

Operational Requirements of Robotic Tank with Electric Coilgun

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Abstract— this paper presents a robotic tank with electric coilgun operated with IoT. This tank is designed to overcome disadvantages of conventional chemical launch technology such as dynamic properties of propellant gases, storing, and handling and transportation problems of chemicals. This technology provides fuel free launching technology with electromagnetic coilgun. Coilgun consist of electromagnetic coils, switches and capacitors which provides ease in control of muzzle velocity. Simulation with two coilguns was performed to understand the performance of coilgun in aspect of electrical parameters.

Keywords— Robotic tank, electric coilgun, IoT, coilgun simulation, fuel free launching technology.

I. INTRODUCTION

Electric coilgun is made with electromagnets which are operated in series after one by one with the help of fast switching components like IGBT. During the switching process electrical energy is provided to electromagnets from charged capacitor. This energy is then converted into electromagnetic energy and it attracts the ferromagnetic material inside the barrel. Ease in control of muzzle velocity can be obtained with the help of current control. The major challenge in coilgun is to avoid the suckback effect. To avoid this opto-coupler is used to detect the position of projectile and accordingly switching is performed.

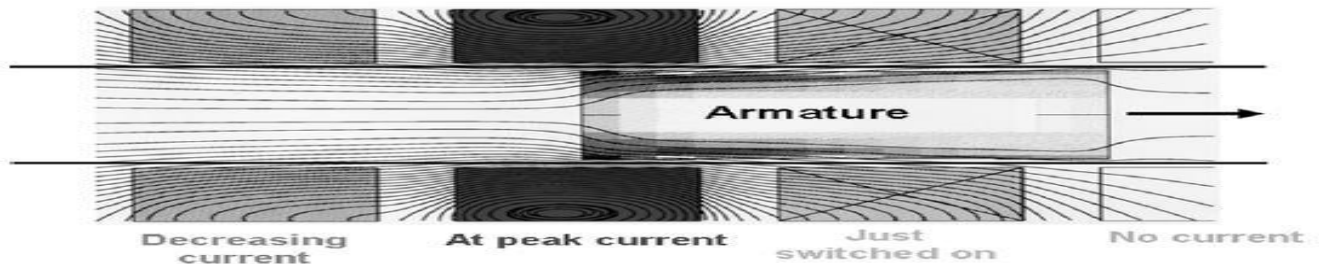


FIGURE 1: Basic operation of electric coilgun

II. PROPOSED METHODOLOGY

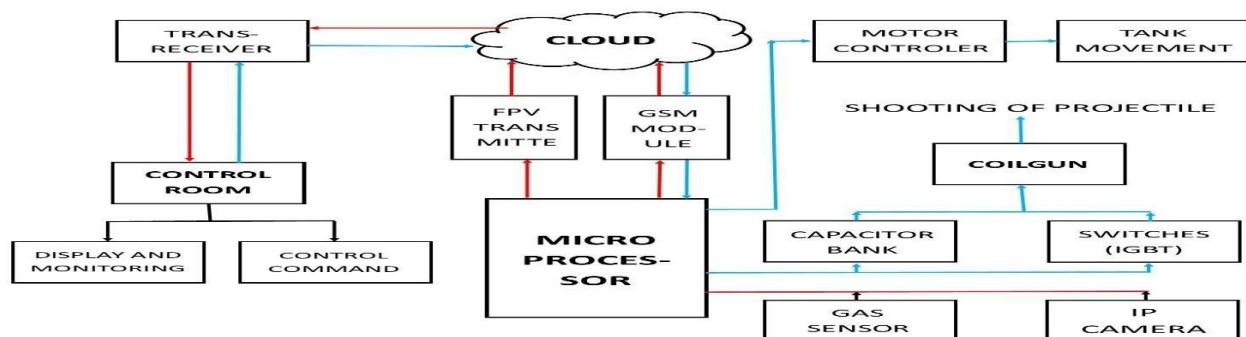


FIGURE 2: Basic operation of electric coilgun

Control room is equipped with display and monitoring devices and control commands. Trans-receiver such as WIFI module is used to transmit the command signal. Cloud provides the link between tank and control room with the help of internet. GSM module inside the robotic tank transmits and receives the command. Microprocessor is used to control and process the commands received from the control room. It also controls the forward backward and right, left movement of the tank with motor controllers. Coilgun, capacitors and switches simultaneously performs to shoot the projectile.

