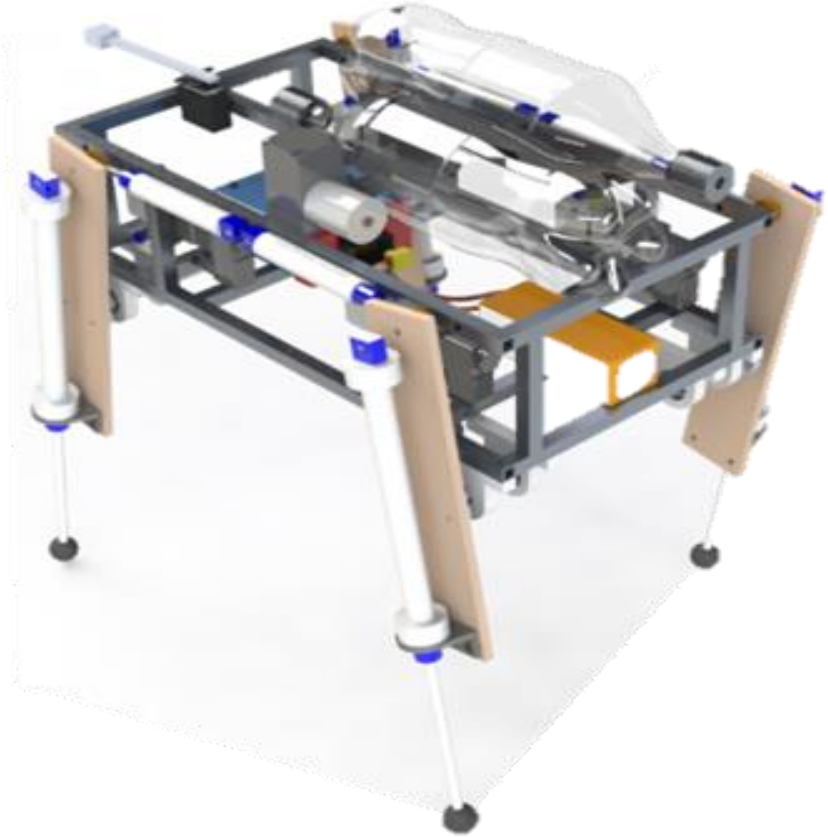
CONTROLLED MOTION OF QUADRUPED BOT



CONTROLLED MOTION OF QUADRUPED BOT

Project Guide : Prof. Swati Mahajan

Sahil Rajpurkar: 1613130
Soofiyan Atar : 1613002
Shreyas Borse :1613061

INDEX

1. Introduction
2. Objective
3. Methodology
4. Literature Review
5. Leg Mechanism
6. Hardware design
7. Algorithms and Process Design
8. Control
9. Final Implementation

INTRODUCTION

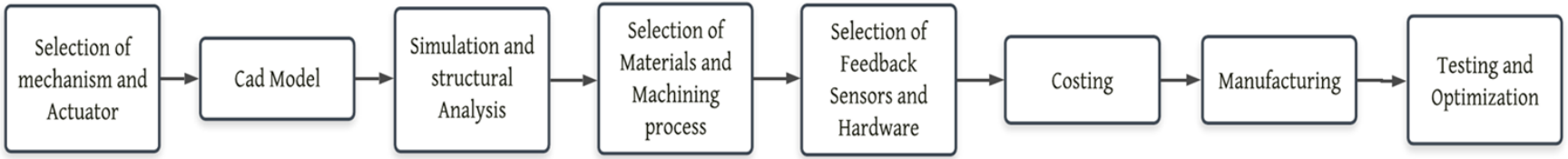
- Mobile robots are usually associated with robots that consist of wheels to move around. There exist a different category of mobile robots that possess the ability to overcome a number of terrains with ease. These are legged robots.
- Dynamic complexity involved in designing and developing gaits on legged platforms has led to the discovery of a number of methods for approaching this challenging issue.
- We introduce the Pneumatic Quadruped Robot, that can traverse with less cost of transportation when compared to robots powered with conventional power sources such as a battery.
- Pneumatics provides precise force control with significant position control which is an important aspect when considering legged robots.

