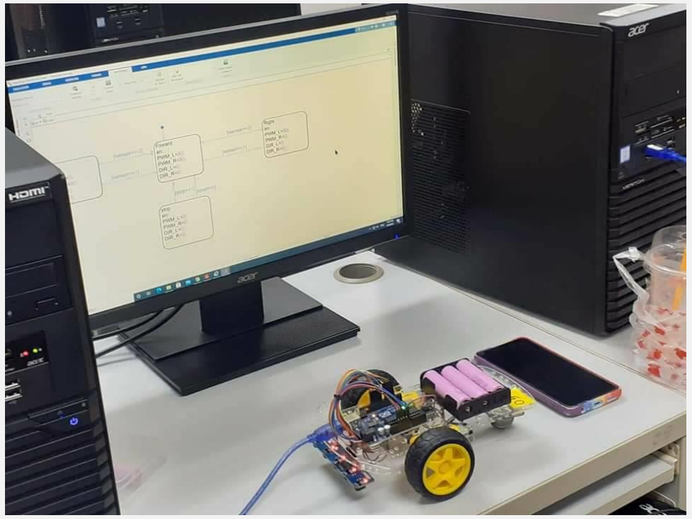
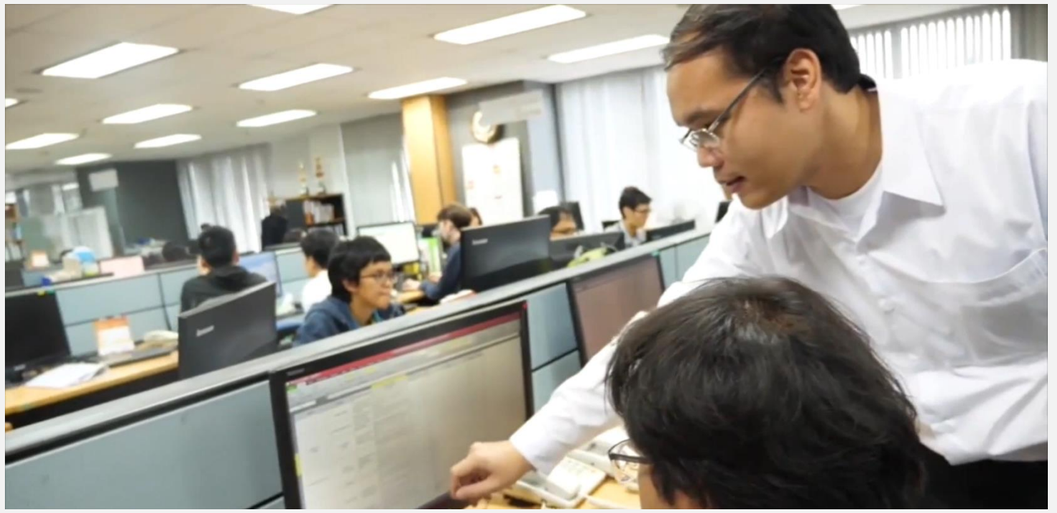
TOYOTA TSUSHO NEXTY ELECTRONICS (THAILAND) CO., LTD.

PRINCE OF SONGKLA UNIVERSITY

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

TOYOTA TSUSHO NEXTY ELECTRONICS (THAILAND) CO., LTD.
IN COLLABORATION with
PRINCE OF SONGKLA UNIVERSITY

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

TOYOTA TSUSHO NEXTY ELECTRONICS (THAILAND) CO., LTD.
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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

TOYOTA TSUSHO NEXTY ELECTRONICS (THAILAND) CO., LTD.
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TOYOTA TSUSHO NEXTY ELECTRONICS (THAILAND) CO., LTD.

NETH Career Identity Training
- Talent workforce development

July – October 2022

Additional students join during senior project proposal in September 2022

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

Student

M1 December 2021 – April 2022

M2

M3

Collaboration project

September 2022 – April 2023

Final qualification

November 2022 – March 2023

NETH can increase number of skill compliance workforce.

Job offering

January – April 2023

Collaborate training program

M3

University

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

Internship program

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

Activity definition

M1	Module 01 Qualification
M2	Module 02 Cultivation
M3	Module 03 Collaboration

Training curriculum development with Model-Based Development (MBD)

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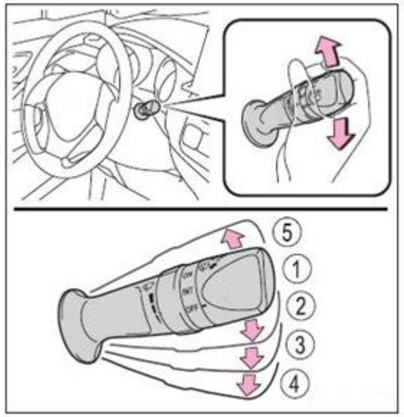
Why we develop training curriculum with MBD ?

