G. H. Raisoni College of Engineering, Nagpur

(An Autonomous Institute Affiliated to RashtrasantTukadojiMaharaj Nagpur University)
Dual Accreditations NAAC "A+" Grade & NBA (Tier-I)
CRPF Gate No. 3, Digdoh Hills, Hingana Road, Nagpur

Project Exhibition

HARDWARE REALIZATION OF (FOPI) CONTROLLER FOR MOTOR

Submitted By, Batch 5 A

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Under Guidance Of,
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Index

INTRODUCTION:-

Welcome to the project on Hardware Realization using Fractional-Order Proportional-Integral (FOPI) Fractional Order in MATLAB! This project explores the fascinating world of fractional-order systems and how they can be effectively implemented using Fractional-Order Proportional-Integral (FOPI) controllers.

This system is comprised of both hardware and software components. The hardware portion encompasses an Arduino Uno microcontroller, an L298N motor driver, an IR sensor, and a DC motor with an encoder. The software component is implemented in MATLAB Simulink, featuring a real-time dashboard for visualization and control. This comprehensive setup allows for a dynamic interplay between hardware and software elements.

Technology stack:

MATLAB & SIMULINK

ARDUINO

AI

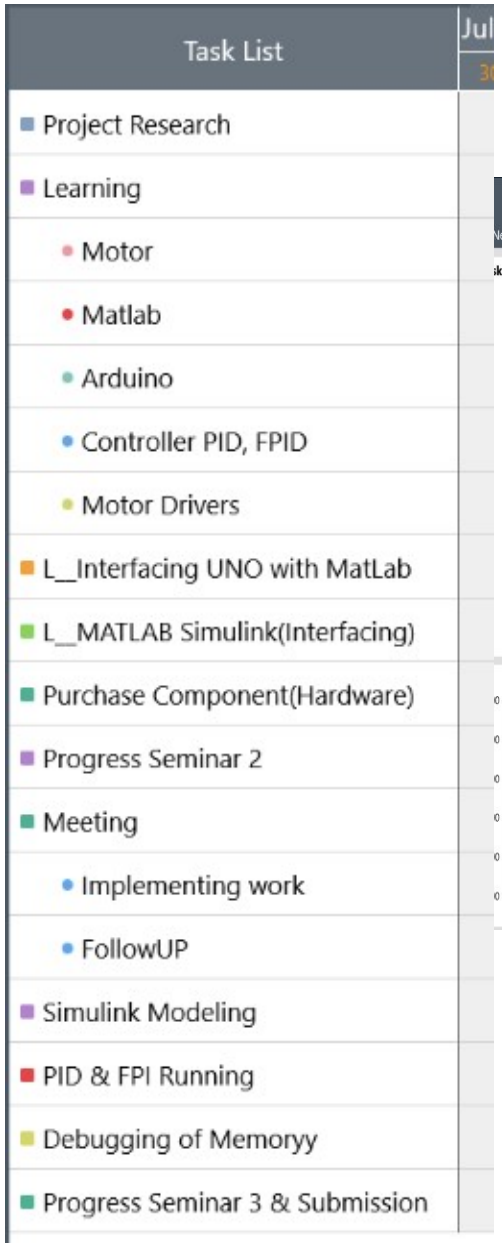
TINKERCAD

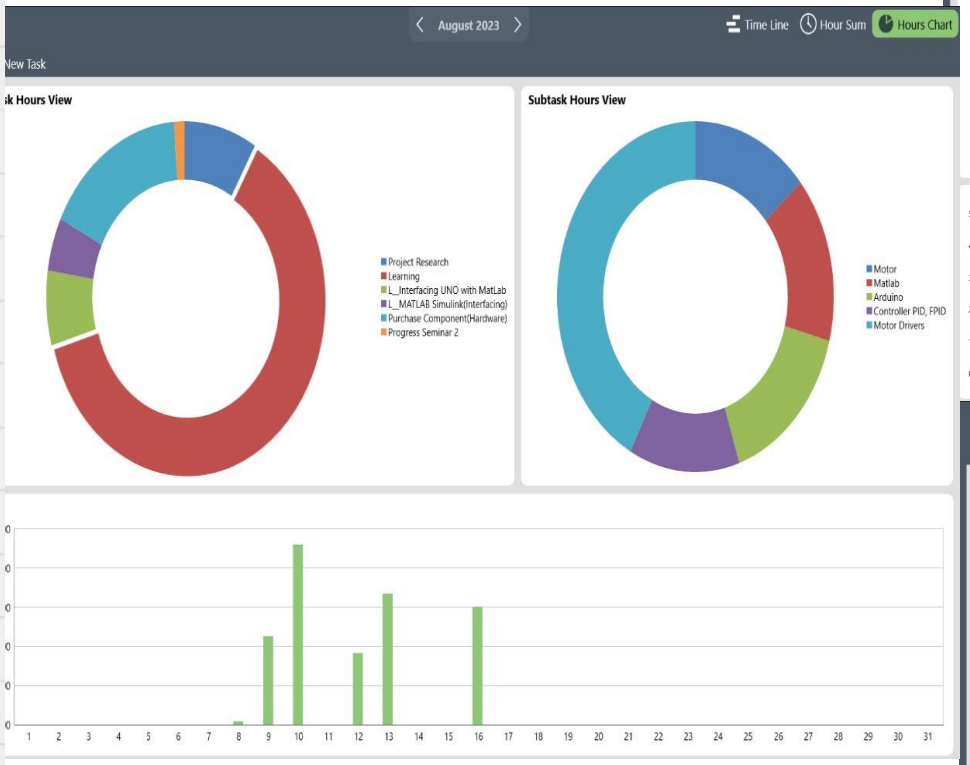
FOMCON

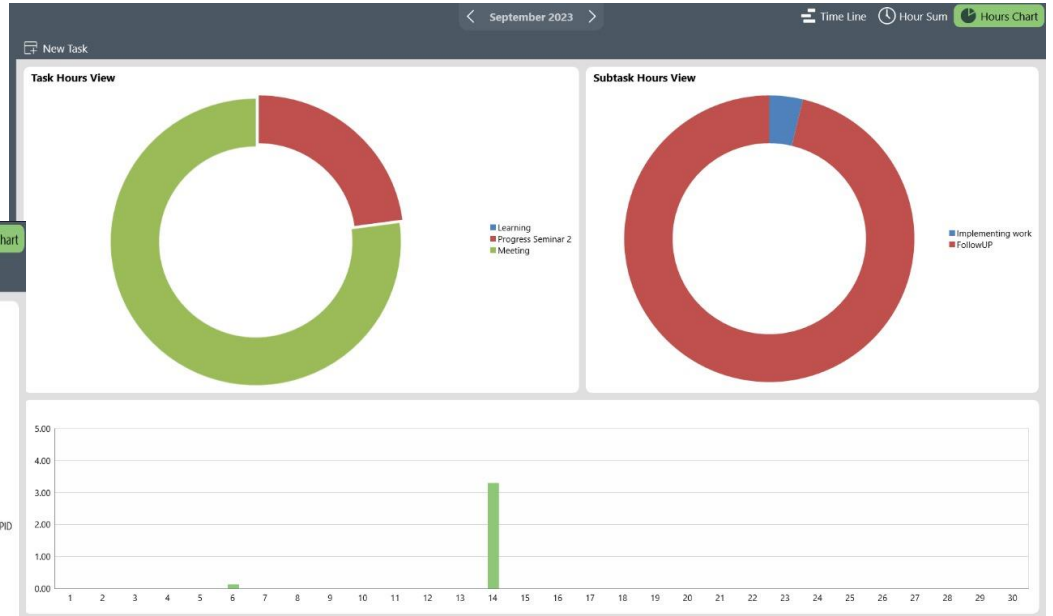
Literature review:-

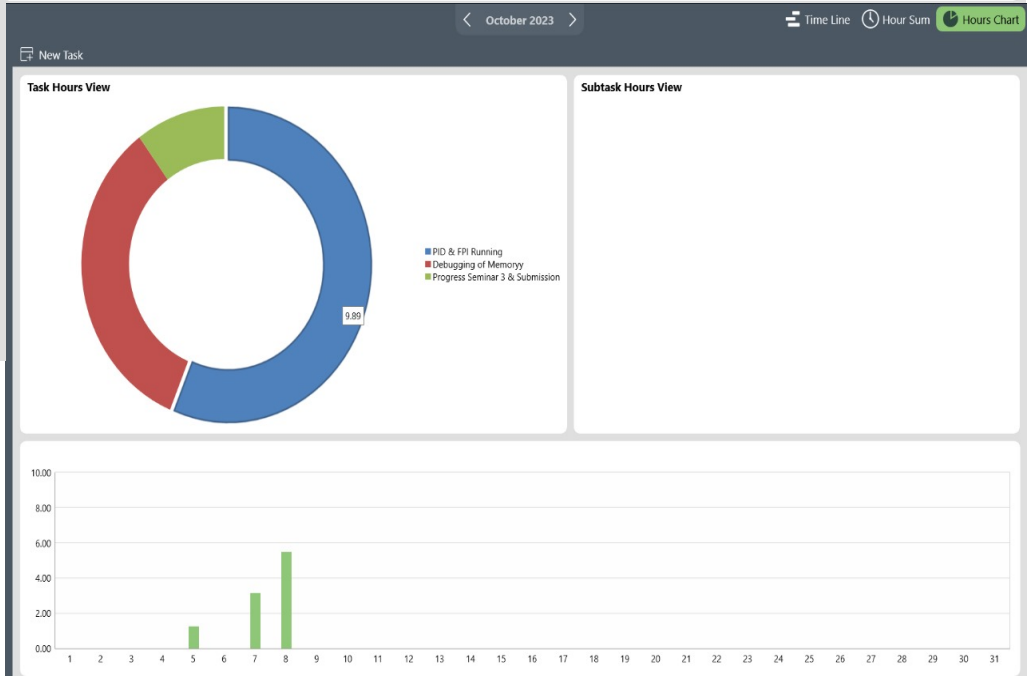
Year	Title	Work Done	Research Gap
2015	Interactive Disturbance Observer Based Filtered PID Controller Design[1]	The paper discusses a MATLAB tool for designing advanced controllers. It allows parameter customization and improves noise reduction and system robustness, offering a practical solution for control system design.[1]	The paper presents a new controller design method but lacks broad real-world testing and doesn't fully explore performance under different plant model uncertainties and measurement noise. [1]
2017	A Comparative Study of PID, PID with Tracking, and FPID Controller for Missile Canard with an Optimized Genetic Tuning Method Using Simscape Modelling[2]	The study compared PID controllers for missile canards, used CAD and Simscape for modeling, and improved genetic tuning algorithms for optimization. [2]	The research identifies a gap in optimizing PID controllers for missile canards, needing a more accurate estimation method than linear transfer functions, and seeking alternatives to traditional tuning methods. [2]