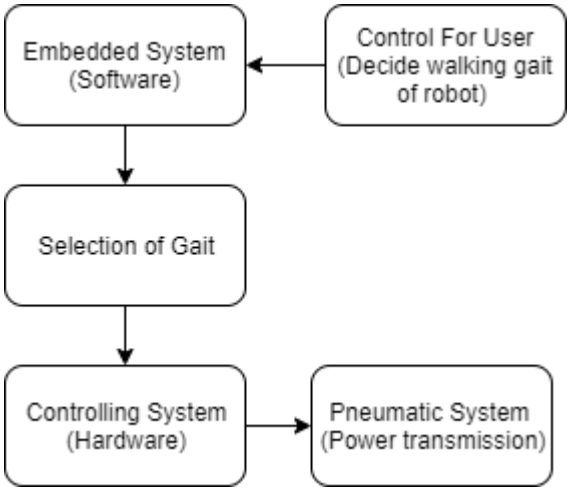
OBJECTIVE

➢The objective of this project is :-

- To design ,analyse and implement a quadruped robot using pneumatic actuators as the primary drive system.
- Using two active degrees of freedom instead of three and to validate if such a design is feasible in terms if the dynamics and controllability.
- Implement the walking and pronking gait for field testing and optimisation.

METHODOLOGY



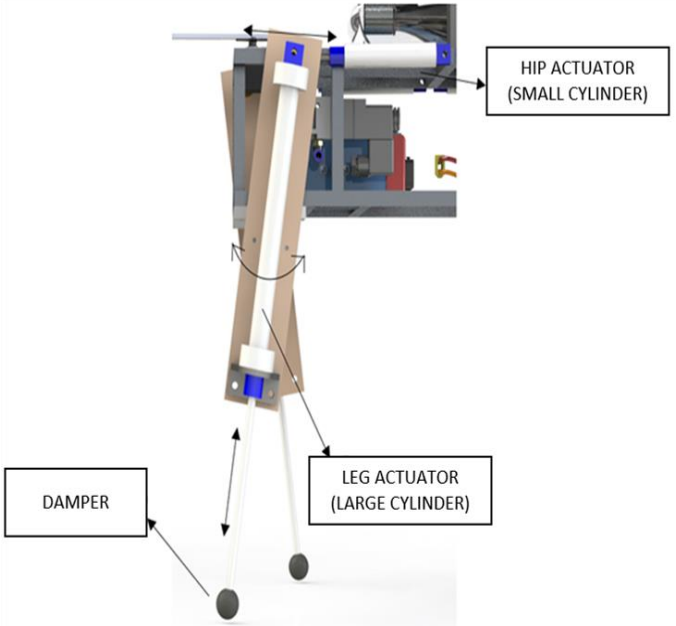


LITERATURE REVIEW

TITLE	AUTHOR	METHODOLOGY
A model-based height controller for a one-legged hopping robot.(2001)	Kale Harbick et.al	Robot kinematic of a pneumatic one legged hopper.
A minimalistic model of a four legged robot using artificial pneumatic muscles to avoid the issue of overheating.(2012)	Kenichi Narioka et.al	Using air muscles instead of pneumatic cylinders.
A four legged robot with two active degrees of freedom modeled on the basis of the movement of a dog for rough terrain.(2018)	M.A.Muqeeth et.al	Design and testing
A pneumatically driven quadruped robot with a biomimetic legs and a flexible spine.(2017)	Yugo Kajiwara et.al	Robot design that mimics actual muscles with a flexible spine.
The control of a quadruped robot using kinematic analysis for low and high speed actuation along with heading angle sensitivity.(2017)	Saab etal	Mathematical analysis in high speed actuation.
Friction and Vibration Characteristics of Pneumatic Cylinder(2014)	Yasunori et.al	Friction and vibration caused in a pneumatic piston.

