EN2533 Robot Design & Competition

Introduction

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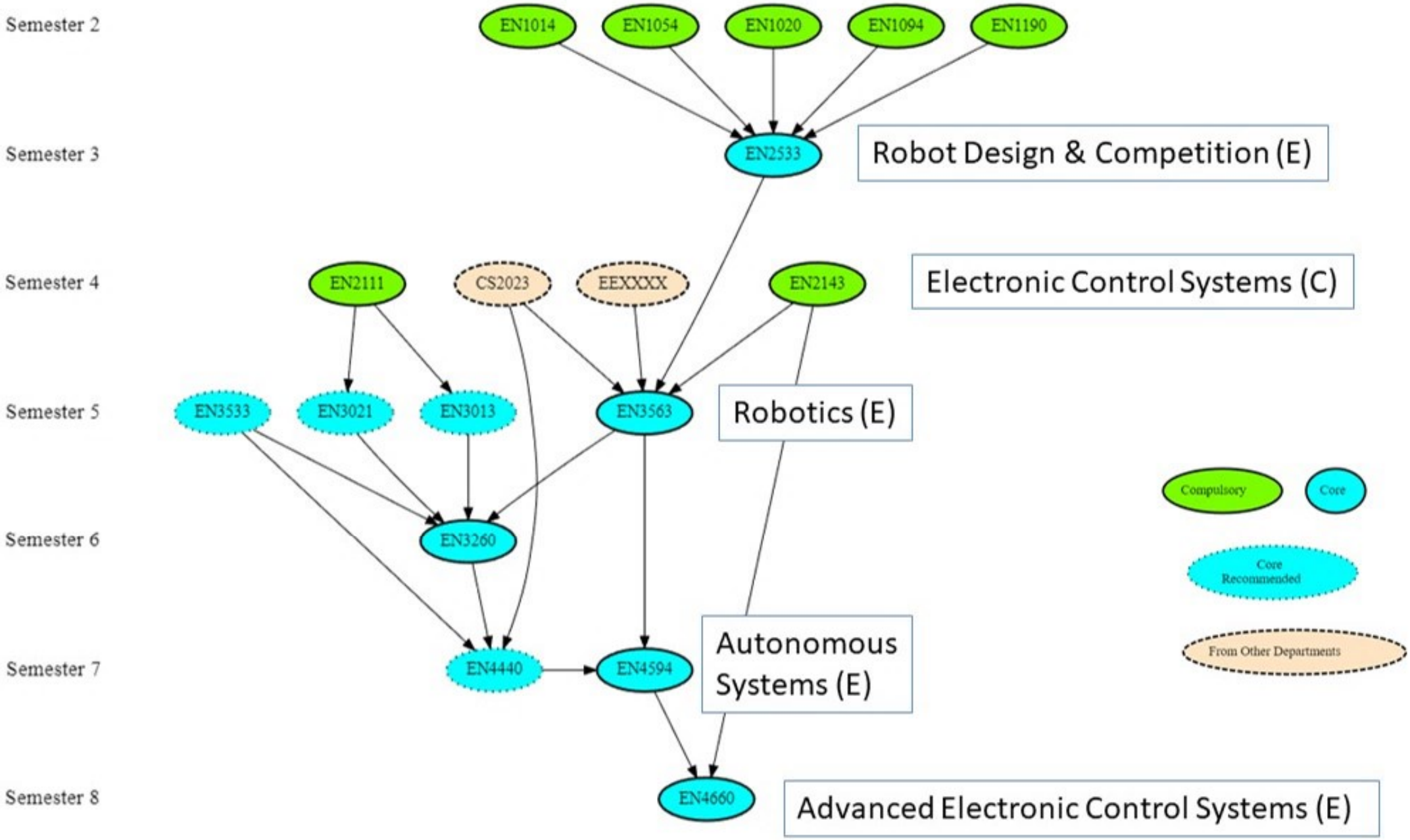
Outline

- Introduction
  - ➢ Course Details
- What is a Robot?
- Learning Outcomes
- Past Robot Competitions
- Task 2023

Introduction

Robotics and Automation Track



Course Details

- Structure
  - Lectures: 1hr/week, Wednesday 8:15am ~ 9:15am, ENTC1
  - Laboratory and Interactive Sessions: 4hr/week

