Data-Driven control modelling of a two wheeled self balancing robot

Course Project for CS637A (Embedded and CyberPhysical Systems)

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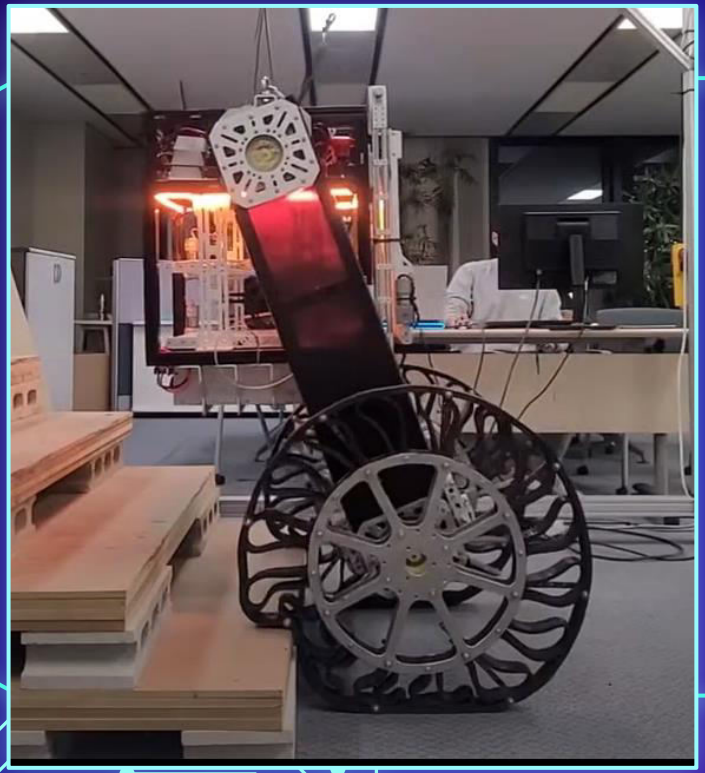
Problem Identification

Last Mile Delivery

In delivery, especially in “last mile” parcel delivery, there are very many factual problems that make this section of the delivery process expensive and inefficient due to dependence on manpower. However, as the parcel delivery market is swept along by the tremendous growth of online commerce, high hopes are being pinned on technological solutions to the “last mile” problem.

Above all, robotics and, to be precise, autonomous robotics are considered forward-looking. This means the delivery of parcels (and also food or similar) by means of small mobile vehicles (“delivery robots”) or delivery drones.

Existing Solutions



01. Two Wheel Delivery Robot

Modelling

DEVELOPMENT STAGES

Structure and Dynamics

Deciding the dimensions.
Choice of Motors and drivers
Battery pack
Reduction techniques

CAD Modelling

Designed various models in Fusion 360 suitable to our requirement

Manufacture and Assembly

Material acquisition
Solving manufacturing problems
Deciding the respective components available in market

