CLUSTERING | PREDICTION | IDENTIFY INTENTION | SHOOT TARGET

CLUSTERING OF AIR OBJECTS BASED ON TRAJECTORY

Smart India Hackathon

TEAM

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ORGANIZATION : DTE OF IT & CYBER SECURITY, DRDO

DOMAIN BUCKET : SECURITY & SURVEILLANCE

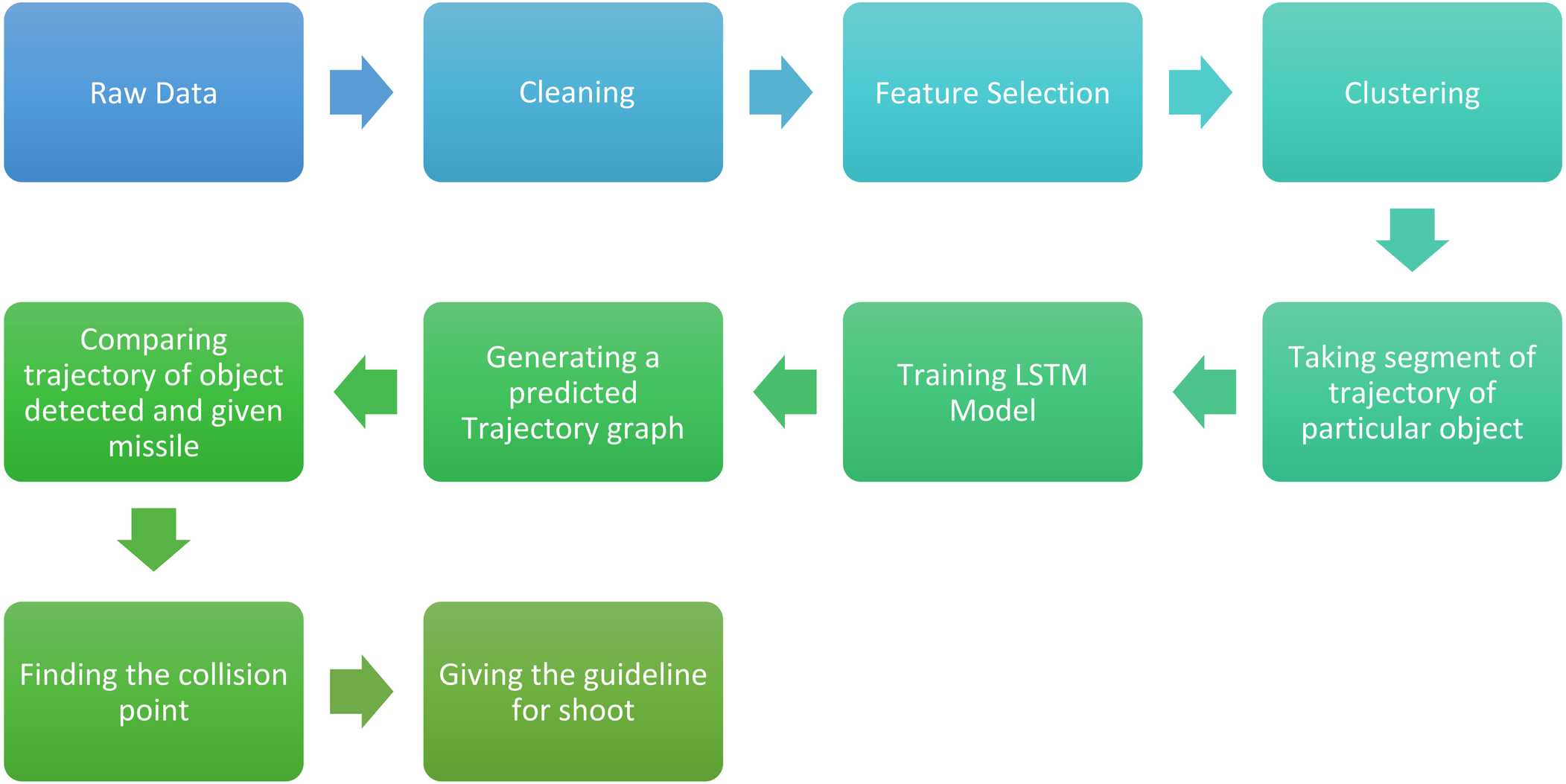
TEAM NAME : CLUSTER CHAMPS

TEAM LEADER : SANSKRITI TIWARI

Problem Statement Description

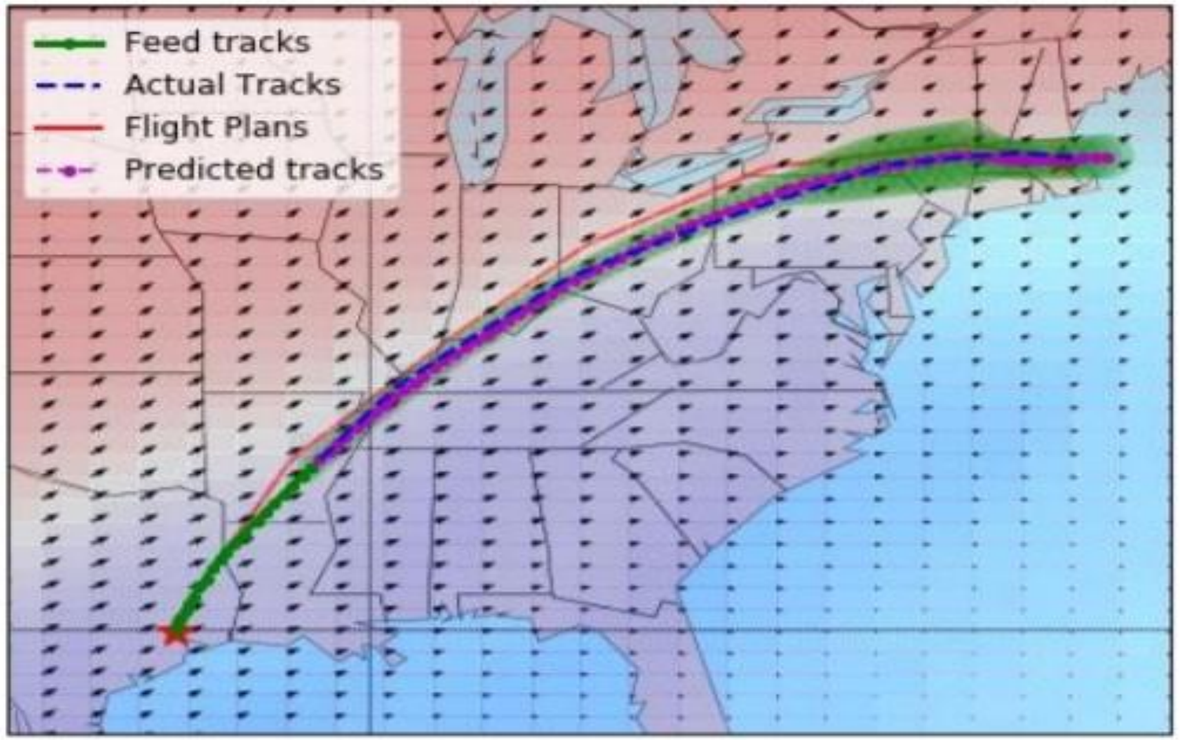
The position of an object in the air can be indicated by latitude, longitude and altitude for a given time. A trajectory is a stream of such quadruples (time, latitude, longitude and altitude). Given a large set of such trajectories, without any other information, problem is to cluster them into meaningful objects such as Helicopter, Fighter/civilian Aircraft, UAV, Cruise Missile, dropped bomb, etc. An optimal scalable solution is desired using open source tools. Design a system to estimate location of flying object based on its trajectory, provide guidance to missile to shoot them depending on their location when missile will meet the object on its trajectory.