III. COILGUN SIMULATION

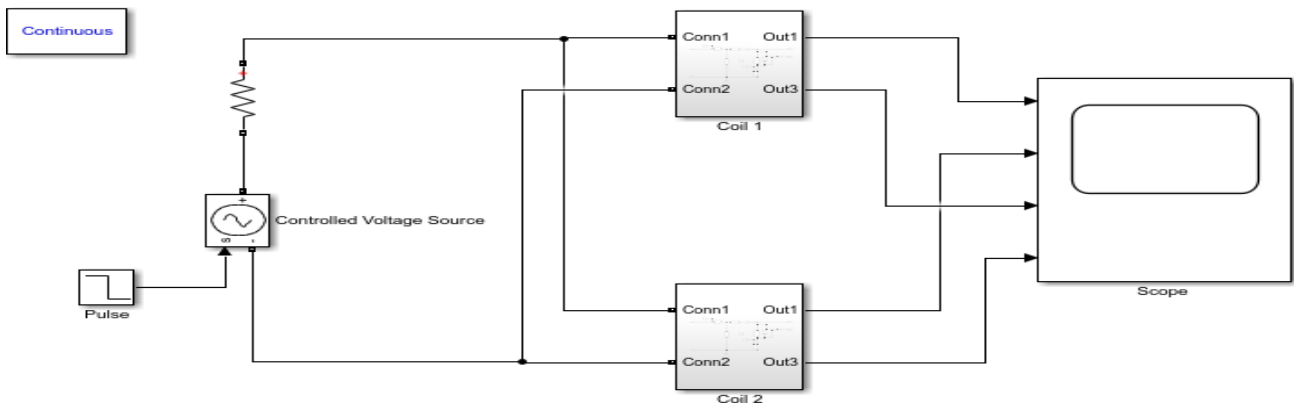


FIGURE 3: Overall Simulation model of electric coilgun

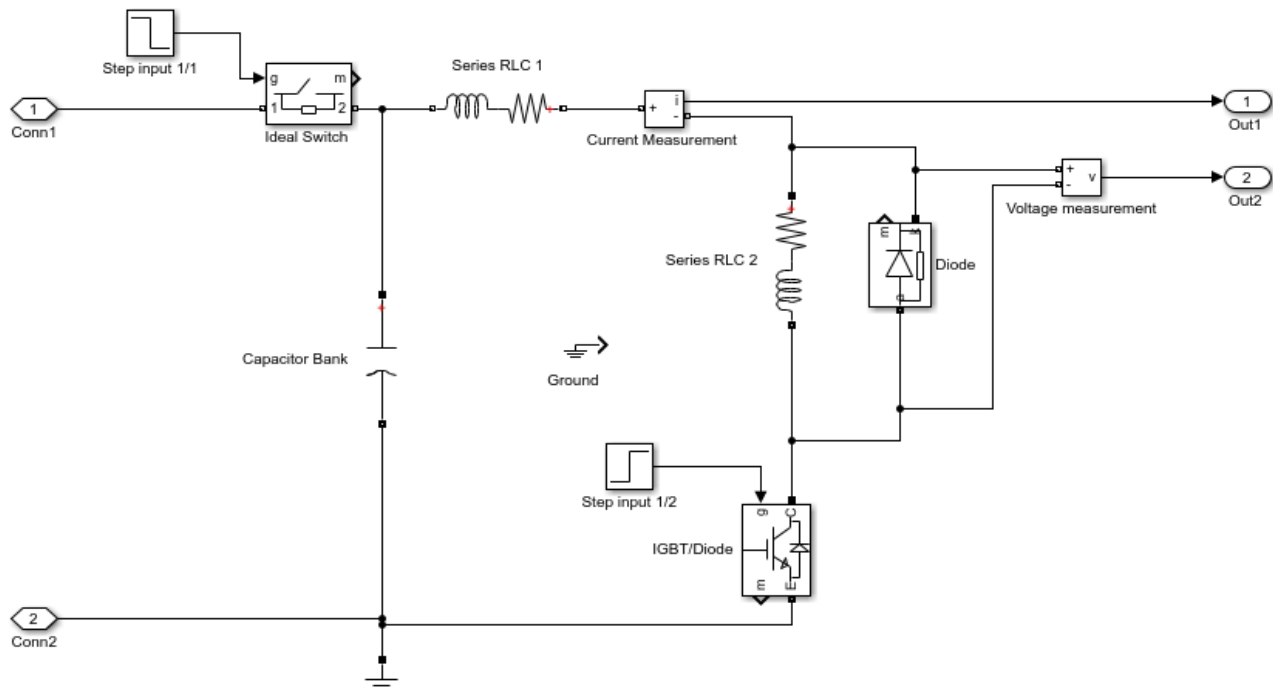


FIGURE 4: Overall Simulation model of electric coilgun

IV. SIMULATION PARAMETERS

TABLE 1: SimulationParameters

Coilgun 1	Coilgun 2	Coilgun 1	Coilgun 2
Capacitor bank: 1 Milli farad	Capacitor bank: 1 milli farad	Series RLC 1:- Resistance:- 1.7 Ohm Inductance:- 2.44 milli Ohm	Series RLC 1:- Resistance:- 1.7 Ohm Inductance:- 2.44 milli Ohm
Step input 1/1:- Step Time:- 0.005 sec Initial value:- 1 Final Value:- 0	Step input 2/1:- Step Time:- 0.01 sec Initial value:- 1 Final Value:- 0	Series RLC 2:- Resistance:- 1.7 Ohm Inductance:- 2.44 milli Ohm	Series RLC 2:- Resistance:- 1.7 Ohm Inductance:- 2.44 milli Ohm