- 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

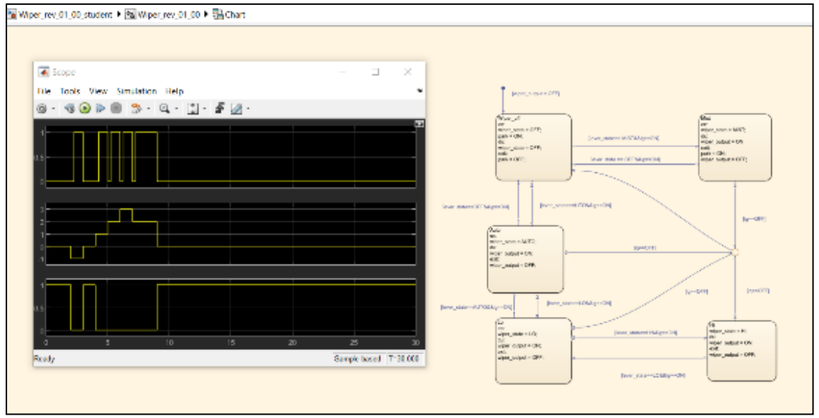
System operation



System functionality

Project Name:			Wiper
Model name:			Wiper_rev_01_00.slx
Project Manager Name:			-
Project Description:			Automatic Rain Sensing Wipers
ID	**Requirement ID**	**Type**	**Functional Requirement**
001	SWR-WP-00100	Overview	Wiper has inputs as follow:
001-01	SWR-WP-00101	Input	Ignition [Range OFF or ON]
001-02	SWR-WP-00102	Input	Lever [Range MIST, OFF, AUTO, LO, HI]
001-03	SWR-WP-00103	Input	Auto sensitivity [Range LOW, MED, HI]
001-04	SWR-WP-00104	Input	Washer pump spray [Range OFF or ON]
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: - off state - mist state - auto state - lo state - hi state

Functional requirement

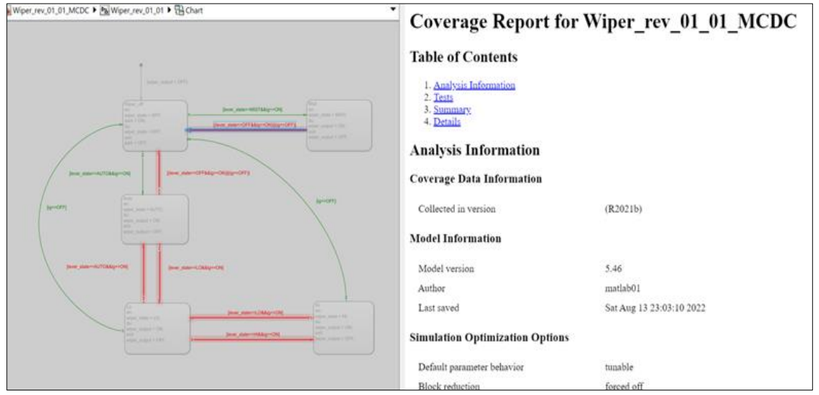


Modeling and functional test

- 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.

Assignment is easy to provide



Analytical skill can practice at home

NETH Career Identity Training Program – 1/2

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• Module 01 Qualification

Basic MBD with MATLAB/Simulink

- **Specification model SW Requirement:**

Variable	Quantity	Description	Type	Data type
Sensors1	1	Objects detection sensor	Input	uint8
Sensors2	1	Objects detection sensor	Input	uint8
Sensors3	1	Objects detection sensor	Input	uint8
Alarm	1	Fail state control	Input	uint8
Light	1	Operating status update	Output	uint8
PartFed	1	Output counter	Output	uint8

Light status definition:
GREEN is 2
ORANGE is 1
RED is 0

Sensors behavior:
3 sensors are generated by using Switch on hardware that can control on/off independently. When push switch is sensor ON.

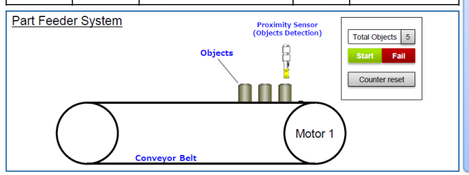
ON is 1

OFF is 0

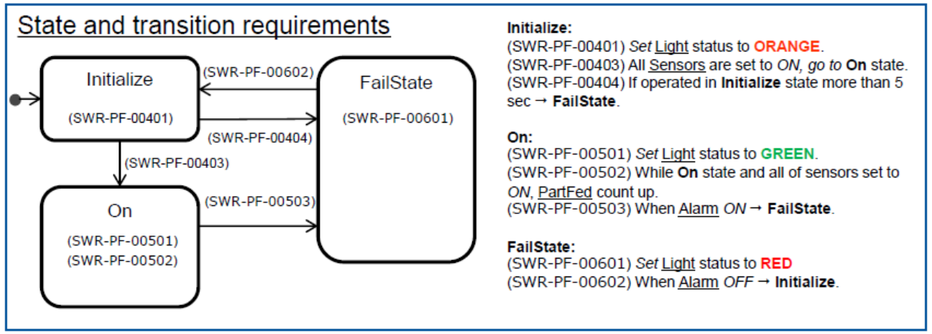
Alarm:
Alarm ON when push switch on hardware.

ON is 1

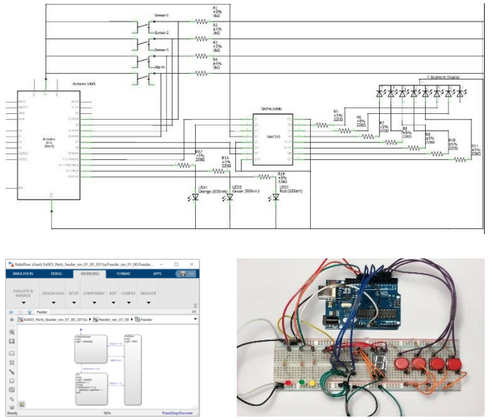
OFF is 0



Requirement analysis



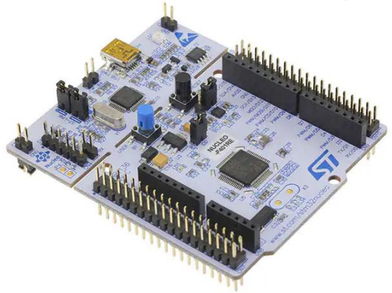
Modeling/ Requirement traceability



Test and HW implementation

• Module 02 Cultivation

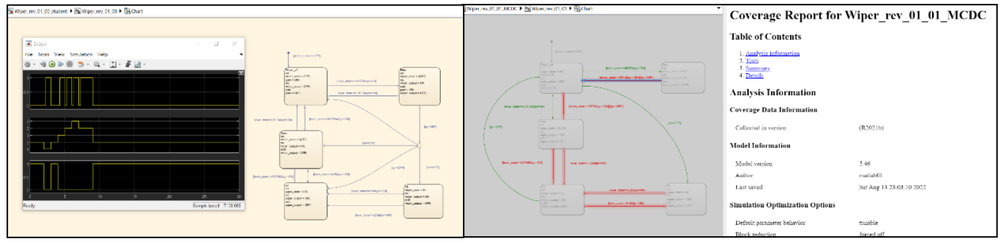
① Embedded SW Development



–Introduction to Embedded Systems
–Interfacing
–Basic Digital Input/Output
–Serial Communications
–Analog-Digital Conversion
–Event Counters, Timers, and PWMs etc.

