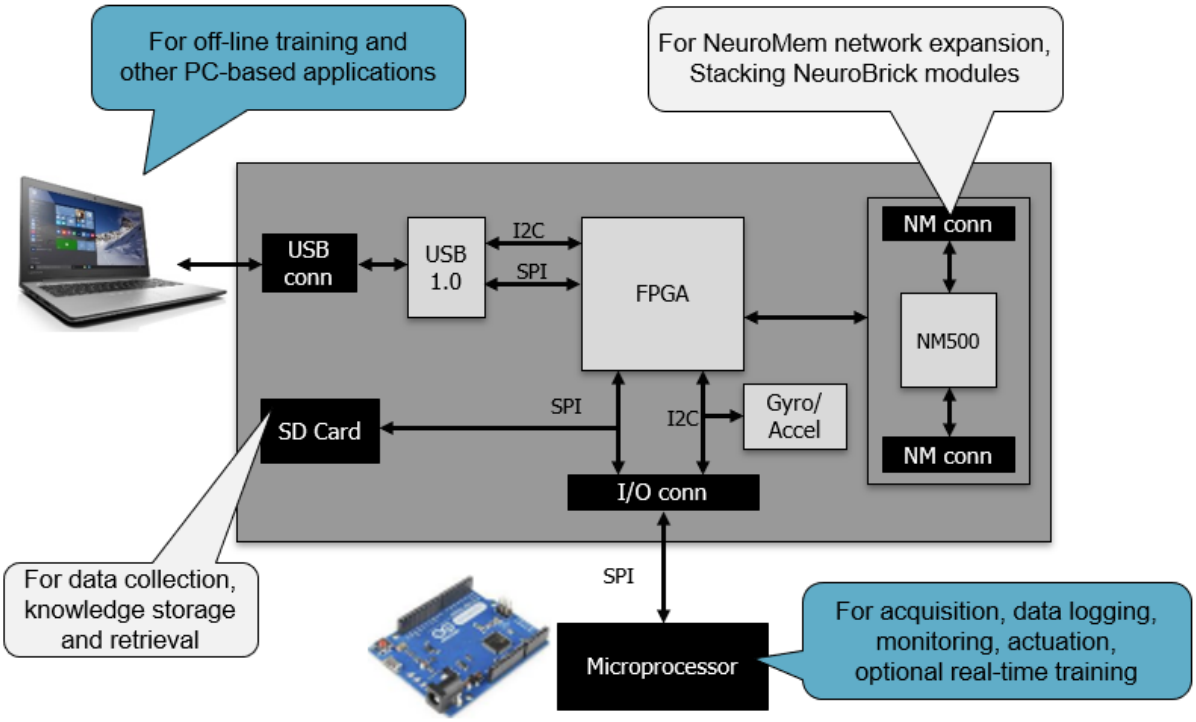
NeuroShield

NeuroShield is a shield board featuring the NM500 neuromorphic chip with 576 neurons ready to learn and recognize stimuli extracted from any type of sensors including IMU, audio, environmental sensors, bio-signal, video and more.

- SPI interface:
  - For use as a shield with Arduino, Raspberry PI, and other microcontrollers to empower embedded systems with access to a NeuroMem network.
- USB Serial interface
  - For use as a simple USB dongle to empower PC-based applications with access to a NeuroMem network.



> NeuroShield and NeuroBrick are products from nepes.
> The NeuroMem® NM500 is a chip manufactured by nepes under license from General Vision Inc.
> General Vision Inc. is the inventor and owner of the NeuroMem® technology.

Download the Board Support package at **https://github.com/general-vision/neuroshield**

The General Vision **Board Support Package** let you develop a complete workflow with the training of the neurons performed (1) on the NeuroShield mounted on a microcontroller or (2) off-line on the NeuroShield connected to a PC via USB, or a combination of both.

Contents

Power Supply & Compatibility

The NeuroShield requires 5V power supply which can be delivered through the USB connector or through the Arduino J1 connector.

