**ODTÜ**

**Department of Electrical - Electronics Engineering**

**Senior Year Engineering Design Projects**

EE 493 Engineering Design I and EE 494 Engineering Design II courses are compulsory courses taken in the 4th year of our department’s undergraduate program and aim to provide an experience in design. The goal of the course is set as the learning and implementation of design processes, and this learning activity is carried out with a "learning while doing" approach through a project.

These two courses are sequentially taken over two semesters and considered to be very important in terms of the skills we aim for our graduates to acquire. Different projects are offered to students each year, and our students work on the project they want with the project teams of their choice.

The following qualities come to the fore in determining the projects at the beginning of the year.

* The project is roughly defined
  + The problem presented in the project should not, to a great extent, lead to a single solution, rather different potential solutions to the problem exist.
  + The project should allow our students to use their creativity and produce original solutions.
* The project content is suitable for electrical and electronics engineering students.
* The project is such that problem definition, idea generation (proposing ideas/solutions, literature survey, comparison of solutions), conceptual design, detailed/critical design, evaluation steps can all be experienced by the students.
* The project includes knowledge and practice in more than one field of Electrical and Electronics Engineering discipline (Biomedical; Computer; Control Theory; Electrical Machines, Motor Drivers and Power Electronics; Electromagnetic Waves, Microwave Techniques and Antennas; Energy and Power Systems; Electronics; Robotics; Signal Processing; Telecommunication)
* The project has realistic constraints.
* The budget of the project is limited (Although the total expenses of the end product are limited to $200 at the most, this budget constraint can be relaxed by examining the expense items specific to the proposed project.)

Each project team formed by the students is assigned to one of the faculty members who works as the design studio coordinator (DSC). Our faculty members do not interfere with the technical solutions that students will develop. Their involvement is rather limited such as providing opinion in case they turn to rather wrong solutions. Throughout the year, DSCs mostly provide general information about the project operational practices (modus operandi) and observe execution. The expectation from company employees who will take place as “mentors” in the projects proposed by the companies is similar to the role of DSC rather than technical assistance. In coordination with DSC, the mentors will provide their opinions on the project team’s course of action.

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**PROJECT PROPOSAL FORM**

| **Company Name**  *A brief information about the company, activity areas of the company, and contact info (web site, phone number)* |  |
| --- | --- |
| **Contact Person**  *Name-Last Name, profession, title, contact info (e-mail address, phone number)* |  |
| **Project Title**  *A descriptive project title along with an acronym* |  |
| **Motivation**  *Real-life use cases leading to the project idea* |  |
| **Project Aims and Objectives**  *The aim achieved by the completion of the project and objectives related to the aim* |  |

| **Project Description and Requirements**  *Detailed description of the work expected to be done within the project and the requirements of the project output (functional, performance and physical)* |  |
| --- | --- |
| **Design Constraints**  *Please write the operation conditions that may be sufficient for the completion of the project in a way that will meet the objectives of the course.* |  |
| **Extra Features**  *It will be instructive to present some possible features beyond the sufficient ones stated in the previous section.* |  |

| **Company Support**  *If the project requires special support (equipment, measuring instrument, training, etc.)*  *The list of equipment expected to be used in the project and to be provided by the institution, how essential the relevant equipment is for the project and alternative project plans to be created in case these cannot be provided* |  |
| --- | --- |
| **Project Mentor**  *Information on the mentor(s) assigned to the project teams and the contribution of the mentor(s)* |  |
| **Date**  **Filled out by** |  |

**PROJECT PROPOSAL CHECKLIST**

| **The aim and objectives of the project are clearly stated.** | **☐** |
| --- | --- |
| **The definition and requirements of the project are defined at a limited level, and it is left to the students to determine the detailed features and requirements.** | **☐** |
| **The project has realistic constraints.** | **☐** |
| **It is possible to solve the problem presented in the project with different approaches, students can produce original solutions in a creative fashion.** | **☐** |
| **The scope of the project is suitable for Electrical and Electronics Engineering students and the solution methods include the knowledge and skills to be used from more than one sub-field.**  *Sub-fields : Biomedical; Computer; Control Theory; Electrical Machines, Motor Drivers and Power Electronics; Electromagnetic Waves, Microwave Techniques and Antennas; Energy and Power Systems; Electronic; Robotics; Signal Processing; Telecommunication* | **☐** |
| **The project is appropriate for students to experience all phases of the project process (e.g., problem definition, idea generation, conceptual design, detailed/critical design and evaluation).** | **☐** |
| **The project has a workload that can be completed in two semesters by 5 Electrical and Electronics Engineering Department senior students.** | **☐** |
| **The project budget is limited.**  *Although it is aimed that the expenses of the project teams will be at most $200, flexibility can be achieved in the budget by examining the expense items specific to the project.* | **☐** |
| **The project mentor assigned by the institution is knowledgeable on the project.** | **☐** |
| **No specialized equipment or setup is needed to test the features of the project output.** | **☐** |

**Sample Project Definitions from Previous Years (the version available to the students)**

## Training Buddy (2022)

Practicing with the best players is critical in advancing your skills in any sport. Table tennis is no exception, yet it is not always possible to train with highly qualified players, since they are often your opponents. In this project, you are asked to design and implement a ping pong ball launcher as a useful training tool with some level of interaction and intelligence.

The ball launcher is a device that

* works with verbal commands from the player
* launches balls in varying and adjustable swing speeds, serve frequencies, and launching angles
* exerts topspins and backspins to balls at varying levels (e.g. heavy topspin, slight backspin)
* determines whether the player was able to hit the ball and records it in a database for sport analytics purposes.

