Projektplan Quadcopter UAV

Open Advanced Course in Embedded Systems

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Background

Drones, particularly quadcopters, have surged in popularity and importance across a range of industries due to advancements in technology and their versatile applications. From military and defense to commercial deliveries, aerial photography, and even humanitarian aid, the development of drones has captured global interest. This excitement is driven by their ability to perform tasks that were previously difficult, dangerous, or impossible for humans to accomplish.

The design and development of drones are particularly fascinating from the perspective of an electrical engineer because of the multidisciplinary nature of the field. It involves several branches of engineering knowledge, including control theory, power electronics, embedded programming, and signal processing. Understanding these key areas provides valuable insights into why drone technology is evolving so rapidly and how it can shape the future.

Objectives

The objective of the project is to construct a simple drone capable of lifting into the air and tilting back and fourth around its horisontal axis. The drone will receive its power from a wire and will thus not contian a battery. Additionally, the drone will be constructed using a prototyping board together with off the shelf electronic components and modules.

Purpose

The purpose of this project is to gain relevant knowladge for conducting a bigger drone project in which the drone will be wireless and where all the electronics are constructed from scratch and integrated into a single custom made PCB. It is also intended that this project features a improved flight controller.

Preliminary Tasks and Work Distribution

The block diagram in figure 1 shows the different parts included in this project. Jonas will be mainly responsible for hardware construction and Sigge will be mainly responsible for designing and implementing the flight controller.

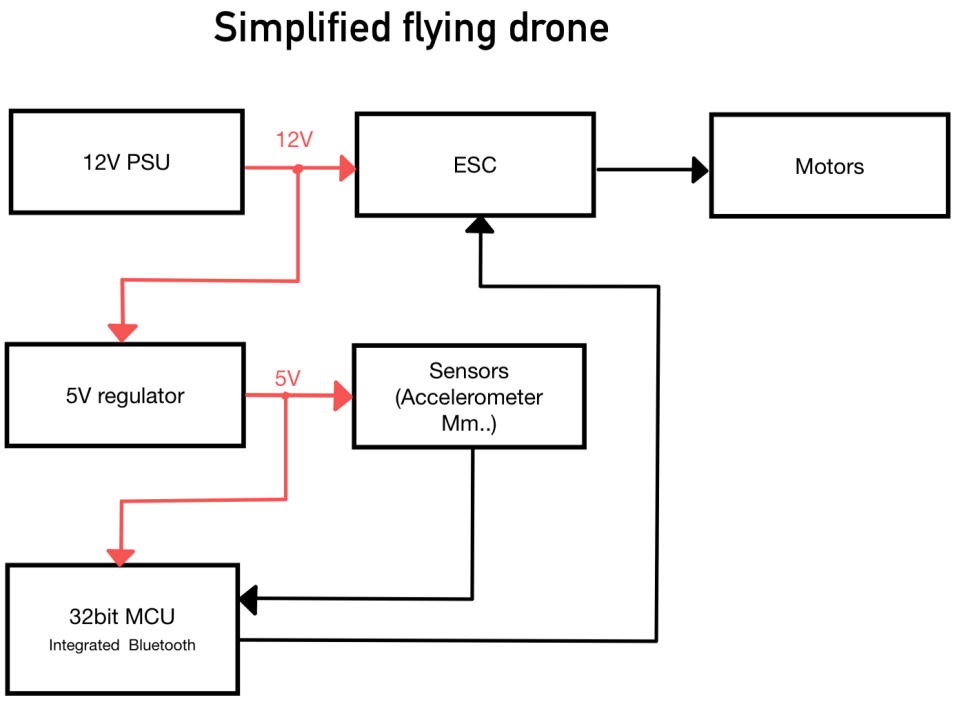

Figure 1: Block diagram of the simplified drone to be built in this project

Suggestion of Grading Criteria

Grade 3 (Basic Level)

1. Basic sensors, such as a gyroscope and accelerometer, are integrated using a microcontroller.
2. Motors are controlled via a pre-built motor controller, with control signals generated by the microcontroller.
3. A simple PID controller is implemented on a 32-bit microcontroller.
4. The quadcopter can lift off but does not need to maintain stable flight.
5. The report includes brief theoretical explanations of the following topics:
    - Basic principles of quadcopter operation
    - PID controllers and Lead-Lag filters
    - ESP32 microcontrollers
    - Brushless DC (BLDC) motors
    - Electronic speed controllers (ESC)
    - Battery management systems (BMS)
    - Voltage regulation and management
    - Gyroscopes and accelerometers
    - Printed circuit boards (PCB)
    - Sensor data filtering (e.g., Kalman filter, low-pass filter)
    - Barometric sensors
    - Quadcopter dynamics
    - Kalman filters

Grade 4 (Advanced Level)

1. The quadcopter can lift off and hover stably for at least 10 seconds.
2. Advanced filtering techniques, such as Kalman filtering and low-pass filters, are implemented to enhance sensor accuracy and minimize noise.

Grade 5 (Challenging Level)

1. The quadcopter can hover and execute stable, controlled maneuvers across all axes in the xyz-plane.

Preliminary Time Schedule

Tidsplan		Klart	Påbörjad	Försenad		
September 9-15	September 16-22	September 23-30	Oktober 1-6	Oktober 7-13	Oktober 14-20	Inlämning rapport 20 Okt
Vecka 37	Vecka 38	Vecka 39	Vecka 40	Vecka 41	Vecka 42	Vecka 43
Välja sensor	Beställa sensor	Implementera sensor	Montera ihop	Börja rapportskrivning	Rapportskrivning	Rapport Lämnas in
Välja motor och ESC	Beställa motor	Implementera motor	Implementera regulator	Finjustering/Rest		Slutpresentation
Beställa ESP32	Programmera ESP32	Skapa och skriv ut kropp		Presentation framsteg		
Komponentlista	Designa regulator	Första test av regulator				
Projektplan	Utvärdera bluetooth	Presentation framsteg				
Presentation plan						

Figure 2: Project timeline