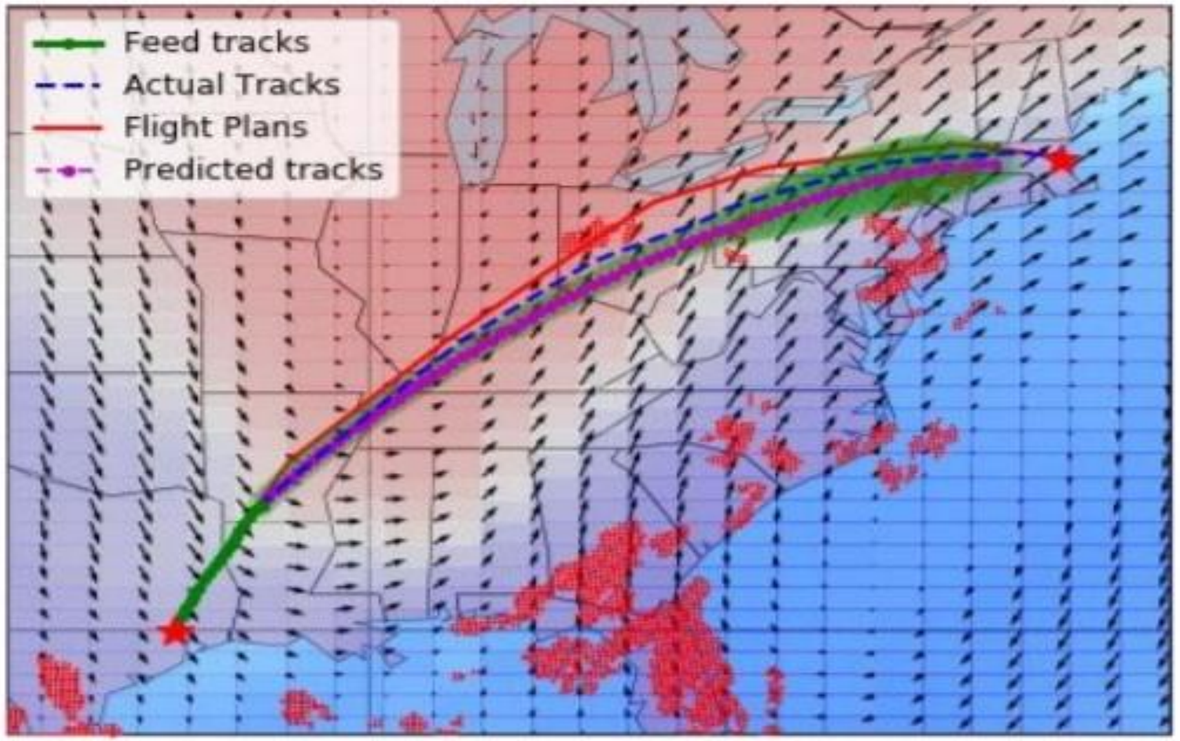
Approach


Raw Data
Cleaning
Feature Selection
Clustering
Taking segment of trajectory of particular object
Training LSTM Model
Generating a predicted Trajectory graph
Comparing trajectory of object detected and given missile
Finding the collision point
Giving the guideline for shoot

Visualization

Evaluation





Student Innovation

Object Intention Recognition :

Air object intention recognition is the process of analysing the information of target to explain and judge the purpose and plan of the enemy. It is based on further clustering and sample expansion

Feature Extraction from Wind, temperature and convective weather:

Convolutional layers are deployed to extract feature representations from high-dimensional weather features

Encoder and Decoder LSTM :