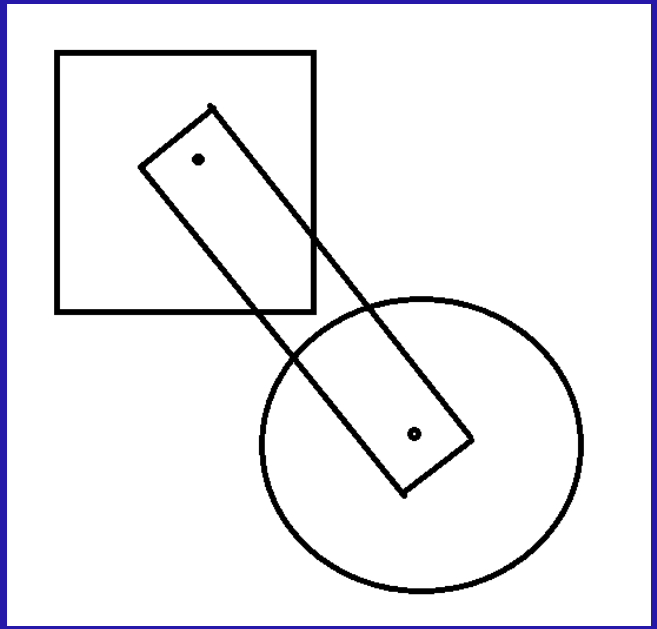
Structure and Dynamics

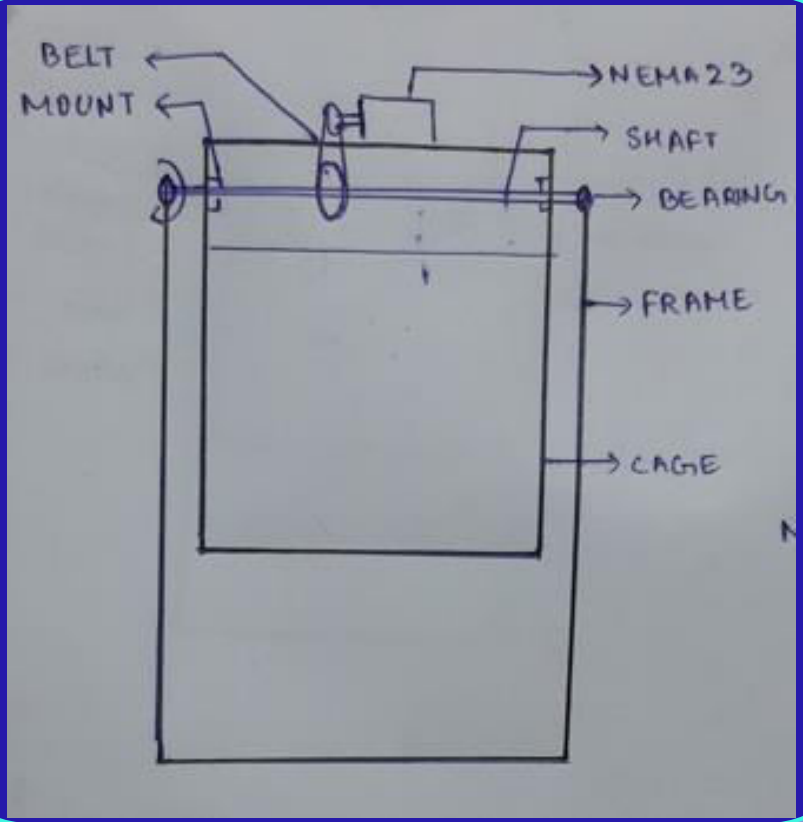
Structure

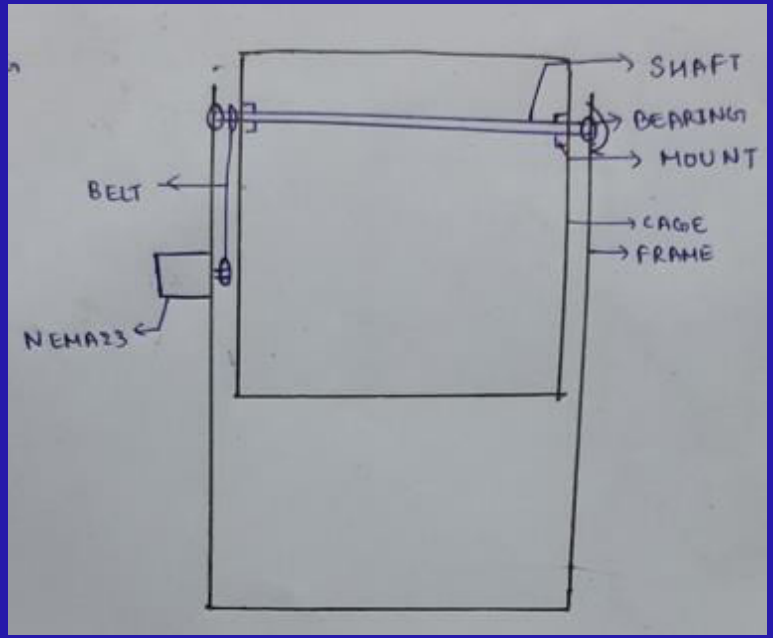
Material chosen: Aluminium Extrusion
Actuator: Nema 23 (18 kgf)
Motor driver:TB6600
Dimensions: cage:30x30x30cm
frame:50x10cm