The ball launcher must have five operation modes as follows:

* Repetition practicing: Consecutive balls are launched in the same style (e.g., topspin to the left).
* Randomized repetition practicing: Balls are launched as in repetition practicing, but with random variations on parameters such as swing speed, launching angle and landing point.
* Sequence practicing: Consecutive balls are launched in different styles in a particular order (e.g., one topspin to the left, one topspin to the right, and then one backspin to the right).
* Randomized sequence practicing: Balls are launched as in sequence practicing, but with random variations on parameters such as swing speed, launching angle, and landing point.
* Game mode: The device simulates an opponent by displaying combinations of all its capabilities and analyzing the skills of the user that require improvement.

The ball launcher must be designed to perform on a real ping pong table. Balls should be launched from at least 1 m away from the net and should land on the opposite side of the table at least 80% of the time in any repetition practicing mode.

## Aid for the Blind (2022)

Aids for the perception of disabled people are proliferating with growing intelligent technology. This project aims at adding to the available tools for visually-impaired users, by designing a wearable device that continuously monitors its surroundings and guides the user to safely navigate the streets.

In this project, first a typical test environment with several streets, pedestrian+vehicle traffic, and crossroads must be situated. The designed system must then be able to perform the following tasks within the test environment:

* Detect and recognize pedestrian crossings (signal displays, line markings, lighting, pedestrian-relevant traffic signs including bicycle road signs, etc.), and notify the user when it is safe to cross the street (by checking the traffic lights, approaching vehicles, etc.).
* Help the user cross the streets under pedestrian and vehicle traffic with the detected pedestrian crossings and traffic signs.
* Warn the wearer when obstacles (animate/inanimate, at least 25 cm high) are encountered, and suggest a path to avoid collision with the obstacles.
* The device must be
* Easy and comfortable to use,
* Light in weight,
* Free of any hard wiring that may hinder motion,
* Stingy in energy dissipation,
* Accurate and efficient in guiding the blind over reasonably complex crossroads, under dense traffic.

Optional feature:

Conversion of text (on boards, paper, etc.) to speech on demand of the user for at least 3 different forms of text, e.g., bus numbers, advertisements, and posters.

## Smart Shopping Cart (2021)

# A self-contained smart shopping cart would take some of the burdens off the shoulders of the shopper.

# One of the most obvious burdens in market shopping is to push and maneuver the cart between the aisles. Therefore, a self-powered cart that follows the shopper autonomously is required.

# Another burden in market shopping is waiting in the cashier’s line, emptying the whole cart in front of the cashier and reloading it to make the payment. Ability to recognize and register an item while it is being placed in the cart and to calculate the total amount to be paid at the end is required. This feature should be mostly automatic; it can resort to semi-automatic solutions only for limited cases when automation fails.

# Your task is to design and construct a scaled-down model of such a cart as a proof of concept. The model should:

# Have a 15-litre container,

# Be capable of handling,

# at least 10 different kinds of goods,

# a total weight up to 2 kilograms,

# Allow for item removal,

# Present precautions against illegal use of the system,

# Follow the shopper autonomously,

# Provide collision avoidance,

# Be completely self-contained except for a possible interaction with the shopper.

# The final product must be demonstrated for a store plan consisting of at least 2 parallel shelves, reachable from both sides.

# Museum Audio Guide and Visitor Monitoring System (2020)

The main purpose of this project is to design and implement a guidance system for the visitors of a museum. The system will allow visitors to purchase tickets for different sections (rooms) of a museum, track their locations during their visit, and automatically inform the visitors about the item they are visiting through the earphone of a portable device.

The system should have the following features:

* At the entrance of the museum, visitors purchase a ticket and they are identified by the system. They select which sections of the museum they would like to visit when buying their ticket and pay accordingly. Each visitor is provided with an electronic handheld museum guide.
* During the visit, the system follows the track of the visitors. If visitors attempt to enter parts of the museum that are not covered by their ticket, the system announces that the credit card of the visitor will be charged if they enter.
* Precise locations of the visitors will be tracked by the system at all times with a maximum error of 50 cm in position. If a certain section reaches a predetermined maximum occupancy, the new visitors should be warned and recommended to wait or go to a different section.
* Electronic equipment can be placed only within a circle of 1-meter diameter around each displayed item.
* The audio guide device should have a sufficiently long battery life to conveniently allow an entire visit of the museum without recharging.
* The system should be capable of handling a museum of at least 2 sections with at least 3 display items within each section. The items should have a distance of 3 meters or more from each other.

# Self-Monitoring for Symptoms (2020)

An important factor to keep a pandemic under control is to identify infected people at an early stage.This will help ease their treatment and also help reduce the spread of the pandemic by proper isolation. For this reason, people are advised to seek medical care and take a test, if they cough or sneeze more often than usual, have a fever or show other major symptoms of COVID-19.

Design and construct a wearable device (\*) to warn the wearer and help seek early medical care if they show such symptoms. The device should monitor and check for symptoms automatically (e.g., cough, sneeze, fever, etc.). It can also ask for the user’s input for undetectable symptoms (e.g., chest pain, etc.).

(\*) Wearable devices are smart electronic devices that are worn close to and/or on the surface of the skin (such as bracelets, necklaces, watches or other ornaments). These devices detect, analyze, and display/transmit information concerning, e.g., body signals such as vital signs, and/or ambient data.

Wearable devices should be non-bulky (i.e., small in size and light in weight) to be comfortable to wear, and battery-operated with little power consumption. They may detect risks and immediately warn the wearer, or keep a log of accumulated risk for future assessment of risks, or both.