NeuroShield V0.3: Compatible with base platforms supporting both 5V and 3.3V IO voltage
(J1 , pin 7, IOREF is not connected)

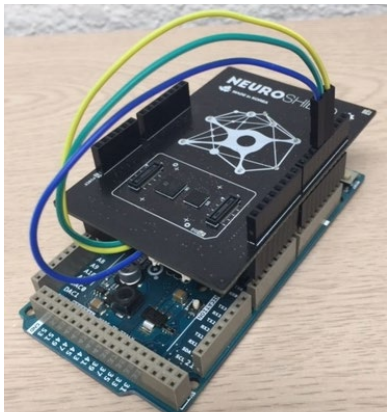
NeuroShield V0.1 and V0.2: Compatible with the Arduino UNO and other base platforms supporting 5V IO voltage. NOT compatible with base platforms supporting 3.3V IO voltage
(J1 , pin 7, IOREF is connected to 5V)

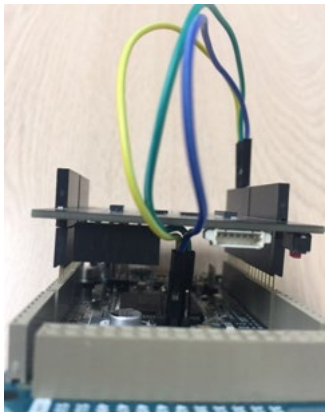
Arduino Examples

- NeuroMem library establishes communication to the NeuroShield through SPI and gives access to the neurons of the NM500 chip.
- Academic Scripts illustrating how to teach the neurons and query them for simple recognition status, or a best match, or a detailed classification of the K nearest neurons.
- Motion recognition examples using the on-board IMU from Invensense (MPU6050) and the IMU from the Arduino101.
- Video recognition examples using an ArduCAM shield
- Object Tracking script

WARNING: The NeuroShield does not feature a 6-pin ICSP connector.

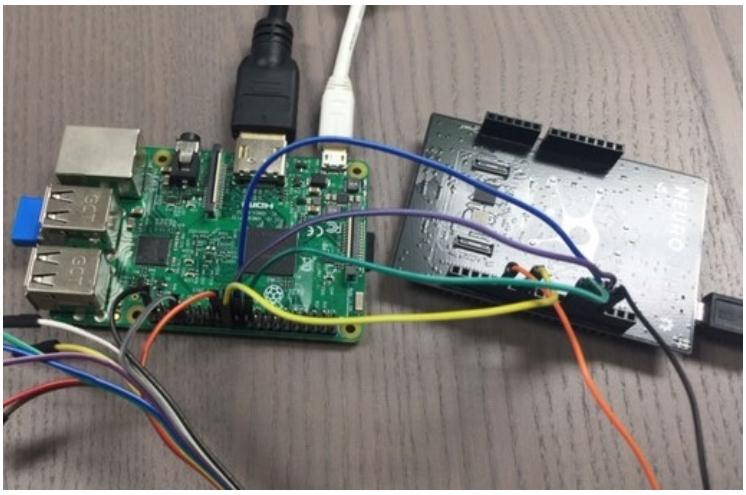
Therefore, it is not directly compatible with the Arduino DUE and any Arduino board with SPI lines assigned to pins other than D11-13. In such case you will have to wire the SPI lines of your board to the J2 of the NeuroShield as described in the table below.





Python examples for Raspberry PI

Connecting the NeuroShield to the Raspberry PI is easy following the instructions in the table below. The Board Support Package includes examples written in Python demonstrating pattern and image recognition.



