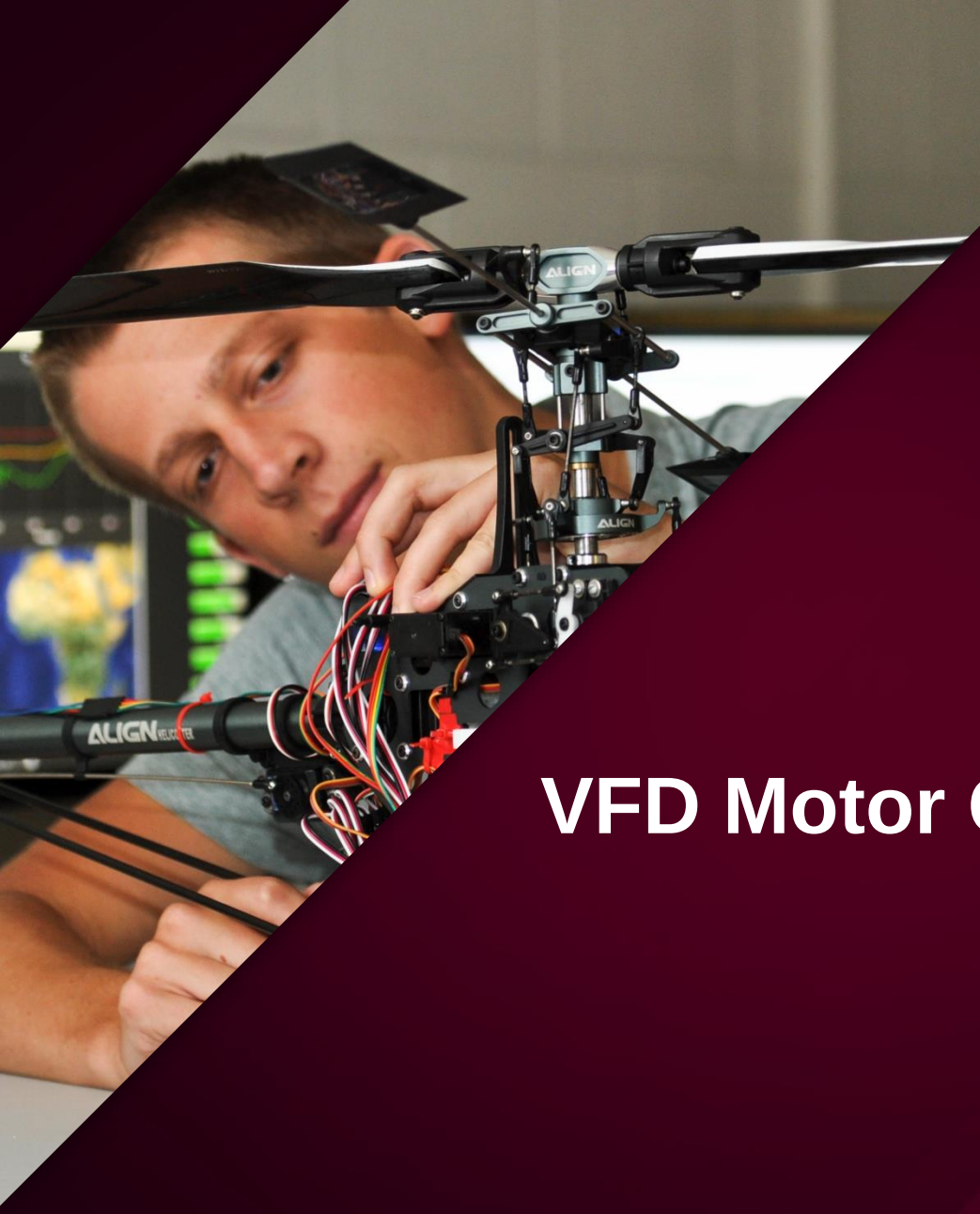


Dwight Look College of
ENGINEERING
TEXAS A&M UNIVERSITY

VFD Motor Control Introduction

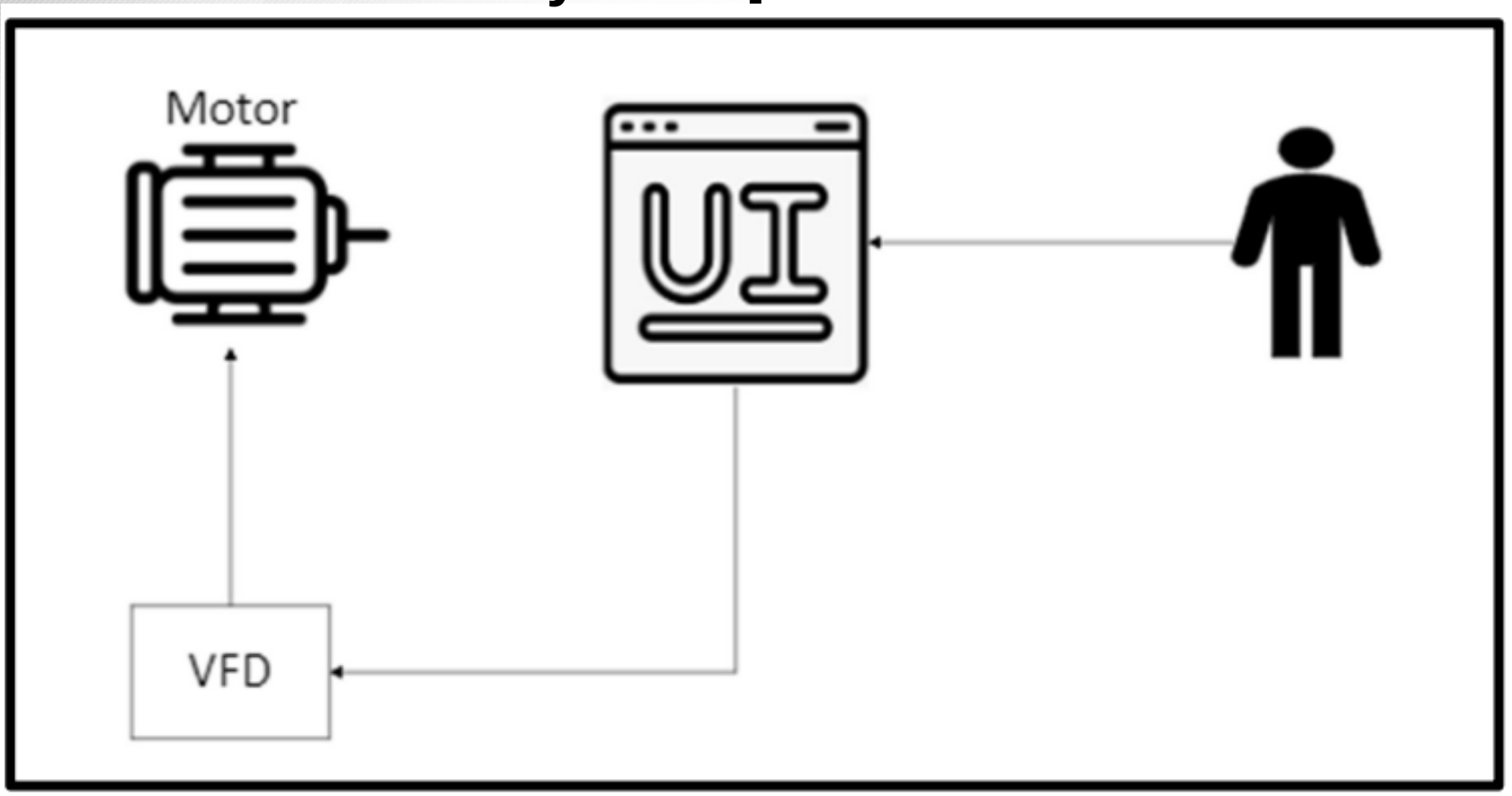
Mackenzie Miller
Andrew Nguyen
Aidan Rader
Ryan Regan

Overview

Problem Statement: A motor control system is needed for an AC induction motor. Traditional motor control systems cannot adjust to varying load demands, resulting in poor energy efficiency, excessive heat generation, and premature component failure.

Solution Proposal: Develop a Variable Frequency Drive (VFD) motor control system to adjust frequency and voltage to load demands, resulting in improved motor controllability, optimized energy efficiency, enhanced safety, and extended component lifespan.