Step input 1/2:- Step Time:- 0.005 sec Initial value:- 0 Final Value:- 1	Step input 2/2:- Step Time:- 0.01 sec Initial value:- 0 Final Value:- 1	IGBT:- Internal resistance (Ron) :- 0.05 ohm Snubber resistance (Rs) :- 0.1 Mega Ohm Snubber Capacitor (Cs) :- inf	IGBT:- Internal resistance (Ron) :- 0.05 Ohm Snubber resistance (Rs) :- 0.1 Mega Ohm Snubber Capacitor (Cs) :- inf
Ideal Switch: Internal resistance (Ron) :- 0.001 Ohm Snubber resistance (Rs) :- 0.1 Mega Ohm Snubber Capacitor (Cs) :- inf	Ideal Switch: Internal resistance (Ron) :- 0.001 Ohm Snubber resistance (Rs) :- 0.1 Mega Ohm Snubber Capacitor (Cs) :- inf	Diode across Coil:- Internal resistance (Ron) :- 0.001 Ohm Snubber resistance (Rs) :- 500 Ohm Snubber Capacitor (Cs) :- 250 nano Farad Forward Voltage:- 0.8	Diode across Coil:- Internal resistance (Ron) :- 0.001 Ohm Snubber resistance (Rs) :- 500 Ohm Snubber Capacitor (Cs) :- 250 nano Farad Forward Voltage:- 0.8