2023	Hardware Realization of FOPI Controller for Motor.	Developed and implemented a real-time system to control DC motor speed using fractional-order proportional-integral-derivative (FOPID) control in MATLAB Simulink with a dashboard for visualization and control.	While FOPID control has been shown to provide improved performance for DC motor control, there is a need for further research to develop and implement FOPID controllers that are robust to noise and disturbances, and that can be used to control DC motors in more complex and challenging applications.

Work Flow


Task List
Project Research
Learning
Motor
Matlab
Arduino
Controller PID, FPID
Motor Drivers
L__Interfacing UNO with MatLab
L__MATLAB Simulink(Interfacing)
Purchase Component(Hardware)
Progress Seminar 2
Meeting
Implementing work
FollowUP
Simulink Modeling
PID & FPI Running
Debugging of Memoryy
Progress Seminar 3 & Submission


August 2023
Time Line
Hour Sum
Hours Chart
New Task
Subtask Hours View
Project Research
Learning
L__Interfacing UNO with MatLab
L__MATLAB Simulink(Interfacing)
Purchase Component(Hardware)
Progress Seminar 2
Motor
Matlab
Arduino
Controller PID, FPID
Motor Drivers


September 2023
Time Line
Hour Sum
Hours Chart
New Task
Task Hours View
Subtask Hours View
Learning
Progress Seminar 2
Meeting
Implementing work
FollowUP


October 2023
Time Line
Hour Sum
Hours Chart
New Task
Task Hours View
Subtask Hours View
9.89
PID & FPI Running
Debugging of Memoryy
Progress Seminar 3 & Submission

System description

This integrated system combines an Arduino Uno microcontroller, L298N motor driver, IR sensor, and DC motor with an encoder. Utilizing MATLAB Simulink, it features a user-friendly dashboard for real-time control and visualization. The hardware components work synergistically, with the IR sensor measuring motor speed. The FOPID controller fine-tunes performance, enabling precise control of the DC motor's speed. This adaptable system finds broad applications in various industries, showcasing the potential of Fractional Proportional-Integral control.

