

# The design of multi-function KIT - MULTIBOARDTNUT used at the laboratory of Thai Nguyen University of Technology

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**Abstract**— This project introduces a design of multi board software development KIT, which can be used to practise programming for many different processors, microcontrollers, embedded computers. The project supports for courses, such as, board design, embedded system, digital integrated circuit design, microprocessor – micro controller, at Faculty of Electronic Engineering, Thai Nguyen University of Technology.

**Index Terms**— multi board, processors, microcontrollers, embedded computers

## I. INTRODUCTION

Now, there are many hardware and software providers offering families of digital ICs and embedded computers. Using these ICs and embedded computers facilitates the design a variety of systems, such as: Smart home, fire alarm control, or temperature control for brooder heater ... Together with the development of digital ICs and embedded systems, many manufactures has designed a lot of versions of software development KIT, which provide the application programming interfaces for studying programming languages. For example, The 8051 Lab Trainer KIT [1] for 8051 microcontroller, Educational Practice Board for AVR Atmega32 [2], or Elegoo EL-KIT-001 UNO R3 [3] for Arduino... These software development KIT includes a series of I/O devices, like: Single LED, 7-segment LED, LCD display, buttons, sensors ... which are fixedly connected with the pins of digital ICs or embedded computers. For this reason, if we want to work with different types of IC, we need to buy different types of KIT. The purpose of this research is to design a multiboard software development KIT, which can connect with some different types of microcontrollers and microprocessors, or embedded computer, through a set of board connectors, to become the experimental tools for some courses.

## II. THE BLOCK DIAGRAM OF KIT

In order to carry out the design of a versatile test KIT that can be used for a variety of microprocessors, microcontrollers, to purchase different KITs, the team developed the block diagrams of MULTIBOARDTNUT are shown in the Figure 1.

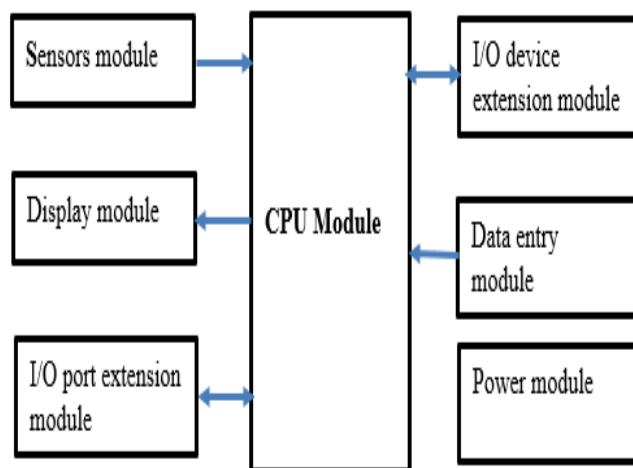


Fig. 1: The block diagram of KIT

### The function of all the blocks in the diagram:

- Sensors module: Included some type of sensors, such as, temperature sensors (18B20, LM35), humidity sensor (DHT11), gas sensor (MQ2), fingerprint sensor, dedicated to sensor reading experiment.
- Display module: Included many single LEDs, 7-segment LEDs, LCD 128\*64, LED matrix 8\*8 ... support for parameters display, of blinking LED experiments.
- I/O port extension module: This module is used to extend the input or output port for the ICs, embedded computer in some specific applications.
- Data entry module: Included buttons, keyboard, for importing all the input data, parameters ...
- I/O device extension module: For connecting the external I/O devices which are not integrated on the KIT.
- CPU module: is connected with the board through two row of board connectors, these two row are already linked to all the block on the KIT. If the users use the KIT with any microprocessors, microcontrollers, or embedded systems, they can themselves design the connector panel or directly connect with the I/O devices through the wires.

## III. THE PRINTED CIRCUIT DESIGN FOR KIT

To design the circuit for the KIT, we use the Altium Designer software for creating both schematic and printed circuit drawing for the KIT (Figure 2).

