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Master of
Cyber Physical Systems

D3.2. Selection and development of case studies

Case Studies for Students

KTH Royal Institute of Technology

Contents

Introduction

The case studies were designed for developing research and development to build and test MSCPS student's theoretical knowledge and enhance their practical competencies. Case studies have increased recently to equip students with the required competence and skills for the job market.

The designed cases are planned to improve quantitative and qualitative research that will produce results beneficial to graduate students to meet the career market demand and foster Entrepreneurial thinking.

The partner universities developed the case studies to fill the gab between academia and enterprise job requirements through skills and competence developments. For this reason we focused on pre-specified pool of skills with are summarized as follows

- Improve the research skills
- Experienced different education and teaching methods
- Access to facilities Labs
- Academic networks and links with partner universities
- Improved Education results
- Improve the employ ability
- To Develop soft skills
- Develop business model skills
- Develop innovation and executing new projects and start-ups
- Improve critical skills such as creativity, communication and presentation.

1. Case Study/Project title: Autonomous Reliable Car

Embedded Systems, Autonomous Systems", "Autonomous Reliable Car"

Case Leader: "Raimund Kirner",
Email address "r.kirner@herts.ac.uk",
Institution: University of Hertfordshire- UK

Embedded Systems, Autonomous Systems", "Autonomous Reliable Car"

Duration: "Up to 10 weeks"
Number of Students: "Can be done individually, but also in groups of a view together.

The Case Study/ Project will contribute to the following
Experienced different education and teaching methods
Improve the research skills
Access to facilities Labs
Improved Education results
Improve the employ ability
Improve critical skills such as creativity,
Communication and presentation."

2. Case Study/ Project title: Optimization of fruits quality based on precision agriculture

Subject Area : Smart Agriculture
End Users: Small and medium farmers, Agricultural structuresâ
Case Leader Walid Barhoumi
Email address ","walid_barhoumi@yahoo.fr "Country ",
Institution Name: University of Carthage-Tunisia

Pre-requisites: Programming, Embedded systems (e.g. Dev. Board), Artificial Intelligence Computer Vision, Data processing, Problem solving and Research skills Problems
Automation of agriculture (e.g. irrigation, cultivation, Smart and environment control (e.g. water saving, optimized fertilizing)

Current State: Existing solutions are mostly expensive and sophisticated in addition to the challenging issue of maintenance (cost + time)
Proposed Solution: Efficient and simple dashboards offering only expected services by small farmers.
The services should be personalized according to the specific requirements of farmers while being of low cost.
Research Questions: Effective data collecting and processing tools (real-time, user friendly, eco-friendly) and understanding of control systems
Criteria to Measure the Success:
Run Test (functional, MVP) and Satisfaction of farmers and/or industrials
Envisioned Steps/Scaffolds to Solve the Use Case:
Iterative Processing
-Collect the requirements of farmers
Prototyping-Design
Design implementation -
Deploy-Evaluate-Adjust/Revise/Update
Used Labs: Software Engineering Lab, Embedded Systems Lab, Sensors and Actuators Lab (creating a Stimulink model, preprocessing data, HMI and dashboards design
Educational Considerations/Special Methods:
Flipped classroom, Team Working, Periodic Presentations and Workshop

Expected Target State: Soft-skills enhancement (team working, time management, customer needs...) and Simulations in real-world contexts Actions/Considerations for Industrialization: -
Who: Startups/SpinOffs and Industries -
What: Minimum Viable Product (MVP) presentation and Outcomes pitching -
How: Requirements of farmers and proposed solutions (main advantages comparatively to existing solutions...)
Evaluation Criteria:
How much did a student interact in the sessions?
How much he/she contribute to the design and implementation of the use as
How he/she interacts with the other team members.
Student Roles:
Requirements collection and definition, Problem solving, Solution Design, software design, Results evaluation, Project management
Learning Outcomes:
Design and implement an effective embedded system related to real-world needs,
Design user friendly data processing and visualization/monitoring dashboards
Envisioned Skill: Soft skills (Communication, team working, time management
Entrepreneurial skills (customer requirement analysis, MBC design, value proposition"",
Duration: ""More than 10 weeks
Number of Students: up to 4 students
Evaluation method: ""Presentation