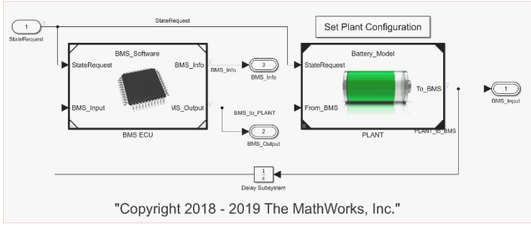
② Automotive SW development with MBD

- 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



③ 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



NETH Career Identity Training Program – 2/2

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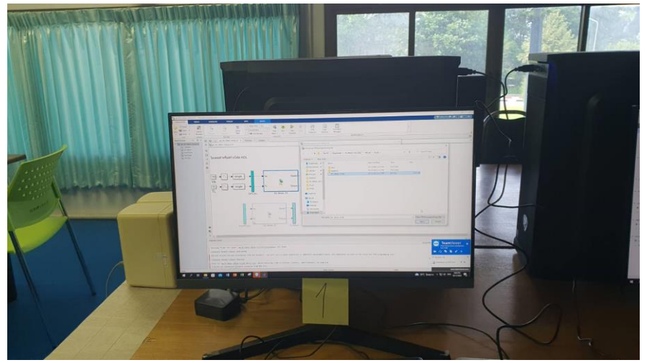
- **Module 02 Cultivation (Cont.)**

  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

TOYOTA TSUSHO NEXTY ELECTRONICS (THAILAND) CO., LTD.
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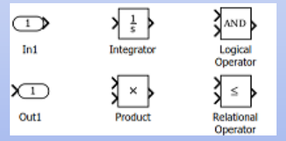
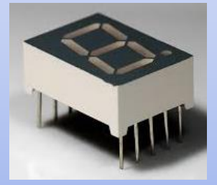
March 2022

Module 01 Basic MBD course

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

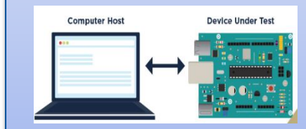




June 2022

Next Gen Higher Education MBD course

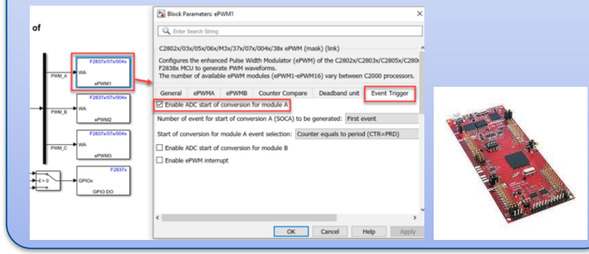
- Learning how to build and deploy model to hardware
- Learning how to use hardware in the loop
- Adaptation MBD with line following robot



December 2022

New staff Co-operation training

- Learning back to back test
- Learning hardware support package Simulink blockset
- C language and embedded system



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. "

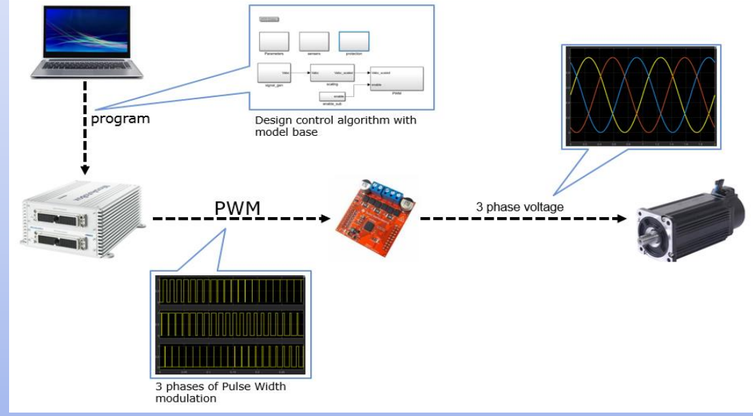
Mr. Patompong Musika
Cooperative Internship student
Prince of Songkla university

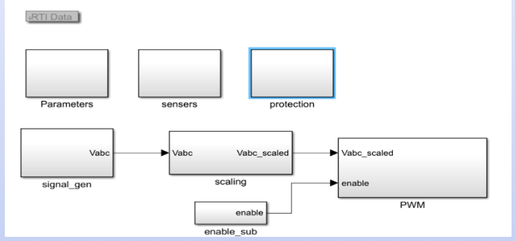
"According to COVID-19 pandemic, I have to apply a lot of online learning session however this activity fulfilled my practical skill for measurement and instrument usage also improved my analytical and problem solving skill."