LEG MECHANISM

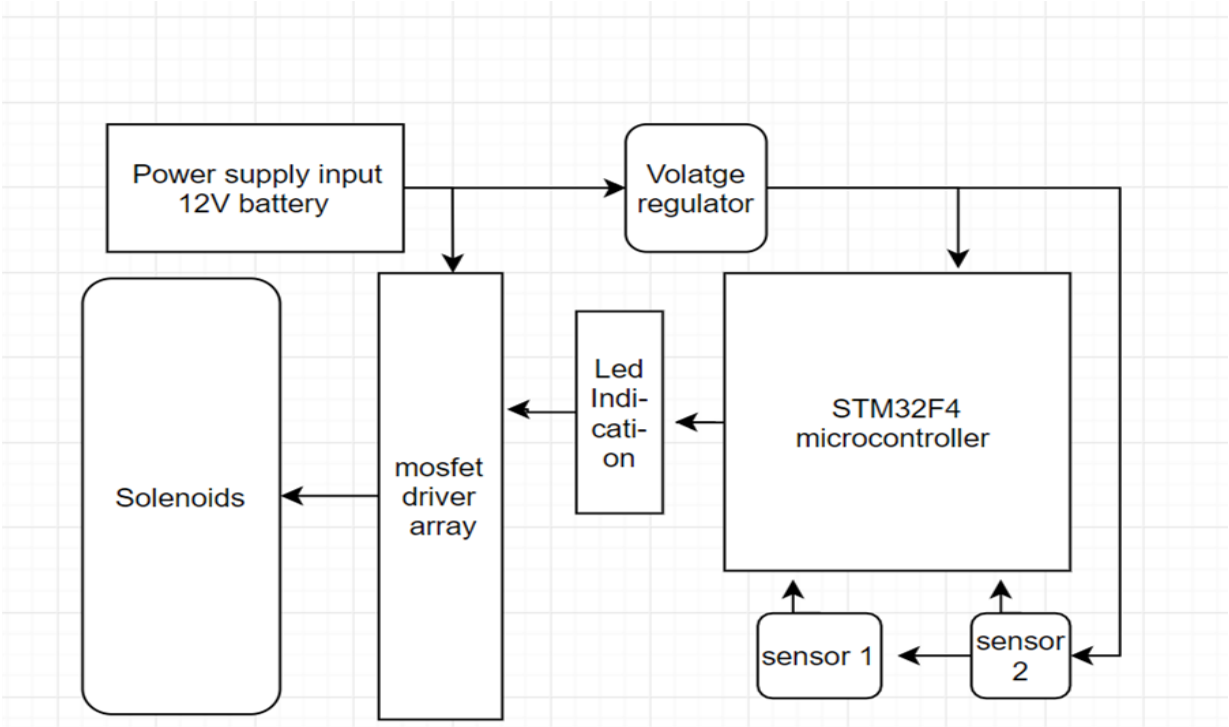
- Each leg has two active degrees of freedom provided by the two cylinders.
- The larger cylinder provides the robot with the necessary force to counterbalance the normal reaction as well as some excess force to lift the body off the ground.
- The lateral oscillatory motion of the larger piston is provided by, the smaller cylinders that help the robot move forward.



