	T.R. **İZMİR KÂTİP ÇELEBİ UNIVERSITY** **FACULTY OF ENGINEERING AND ARCHITECTURE** **MECHANICAL ENGINEERING DEPARTMENT**	**Form No:** FRM-1 **First Pub Date:** 15.11.2016 **Revision Date:** 15.02.2017

DESIGN PROJECT PROPOSAL FORM

Academic Year	**2022 -2023**	**Semester**	Fall ☐ Spring ▣
Project Type	**Research** ☐ ME 411 Thermal & Fluid Design ☐ ME 413 Mechanical Design × ME 415 Robotics & Control Design	**Application** ☐ ME 412 Thermal & Fluid Design ☐ ME 414 Mechanical Design × ME 416 Robotics & Control Design	
Advisor	Asst.Prof.Dr.Çağlar UYULAN		

Project Title	Automatic Flight Control System for Landing on Moving Naval Platforms
Purpose and Scope	Ship-deployed Unmanned Aerial Vehicle Systems are UAV systems that can be deployed on the ship to conduct surface reconnaissance and transfer the detected and identified target information to the relevant units. Take-off and landing from a moving ship are one of the basic needs of all flying platforms deployed on board. This need has been met by placing additional equipment on the runway in some UAVs in use, by monitoring and interpreting the signs and markers on the landing area by the pilot in manned systems. This study aims to develop algorithms and software that will autonomously perform the landing and take-off of Ship-Boarded Unmanned Aerial Vehicle Systems on a moving ship, using the existing camera infrastructure, without adding to the user loads on it. Although the waves in the sea seem to move randomly, their movements can be based on a stochastic model. The proposed project will use this information as a starting point and accordingly reduce the landing and take-off system to two simultaneous processes. The first of these is the landing-take-off adaptive control process with a rotary-wing (quadrotor) on a platform with known stochastic motion model and position angles; The second is an adaptive forecasting process that blends visual measurements with the position and inertia data of the air platform, predicts the stochastic model of the surface platform, and predicts the position and position angles of this stochastic model. Within the scope of this project proposal, the surface platform model and the aircraft model will be handled in an integrated manner and the aircraft will be controlled with the model predictive control (MPC) method.
Work Packages	• Modelling and Design of a Quadrotor System • Developing Control System and Estimation Algorithms • Real-time Test, Validation and Integration Developed Algorithms • Experimental Design and Construction of Low-Budget Test Platform • Demonstration
# of Team Members	

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Therefore, the final report of the project should contain the following:

i. Definition of the design problem and its limitations
ii. Theoretical information about the topic, standards and patents
iii. Different design options and selection criteria
iv. Optimal solution with appropriate selection criteria
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Advisor	Asst.Prof.Dr.Çağlar UYULAN		

Project Title	Model-Based Verification and Validation of Distributed Controller Architectures (Microcontroller Application: Automated Guided Vehicle)
Purpose and Scope	This research project is devoted to strategies for automated model-based verification and validation (V&V) of distributed control systems. Such systems are fundamentally Cyber-Physical, as they involve the use of networked micro-controllers to control the behaviour of physical systems and can be found in many application areas, including aerospace, medicine and automotive. This effort is driven by the profound benefits of model-based development for the design of single-controller embedded software, and by the great challenges that currently confront designers of distributed controller architectures, especially in modern ground vehicles. **Executable modelling of real-time architectures.** A mathematically well-grounded modelling notation for distributed real-time architectures (for example Automated Guided Vehicle (AGV) model) is being developed for use in defining models of interacting controllers. **Defining inter-model consistency.** A framework is being built for determining when a system model developed by systems and software engineers is sufficiently similar to an idealized controller model. **Algorithmic consistency checking.** Strategies for automatically computing whether the system and idealized models are consistent in all possible contexts will be developed, using research in model checking as a basis. **Scenario-based consistency checking.** Techniques for establishing consistency of system and idealized models in specific, user-defined scenarios are being developed, again using model checking as an enabling technology. **Tool development.** A modelling environment for distributed systems, and tools for consistency checking, is being built around the environment will be built on top of MATLAB / Simulink / Stateflow. V&V of distributed controller systems. The mathematics being developed is aimed at providing a basis for reasoning about system behaviour before the systems are constructed. Its impact lies in both the formalization of basic notions such as architecture and model consistency that are still being understood within the controls community and the algorithmic analyses made possible by these formalizations. These tools are built for simulating and validating distributed control architectures without having to build costly prototypes. The enhanced efficiency in engineering design