Dynamics

3 models were thought of based on the dynamics requires to rotate the cage




BELT
MOUNT
NEMA23
SHAFT
BEARING
FRAME
CAGE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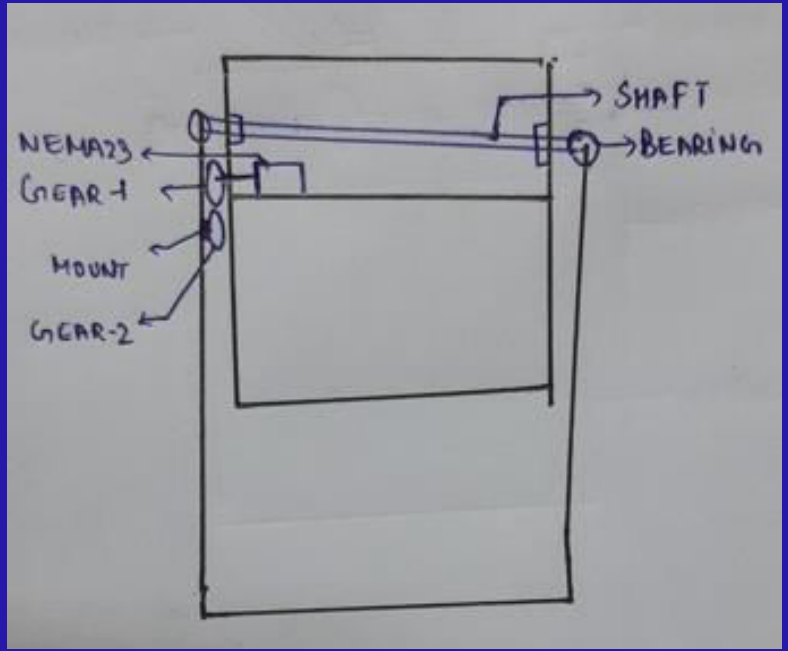
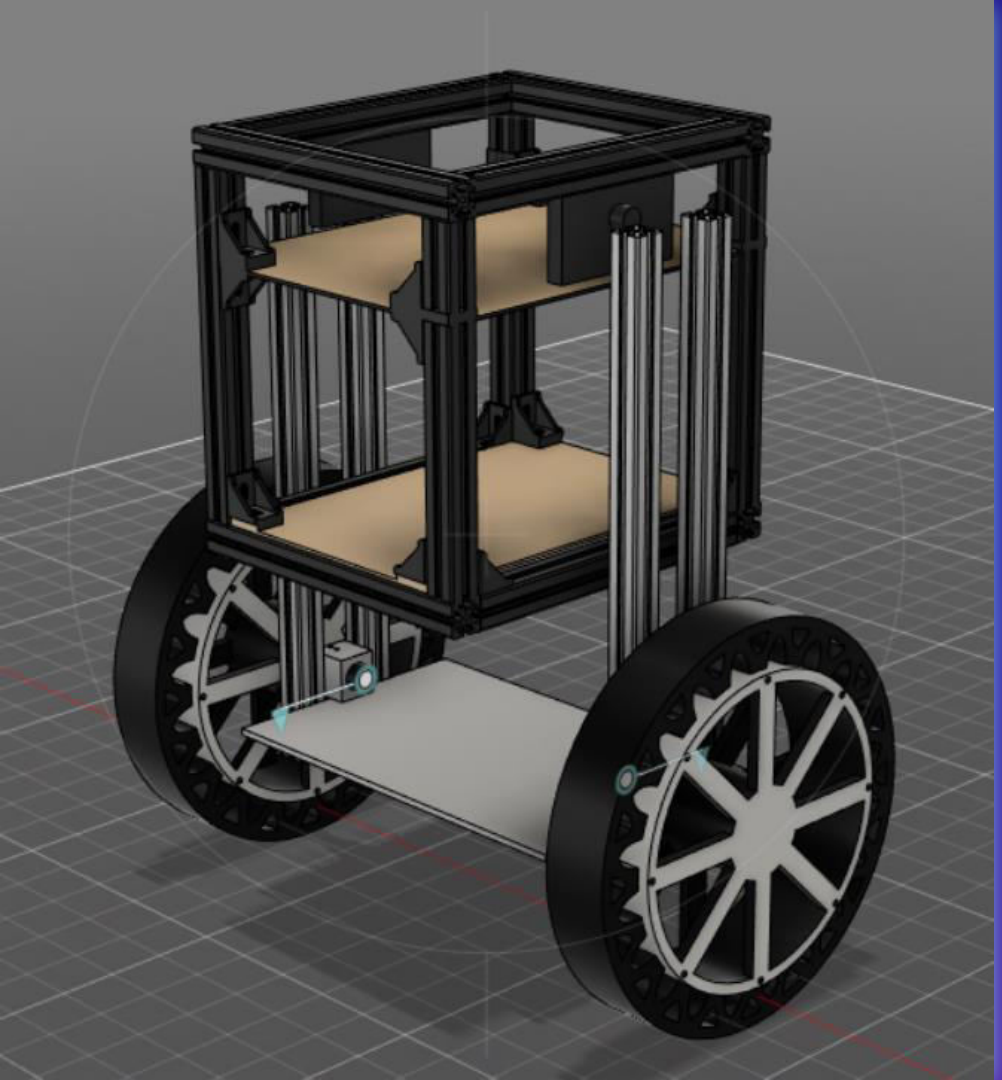