V. SIMULATION RESULTS

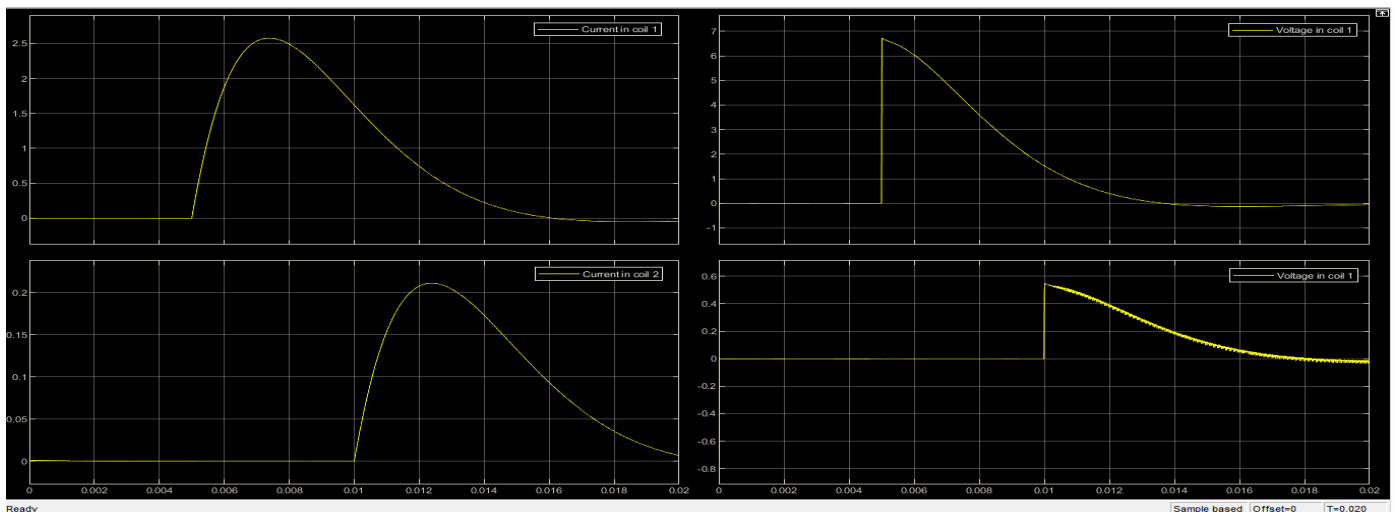


FIGURE 5: Simulation results of electric coilgun

VI. CONCLUSION

This project demonstrates the basic idea and design of the coilgun. This project presents the best solution with a robotic tank with electric coilgun and IoT. Electric coilgun provides features such as fuel-free launching technology, eco-friendly, ease in control of muzzle velocity through electric current. This coilgun eliminates most of the disadvantages of conventional chemical launching systems such as dynamic properties of propellant gas, hazardous nature of propellant gas, storing, handling and transporting difficulties of propellant gas and also high operational cost. This project gives a detailed idea of a simulation of coilgun and analysis of the simulation result.

REFERENCES

- [1] Beyong-soo go, "Desin, fabrication and analysis of a coil assembly for a multistge Induction type Coilgun system", IEEE 2018
- [2] Marcelo Perotoni, "Coilgun velocity optimization with current switch circuit", IEEE 2017
- [3] Sucheta Khandekar, "Coilgun: Simulation and Analysis", International Journal of Recent Research in Electrical and Electronics Engineering (IJRREEE) sept 2016
- [4] Zizhou Su, "The Feasibility Study of High-velocity Multi-stage Induction Coilgun", IEEE 2012
- [5] Mahdi Mahmoodi Vaneghi, "Design and SwitchingPosition Optimization of Multi-Stage Coilgun", ©2011 IEEE
- [6] Mahdi Mahmoodi Vaneghi, "Design and SwitchingPosition Optimization of Multi-Stage Coilgun", ©2011 IEEE
- [7] Liuming GUO, "Simulation and analysis of electromagnetic coilgun"
- [8] J.L. He, "analysis of induction coilgun performance based on cylindrical current sheet model", IEEE 1991
- [9] R. Murugan, "Estimation Of Inductance Gradient Empirical Formula Of Rails Using Regression Analysis Technique", Int J Adv Engg Tech/Vol. VII/Issue I/Jan.-March.,2016/607-610
- [10] Ugur Hasirci, "Design, Implementation and Test of a Coilgun-Type Electromagnetic Launcher Prototype", 978-1-4244-3628-6/09/\$25.00 ©2009 IEEE
- [11] B. M. Marder, "SLINGSHOT—A coilgun design code," Sandia National Laboratories Report, SAND2001-1780, Sep. 2001
- [12] B Skala, "Electromagnetic coilgun - construction and basic and simulation" Springer International Publishing Switzerland 2014