HOURS	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
08.15-09.15	EN2031 Fundamentals of Computer Organisation and Design (L) [ENTC1]	EN2091 Laboratory Practice and Projects (P)	EN2533 Robot Design and Competition (L) [ENTC1]	MA2024 Calculus (L) [NA2]	EN2533 Robot Design and Competition (P)
09.15-10.15	-do-	-do-	EN2130 Communication Design Project (L) [ENTC1]	-do-	-do-
10.15-11.15	EN2014 Electronic Circuits and Analysis (L) [ENTC1]	EN2063 Signals and Systems (L) [ENTC1]	EN2130 Communication Design Project (P)	*Research Seminar* *(Not to be used for other Academic Work)*	EN2031 Fundamentals of Computer Organisation and Design (T/P) [ENTC 1]
11.15-12.15	-do-	-do-	-do-	*Union Hour* *(Not to be used for Academic Work)*	-do-
12.15-13.16	L U N C H				
13.15-14.15	EN2054 Communication Systems and Networks (L) [ENTC1]	EN2533 Robot Design and Competition (P)	EN2054 Communication Systems and Networks (L)* [ENTC1] / BM2210 Biomedical Device Design (L) [ENTC1]	EN2014 Electronic Circuits and Analysis (L)* [ENTC1] / EN2063 Signals and Systems (L)* [ENTC1]	MA2014 Differential Equations (L) [NA2]
14.15-15.15	-do-	-do-	-do-	-do-	-do-

Course Details

- Structure
  - Lectures: 1hr/week, Wednesday 8:15am ~ 9:15am, ENTC1
  - Laboratory and Interactive Sessions: 4hr/week
  - Weekly Assignments: Group and individual
  - Reviews
    - Proposal Review
    - Mid Review
    - Final Competition
- Weightage: 3.0 Credits
  - Final Examination: 30%
  - Labs: 15%, Assignments: 10%
  - Proposal Review: 5%, Mid Review: 10%
  - Robot Competition: 30%

Course Details

- Continuous Assessments
  - Lab Sessions
    - Sensor Interfacing: IR Sensor, Ultrasound Sensor, Digital Compass
    - Motor Control: DC Motor, Servo Motor
  - Reviews
    - Proposal Review: Proposal to achieve the final task should be presented
    - Mid Review: Robot functionalities required for the final task
    - Final Competition
- Final Examination
  - 1 hr, 40 Multiple Choice Questions
- Group Forming
  - Max. 5 students per group (your choice)

Course Details

- Robot Competition
  - At the end of the semester
  - Organized by the students
  - Robots can be designed using any microcontroller board
  - Finalized task will be given around the 4th week
  - We will have a physical robot competition

- Webpage
  - Moodle EN2533

Course Details

- Resources by ENTC
  - ➢ Two 34:1 Metal Gear motors per group
    - 12V High power, 48 CPR Encoder
  - ➢ LiPo Batteries 11.1V 2200mAh 3S 40C
    - Voltage tester
    - Balanced charger
  - ➢ ENTC Custom Motor Driver

Pololu 34:1 Metal Gear Motors

  - ➢ Please use them with care
    - If damaged, the group must replace the component

- Financial Assistance
  - ➢ No funding is provided by the department/university to build robots

Why Competition?

- Learning from others: beneficial peer comparison
  - ➢ Different solutions to same problem
- Face challenges
  - ➢ Managing deadlines
- Improve teamwork and collaboration
  - ➢ How to lead a group?
- To think out of the box: innovative thinking
  - ➢ New task every year
- Platform to be recognized: develop academic heroes
- Winning the competition is not the ultimate goal
  - ➢ Participation is important
  - ➢ Learning lessons for future challenges

What is a Robot?

Robot

- What does a Robot mean to You?
  - What do you expect a robot to be?

Automatically controlled, reprogrammable, multipurpose machine

Robotics

- Robotics among the 4 driving world technologies for the future
  - GRIN technologies* (Genetics-Robotics-IT-Nanotechnology)
  - Imperative to pay a serious commitment to develop robotics technology

- Robotics is multidisciplinary

Mathematics	Physics	Mechanical Engineering
Electronics Engineering	Electrical Engineering	Computer Science
Control Engineering	Materials Engineering	Communication Engineering

www.robotics.org

*https://www.academia.edu/

A 50 Year Journey …

https://vimeo.com/137042620

Robotics in New Millennium

- With the maturity of the field and advances in related fields, Robotics' main focus has started to change from industrial robotics to service robotics
  - Coexistence with humans in homes, workplaces and other communities was the new trend
  - Service robots were required to support services, entertainment, education, healthcare and assistance

- Robotics in the new millennium is more interdisciplinary
  - Biomechanics
  - Haptics
  - Neurosciences
  - Virtual simulation
  - Animation
  - Surgery
  - Sensor networks

  etc.