	processes that are enabled is intended to promote the faster development of more sophisticated distributed control systems, leading to safer and better-performing ground vehicles and other such systems.
Work Packages	• Software Architecture and Distributed Control Specifications • Augmenting the control framework with real-time (embedded microcontroller, integrating MATLAB models) • Modelling communication primitives • Model-Checking Solutions to Consistency • Scenario-Based Consistency Checking
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Advisor	Asst.Prof.Dr.Çağlar UYULAN		

Project Title	Identification, Learning, and Control in Robotic Systems
Purpose and Scope	The research focuses on cyber-physical systems for robotic manipulators with the specific goal of achieving: 1) trajectory tracking controller design, 2) methods for integrating, identification, planning, control and learning with the nonlinear dynamical system, and 3) developing integrated physical manifestations with sensing, actuation, and computation necessary to realize the robotic manipulation (3 DOF is preferable)
Work Packages	• Dynamical Modeling of a Robotic Manipulator • Identification of Dynamics Model • Controller Design and Implementation • Path Planning, Parameter Tuning • Experimental Realization
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Advisor	Asst.Prof.Dr.Çağlar UYULAN		

Project Title	Developing Machine Learning-based Recognition Algorithm through Data Acquisition from Eye Tracking Equipment
Purpose and Scope	The primary use of the eye-tracking devices will be in developing a "natural" computer authentication scheme, ultimately using only standard computer hardware. "Natural" authentication means transparent to the user: able to recognize the user while performing productive activities, without requiring any special authentication tasks. Ideally, instead of having to correctly enter a password, the user will be recognized gradually through natural interaction with the computer. This form of authentication will be based on a composite profile of the user, including biometric and behavioural traits. Using eye-tracking equipment, the co-PIs will research new schemes and ways to integrate already published authentication schemes. A second direction involves the development of assistive software for teaching lectures. Eye-tracking devices can be used to assess the habits of users as revealed by eye dynamics, as well as to determine the differences between novice and expert users. Eye dynamics are relevant in applications where the users must be trained to browse visually in a particular pattern.
Work Packages	• Data Acquisition and Labeling Process • Feature Extraction • Classification • Real-time Tests of the Developed Algorithms
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Advisor	Asst.Prof.Dr.Çağlar UYULAN		

Project Title	Multi-purpose Tactical UAV Design and Manufacturing
Purpose and Scope	In this study, the mechanical design, simulations, and manufacturing of micro class fixed-wing tactical unmanned aerial vehicles designed to be used in various missions will be done. National and international competitions have been decisive in determining the design requirements. The designed vehicle has a maximum take-off weight of 3.5 kg and a payload of 0.5 kg. The wingspan of the vehicle is 1.4 m, the flight duration is 20 minutes, the cruising speed is 20 m/s, the duty altitude is between 5-50 m depending on the equipment used. It has the features of autonomously identifying coloured ground targets, landing and taking off, returning to the starting point in case of signal loss or low battery.
Work Packages	• Mechanical Design, Configurations, Weight Estimation (Initial) • Wing Profile Selection • Thrust-Weight Ratio and Wing Loading Evaluations • Dimensionalization • Aerodynamic Calculations • Motor and Battery Selection • Detailed Design • Modelling and Simulation, CFD Analyzes • Manufacturing Process
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