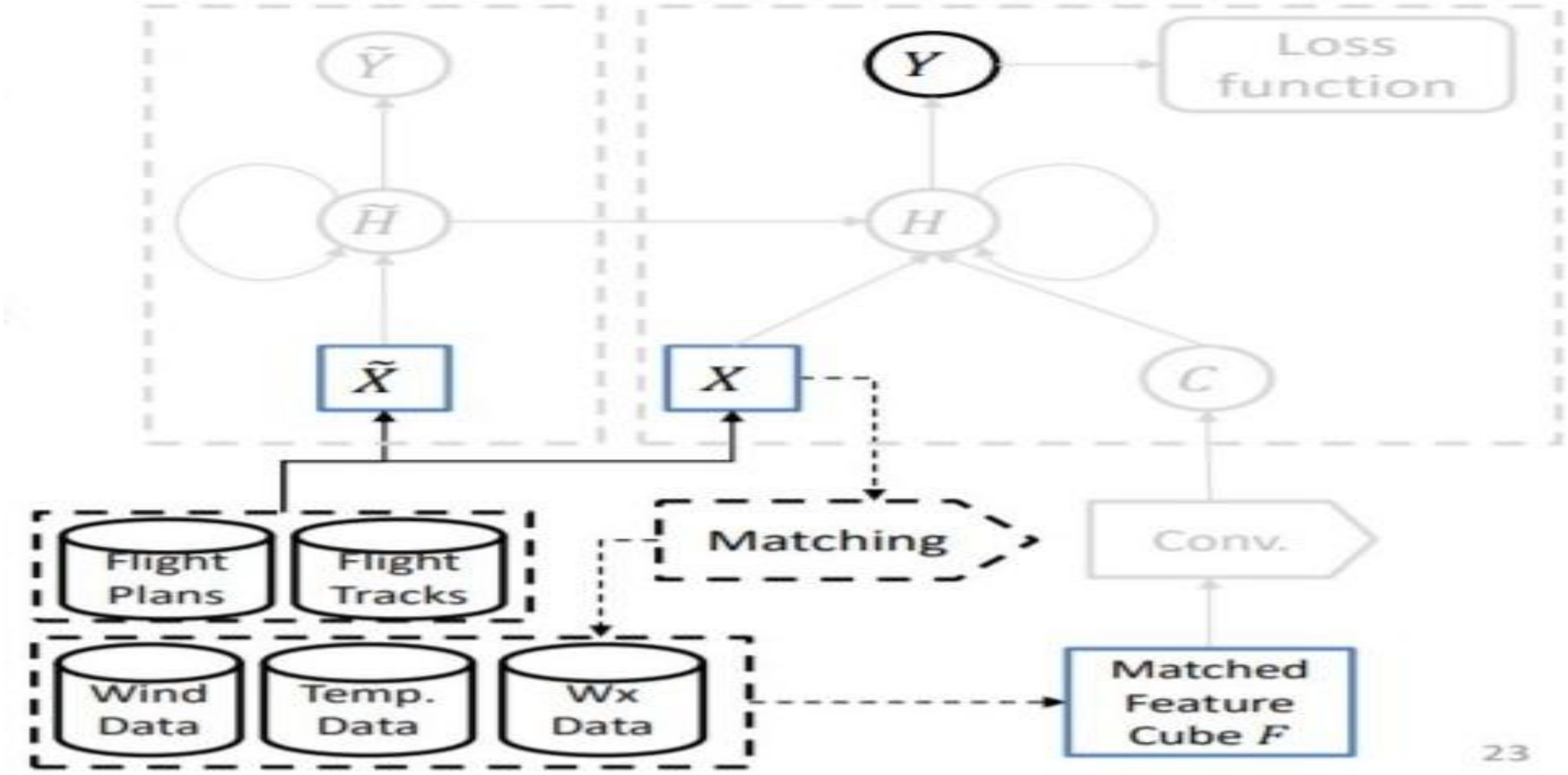
The model, used to predict the trajectory of the object integrates two modules :

1. An encoder LSTM to embed flight plans into a fixed size feature vector and
2. A decoder LSTM that maps the fixed size feature vector to target the flight trajectory sequence.