The Journey Continues …

https://vimeo.com/173394878

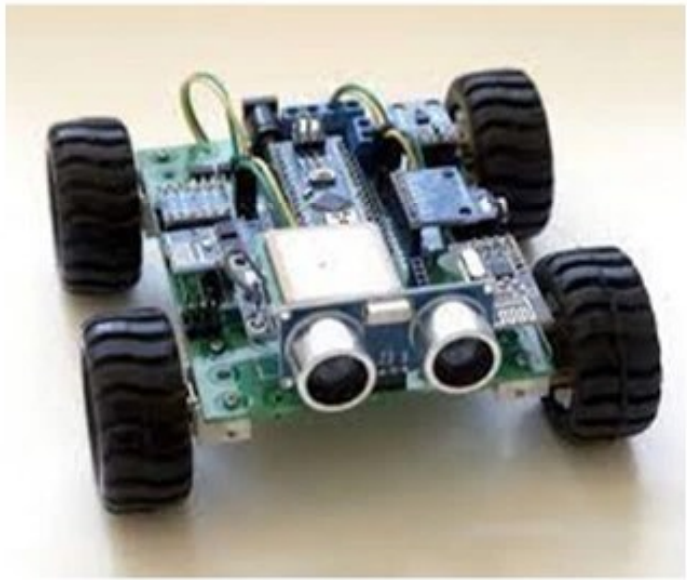
Learning Outcomes

Learning Outcomes

- Module Aim
  - To provide a starting point and immediate knowledge needed to design and implement a basic robot using suitable sensors and actuators to perform a simple task
- Learning outcomes
  - Identify the composition of a basic robot system and explain the functionality of each component
  - Select suitable sensors, actuators, mechanisms, and a power source for a simple robot design to perform a given task
  - Design and build a small robot and its control system for the required functionality
  - Tune, test and troubleshoot the robot to achieve best performance
  - Demonstrate teamwork and collaborative efforts to achieve a common goal and complete a task in the given time frame

Learning Outcomes

- Syllabus
  - Introduction to Robotics
  - Robot Mechanical Design
  - Robot Behavior
  - Robot Sensors
  - Robot Motion
  - Robot Power
  - Robot Communication
  - Building Robots



Learning Outcomes

- Engineering Skill Development
  - ➢ Hands-on robotics, state-of-the-art mechatronic design
  - ➢ Multidisciplinary experience
    - ▪ Electronics
    - ▪ Mechanics
    - ▪ Software and algorithms
    - ▪ Power distribution
    - ▪ Data communication
    - ▪ Materials
  - ➢ Problem solving using machines
  - ➢ Machine design capability
    - ▪ simplicity
    - ▪ robustness
    - ▪ cost effectiveness

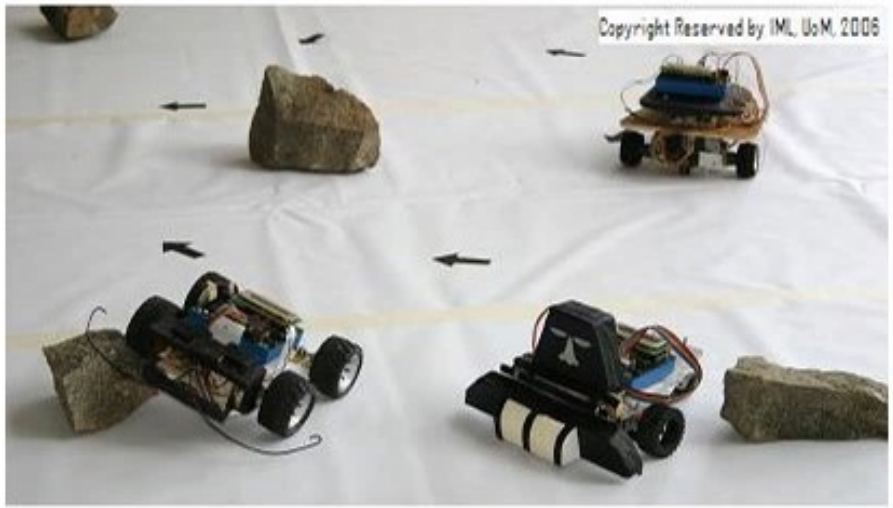
Plan to Win

- Create a winning robot design
  - ➢ Customized design to perform the given task in minimum time
- Build the robot considering
  - ➢ Weight, Accuracy, and Speed
- Tune, Test, and debug the robot properly
- Training and modifications to achieve best performance