System Overview



System Overview

Task Partition

- Mackenzie: Design optoelectronic circuit, tachometer, and voltage and current monitoring circuit. Optoelectronics makes the analog and digital sides communicate via light so they do not touch.
- Andrew: Design PCB for the MCU, MCU will send PWM signals to power control system to control the frequency of VFD, step down voltage to a usable 3.3V,take inputs from a user and output the frequency needed for the task
- Aidan: Design PCB with rectifier to convert AC to DC, DC link circuit to filter DC, and power control to convert DC to AC.
- Ryan: Design and write all firmware necessary for microcontroller and any other systems; create a user interface to make controlling and monitoring the system more straightforward

Subsystem progress in past 1.5 months

- Mackenzie: Researched materials and concepts, almost completed subsystem introduction project, and started schematic design
- Andrew: Researched needed materials, almost completed subsystem introduction, began creating schematics for my PCB
- Aidan: Researched concepts and components, started subsystem introduction project (SIP, steps 1-4), completed schematic design (SIP, steps 1-3)
- Ryan: Researched and outlined main firmware for VFD, designed GUI for user interface

Exexcution Plan 8/20/2024-12/5/2024																	
	8/20	8/27	9/3	9/10	9/17	9/24	10/1	10/8	10/15	10/22	10/29	11/5	11/12	11/19	11/26	12/3	Date
CONOPS Report																	9/15
FSR, ICD, Milestones, & Validation Plan																	9/26
Project Introduction Presentation																	9/30
Schematic Layout																	9/30
Subsystem Introduction Project																	10/7
Order Parts																	10/8
Firmware Code																	10/14
PCB Layout																	10/14
Order PCBs																	10/15
Project Update Presentation																	10/21
Firmware Validation/Debugging w/ Dev Board																	10/28
PCB Assembly																	11/5
Final Presentation																	11/18
PCB & Firmware Validation/Debugging																	11/26
Project Subsystem Demonstration																	11/26
Final Report																	12/5

Not Started
In Progress
Completed
Behind Schedule

Validation plan

Paragraph #	Test Name	Success Criteria	Methodology	Status	Responsible Engineer(s)
3.2.1.1	Speed and Torque Requirement	Motor shall operate within speed range of 0RPM to 1800RPM and torque range of 0lb-ft to 0.729lb-ft.	Input motor with voltage and check if it achieves 0RPM and 0lb-ft . Repeat for 300RPM, 600RPM, 900RPM, 1200RPM, 1500RPM, 1800RPM.	Untested	Andrew, Ryan
3.2.1.2	Frequency Requirement	System shall operate within frequency range of 5Hz to 60Hz.	Input system with frequency generator set to 5Hz and check if the motor runs smoothly. Repeat for 10Hz, 20Hz, 30Hz, 40Hz, 50Hz, 60Hz.	Untested	All
3.2.1.3	Temperature Requirement	System shall operate within temperature range of 0˚C to 70˚C.	Place system in freezer set to 0˚C and check if the motor runs smoothly. Repeat with oven set to 70˚C.	Untested	All
3.2.3.2	Input Voltage Level	System input voltage shall be 208V_{AC}.	Measure with mutlimeter and check if the voltage is 208V_{AC}.	Untested	Aidan
3.2.3.3	Input Noise and Ripple	System shall not exceed ripple range of 0V to 0.165V.	Measure with mutlimeter and check if the voltage exceeds 0V to 0.165V.	Untested	Andrew
3.2.3.4	External Commands	External commands shall be documented in appropriate ICD.	Show to teaching team and check with them for approval.	Untested	All
3.2.3.5	Visual Output	System shall display output measurements on GUI.	Input system with known values and check if the output measurements match. Repeat for six additional sets of known values.	Untested	Ryan
3.2.3.6	Connectors	System shall use terminal blocks for power and signal connections.	Observe power and signal connections and check if they are are terminal blocks.	Untested	Mackenzie, Andrew, Aidan
3.2.3.7	Overtemperature Shutdown	System shall automatically shut down if sensor exceeds temperature range of 0˚C to 70˚C.	Place sensor in freezer set to -1˚C and check if sensor is triggered. Repeat with oven set to 71˚C.	Untested	Mackenzie
3.2.3.8	Built in Test	System shall generate and evaluate test signals to assess failure status.	Compare generated values with known values and check if the failure statuses match. Repeat for six additional sets of values.	Untested	All
TBD	Inputs	The parameters are within the expected range.	Confirm that all electrical parameters (voltage, current, power) remain within safe and expected ranges under varying conditions.	Untested	All
TBD	Communication Testing	Firmware is successfully uploaded, and system can communicate to PC.	Verify that data transfer between the VFD controller and the PC is reliable and supports functions like setting parameters and uploading firmware.	Untested	Andrew, Ryan
TBD	Controller Performance	Motor spins according to user defined parameters.	Validate that the system operates efficiently and delivers accurate motor control across the expected range of operating conditions.	Untested	All
TBD	MCU Voltage Step Down	MCU converts the voltage it is given to 3.3V.	Measure the voltage of the signals being sent to the MCU and measure that the MCU converts it to 3.3V.	Untested	Mackenzie, Andrew