NETH talent workforce development program with university collaboration

NETH Career Identity Program

May 11, 2023 @ MATLAB EXPO 2023

TOYOTA TSUSHO NEXTY ELECTRONICS (THAILAND): NETH
PRINCE OF SONGKLA UNIVERSITY (HAT-YAI CAMPUS): PSU

KOSIN PATTANON
NATTHA JINDAPETCH
Organization overview

Prince of Songkla University (PSU) was established in 1967 as the first university in southern Thailand. The original aims of the university were to raise the general education standards and support regional industry and development.

Today, PSU is a leading public university, committed to academic excellence, reputable research and innovation. PSU is one of top 10 national research universities in Thailand by Quacquarelli Symonds’ (QS) ranking.

Toyota Tsusho NEXTY Electronics, Thailand (NETH) was established in April 2005 as an offshore location for in-Vehicle embedded software development.

Since then, thanks to support from our customers, we have been growing steadily. At the same time, we have been expanding our business into various fields such as sales of car-mounted electronic devices (parts and semiconductors) and development and distribution of contents for automobiles.
Background

Company view

- Develop talent workforce.
- Increase number of company culture compliance workforce.
- Develop training curriculum based on automotive SW development business.
- Accelerate the pace of learning for fresh graduates.

Academic view

- Develop training curriculum based on industrial requirement.
- Provide skills to undergraduate students that match with industrial expectations
- Deliver work integrated learning* to students.
- Technology and knowledge exchange.
*Work integrated learning is a form of curricular experiential education that integrates a student's academic studies with experiences within an industrial workplace.

Student view

- Motivate and develop student's career match with student opinion.
- Introduce industrial standard workflows in academic curriculum.
- Examine work atmosphere and company culture fit.
- Learn team collaboration with co-workers.
NETH Career Identity Activity

University benefits:
- Develop training curriculum based on automotive SW development business
- Technology and knowledge exchange

Internship student benefits:
- Examine work atmosphere
- Practice social soft skill

Internship program

Collaboration project

Collaboration project student benefits:
- Career development
- Skill up and experience industrial technology

Final qualification
November 2022 – March 2023
NETH can increase number of skill compliance workforce.

Job offering
January – April 2023

Activity definition
- M1 Module 01 Qualification
- M2 Module 02 Cultivation
- M3 Module 03 Collaboration
Why we develop training curriculum with MBD?

- Easy to visualize the system operation concept with graphical simulation result
- Software functional design concept with less coding skill in beginner level
- Software product quality characteristics can applied in learning such as: Learnability, modularity, maintainability, reusability etc. with less coding idea

- Use Simulink Stateflow and Simulink coverage for develop logic control system based on requirement, including model scenario test and coverage analysis to ensure correct operation based on specification and defined standard.

- Further design and verification assignment can continuously contribute to university students after company training class by a campus-wide license support from each university.

Project Name: Wiper
Model name: Wiper_rev_01_00.slx
Project Manager Name: -
Project Description: Automatic Rain Sensing Wipers

<table>
<thead>
<tr>
<th>ID</th>
<th>Requirement ID</th>
<th>Type</th>
<th>Functional Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>SWR-WP-00100</td>
<td>Overview</td>
<td>Wiper has inputs as follow:</td>
</tr>
<tr>
<td>001-01</td>
<td>SWR-WP-00101</td>
<td>Input</td>
<td>Ignition [Range OFF or ON]</td>
</tr>
<tr>
<td>001-02</td>
<td>SWR-WP-00102</td>
<td>Input</td>
<td>Lever [Range MIST, OFF, AUTO, LO, HI]</td>
</tr>
<tr>
<td>001-03</td>
<td>SWR-WP-00103</td>
<td>Input</td>
<td>Auto sensitivity [Range LOW, MED, HI]</td>
</tr>
<tr>
<td>001-04</td>
<td>SWR-WP-00104</td>
<td>Input</td>
<td>Washer pump spray [Range OFF or ON]</td>
</tr>
</tbody>
</table>

| 002 | SWR-WP-00200 | Overview | Wiper has outputs as follow: |
| 002-01 | SWR-WP-00201 | Output | Wiper control [Range WIPE_ON, WIPE_OFF] |
| 002-02 | SWR-WP-00202 | Output | Wiper park |

| 003 | SWR-WP-00300 | Overview | Wiper has 5 control states as follow: |
| 003-01 | SWR-WP-00301 | Output | Off state |
| 003-02 | SWR-WP-00302 | Output | Mist state |
| 003-03 | SWR-WP-00303 | Output | Auto state |
| 003-04 | SWR-WP-00304 | Output | Low state |
| 003-05 | SWR-WP-00305 | Output | High state |

Assignment is easy to provide

Analytical skill can practice at home
Module 01 Qualification
Basic MBD with MATLAB/Simulink

- Specification model SW Requirement:
  - Requirement analysis
  - Modeling/ Requirement traceability
  - Test and HW implementation

Module 02 Cultivation
Embedded SW Development

- Automotive SW development with MBD
  - Automotive SW development overview
  - Car functionality vs software module
  - Model-Based Development Process
    - MBD process and process definition
    - Type of model development in MBD
    - Difference between MiL, SiL, PiL
  - Model functionality test
  - Model coverage verification

- Deploying Battery Management System Algorithms
  - Overview of the basic BMS operation and functionality
  - Simulink for BMS application covering:
    - Cell Voltage Measurement
    - SOC Main Operation
    - State of Health
    - Cell Voltage Balancing
  - BMS Safety and Protection Function
  - Development BMS with MBD until HW
  - Implementation and typical specification example

- Introduction to Embedded Systems
- Interfacing
- Basic Digital Input/Output
- Serial Communications
- Analog-Digital Conversion
- Event Counters, Timers, and PWMs etc.
Module 02 Cultivation (Cont.)