January – February 2023

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

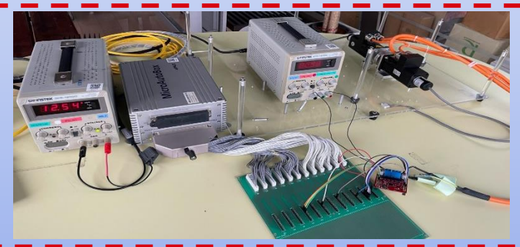
Concept





Software part

Hardware part



NETH-PSU Collaboration Program since 2016

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NETH – PSU Student Senior Project Collaboration

Battery Cell Active Balancer

TOYOTA TSUSHO NEXTY ELECTRONICS (THAILAND) CO., LTD.
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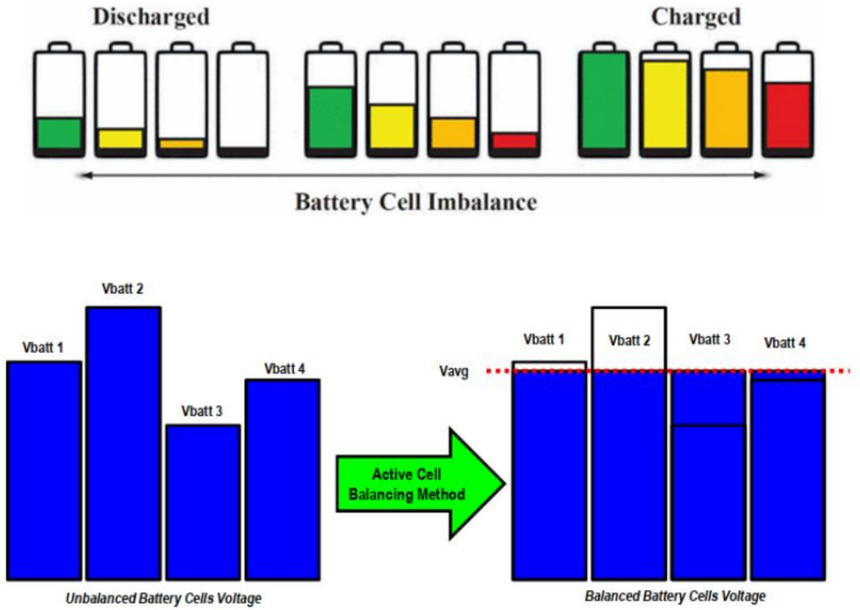
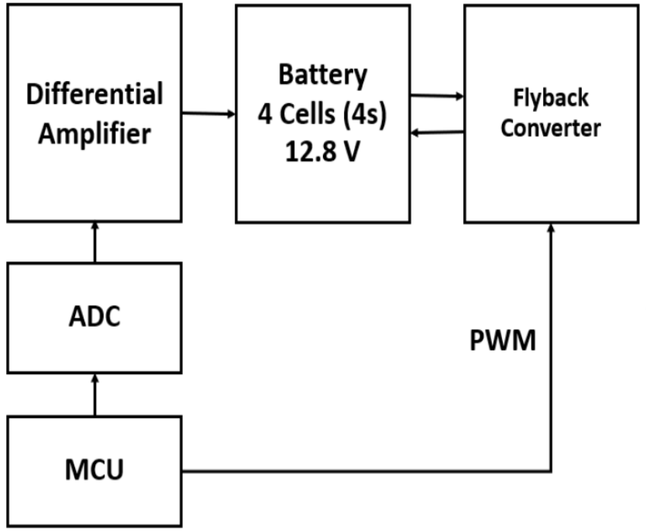
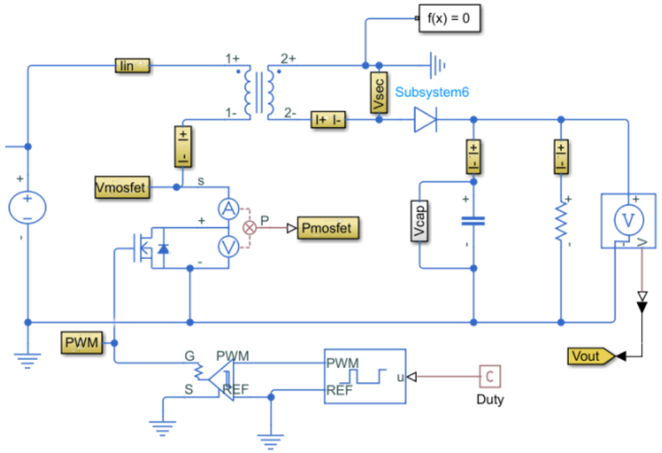
Objectives