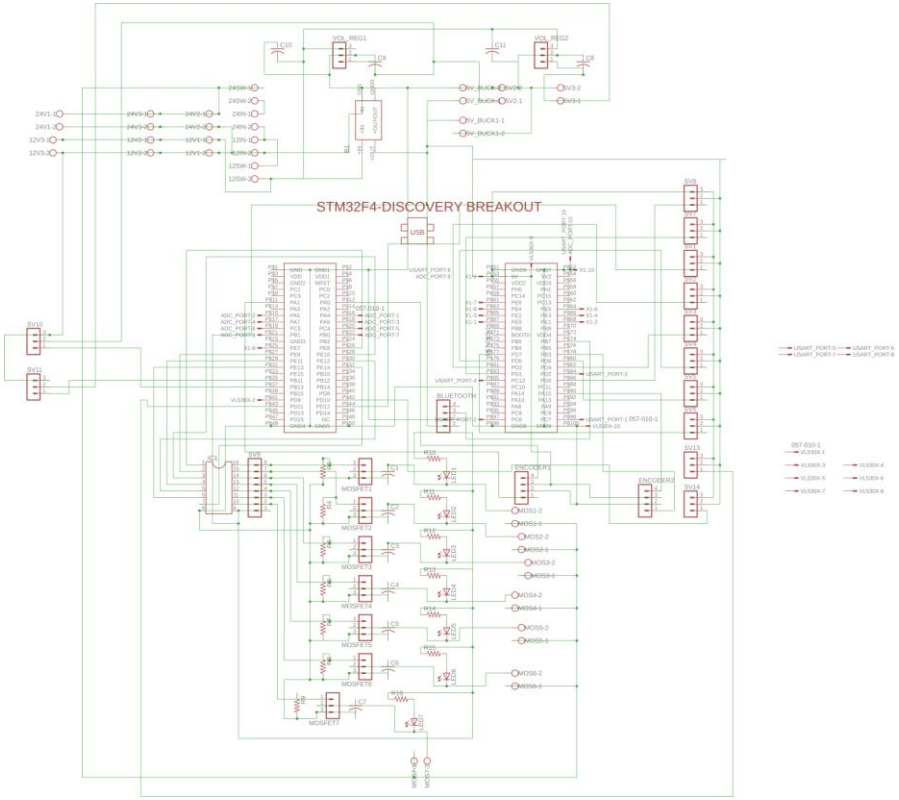
Circuit Components

- Voltage regulator – LM2579 3A 12V TO 5V
- IRFZ44N power Mosfet.
- ULN2803 inverter 600mA per channel.
- Varistor(MOV) and a 10K resistances.
- For Wireless Control - AtMega 328p , HC- 05, Push Buttons
- Batteries -12V 5200mAh and 3.3V 1500 mAh