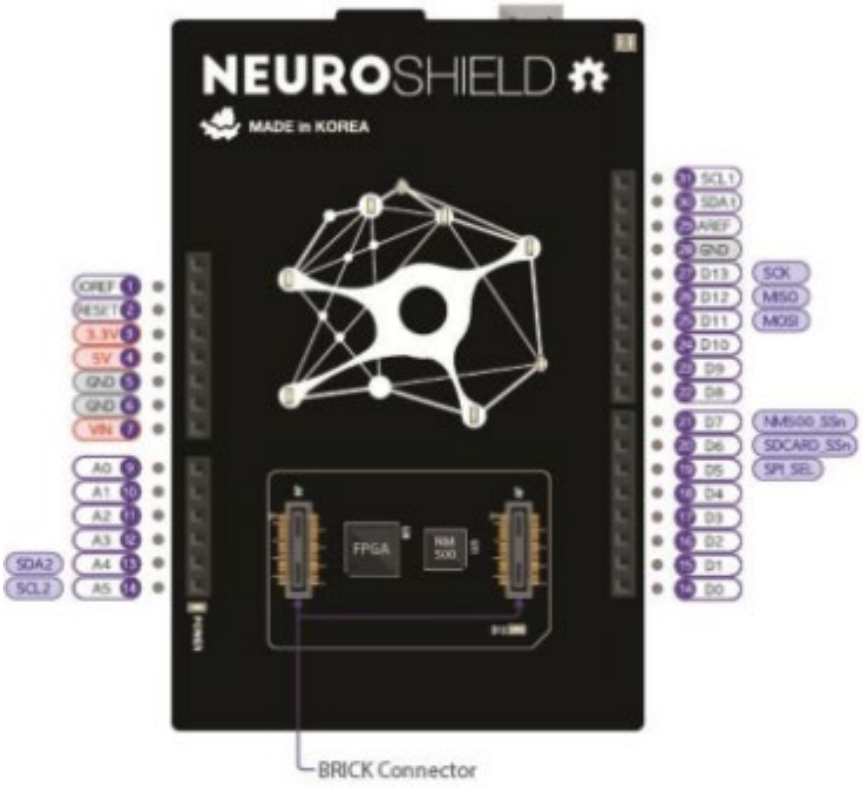
- NeuroMem library establishes communication to the NeuroShield through SPI and gives access to the neurons of the NM500 chip.
- Academic Scripts illustrating how to teach the neurons and query them for simple recognition status, or a best match, or a detailed classification of the K nearest neurons.
- Video recognition examples using the RaspiCam

SPI interface for ESP32, Mbed, and other microcontrollers

NeuroShield can be interfaced to any device supporting an SPI interface and access to the neurons is made through a simple API based on a 10-bytes protocol described in https://www.general-vision.com/documentation/TM_NeuroMem_Smart_protocol.pdf.

Source code of the primitive SPI_Connect, SPI_Read and SPI_Write as well as more advanced functions can be found in the Board Support Package:

- Arduino\Libraries\Src\NeuroMemSPI.cpp
- Python\GVcommSPI.py
- USB\NeuroMemAPI\lib



pin	Description
D13	SCK
D12	MISO
D11	MOSI
D7	SPI_CS_NMn, SPI select to access the neurons
D6	SPI_CS_SDn, SPI select to access SD card
D5	SPI_SELn to GND or to GPIO Low

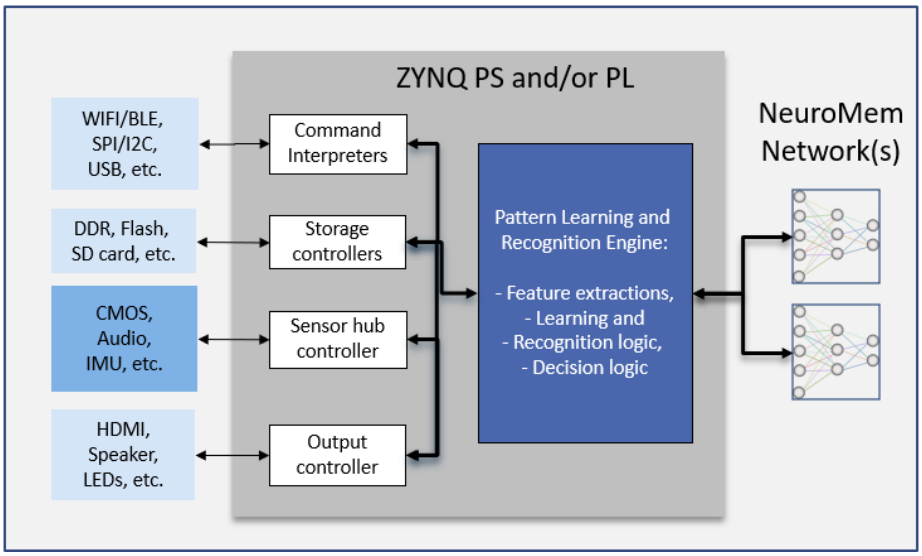
If using the USB port for power supply, do not forget to connect a GND pin of the NeuroShield to a GND pin of the host.