Past Robot Competitions

1st Competition (05 Batch)

- Treasure Hunting (2006)



Robot Competition (06 Batch)

- GPS based Autonomous Navigation

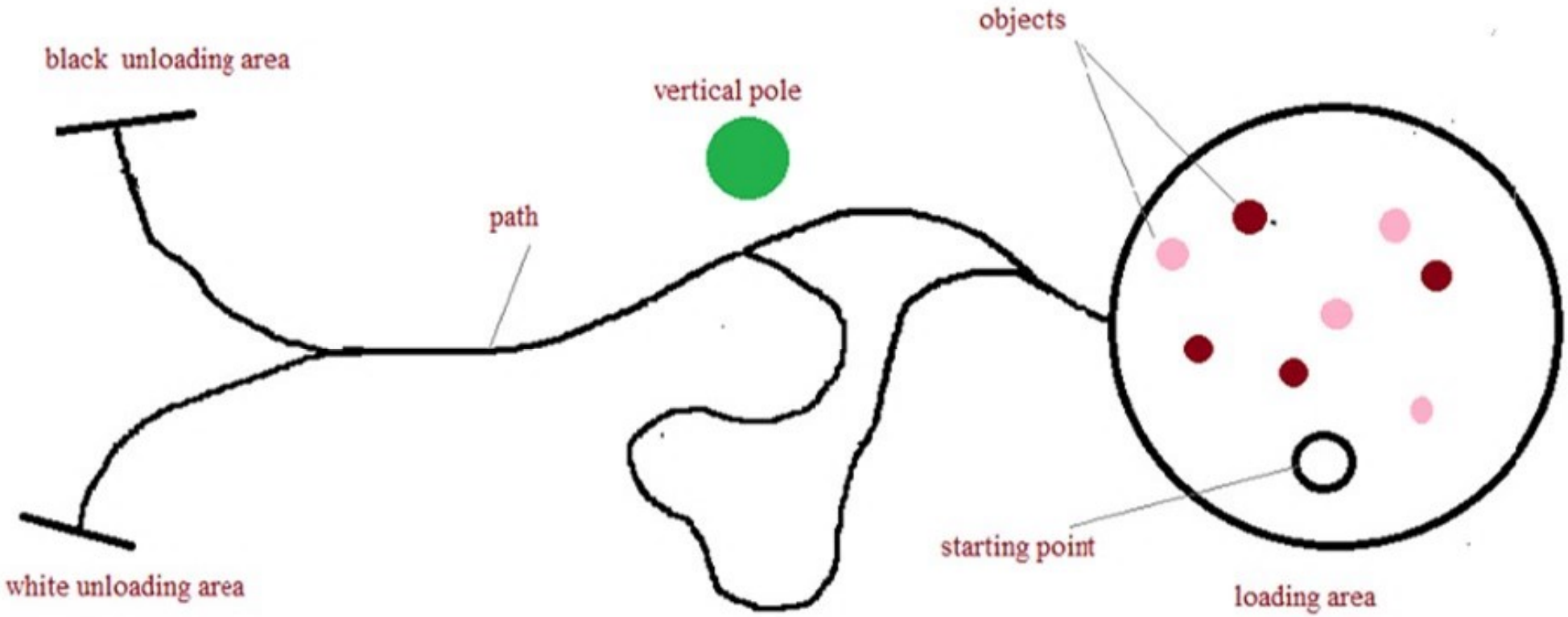
Robot Competition (07 Batch)

- Fire-fighting (2009)

[shortest time 146s, no collisions]

Robot Competition (08 Batch)

- Warehouse Robots (2010)
  - Cube delivery robot



Robot Competition (08 Batch)

- Warehouse Robots (2010)
  - ➢ Cube delivery robot

Robot Competition (08 Batch)

- Warehouse Robots (2010)
  - ➢ Cube delivery robot

http://www.youtube.com/watch?v=lXtsDWGl7Mg

Robot Competition 2011

- Ring Collector

http://www.youtube.com/watch?v=ucuk-kEFnuw

Robot Competition 2012

- Cube Collector

http://youtu.be/nm81AXcEPUM

This robot accomplished the task in 141[s]