SHAFT
BEARING
NEMA23
GEAR-1
MOUNT
GEAR-2

CAD Modelling

We tried modelling our imagination into Computer-Aided-design(CAD)

Modelling of structure
Modelling of tweels(non pneumatics tubeless tyres)



Components Required

Level-1

- Sensors:MPU6050x3
- Nema23
- TB6600
- Mounts and bearing
- Lipo battery(5500mAh 24V)
- Arduino Uno

Level-2

- Area to keep payload

Level-3

- Nema23x2
- TB6600x2
- Mounts and bearing
- Arduino UNO
- Raspberry pi-3B

Problems faced

Tweels

Designing of tweels and its alternative

Stepper Motor

Controlling a stepper with the accelstepper library

Power Supply

Providing the accurate power supply

Aluminium Exrtusions

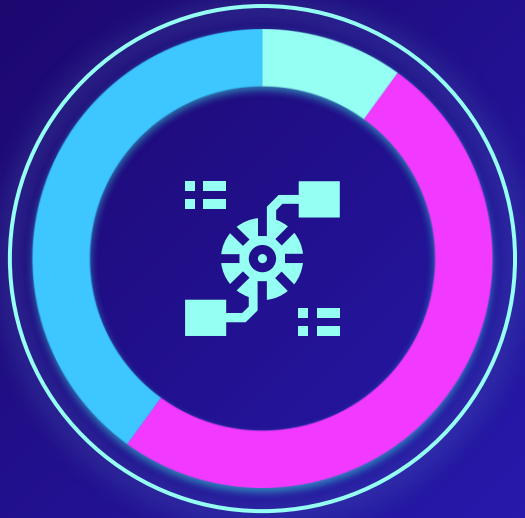
FInding connectors for extrusions

Mechanical knowledge

Budget

We required a budget of 20k to complete this project

How did we finally build the robot?



10%

Buying Materials

A lot time went in roaming in streets of LaTouche road and hardware shops.

40%

Manufacturing and Assembly

Cutting, drilling and joining all the components.

50%

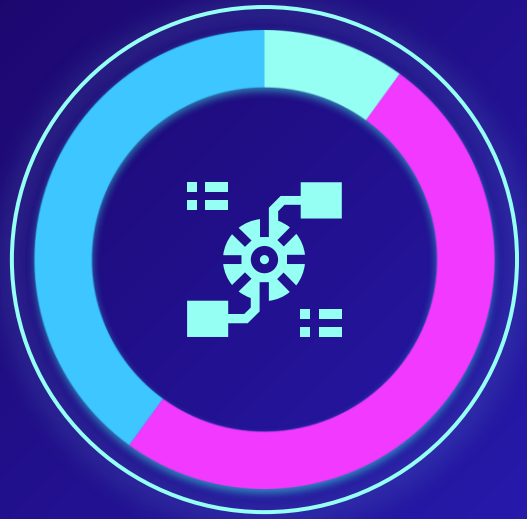
Jugaad

Replacing unavailable parts with unconventional alternatives.

Current updates

- We have arranged all the required components.
- Using buggy wheels as an alternative to tweels
- Trying to complete the assembly of our robot

Future Plans and timeline



10%

Data Acquisition

Once we are done with assembly. We will be start acquiring input and output data points

40%

Cleaning Data

Go through the recorded data and remove all the human errors and errors while recording data

50%

Training the model in Open AI-Gym

We will train a controller for this non-linear system using RL on Gym platform

Work distribution:

Names:	Work done:
Batta Soumith	Work done equally
Akshat Arya	Work done equally
B Naveen Teja	Work done equally

THANKS

Do you have any questions?

LMiT-22 has the capability to solve the last mile delivery problems, our world is currently facing