On the raspberry PI, do not forget to enable the SPI interface, under Interfacing options (run sudo raspi-config).

For more details regarding the hardware, refer to the nepes NeuroShield Hardware Manual

SPI Interface to ZYNQ7000 SOC development boards

New NeuroShield HDK for ZYNQ7000 development boards allows ARM and FPGA programmers to can create applications interfacing to the NeuroMem neurons from the Zynq Processor Subsystem (PS) and/or the Programmable Logic (PL) fabric.



Package Content:

- NeuroShield embedded system file for ZYNQ7000 SOCs integrating an SPI interface to the neurons (*.hd file) for the platforms listed below
- Standalone ARM project including the NeuroMem API in C/C++ and Academic Script illustrating how to teach the neurons and query them for simple recognition status, or a best match, or a detailed classification of the K nearest neurons.
- Complete Vivado project (** optional use to adapt to your own ZYNQ platform; version 2018.3)

USB interface (windows)

NeuroShield can be connected to a PC through USB so you can access the neurons from our Knowledge Builder software or develop your own applications using our standard API or SDKs.

- NeuroShield Console Manual (PDF) and video tutorial
- NeuroMem API

Additional generic tools available from General Vision:
- NeuroMem Knowledge Builder for training and validation
- CogniPat SDK C++/C#/Python
- CogniPat SDK MatLab
- CogniPat SDK LabVIEW

Additional imaging tools available from General Vision:
- Image Knowledge Builder
- CogniSight SDK C++/C#
- CogniSight SDK MatLab
- CogniSight SDK LabVIEW

USB interface (Linux)

While General Vision's current Knowledge Builder applications and Software Development Kits are not yet available for Linux, our NeuroMem API features C/C++ source code and documentation showing how to interface to the NeuroShield through the Cypress USB Serial driver for windows.

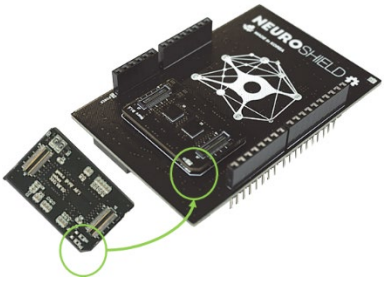
- NeuroMem API

This source code can be used and adapted for Linux, knowing that for Linux and OS-X, there are no installation steps necessary to use products with USB ports powered by Cypress' USB-Serial products. Linux and OS-X does not need separate driver or library in CDC device class operation. Please use native Serial communication API's for accessing the CDC mode device. For more information, please refer to:
http://www.cypress.com/documentation/software-and-drivers/usb-serial-software-development-kit

Expanding the network

The NeuroMem network of the NeuroShield is composed of a single NM500, but it has the provision to be expanded by stacking passive NeuroBrick modules:

NeuroShield	576 neurons
+ 1st NeuroBrick	1728 neurons
+ 2nd NeuroBrick	2880 neurons
+ 3rd NeuroBrick	4032 neurons



- Make sure to disconnect the NeuroShield from its power supply before plugging a NeuroBrick module
- Make sure to align the cut corner of the NeuroBrick with the same marking on the NeuroShield
- The Connect function of the API automatically detects the size of the NeuroMem network and returns its value through the GetNetworkInfo function