Wide Range of Applications

Explore diverse fields in which fractional order systems are applied, such as industrial automation, robotics, automotive engineering, Electrochemical Processes, Biomedical Engineering, Viscoelastic Materials, Oil Reservoir Engineering, and Control of Complex Systems.

Block Diagram

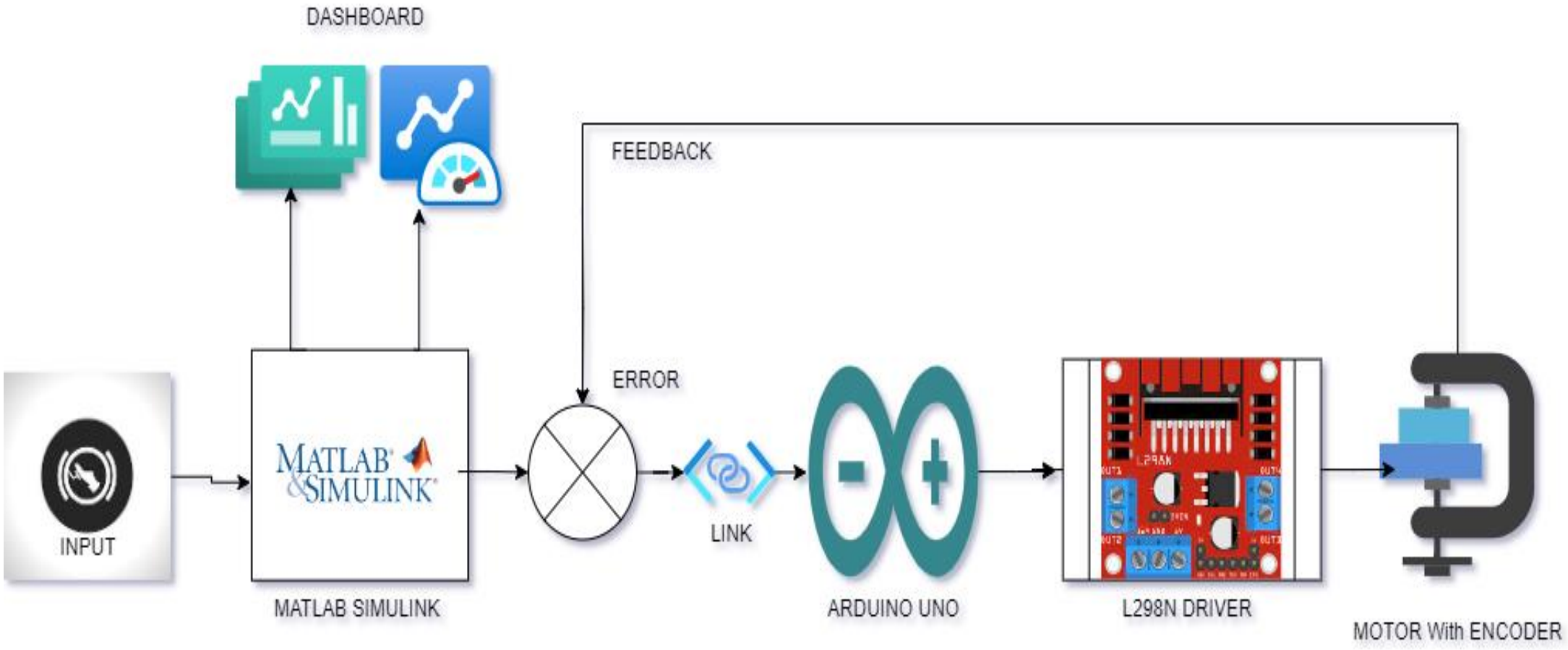
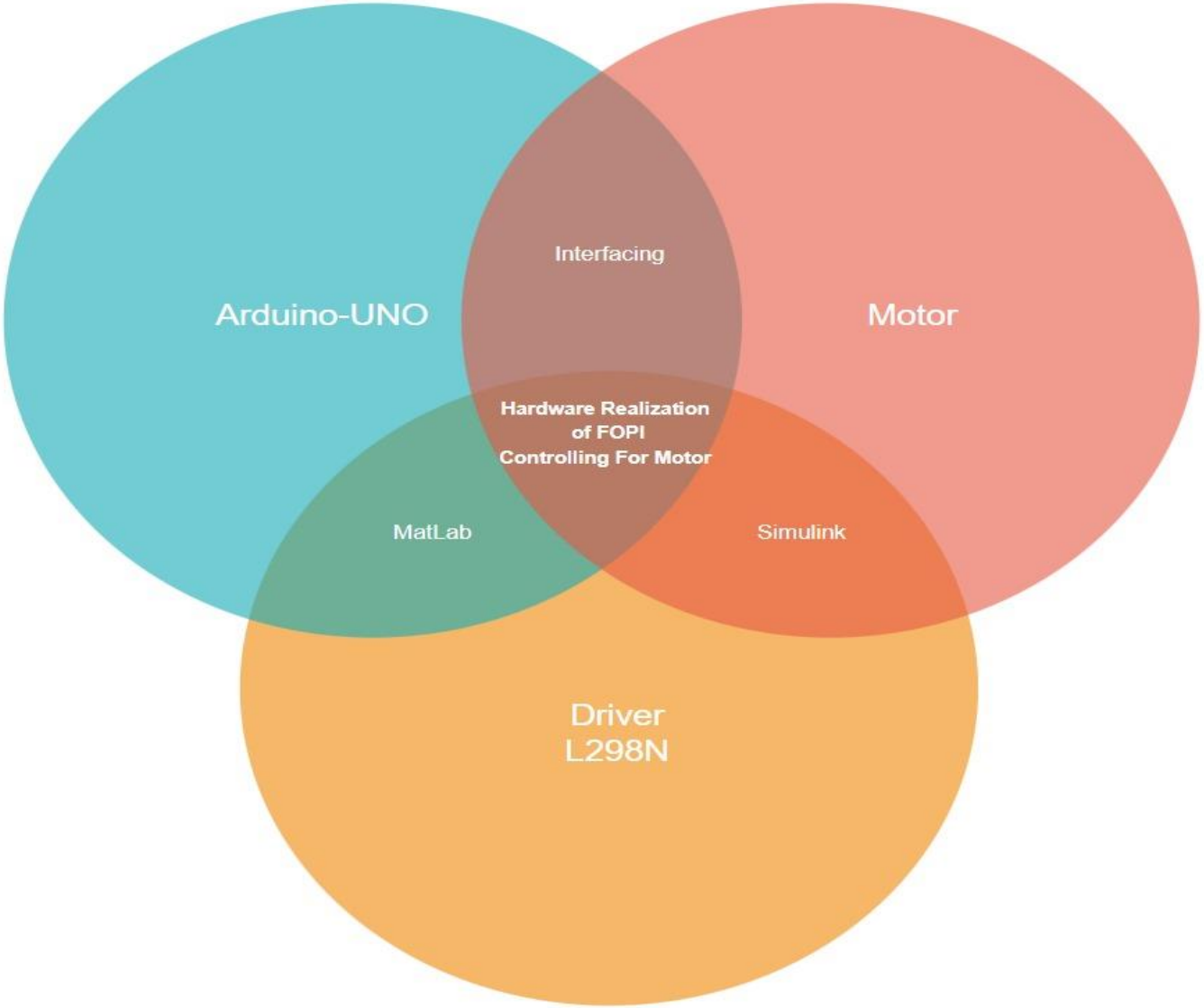