3. Case study/Projects Title: Emotion Recognition based on EGG Signals and Computer Vision

Subject Area : Artificial Intelligence ","Emotion Recognition based on EGG Signals and Computer Vision
End Users: Customers (for CMS systems)
Case Leader Walid Barhoumi, Bchira Ben Mabrouk
Email address ","walid_barhoumi@yahoo.fr , chirabenmabrouk1@gmail.com
Institution Name: University of Carthage-Tunisia

Pre-requisites: Programming, Embedded systems, Computer Vision, Machine Learning, Feature Engineering
Problem solving and Research skills
Problems: Analysis of EGG signals and Image content for emotion recognition of subjects (students, customers)
Current State: Existing solutions are mostly expensive and time consuming, Accuracy of current solution could be ameliorated
Proposed Solution: Efficient and effective system that is able to recognize the current emotion of a subject given his/her image and/or EGG signals.
Research Questions: Effective data collecting, cleaning and predictive tools (real-time, user friendly â€¦) and metrics to evaluate the effectiveness and the accuracy of an emotion recognition system
Criteria to Measure the Success: Emotion Recognition Accuracy, Confusion Matrixes, Run Test (functional, MVP…) and Degrees of satisfaction of end-users Envisioned Steps/Scaffolds to Solve the **Use Case:**
Iterative Processing (collect, design, test, evaluate, pivot and adjustâ€¦.) -
Draft-Prototyping-Design -
Design implementation -
Deploy and Assess obtained results -
Adjust/Revise/Update
Used Labs: Software Engineering Lab, Embedded Systems Lab, Sensors Lab, Interfaces Design and implementation Lab Educational Considerations / Special Methods: Flipped classroom, Team Working,
Periodic Presentations and Workshopsâ€¦ Expected Target State: Soft-skills enhancement (team working, time management, customer needs…) and Simulations in real-world contexts Actions/Considerations for Industrialization: -
Who: Startups/SpinOffs and Industries - What: Minimum Viable Product (MVP) presentation and Outcomes pitching -
How: Main advantages comparatively to existing solutions (accuracy, CPU time, interfaceâ€¦)
Evaluation Criteria: how much did a student interact in the sessions?
How much he/she contribute to the design and implementation of the use as?
How he/she interacts with the other team members?â€¦.
Student Roles: Requirements collection and definition, Problem solving, Solution Design, software design, Results evaluation, Project managementâ€¦
Learning Outcomes: Design and implement an effective emotion recognition system that could be deployed within a real-world framework, Design user friendly data processing and visualization interfaces
Envisioned Skill: Soft skills (Communication, team working, time managementâ€¦) and Entrepreneurial skills (customer requirement analysis, MBC design, value propositionâ€¦)"","
Duration: "More than 10 weeks""
Number of Students required: up to 4Students
Evaluation: Presentation

4. Case Study/Projects Title: medication reminder for elderly people"

Subject Area
"Artificial intelligence application"

Case Leader Cali Nuur, r Mohammad Saleh
KTH Royal Institute of Technology
Sweden
Email address: cali@kth.se
Mohsaleh@kth.se

Aim and objectives
Help elderly/ sick people to get their treatment on time Sort out the medication and dose to take Avoid side effect of mixing medication provide a medical report for doctor.
Medication dose, as well as information about the effectiveness and side effects of medication, are generally determined by studies done in relatively young, healthy people.
This information may not apply to older adults, because our bodies and how we process medications change with age. As we get older, our bodies react to drugs differently than when we were younger.
The aging process, along with medical conditions, often impacts the benefits and side effects of medications.
Required skills: Programing , Embedded system, writing skills
Duration: Up to 10 weeks",
Number of Students : up to 2 students
Evaluation
Final Report and presentation",

5. Case Study/Projects Title: Cloud computing resources management using Machine Learning (ML)

Subject Area: Cloud computing

Case Leader Sulieman Al Meqdadi
Email address: S.AlMeqdadi@gju.edu.jo
German Jordanian University- Jordan,

