Codename **WIZcube**

Description M10CUBE + R2040 + WIZnet Ethernet HAT Inside

Submitted to WIZnet Ethernet HAT Contest 2022 https://maker.wiznet.io/wiznet-ethernet-hat-contest-board/

Team's project members
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20/02/2022

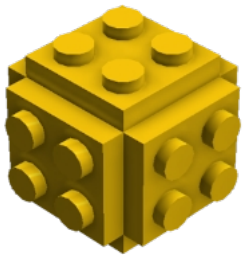


Table of Contents

Long story short

M10CUBE is a project with a long history in the Make. From the day I made the announcement in Raspberry Pi forum in 15/08/2011
Raspberry Pi into a P.L.C (Programmable Logic Controller) . First announcement for the PLC idea.
https://www.raspberrypi.org/forums/viewtopic.php?f=41&t=455&hilit=vorrias

It is a way to have our contribution to Climate Crisis. “Think Green” and have reusable modules for many applications another motto of ours from day one when we started M10CUBE and we clearly state it in our wiki back in **03/05/2020**
https://gitlab.com/m10cube/m10/-/wikis/home

To the day 27/01/2022 announcement we decided to have raspberry PI Pico (Raspberry silicon R2040) on our I/O modules.
https://gitlab.com/m10cube/m10/-/blob/master/README.md

The decision was taken because we needed intelligence on the Edge, flexibility and peace of mind due to the shortage of special interface chips.
In fact the motto in the team “ R2040 on every M10CUBE module” got us very enthusiastic. Not only because R2040 is “dirty” cheap but for its endless possibilities plus the grate support by the Raspberry foundation.

We became exited not only by writing firmware for M10CUBE modules (Input, Output, PWM, Analog IN/OUT etc) but in reality **every I/O module is a full controller with industrial grade interface to the outside world.**

What thrilled us was the extraordinary capabilities of that ARM monster (R2040) plus how seriously the Raspberry Pi foundation sees the further development and evolution of Raspberry products.

Thus Raspberry Pico is here to stay so inevitably we are investing on that and M10CUBE – PICO idea was born on a design already had “Raspberry Pi on board”.

Still we had the missing key for our modules. An easy and straight forward way for FAST connectivity between M10CUBE modules. These designs can become nodes to a larger network even tenths of meters apart each other.

Our experience in Automation Industry was showing us the way, but we are looking for the concept to be cheap, easy to incorporate, supported and familiar with the Make OSHW community.

That is **wired Ethernet** connectivity. We are saying wired because of the POE feature in near future for the remote nodes.
The trend for Home and Office is wiring with Ethernet cables transferring enough power to feed 48V LED for lighting but in the same time the node can be a smoke detector or an intruder alarm sensor or whatever.
Ethernet cabling (whenever feasible) is by far the best way to do power transfer together with the data communication. It can be extremely fast, reliable and easy to service.

Of course a lot of hardware is out there and we are thinking of some ideas already.

Then came a lightening…

On Fri, Jan 28, 3:22 PM I found The MagPi — Issue 114 in my email
An article took my attention and discover the WIZnet set a contest here
https://maker.WIZnet.io/WIZnet-ethernet-hat-contest-board/

We did know at the time about the WIZnet Ethernet HAT or the WIZnet Pico clone with Ethernet. Other obligations kept me away of that info.

One day we are announcing the decision to go with Raspberry Pico on board and the next day WIZnet Ethernet HAT discovered.

Someone above was smiling to us. That because we were on a middle of huge project designing a GRBLHAL controller with Raspberry Pico on board announced on 01/06/2022 here:
https://hackaday.io/project/171770-m10cube/log/202098-m10cube-pico-cnc

The idea of how to make fast distributed inputs from our M10CUBE I/O and having virtually unlimited number of inputs was troubling as. The idea of replacing specialize I/O chips was already on the table despite the fact that we had already designed and build M10CUBE modules with these chips. I2C with interrupts and SPI was considered candidates at that instance but these are solving the problem partly because I2C has low speed and with SPI application we are limited by CS signals.

Anyway none of the above was solving the remote nodes problem being at a distance.
We needed High speed communication 10MHZ and up.

When **WIZnet** idea dropped it was a trip without return for us to go ahead and return to drawing board with WIZnet Pico solution on the table.

Of course the participation to WIZnet concept was inevitable and then the idea was born. That could give us a boost to further develop the M10CUBE remote nodes

Then **WIZcube** idea was born and the slogan "**M10CUBE + R2040 + WIZnet Ethernet HAT Inside**". That is Ethernet out of the box for our M10CUBE modules. Every M10CUBE we had designed and the ones we are going in the future will be "Ethernet enabled" because of the **WIZnet** Ethernet HAT addition. Only small modifications needed to share the same pins for the SPI communication.

KiCAD is our PCB design software. That helped us to make the appropriate modifications very fast and have the idea ready for the contest.

But we are talking here for a huge project. Without knowing if we will have the time to submit our idea we have been working very hard to prepare our proposition to the WIZnet contest.
Corrections will be made after the submission since it is impossible for a project of that scale to be perfect and without errors.