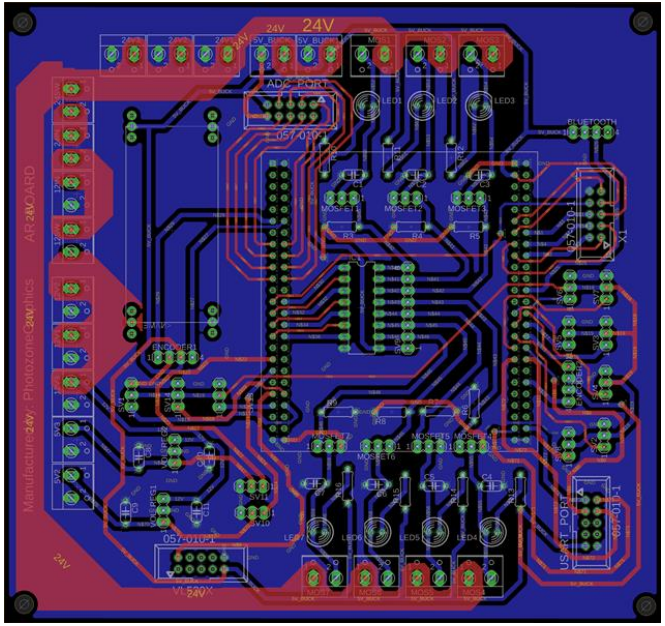
Circuit Block Diagram



Overall circuit of the Board



Board Layout

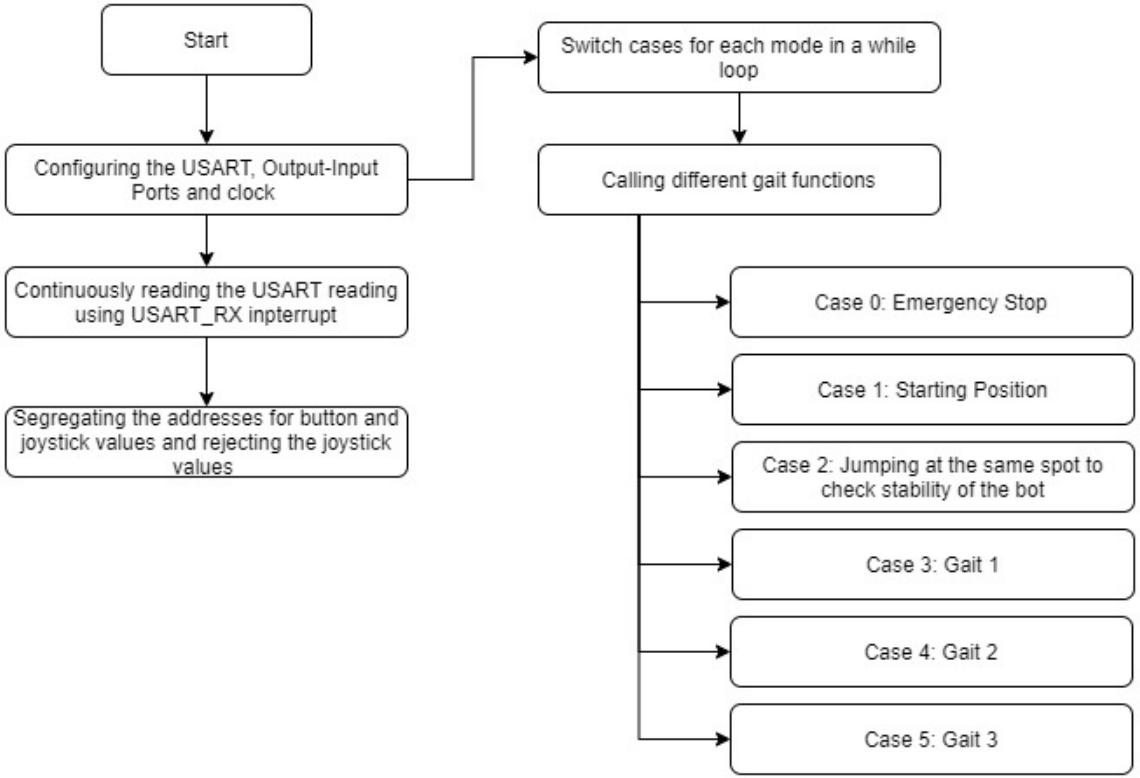


continued....

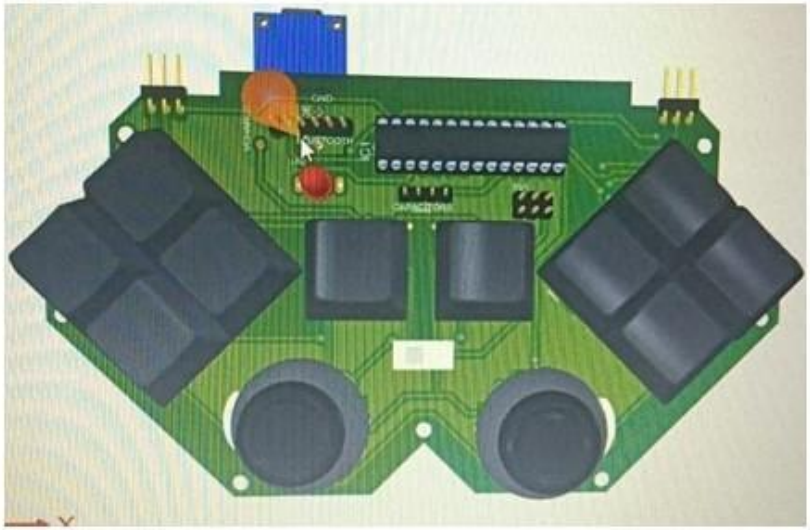
ALGORITHMS AND CONTROL

- We have implemented LQR controller where we have to control the velocity of the bot and also to control the height of the bot.
- As we are controlling each leg of the bot using LQR controller we can also control the forward velocity of the bot.
- We have also used turning control for the bot where we are turning by pivoting one leg.
- We will also be using path planning algorithms for a given map of the environment and then we can localise the bot at any given point for the map.

Algorithm Flow chart.



Controls with button module



Testing Videos

Final Implementation Video.

Thank You!