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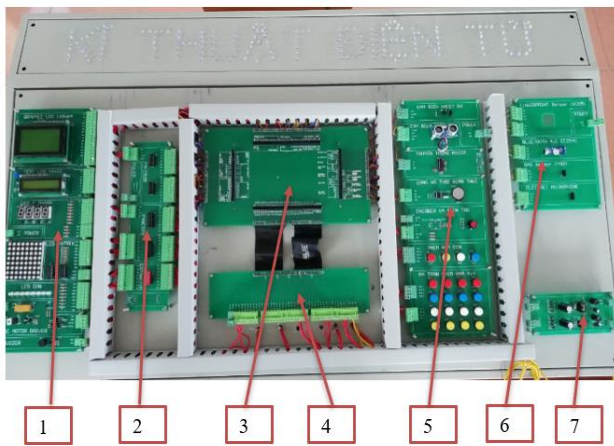


Fig. 2: Picture of MULTIBOARDTNUT KIT

### 3.1 Printed circuit for Display module

Printed circuit for Display module (Block 1 – Figure 2) includes 128\*64 LCD display, 16\*2 LCD display, single LED, 7-segment LED, and LED matrix. This module is connected with the CPU through Connector EDG (Block 4 – Figure 2).

### 3.2 Printed circuit for sensors module

Printed circuit for sensors module (Block 5 – Figure 2) includes temperature, humidity, distance, fingerprint, gas sensors, bluetooth module, electret microphone. This module is connected with the CPU through Connector EDG (Block 4 – Figure 2).

### 3.3. Printed circuit for I/O port extension module

Printed circuit for I/O port extension module (Block 2 – Figure 2) includes IC 74HC595, IC 74HC573 and DIP Switch. This module is connected with the CPU through Connector EDG (Block 4 – Figure 2).

### 3.4. Printed circuit for power supply module

Printed circuit for power supply module (Block 7 – Figure 2). This module supplies electric power to all the blocks. The power supply provide the +5V, +3.3V, GND voltage.

### 3.5. Printed circuit for CPU module

Printed circuit for CPU module (Block 3 – Figure 2) links to all blocks of the KIT. This module is integrated rows of female board connector, to practise programming with KIT, user will connect the microprocessor, microcontroller, of embedded computer with the I/O devices through these rows of female board connector.

## IV. DESIGN OF SOME CPU MODULE CIRCUIT

To evaluate the performance of the KIT and make the experimental manual for the courses, we design some CPU modules, including: CPU module using Arduino Mega (Figure 3, Figure 4), CPU module using PIC 16F887 (Figure 5, Figure 6), CPU module using Raspberry Pi 3 (Figure 7). These CPU modules are designed for some experiment exercises as follow: Program to read value of temperature, humidity sensors and display on LCD 128\*64 and LCD 16\*2, Program for running text “ KỸ THUẬT ĐIỆN TỬ” with LED, and Program to display the value of distance on LCD 128\*64 and LCD 16\*2.

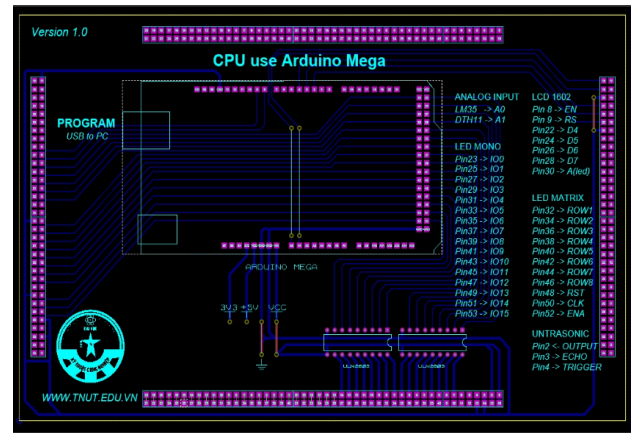


Figure 3: Printed circuit image of the central processing module using the Arduino