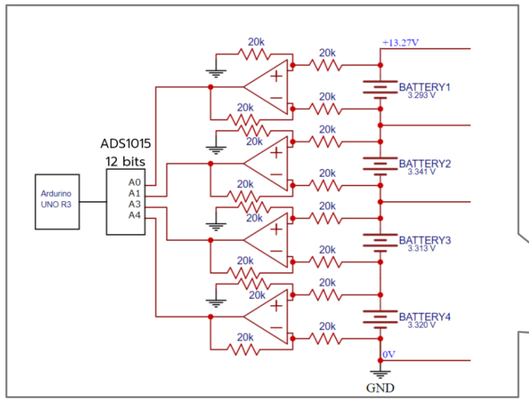


Block Diagram

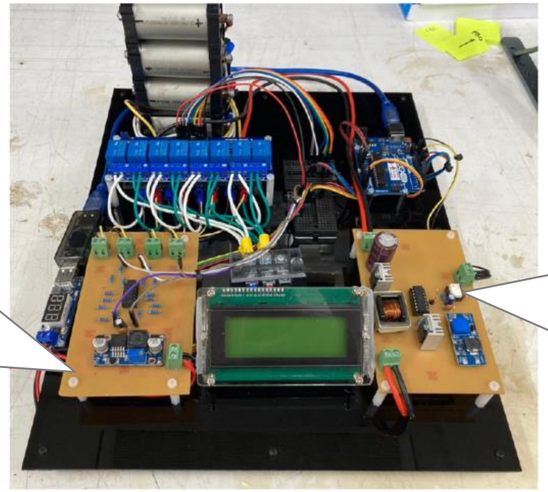


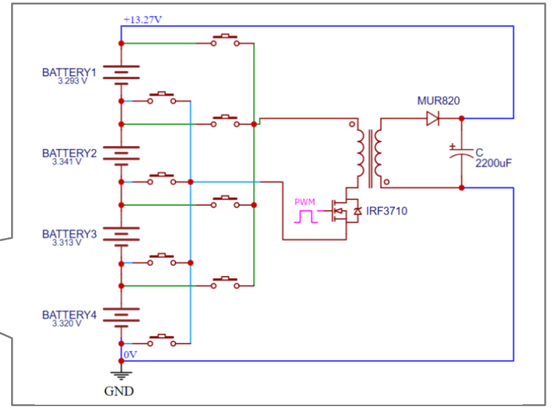
Flyback converter in Simulink



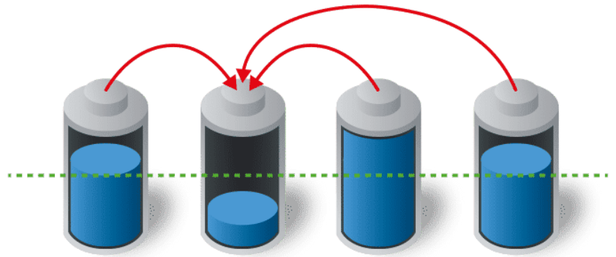


Voltage Measurement





Active Balance



3-Phase Motor Drive for Electric Shuttle Bus

TOYOTA TSUSHO NEXTY ELECTRONICS (THAILAND) CO., LTD.
IN COLLABORATION with
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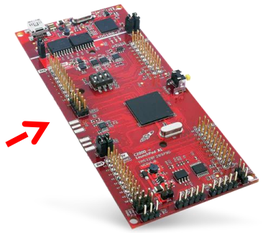
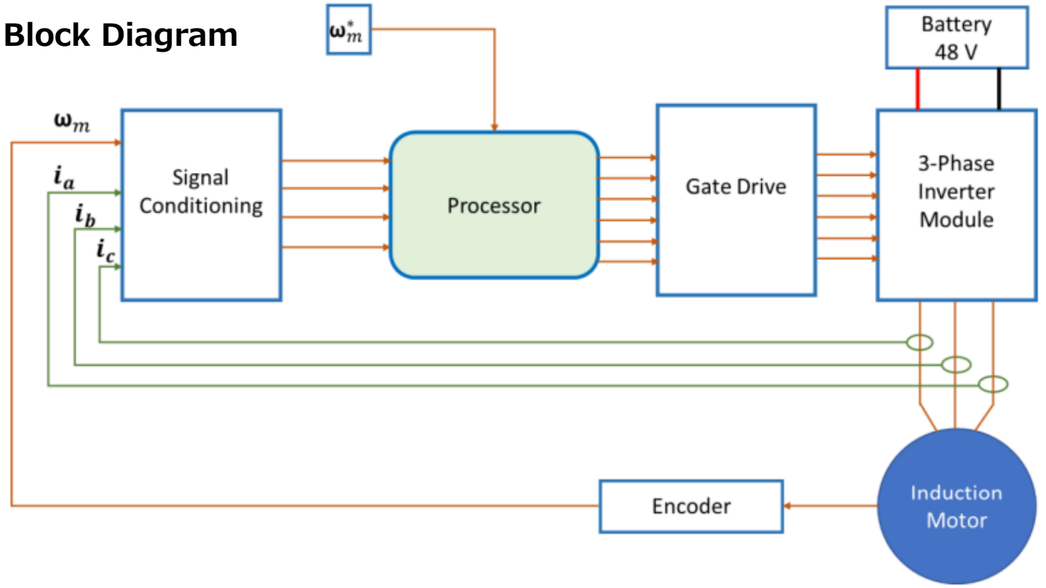
Objectives