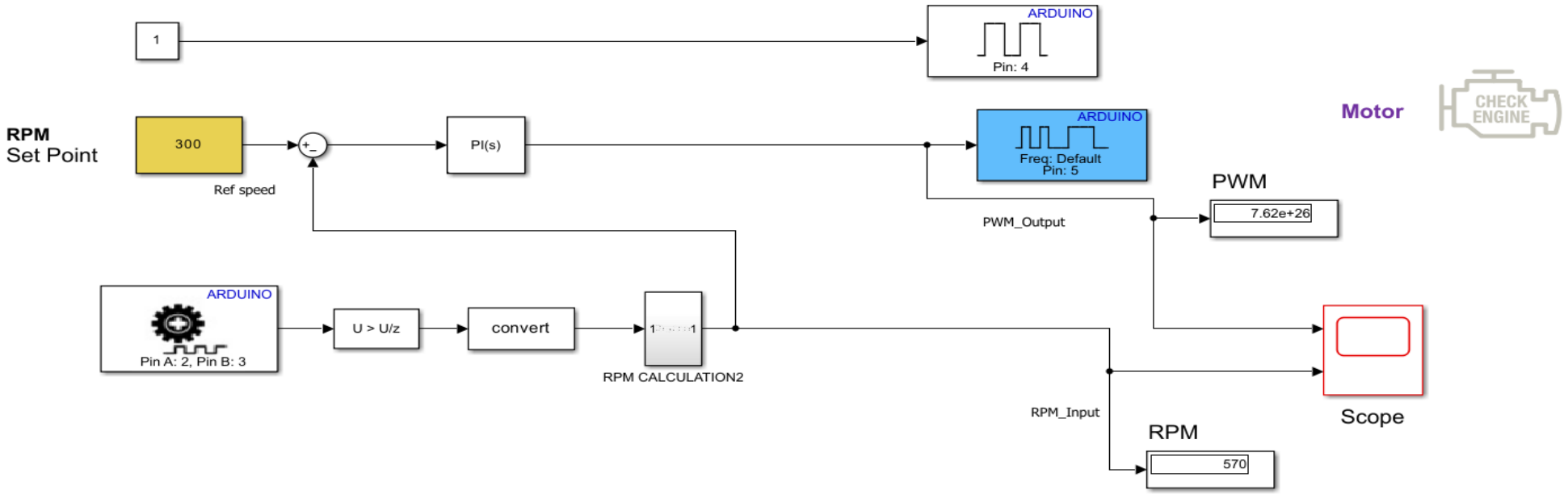
Fig: Block Diagram

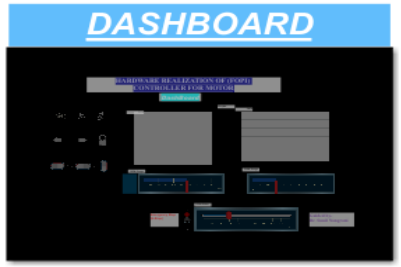
Block Diagram



Simulink Model Diagram

HARDWARE REALIZATION OF (FOPI) CONTROLLER FOR MOTOR





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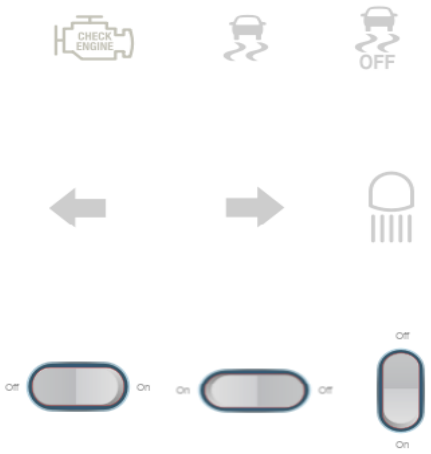
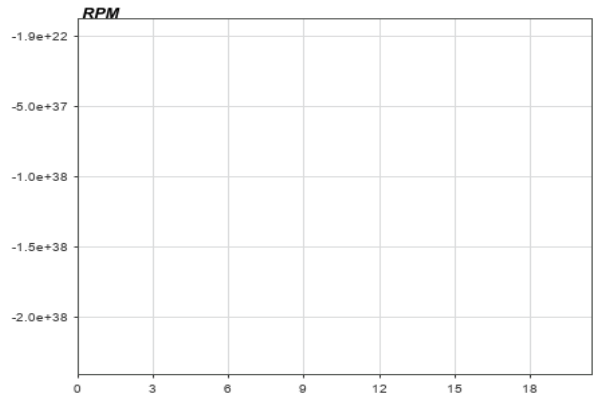
Simulink Model Diagram