Aim and objectives

"The purpose of the case study is to prepare the students on how to make a review research paper in the field of cloud computing and Big Data.
This use case will be specialized in Cloud computing resourcesâ€™ management, which is an important topic that has been explored in the past few years in order to
help network administrators in making proper planning and utilization for cloud network infrastructure and resources.
The main objectives of the use case is to describe how different Machine learning (ML) algorithms and approaches can be used to optimize the resources provisioning and utilization on a cloud environment, such that the end customers will have high quality of service while utilizing the cloud resources properly and in a cost-effective way.
list and compare different machine learning algorithms used to optimize the cloud resources and mange their usage.
The students will have to compare between the different algorithms focusing on the pros and cons of each one.
Required skills: The students need to know the theoretical basics of Big data and cloud computing, which is taught inside the class.
In addition the students need to learn the basics of machine learning.
Furthermore, the students need to know how to search for scientific research papers, how to read them and analyze them and how to construct a research review paper using professional tools such as latex.
In this course, students have to learn Overleaf, an online, easy to use tool that can be used to make research papers using latex.
Proper guidance to the students have been give to them such as: providing them with the needed resources to conduct the review paper.
Taught them how to search for research papers. Provide them with educational videos to teach them how to use overleaf to be used for their paper writing. ",
Duration: "Up to 10 weeks",
Number of Students: 1
Evaluation: Final Report

6. Case Study/Projects Title: Defect Detection

Subject Area " Manufacturing Challenge"

Case Leader Bassem Bouaziz
Institut superieur informatique et multimedia de sfax
Tunisia
Email address: bassem.bouaziz@isims.usf.tn

Aim and objectives
In order to ensure zero defect in manufactured components and products and to answer the question Does a surface of a manufactured part contain a defect?
Quality inspection is a key capability that manufacturing companies should develop. Manual inspection is tedious, labour intensive and often error prone.
Vision-based automated quality inspection is a promising technology for manufacturing companies. Al is a potential enabler to develop such solutions.
The expected results are Establishing a baseline accuracy on defect detection on the DAGM20117 / KolektorSDD/KolektorSDD2 data sets Providing an efficient ONNX model, through model compression and quantization.

Deployment on a set of arm-based platforms through ONNXruntime, LPDNN or TensorRT. Integration of the whole workflow as an end-to-end Al asset.
The Target Platform is : Bonseyes Developer Platforms I NVIDIA Jetson AGX JetPack 4.6.1 TensorRT 8.0.1
Target Hardware is NVIDIA Jetson AGX using DLA via TensorRT 8.0.1",

Required skills:

Duration: Up to 10 weeks",
Number of Students : up to 2 students
Evaluation
Final Report and presentation

7. Case study/ Project title: DoF Object Detection

Subject Area Manufacturing Challenge

"Artificial intelligence application"

Case Leader Tarek Zlitni
Higher Institute of computer science and multimedia of sfax, Sfax, Tunisia Tunisia
Email address: tarek.zlitni@isims.usf.tn

Aim and objectives

The goal of this challenge is to automatically detect object location and orientations (6 Degrees of Freedom - DoF) in a production environment.
The capability will be used by high performance feeding systems in Bin Picking scenarios. Â Must work globally across several types of industrial products.
In fact, Production lines with different manufacturing and assembly stations/machines are often interconnected using transfer systems like conveyors.
In order to feed the production lines with well positioned/oriented components and parts, a feeding system is often needed.
Bin picking is one of the major challenges to solve in order to have high performance feeding syst em.
Vision based and Al enabled 3D object detection with six degrees of freedom (6DoF) is an essential capability.
The question to be answered is What is the location and the orientations of a 3D object (manufactured parts)?

The expected resultas are: Establishing a baseline accuracy on 3D object detection using Fraunhofer IPA Bin-Picking and LINEMOD datasets Providing an efficient ONNX model, through model compression and quantizat ion.
Deployment on a set of arm-based platforms through ONNXruntime, LPDNN or TensorRT. Integration of the whole workflow as an end-to-end Al asset .
The Target Platform Bonseyes Developer Platforms I NVIDIA Jetson AGX JetPack 4.6.1 TensorRT 8.0.1 Target Hardware NVIDIA Jetson AGX using DLA via TensorRT 8.0.1"",

Required skills:

Duration: Up to 10 weeks",
Number of Students : up to 2 students
Evaluation
Final Report and presentation

8. Case Study/Projects Title: Using DNA in Determining the Nationality using machine learning algorithms

Subject Area " Machine learning"

Case Leader Zaid Alhalhouli
Tafila Technical University (TTU)
Jordan
Email address: zaid_halhouli@ttu.edu.jo

Aim and objectives
"The purpose of the case study is to prepare the students on how to make a review research paper in the field of Machine learning, especially in deep learning.
This use case will be specialized in Deep Learning and Unsupervised Learning. In the past few years, a lot of interest was raised in the field of Data sciences and Bigdata and many researchers were worked on improving and enhancing the ML algorithms and tools to analyze the Bigdata and classify it in the proper way.