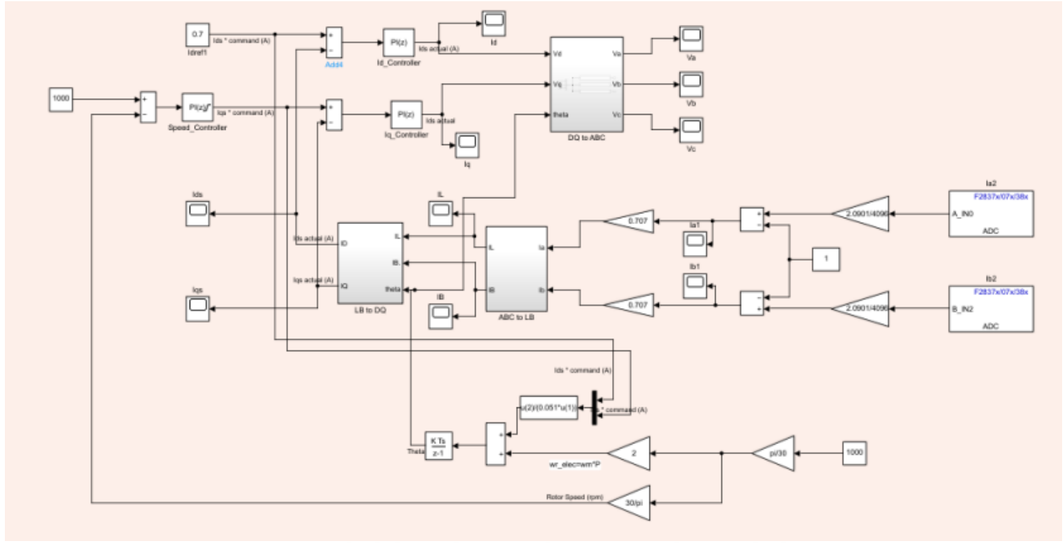
FOC MOTOR DRIVE BOARD



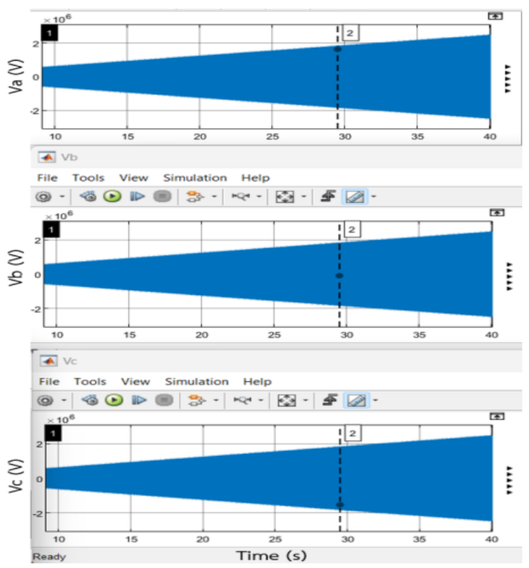
TI C2000

Block Diagram

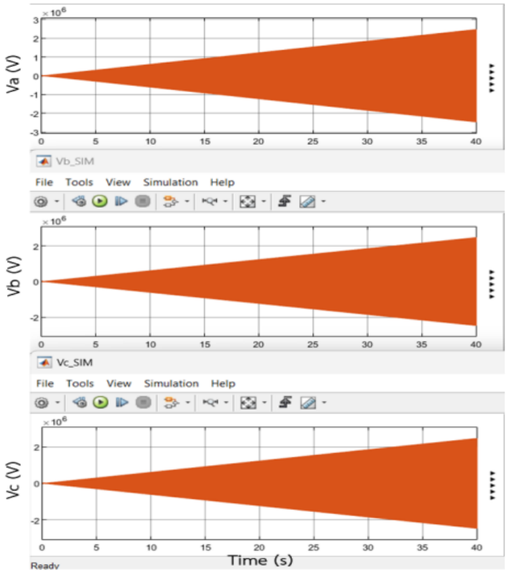




Field Oriented Control Model



Result: TI C2000



Result: MATLAB & Simulink

Design of a CAN Bus Communication in Electric Vehicles

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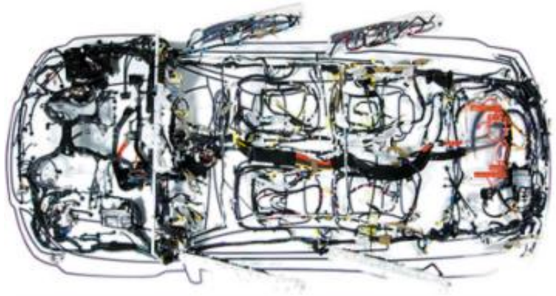
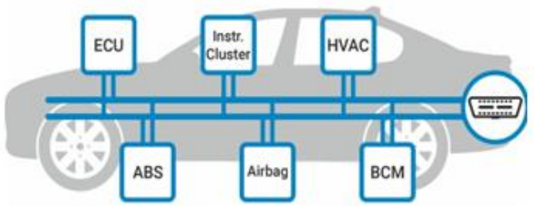
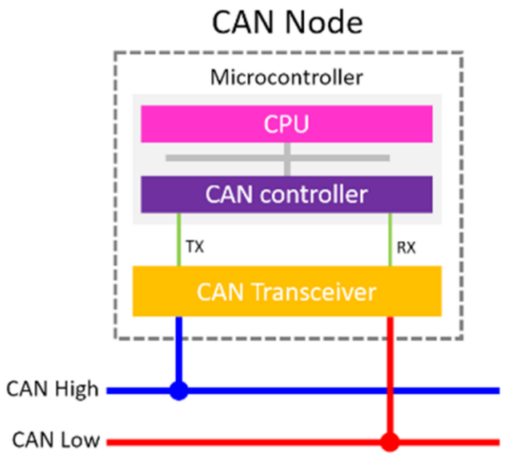
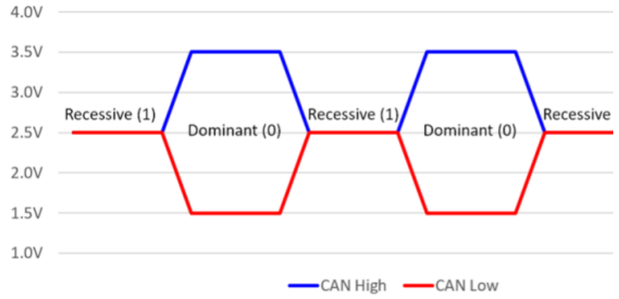