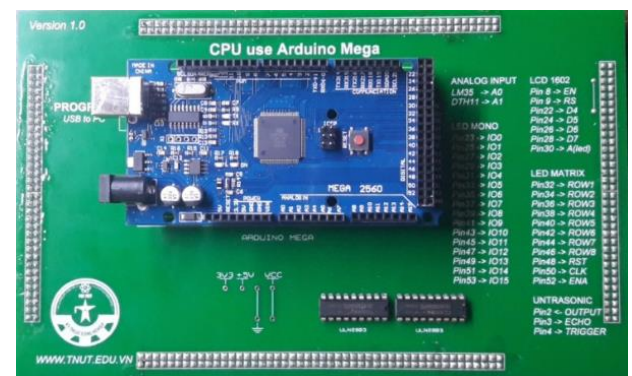


Figure 4: Real circuit image of the central processing module using the Arduino

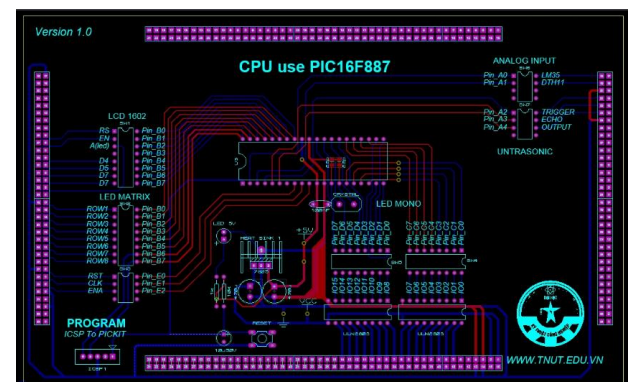


Figure 5: Printed circuit image of the central processing module using PIC16F887

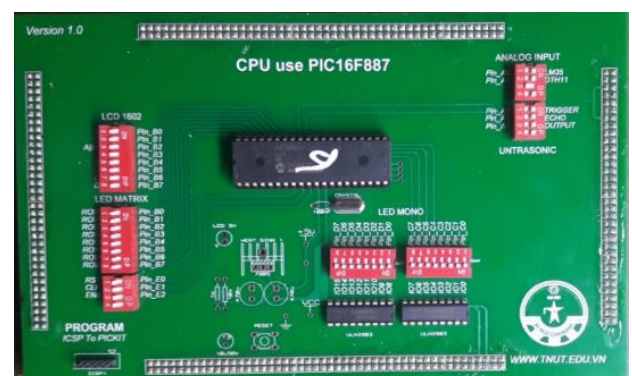


Figure 6: Real circuit image of the central processing module using PIC16F887

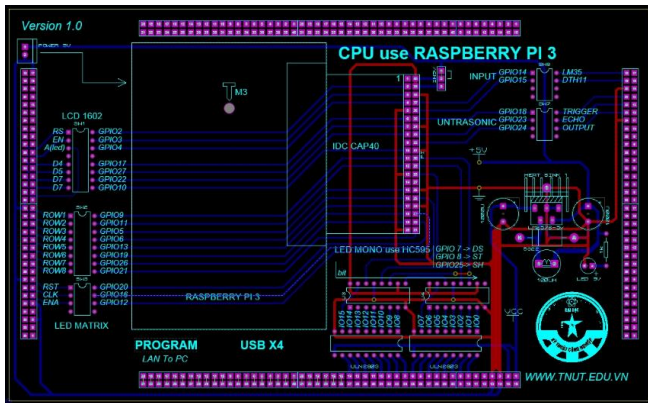


Figure 7: Printed circuit image of the central processing module using Raspberry Pi 3

## V. CONCLUSION

This project proposed an idea of designing a multiboard software development KIT which can connect with many of I/O devices, using many different types of microprocessors, microcontrollers, and embedded computers. This project also provides the design of some CPU modules with many different types of microprocessors, microcontrollers, and embedded computers and detailed experiment manuals as the reference material for some courses in electronic engineering field. The result of the project will be used at the Electronic Engineering Laboratory, Faculty of Electronic Engineering, Thai Nguyen University of Technology.

## ACKNOWLEDGMENT

This research was supported by a grant for the university research from the TNUT (Thai Nguyen University of Technology), under project T2018-TN05. We thank our colleagues from the TNUT who provided insight and expertise that greatly assisted the research.

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