We hope until the end of correction period to be able to have prototypes running but that depends of the fabrication shops and delivery schedules .

We stronly believe **WIZcube** nodes will have a grate impact on the Market and a welcomed acceptance by the DIY and Maker community.

Finally our idea in the next lines will put the reader into what **WIZcube** submission will be.

How we found ourselves here?

A Road map to the **WIZcube i**dea.

15/08/2011
Raspberry Pi into a P.L.C (Programmable Logic Controller) . First announcement for the PLC idea.
https://www.raspberrypi.org/forums/viewtopic.php?f=41&t=455&hilit=vorrias

10/04/2020
A SLACK privet workspace created to help collaborating for M10CUBE evolution
https://app.slack.com/client/T012D6V2UP8/C01256UFE95

03/05/2020
M10CUBE Presented publicly
https://gitlab.com/m10cube/m10
https://hackaday.io/project/171770-m10cube
https://gitlab.com/m10cube/m10/-/wikis/home

09/07/2020
M10CUBE OSHWA UID
https://certification.oshwa.org/gr000004.html

09/11/2020
M10SENSOR BUILD AND WORKING
https://hackaday.io/project/171770-m10cube/log/185946-m10sensor-build-and-working

22/01/2021
THOUGHTS ON M10CUBE AFTER ONE YEAR
https://hackaday.io/project/171770-m10cube/log/188408-thoughts-on-m10cube-after-one-year

06/02/2021
M10CUBE PI PICO STARTED
https://hackaday.io/project/171770-m10cube/log/189044-m10cube-pi-pico-started

06/01/2022
M10CUBE PICO CNC . Discussion started M10CUBE PICO CNC. A Universal Controller ?
https://hackaday.io/project/171770-m10cube/log/202098-m10cube-pico-cnc

17/02/2022
Submit WIZcube idea to Wiznet contest
https://maker.wiznet.io/wiznet-ethernet-hat-contest-board

WIZcube in a Nutshell

WIZcube is a controller cube or a PLC or a PAC cube but its use is beyond the general Programmable Logic Controller we know from Industry. We may say that iWIZcube is where Industrial grade PLC meets the DIY and Maker community. Makers can have real PLC experience by building these designs and many more to come.
We are building some boards at the moment to support our design in the contest. Not sure if we can manufacture everything before the end of the contest since transportation back and forth to fabrication house involves and that takes time. We are optimistic to have all 7 modules below before summer 2022 or earlier.

According to needs many boards can be build with the help of the the community.

PCB coding has a meaning according to M10XXYY-ZZ already explained in GITLAB

Boards will have **Raspberry Pico** + **WIZnet Ethernet HAT** or **W5100S-EVB-Pico**

A/A	PCB NAME	DESCRIPTION
1	M10RL01-20	I/O 8X24V RELAY OUTPUT
2	M10DX01-20	I/O 8X24V INPUT 8X24V HIGH SIDE OUTPUT
3	M10NC02-20	CNC UNIVERSAL CONTROLLER
4	M10HM01-20	HMI MAIN MODULE
5	M10HM02-20	HMI LCD MODULE
6	M10HM03-20	HMI KEYPAD MODULE
7	M10HM04-20	HMI LARGE ROTARY ENCODER MODULE
8	M10XXXX-XX	? MULTIFUNCTION MODULES PLANED WITHIN 2022

FIELD OF APPLICATIONS.
The field of applications is endless but here are some

- Input/Output Industrial grade Ethernet Control
- GRBLHAL Ethernet Motion Controller
- PLC applications
- Edge Computing
- CODESYS ready Remote Nodes via Modbus TCP/IP
- Scientific Research projects
- Ethernet HMI GRBLHAL Motion Controller
- Data Entry Module can be an Autonomous Ethernet data entry keypad
- LCD Module can be an Autonomous Ethernet Indication module
- LCD module can incorporate a Touch LCD so data entry can be done as well

CNC UNIVERSAL CONTROLLER

WIZcube

PART 1

M10CUBE + R2040 + WIZnet Inside

A team project. Members:
Olivier Gaillard of Denmarkvolksolive@hotmail.com
Vasilis Vorrias of Greece vorrias.argo@gmail.com

CNC UNIVERSAL CONTROLLER

Ethernet I/O & 6 Axis Controll

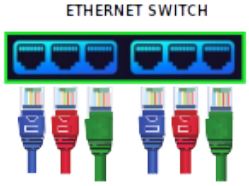
WIZcube RELAY MODULE
- W5100S-EVB-Pico or
- Raspberry Pi Pico + WIZnet Ethernet HAT