Robot Competition 2017

- GPS based Autonomous Navigation
  - ➢ Ring collector

snapshots of the competition

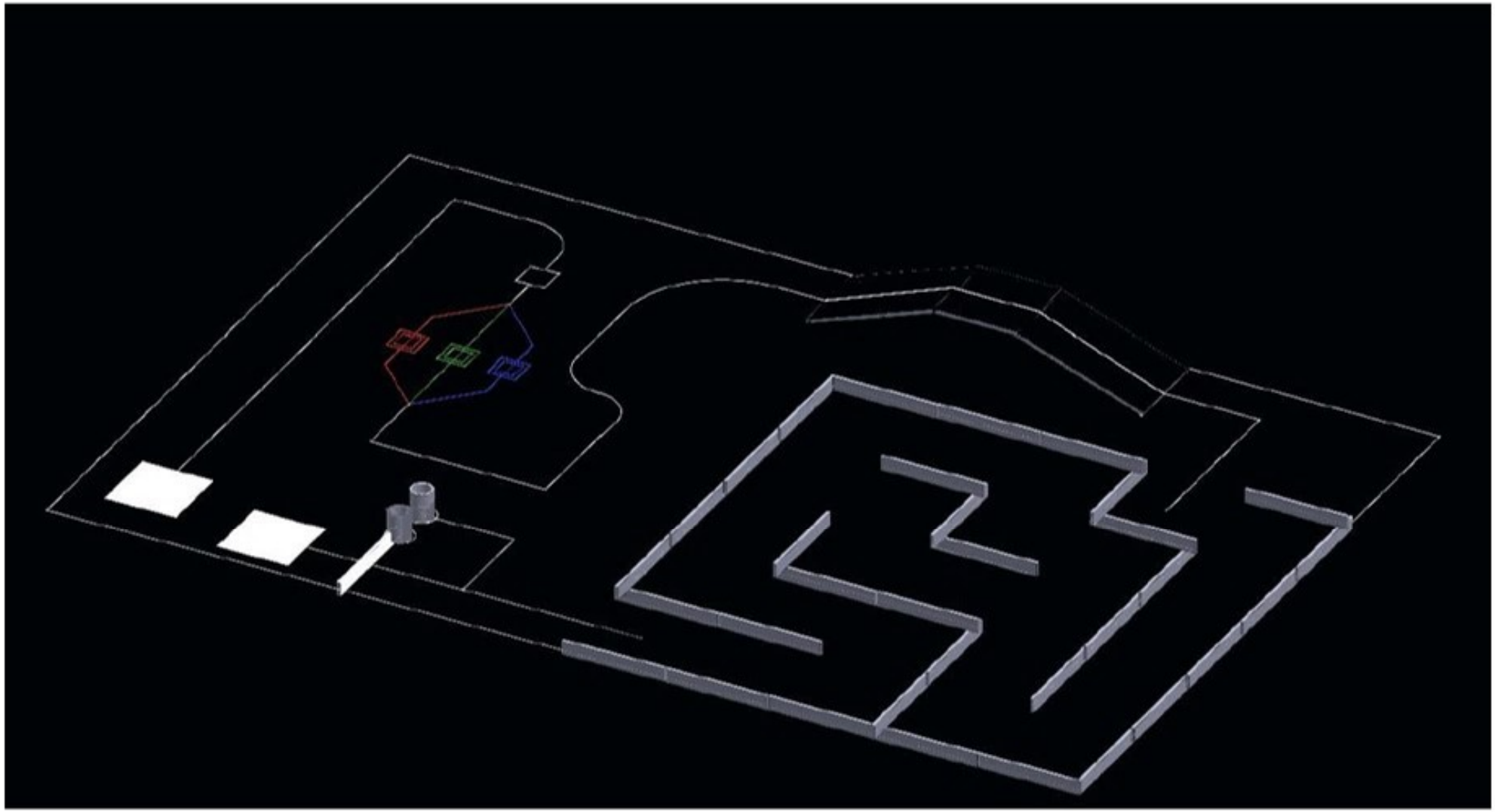
Robot Competition 2018

- Coin collector

3D sketch of
the arena

Robot Competition 2019

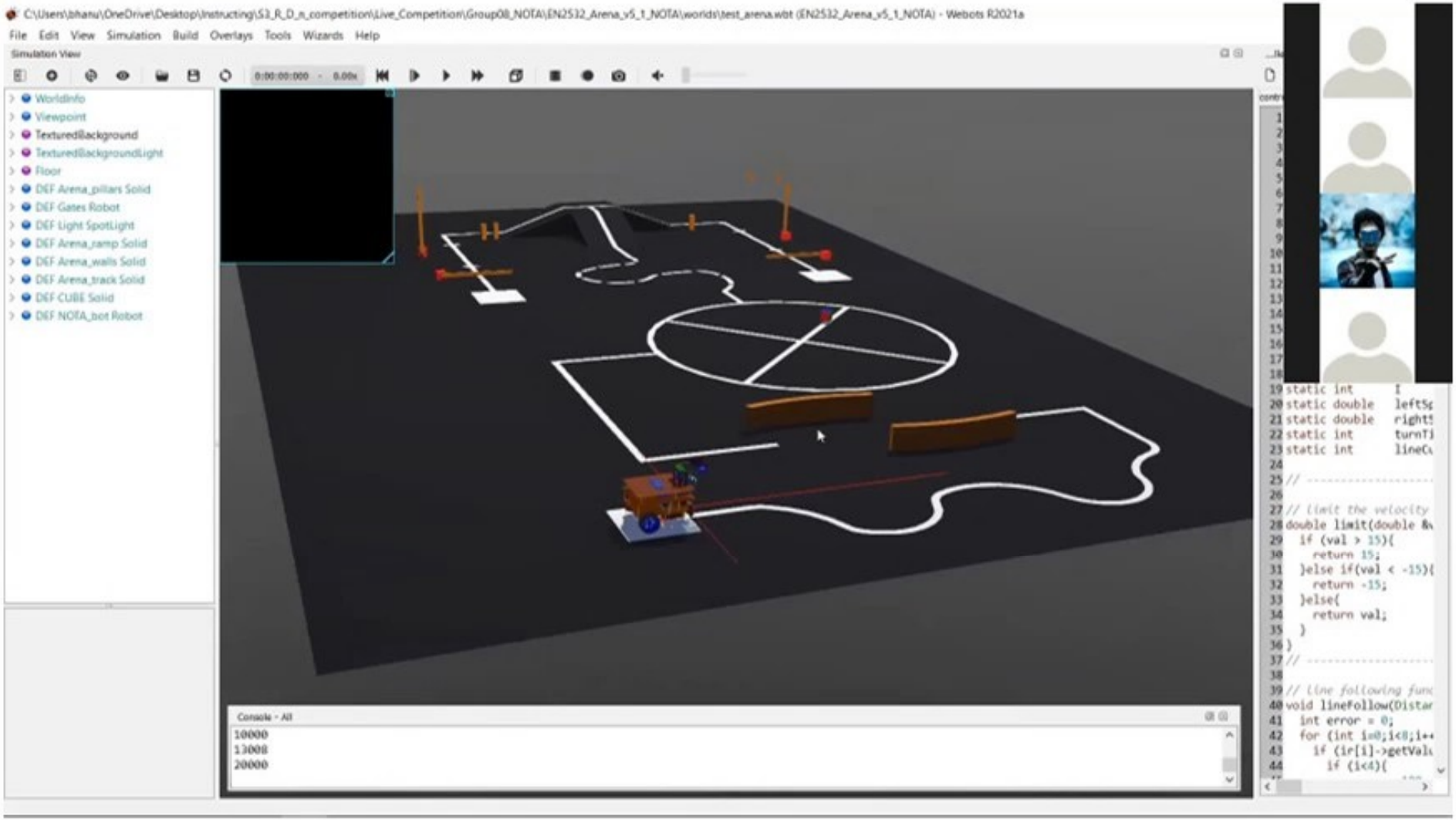
- Water transfer



3D sketch of the arena

Robot Competition 2020

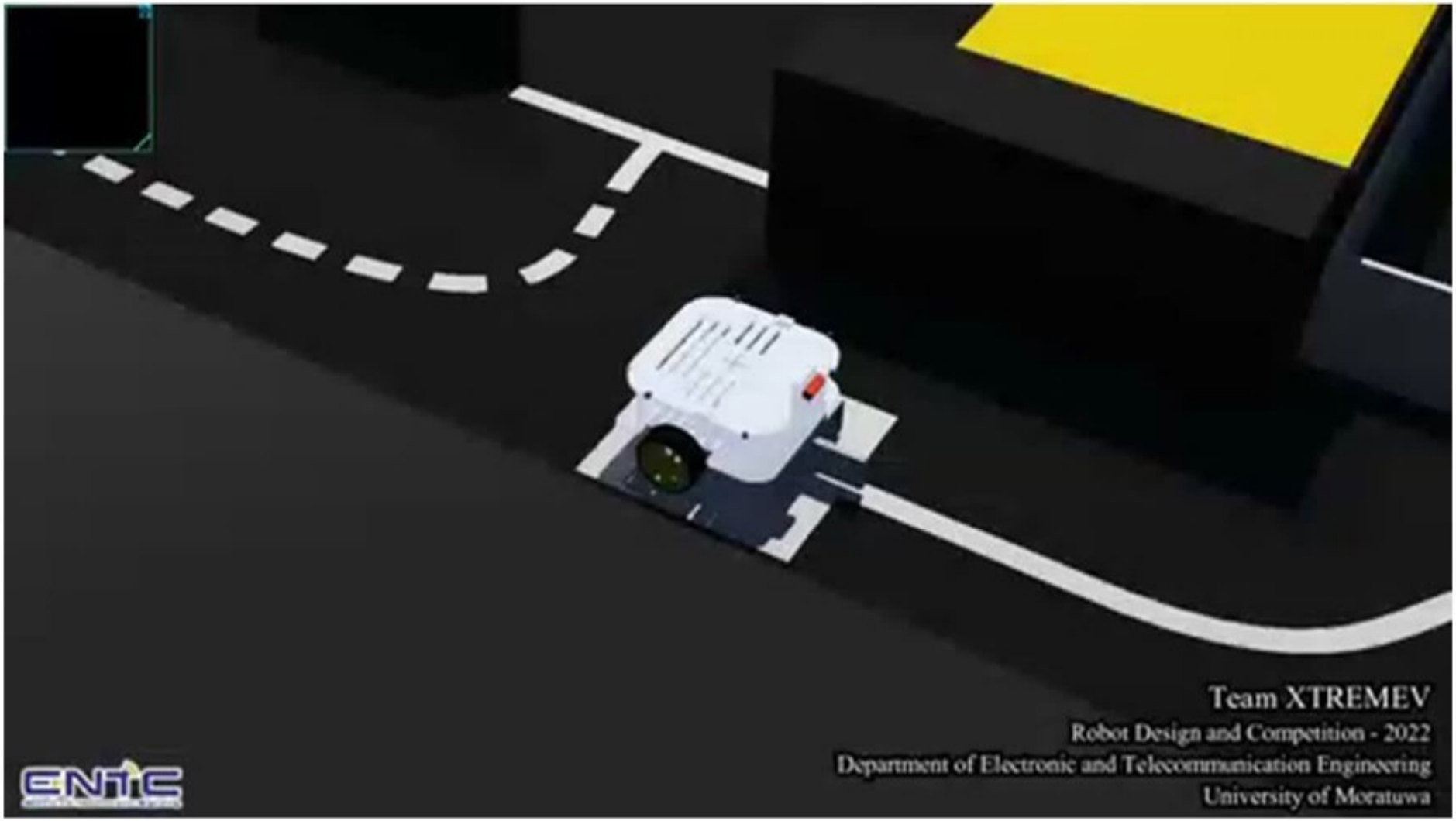
- First-ever virtual competition



Webots simulation

Robot Competition 2021

- Virtual competition



x4

Webots simulation

What's Out There

- EN2533 Robot Competition
- SLIIT Robofest
- Sri Lanka Robotics Challenge
- International ABU RoboCon

ABU RoboCon

- UoM Team got selected to represent Sri Lanka

ABU RoboCon, Japan, 2017

ABU RoboCon, Mongolia, 2019

Task 2023

Sub-Tasks

- Line following: regular and dotted
- Wall following
- Color detection
- Box manipulation
- Distance measurement
- Navigation on slopes
- Example Special Tasks
  - Navigating through automated gates
  - Water transfer etc.

Summary

Summary

- Course Details
  - Does not teach a great deal of theory but sets up a competitive learning environment to develop hands-on skills on robotics
- Robot
  - Automatically controlled, reprogrammable, multipurpose machine
- Learning Outcomes
  - Hands-on experience on multidisciplinary fields
- Robot Competition
  - 1st competition in 2006
  - Task got difficult each time