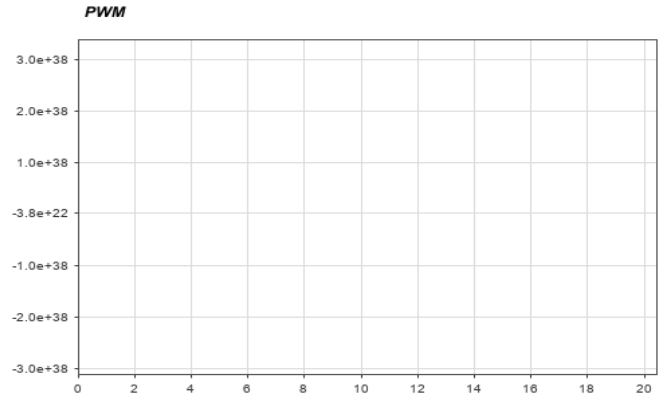
HARDWARE REALIZATION OF (FOPI) CONTROLLER FOR MOTOR

DashBoard

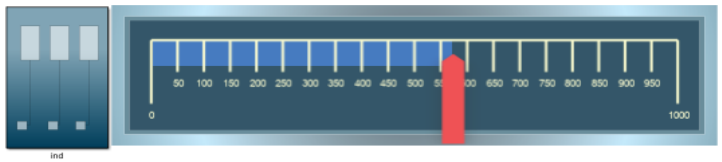


Scope

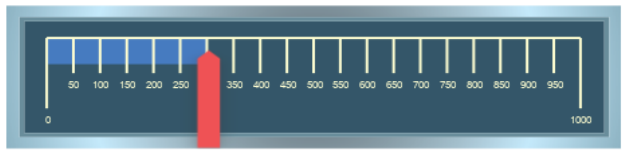




RPM Gauge

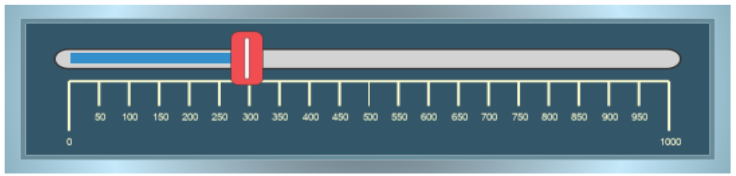


PWM Gauge



Emergency Stop (E-Stop)

RPM Slider



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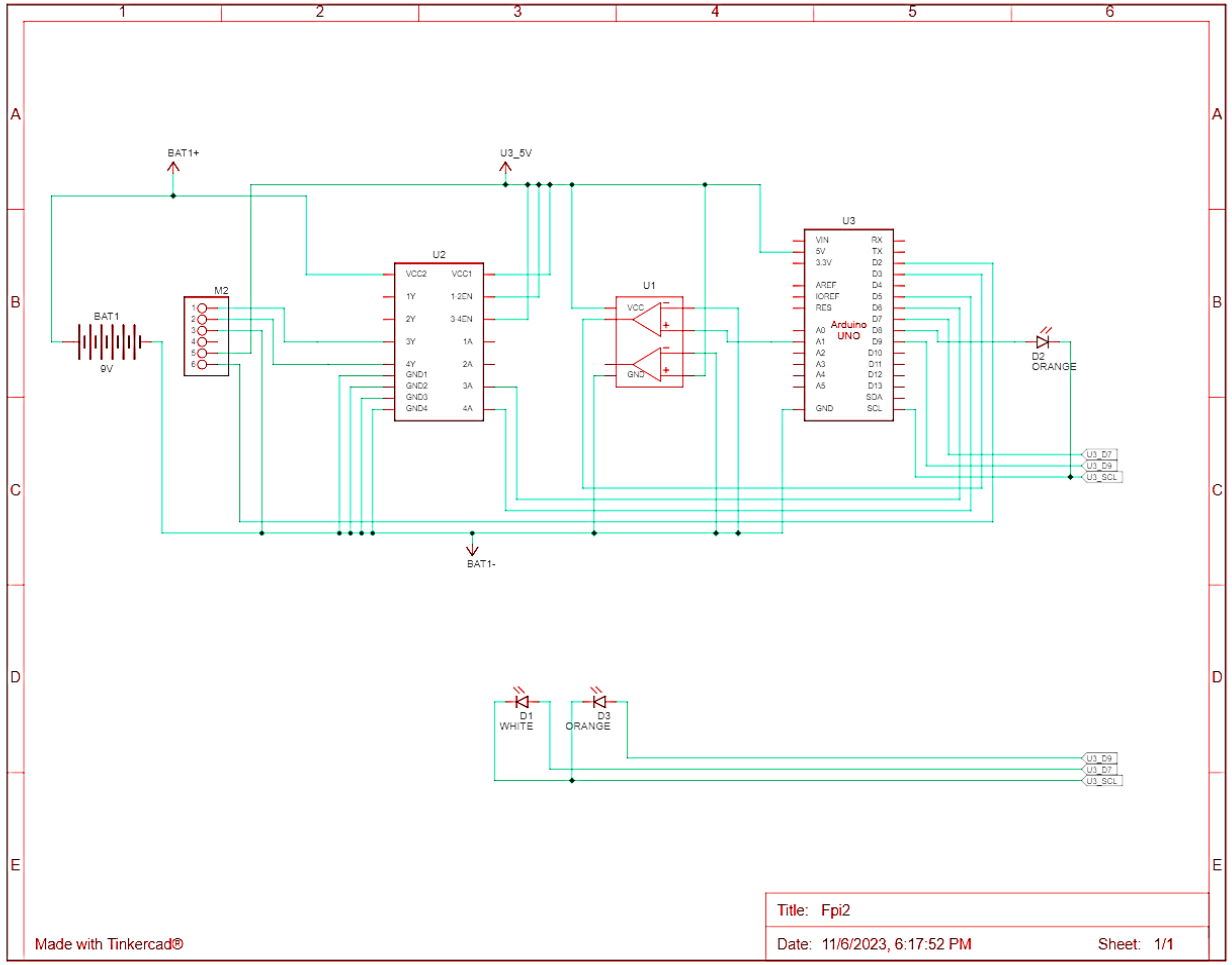
Circuit diagram