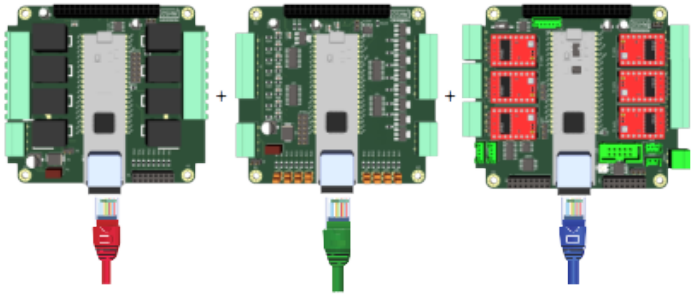
WIZcube I/O MODULE
- W5100S-EVB-Pico or
- Raspberry Pi Pico + WIZnet Ethernet HAT

WIZcube CNC MODULE
- W5100S-EVB-Pico or
- Raspberry Pi Pico + WIZnet Ethernet HAT

Indipendant Logic Controll in every I/O module

ETHERNET SWITCH





Building on the M10CUBE platform we have a "Production Ready system" to be used in the field.
Since its creation M10CUBE standard incorporates a 40 pin Raspberry PI Connector on board
Even with the litle Raspberry Zero plugged on the Bus it makes the concept ready for
CODESYS & Beremiz complicated control applications or
the uprising use of Raspberry Pi as versatile tool for biological sciences

FIELD OF APPLICATIONS
- Input/Output Industrial grade Ethernet Control
- GRBLHAL Motion Controller
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HMI MODULE

WIZcube

M10CUBE + R2040 + WIZnet Inside

PART 2

A team project. Members:
Olivier Gaillard of Denmarkvolksolive@hotmail.com
Vasilis Vorrias of Greece vorrias.argo@gmail.com

HMI MODULE

Consists of 3 Modules: CPU, LCD, Data Entry

WIZcube CPU MODULE

- W5100S-EVB-Pico or
- Raspberry Pi Pico + WIZnet Ethernet HAT

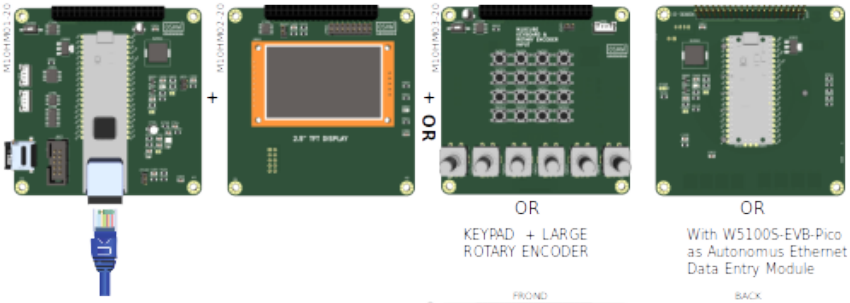
WIZcube LCD MODULE

WIZcube DATA ENTRY MODULE

Raspberry Pi Pico or W5100S-EVB-Pico
Choice of small or large Rotary Encoder

KEYPAD + 6X SMALL ROTARY ENCODES

ETHERNET SWITCH

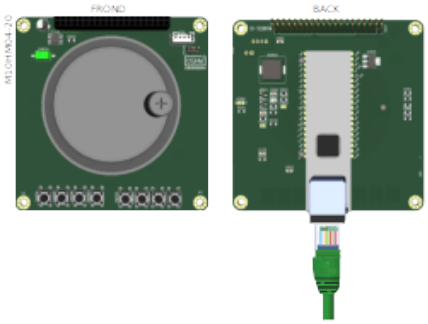


OR

KEYPAD + LARGE ROTARY ENCODER

OR

With W5100S-EVB-Pico as Autonomus Ethernet Data Entry Module



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PLC CODESYS ENABLED

WIZcube

PART 3

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Vasilis Vorrias of Greece vorrias.argo@gmail.com

PLC CODESYS ENABLED

Ethernet I/O Modbus TCP/IP

WIZcube RELAY MODULE
- W5100S-EVB-Pico *or*
- Raspberry Pi Pico + WIZnet Ethernet HAT

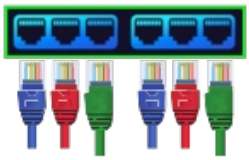
WIZcube I/O MODULE
- W5100S-EVB-Pico *or*
- Raspberry Pi Pico + WIZnet Ethernet HAT

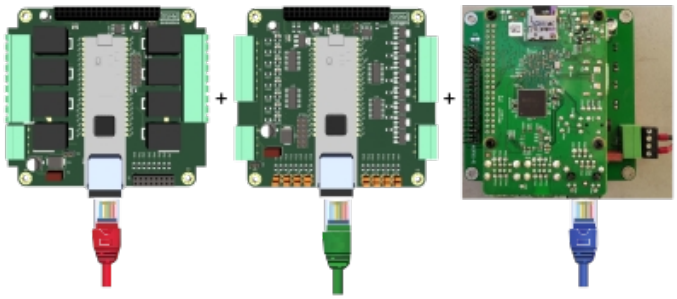
RASPBERY PI PLC
- M10CUBE 24V to 5V PSU module
- Raspberry Pi plugged into PSU
- CODESYS Run Time
- Modbus TCP/IP

CODESYS
www.codesys.com

Indipendant Logic Controll in every I/O module

ETHERNET SWITCH





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