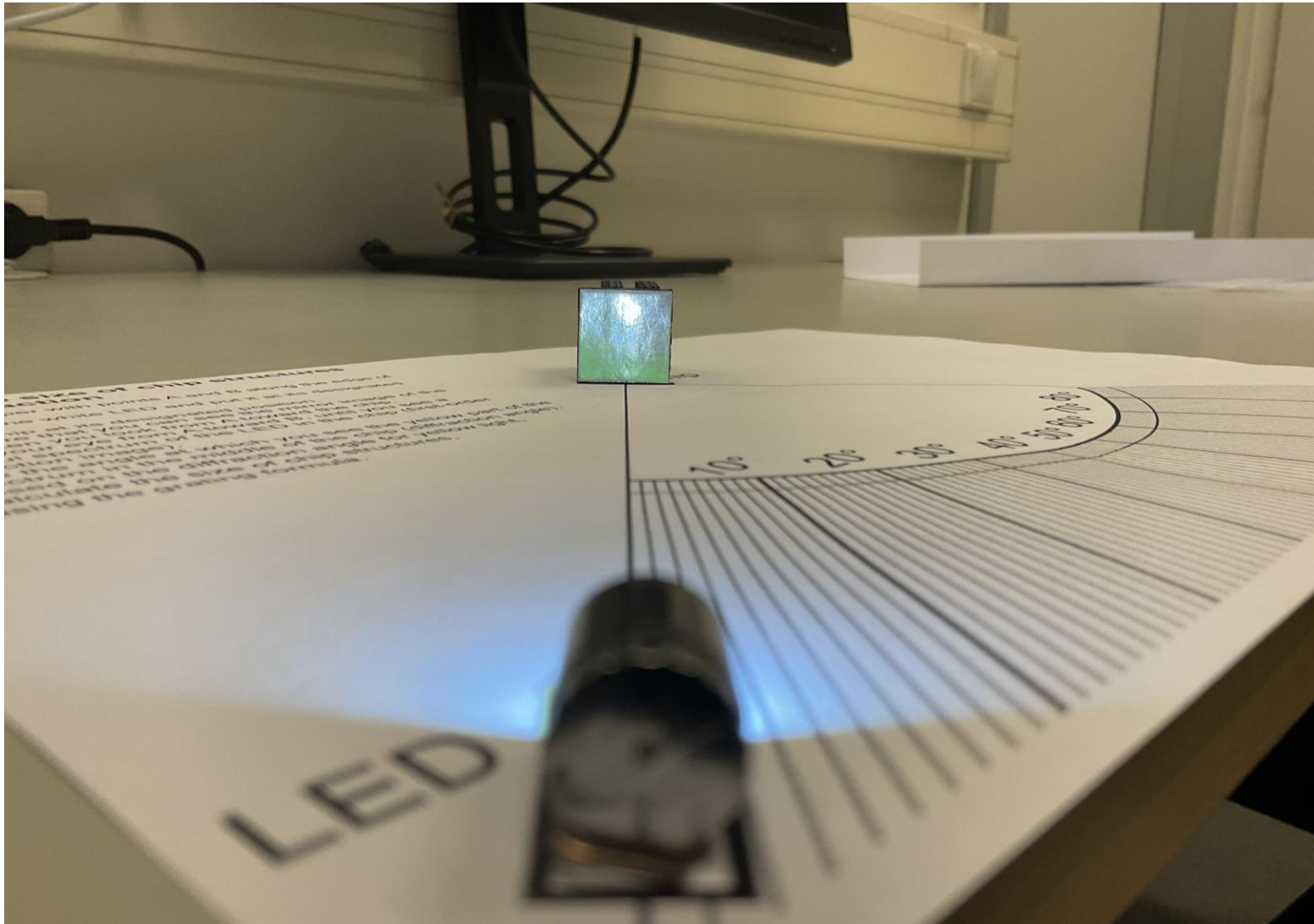
This LabKit enables the measurement of chip structure sizes by utilizing the principle of light diffraction. By shining a light through the chip and observing the resulting diffraction pattern, users can calculate the size of the chip's structures using the grating formula, providing a non-destructive and accurate method for characterizing chip features.

Instruction:

1. Place the paper with points A and B along the edge of your table.
2. Switch on the white LED and put it at its designated position.
3. Put the chip at its designated position.
4. Make sure that you can see the mirror image of the LED when you look from A toward the chip.
5. Move your eye from A toward B, until you see a colorful spectrum of the LED in the chip (first-order diffraction image).
6. Note the angle at which you see the yellow part of the spectrum in the middle of the chip (diffraction angle).
7. Based on the diffraction angle for yellow light, calculate the size of chip structures, using the grating formula.



Mirror image (0th order)



Diffraction image (1st order)