The main objectives of the use case are to list and compare different kind of ML algorithms and explain how they can be used in the analysis process.
Furthermore, the students will be asked to build a deep learning model by using simulator tools, and this tool we will select it according to its capability and features.

Required skills: The students need to know the theoretical basics of machine learning algorithms, deep learning techniques, and machine learning simulators, which are taught inside the class.
Furthermore, the students need to know how to search for scientific research papers, how to read them and analyze them, and how to construct a research review paper.
In this course, students have to learn Orange tools, an open-source data visualization, and analysis tools, it contains components for machine learning, add-ons for bioinformatics and text mining and it is packed with features for data analytics, Orange is a Python library.

Duration: Up to 10 weeks",
Number of Students : up to 2 students
Evaluation
Final Report and presentation

9. Case Study/Projects Title: Investigation of security and privacy issues associated with IoT systems using Machine Learning Techniques

Subject Area " Security and Privacy and Machine Learning"

Khalid Alemerien
Tafila Technical University (TTU)
Jordan
Email address: khalid.alemerien@ttu.edu.jo

Aim and objectives

The purpose: The purpose of this case study is help students in:-
Performing a literature review of the applying the machine learning techniques in the security and privacy of IoT systems field.
Run experiments using the existing datasets.
Providing a research paper including the gained results. -
Presenting, orally, the results of the project This case study is a part of security and privacy and machine learning courses.
The proposed technique may help communities with detecting the privacy and security issues in IoT systems.

The main objectives of the use case are to list and compare the proposed techniques and solutions for detection purpose.
The students will perform practical experiments and construct a required data set.
Also, the students present their results in oral and written manners.
The expected result of this project is to provide the students with required knowledge and practical skills to conduct thesis experiments in future, and the best practices of scientific research.

Required skills:
-The students need to know the theoretical basics of machine learning and security and privacy, which are taught inside of two classes.
-The students need to collect the required data sets.
-The students need to know how to conduct scientific research, which focuses on security and privacy issues associated with IoT.
-The students need to learn how to use some specific tools such as python, R programming language, Matlab with machine learning package, or Orange or Wika.
-Presentation and Scientific Writing skills"","

Duration: Up to 10 weeks",
Number of Students : up to 3 students
Evaluation
Final Report and presentation

10. Case Study/Projects Title: Smart Street Lighting

Subject Area "Internet of Things"

Case Leader Isam Ishaq
Al-Quds University
Palestine
Email address: isam@alquds.edu

Aim and objectives
"Street lights consume a considerable amount of electrical energy.
This energy is not efficiently used because usually streetlamps are kept on at full intensity during the night, regardless if there is need for them to be on or not.

This project proposes a smart street lighting system that automatically switches off the light for the parts of the streets having no motion detection and turns on the light for the parts of streets where motion is detected when it is dark. Smart street lighting also controls the luminosity of light based on motion and performs automatic light dimming which is an aspect that serves to reduce energy consumption.
The intensity of light can be controlled based on the number of vehicles and the weather conditions.
The idea of this project is to provide smart street lighting by measuring the sunlight intensity and observing objects' movement on the street, ' to decide whether to turn on or off the lights that are implemented in a section of the street. ",
Required skills:

Duration: Up to 10 weeks",
Number of Students: up to 4 students to achieve better quality projects
Evaluation
Final Report and presentation

11. Case Study/Projects Title: Free Space Optics in Palestinian Weather Conditions

Subject Area "Wireless Communication Networks"

Case Leader Yousef Hamouda
Al-Aqsa University
Palestine
Email address: ye.hamouda@alaqsa.edu.ps

Aim and objectives
Free Space Optics (FSO) considers one of the highest data rate wireless communication system.
The aims of the proposed use case is to study and model the weather condition effect on FSO signal.
Therefore, the main objective is to model and determine the weather conditions in Palestine and its effect in FSO including fig and rain.