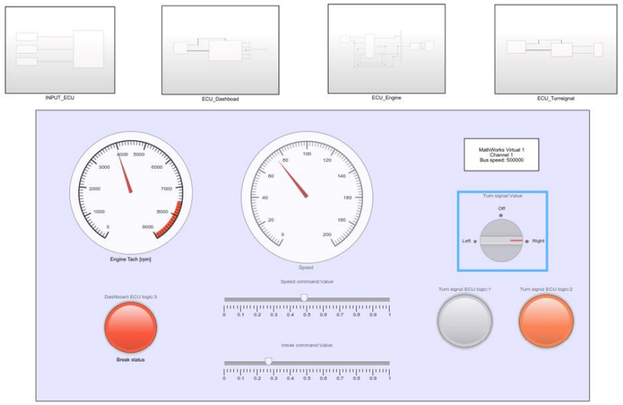


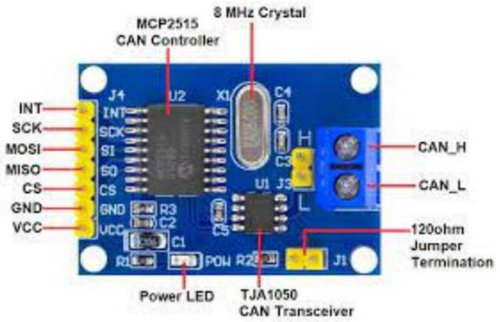
Communication in Electric Vehicles





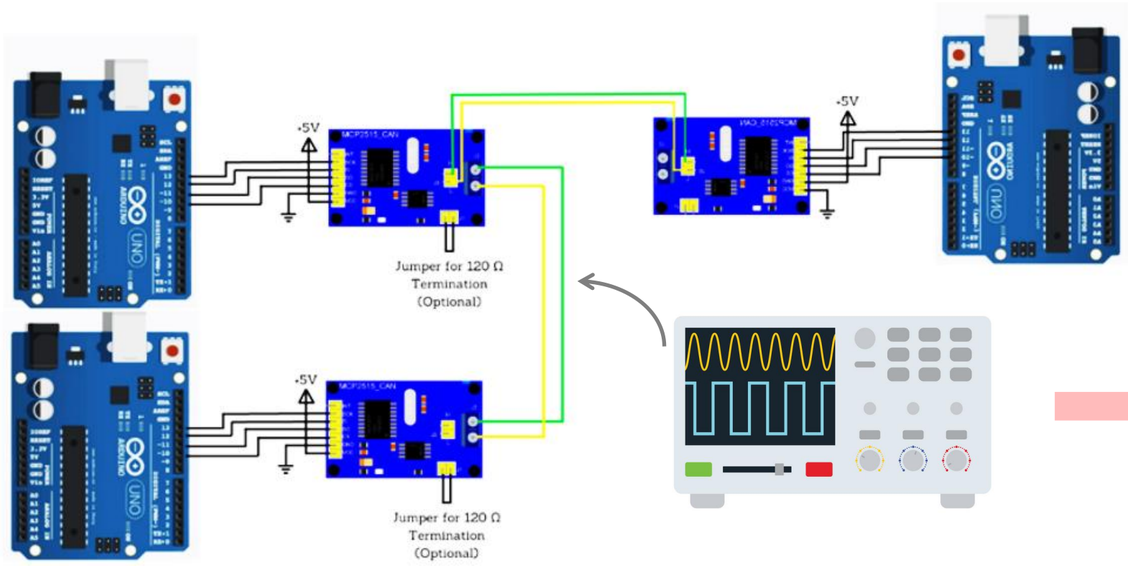
CAN model in Simulink

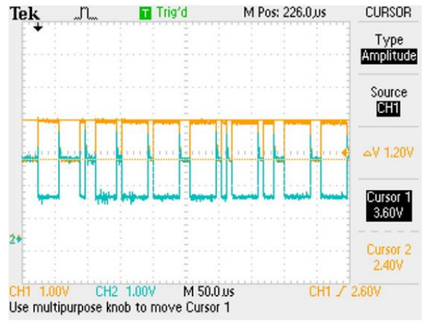


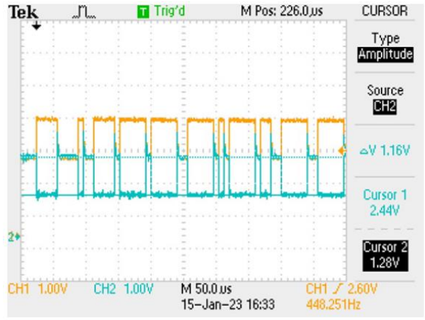


CAN Bus Module

CAN Bus Communication







Quotes from PSU Collaboration Students:

TOYOTA TSUSHO NEXTY ELECTRONICS (THAILAND) CO., LTD.
IN COLLABORATION with
PRINCE OF SONGKLA UNIVERSITY

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

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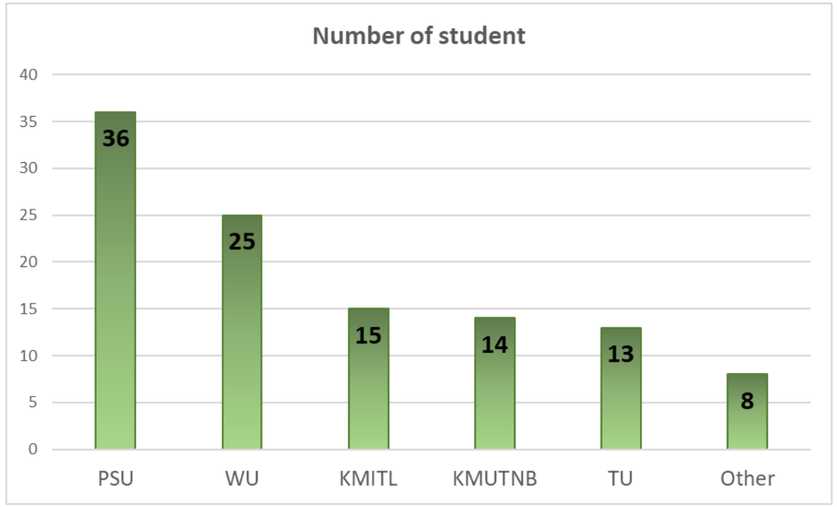
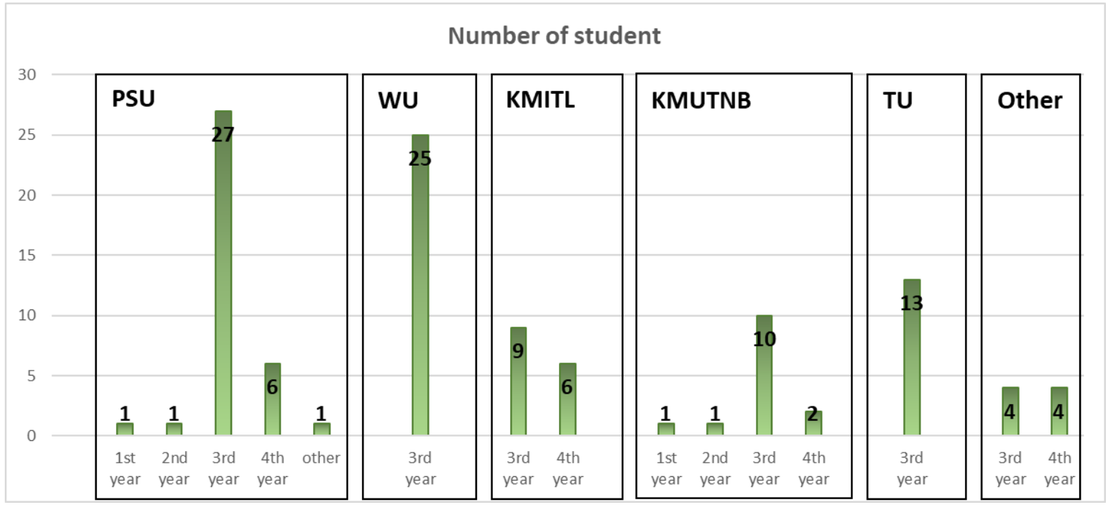
- In fiscal year 2022, number of undergraduate students who join NETH training shown as below:

By University



University	Number of student
PSU	36
WU	25
KMITL	15
KMUTNB	14
TU	13
Other university	8
Total	111

By Year of studying



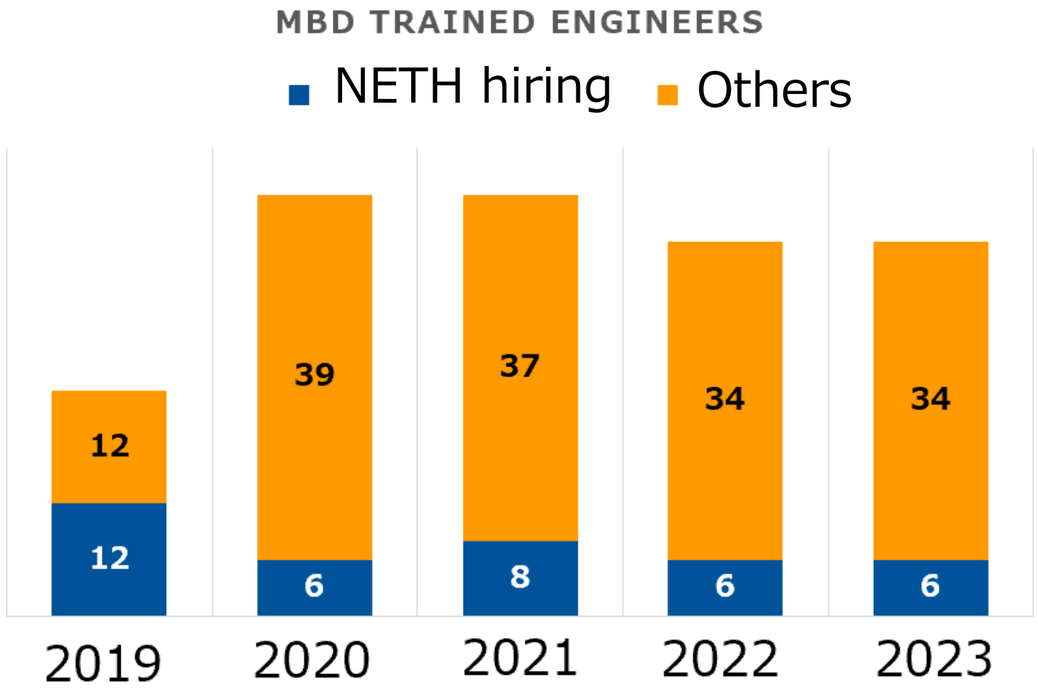
- The most student joined training program is the 3rd year undergraduate students.

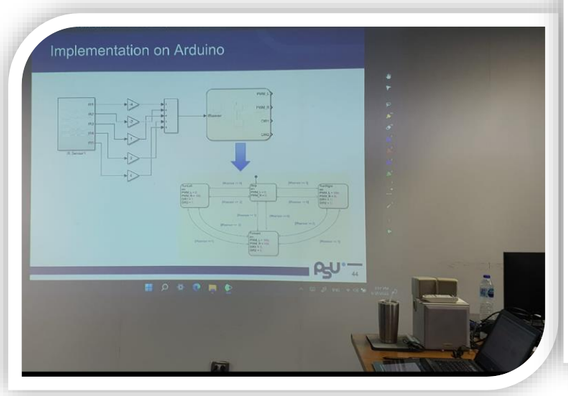
Abbreviation:
PSU: Prince of Songkla University
WU: Walailak University
KMITL: King Mongkut's Institute of Technology Ladkrabang
KMUTNB: King Mongkut's University of Technology North Bangkok
TU: Thammasat University

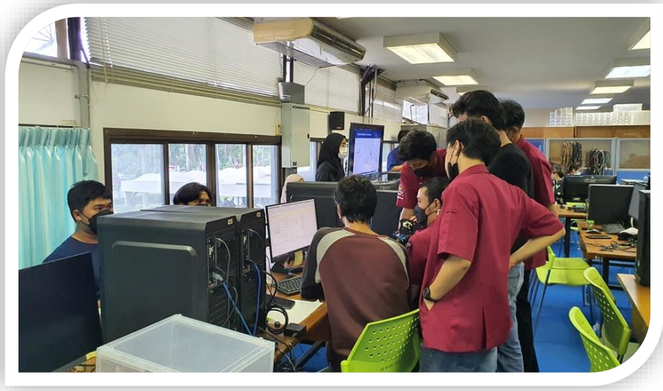
Collaboration Outcome: PSU

TOYOTA TSUSHO NEXTY ELECTRONICS (THAILAND) CO., LTD. IN COLLABORATION with PRINCE OF SONGKLA UNIVERSITY

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







Key Message

TOYOTA TSUSHO NEXTY ELECTRONICS (THAILAND) CO., LTD.
IN COLLABORATION with
PRINCE OF SONGKLA UNIVERSITY

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