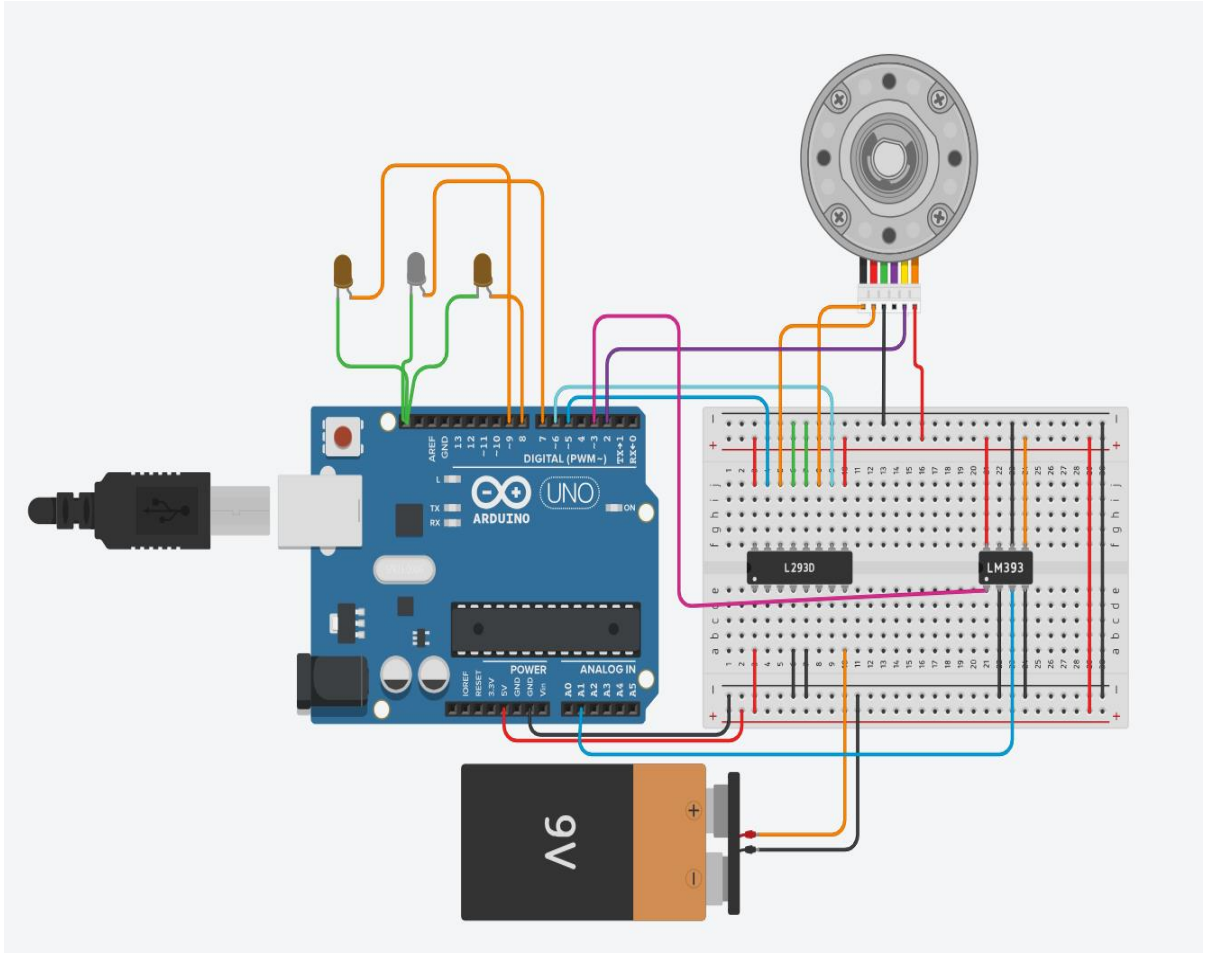


Fig: Circuit diagram

Circuit diagram

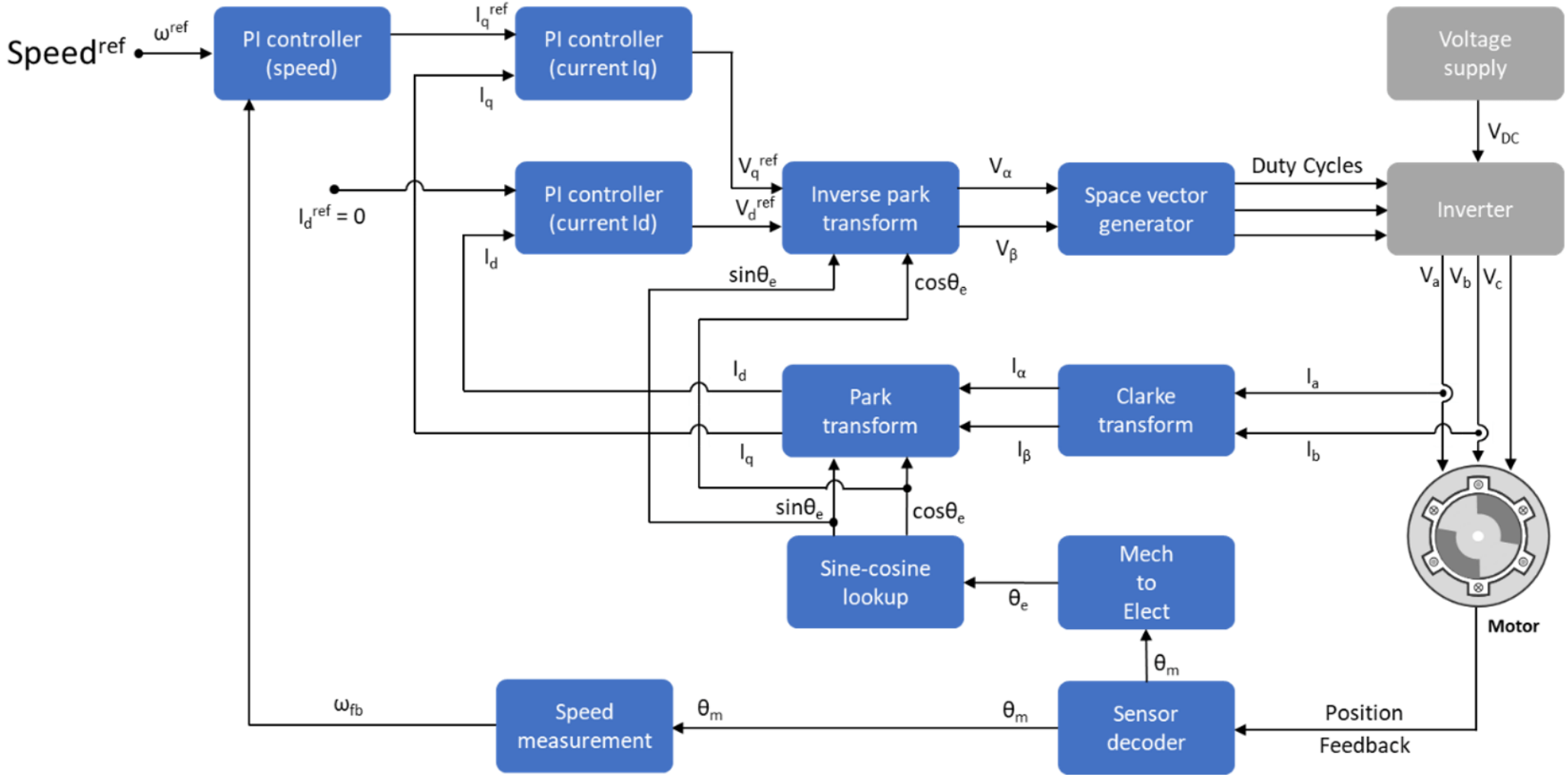


Fig: Circuit diagram

PID Results:

Results:

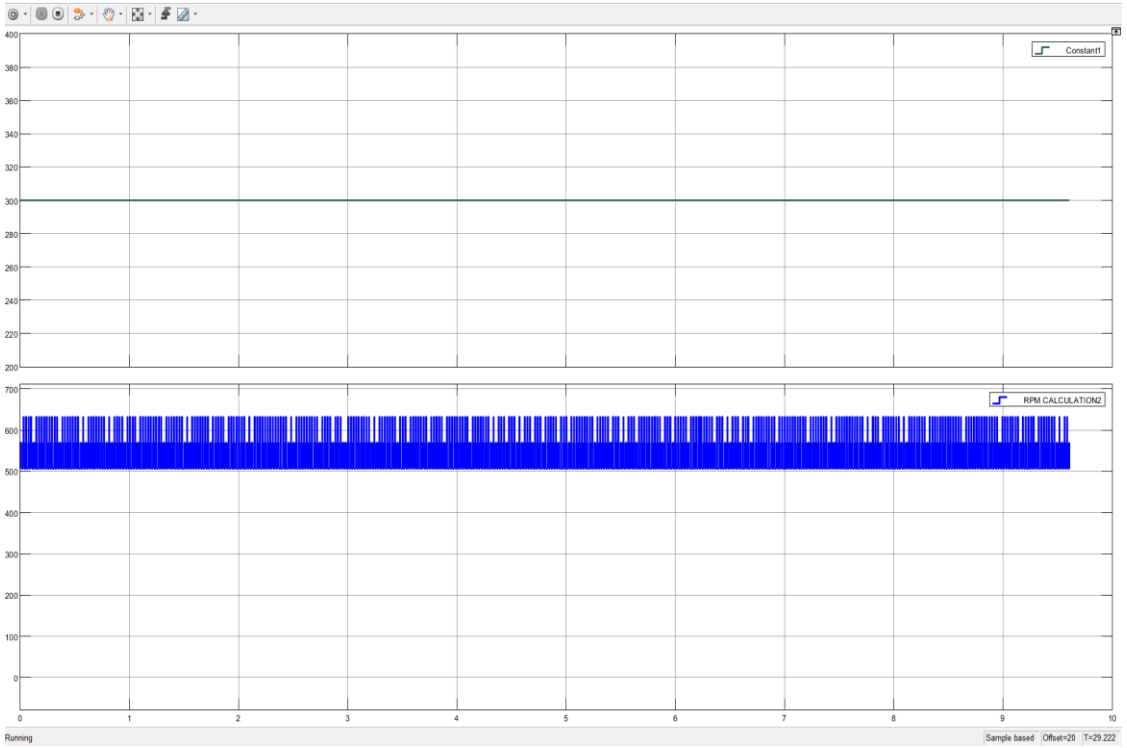


Fig: With-Out PID (Open Loop)

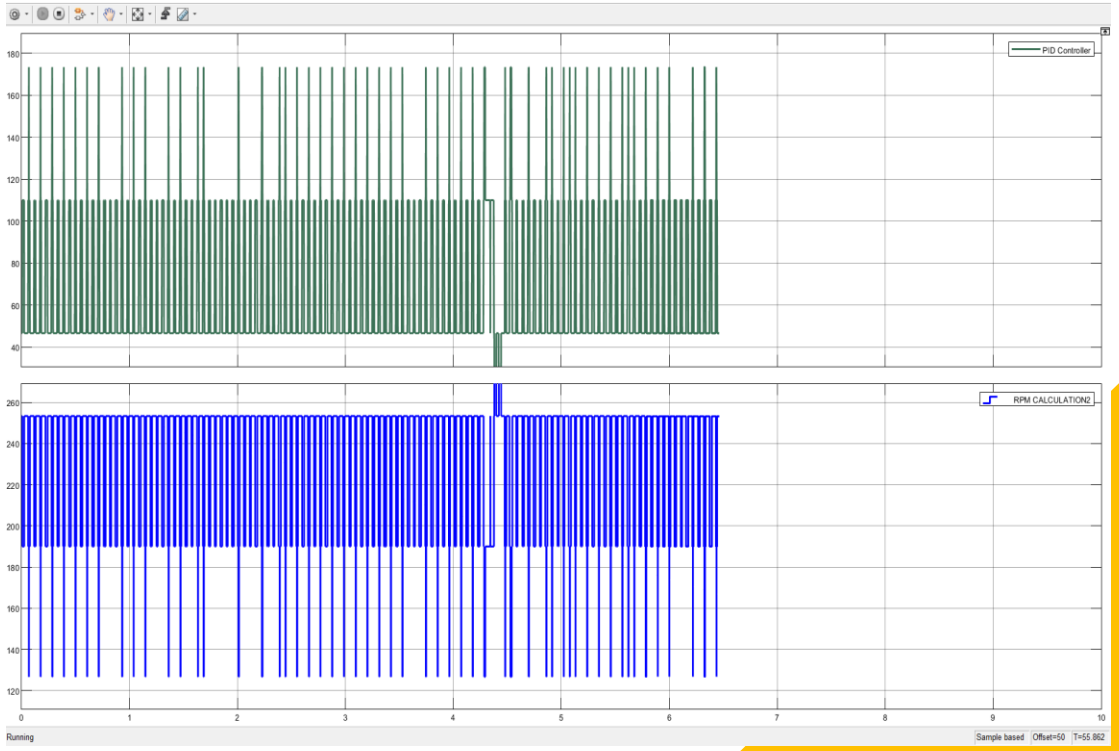


Fig: With PID (Closed Loop)