Required skills:

The main skills needed for this use case include research, modelling, simulation, mathmatics, writing, presentation, and communication skills.
The supervision process includes main supervision by Yousef Hamouda and co-suppervision from other universities.",

Duration: Up to 10 weeks",
Number of Students: up to 3 students

Evaluation
Final Report and presentation

12. Case Study/Projects Title: Baby Health Monitor

Subject Area "Internet of Things"

Case Leader Isam Ishaq
Al-Quds University
Palestine
Email address: isam@alquds.edu

Aim and objectives
"Develop a system to monitor the health of new born babies by monitoring their vital health signs. Parents and baby siters can be alerted via various means such as mobile devices when any abnormality.

Required skills:

Duration: Up to 10 weeks",
Number of Students: up to 4 students to achieve better quality projects
Evaluation
Final Report and presentation",

13. Case Study/Projects Title: Clustering of wafer error patterns for supporting expert driven root cause analysis

Subject Area semiconductor manufacturing - semi-automated quality testing - statistical root-cause analysis - clustering - classification - machine learning - decision support

Case Leader "Christian Weber",
Email address: "christian.weber@uni-siegen.de","Germany",
"University of Siegen","postdoctoral researcher",
Germany

Aim and objectives
The assignemnt is planned to be solved in groups of two or three people in a period of up to 10 weeks or shorter. As an individual work it can be tackled using longer time periods.
The work is focused on a practical exploration and identification of methods and their comparison.
To use the use case for a master thesis, the task has to be extended, either through creating a software tool that integrates the methods, or by designing a more detailed theoretical method pipeline.
The latter may take the shape of a decision tree that selects the methods to use, based on self defined indicators and requirements listings.
To work through the use case in groups, several ""splits"" are possible.
Tasks can be: classic statistical clustering methods vs machine learning based clustering (again can be split into classical ML vs deep learning is possible)
classification of the pre-existing labels and created cluster labels for evaluation 2D image pre-processing and augmentation for equalized and/or growing data sets.
At the end of the group work, the methods have to be combined to one shared data pipeline.

The purpose of the assignment is to work on a more open ended problem, for which methods have to be compared and combined to achieve the intended results.
Reflective skills, interactive exploration and potentially group work and group communication are needed to complete the tasks.
Additionally the participants have to think into the role of the supported engineer who will use the final tool to support the root-cause analysis.
- aim and objectives -
- learn about machine learning methods
- learn about pre-processing and data augmentation methods
- build a data mining pipeline that clusters the wafermaps
- find ways to evaluate the created clusters
- prequisites and skills required -
- understanding of data-driven methods
- basic experience/knowledge with explorative data analysis
- mathematical skills/logic to master the machine learning methods
- basic application area understanding or readiness to learn applications in the field of semiconductor manufacturing
-**support and supervision process**
- The nature of the task is explorative analysis and method selection and exploration.
As such the supervisor should have skills in the field of machine learning, basic statistics and potentially semiconductor manufacturing knowledge, to help the student/s to find the way in the relatively open task. The supervision starts with a use case meeting to talk through the application and method requirements.
With that in mind a first investigation of the literature is conducted on the student's side. Based on this, either a short expose of the case has to be written, or the data analysis starts.
- The data set is presented to the student/s: http://mirlab.org/dataSet/public/ - More information can be found: https://www.kaggle.com/code/ashishpatel26/wm-811k-wafermap
- An example implementation publication is given: https://ieeexplore.ieee.org/document/9658907/",
Duration: Up to 10 weeks",
Number of Students: 1 student
Evaluation Final Report and presentation

14. Case Study/Projects Title: Design and implementation of a smart greenhouse for crops' growing

Subject Area " Electrical and computer engineering"
Palestine Technical College - Deir El-Balah
Case Leader Ezzaldeen Edwan
Palestine
Email address: ezedwan@ptcdb.edu.ps

Aim and objectives

"The goal is giving the student insights about design of smart systems e.g., IoT based systems.
Prerequisites: Knowledge of programming languages, development boards, sensors and actuators.
Required skills:
research and development skills are needed, technical skills in construction of the greenhouse.

Support and supervision process: I will help is guiding the student is every step of the development.
I will offer needed scientific material e.g., journal and conference papers.",

Duration: Up to 10 weeks",
Number of Students: up to 2 students
Evaluation
Final Report and presentation