4. DC Motor Hardware in the Loop with FPGA (By PSU)
   - Principle and operation overview of DC motor
   - DC motor characteristic and its mathematical model
   - DC motor modeling in s-domain
   - DC motor modeling with Simulink
   - FPGA in the Loop
   - System response and result analysis

DC motor modeling with Simulink

Workshop both online and hand-on in PSU
Module 03 Collaboration and its outcome
Cooperative Internship Program Outcome

March 2022

Module 01 Basic MBD course
- Understand what MBD is
- Learning how to use Simulink block
- Practise MBD with 7 segment simple model

June 2022

Next Gen Higher Education MBD course
- Learning how to build and deploy model to hardware
- Learning how to use hardware in the loop
- Adaptation MBD with line following robot

December 2022

New staff Co-operation training
- Learning back to back test
- Learning hardware support package Simulink blockset
- C language and embedded system

January – February 2023

Co-operation project: PMSM motor drive by adaptation rapid control prototype (RCP) concept

Mr. Muhammad Samoh
Cooperative Internship student
Walailak university

“I have done PMSM motor drive by using a Rapid Control Prototype concept. A lot of hardware blockset included in MATLAB/Simulink helped to reduce manual coding to control hardware.”

Mr. Patompong Musika
Cooperative Internship student
Prince of Songkla university

“According to COVID-19 pandemic, I have to apply a lot of online learning session however this activity fulfilled my practical skill for measurement and instrument usage also improved my analytical and problem solving skill.”
NETH-PSU Collaboration Program since 2016
NETH – PSU Student Senior Project Collaboration
Battery Cell Active Balancer

Objectives

- Voltage Measurement
- Active Balance

Block Diagram

- Differential Amplifier
- Battery 4 Cells (4s) 12.8 V
- Flyback Converter
- ADC
- MCU
- PWM

Flyback converter in Simulink
3-Phase Motor Drive for Electric Shuttle Bus

Objectives

Block Diagram

Field Oriented Control Model

Result: TI C2000

Result: MATLAB & Simulink
Design of a CAN Bus Communication in Electric Vehicles

CAN Node
- Microcontroller
  - CPU
  - CAN controller
- TX
- RX
- CAN Transceiver

Communication in Electric Vehicles

CAN Bus Module

CAN Bus Communication

CAN model in Simulink
Quotes from PSU Collaboration Students:

Mr. Pisit Palasinmongkol, 4th year Electrical Engineering (Power), PSU

“My project is Battery Cell Active Balancer. I learn battery behaviour and design flyback converter on MATLAB/Simulink before designing the real hardware.”

Mr. Pongpon Poonpakdee, 4th year Electrical Engineering (Power), PSU

“My project is 3-Phase Motor Drive for Electric Shuttle Bus. I build MBD (Model Based Design) for PI control in MATLAB/Simulink. The signals can be real-time display in computer. This helps me easily fine-tune the PI coefficients.”

Mr. Pannatorn Khansai, 4th year Electrical Engineering (Electronics), PSU

“My project is Design of a CAN Bus Communication in Electric Vehicles. MBD (Model Based Design) in MATLAB/Simulink can create the systematic thinking in design of CAN bus.”
Collaboration Outcome: NETH

- In fiscal year 2022, number of undergraduate students who join NETH training shown as below:

**By University**

<table>
<thead>
<tr>
<th>University</th>
<th>Number of student</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSU</td>
<td>36</td>
</tr>
<tr>
<td>WU</td>
<td>25</td>
</tr>
<tr>
<td>KMITL</td>
<td>15</td>
</tr>
<tr>
<td>KMUTNB</td>
<td>14</td>
</tr>
<tr>
<td>TU</td>
<td>13</td>
</tr>
<tr>
<td>Other university</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>111</strong></td>
</tr>
</tbody>
</table>

**By Year of studying**

- The most student joined training program is the 3rd year undergraduate students.

**Abbreviation:**

- PSU: Prince of Songkla University
- WU: Walailak University
- KMITL: King Mongkut’s Institute of Technology Ladkrabang
- KMUTNB: King Mongkut’s University of Technology North Bangkok
- TU: Thammasat University
Collaboration Outcome: PSU

- Next Generation Higher Education funding from Ministry of Higher Education, Science, Research and Innovation

<table>
<thead>
<tr>
<th>Year</th>
<th>MBD Trained Engineers</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>12 (6 NETH hiring, 6 Others)</td>
</tr>
<tr>
<td>2020</td>
<td>39 (8 NETH hiring, 31 Others)</td>
</tr>
<tr>
<td>2021</td>
<td>37 (6 NETH hiring, 31 Others)</td>
</tr>
<tr>
<td>2022</td>
<td>34 (6 NETH hiring, 28 Others)</td>
</tr>
<tr>
<td>2023</td>
<td>34 (6 NETH hiring, 28 Others)</td>
</tr>
</tbody>
</table>
Key Message

Benefit to Academia

- Training curriculum based on industrial requirement.
- Undergraduate student's skill matched with industrial expectations.
- Technology and knowledge exchange between university and industrial organization.

Benefit to Toyota Tsusho NEXTY Electronics, Thailand

- Skill and knowledge compliance workforce.
- To accelerate the pace of learning for fresh graduate staff.
- Training curriculum based on automotive SW development business.
Thank you for your collaboration