FOPI Results:

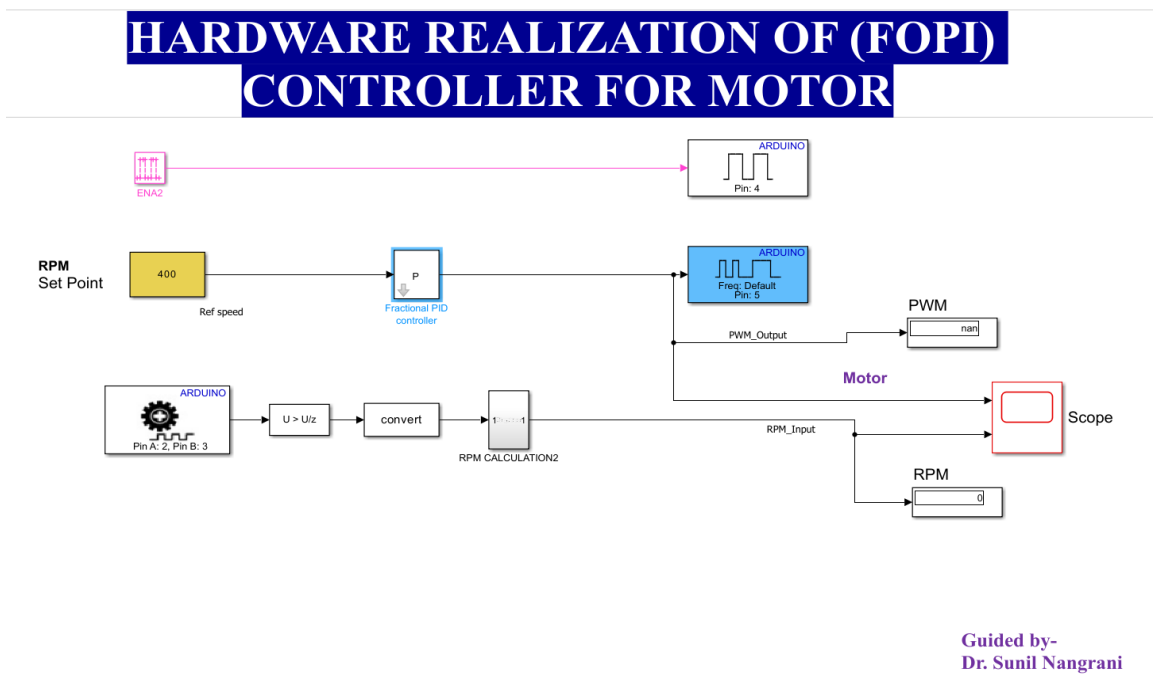


Fig: Simulink Model With FOPI (Open Loop)

Results:

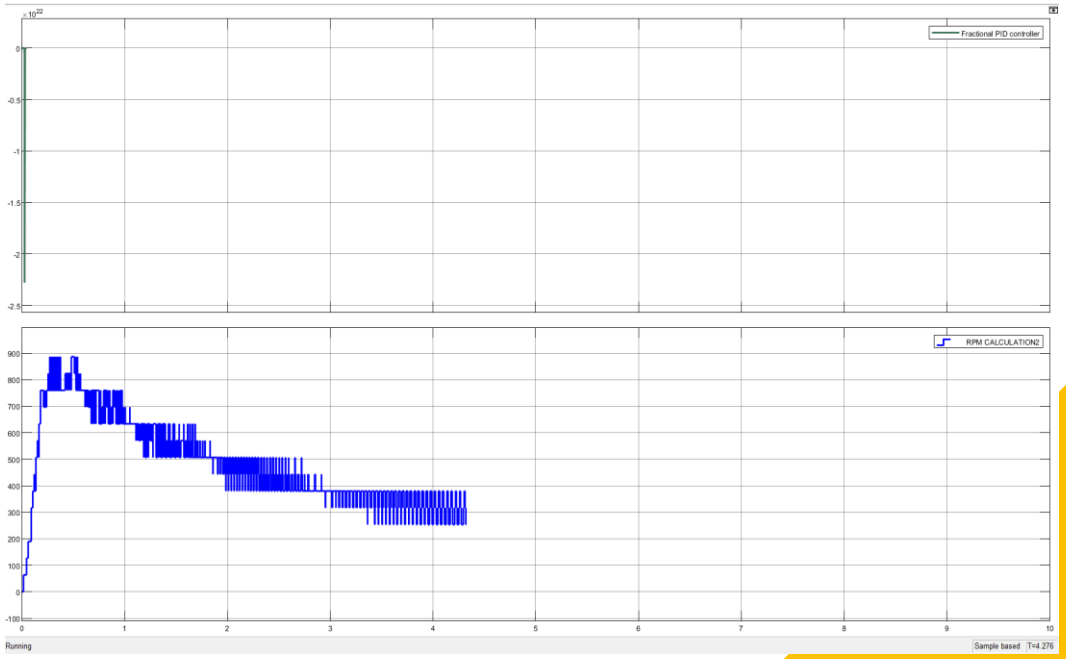


Fig: FOPI Result

Conclusion

This invention presents a hardware system for DC motor speed control using FOPID. It includes an Arduino Uno microcontroller, an L298N motor driver, an IR sensor, and a DC motor with an encoder, controlled by MATLAB Simulink software. The system showed precise speed control, improved tracking performance, and reduced overshoot. It has potential applications in industrial automation, robotics, automotive engineering, and more.

REFERENCES

1) A comparison with traditional linear PID controller design methods can be made. Keywords: Disturbance observer, PID control, performance, robustness, noise attenuation, MATLAB/Simulink, interactive tool Available online at www.sciencedirect.com

2) Saif ALAMERI et al.: A Comparative Study of PID, PID with Tracking, and FPID Controller for Missile Canard with an Optimized Genetic Tuning Method Using
https://doi.org/10.17559/TV-20171207130458
Original scientific paper

Thank YOU!