Object Intention Recognition

Azimuth (mil)	Distance (km)	Horizontal Velocity (m/s)	Heading Angle (°)	Height (km)	Intention
2300.00	210.00	300.00	310.00	4.00	Attack
2325.00	215.00	320.00	324.00	4.20	Attack
2250.00	150.00	300.00	155.00	5.00	Attack
2900.00	290.00	272.00	350.00	5.60	Attack
2800.00	260.00	215.00	260.00	7.70	Surveillance
810.00	281.00	250.00	202.00	6.00	Reconnaissance
820.00	280.00	245.00	201.00	6.50	Reconnaissance
830.00	282.00	255.00	200.00	4.20	Reconnaissance
825.00	284.00	250.00	204.00	5.00	Reconnaissance
4000.00	110.00	300.00	50.00	3.40	Cover
4020.00	120.00	280.00	52.00	3.60	Cover
5120.00	110.00	210.00	52.00	3.60	Other
4800.00	140.00	220.00	18.00	9.60	Other

Precision from weather data



Encoder and Decoder LSTM

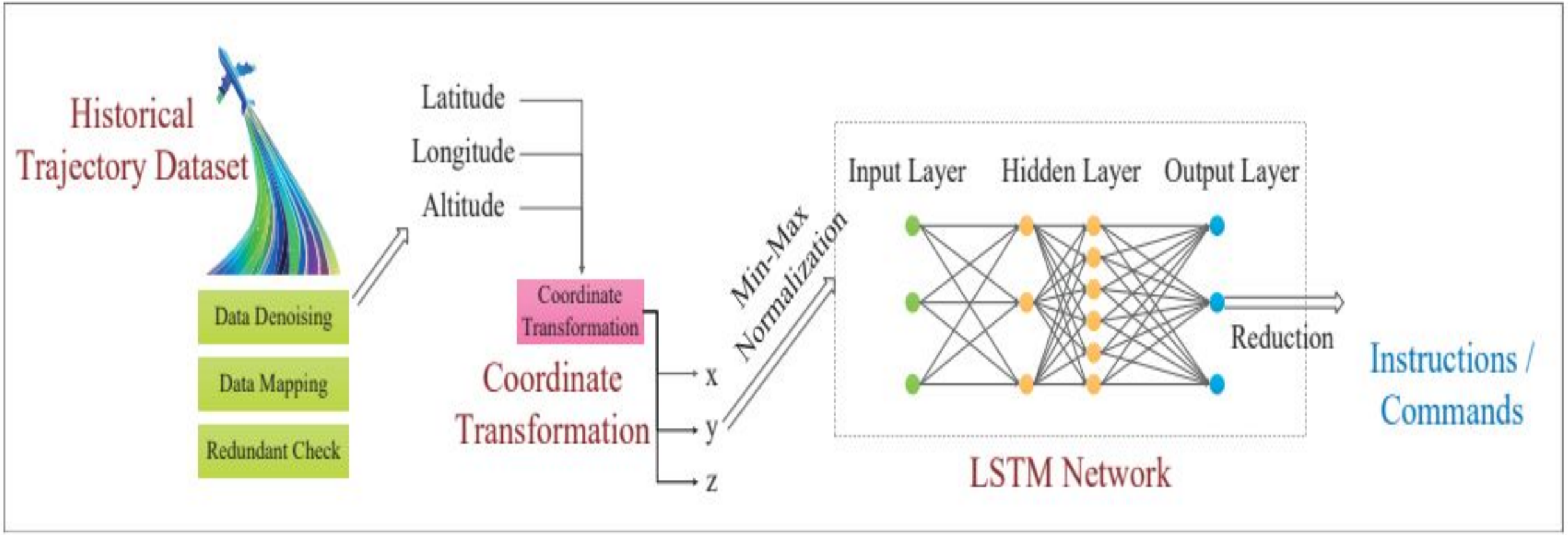
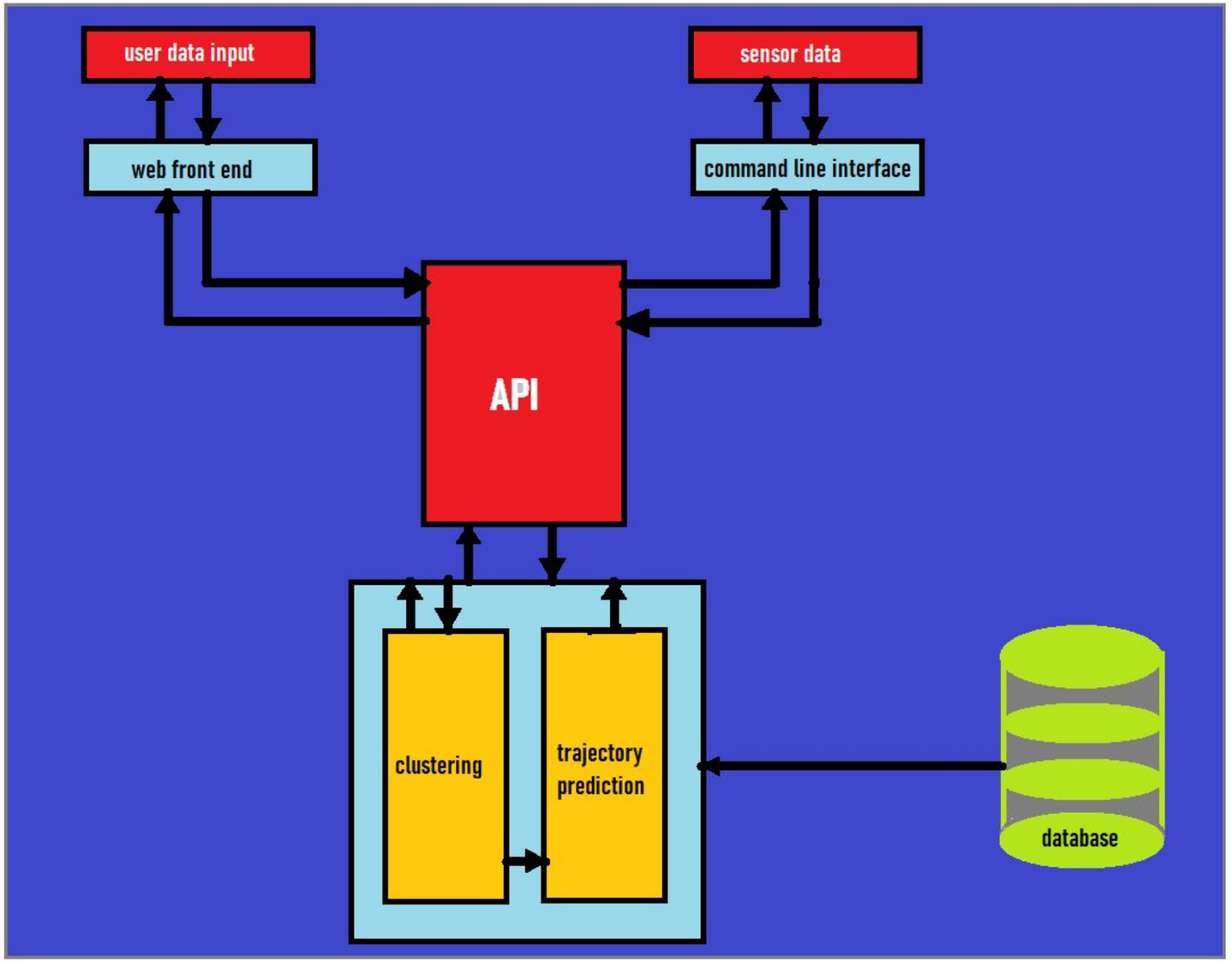


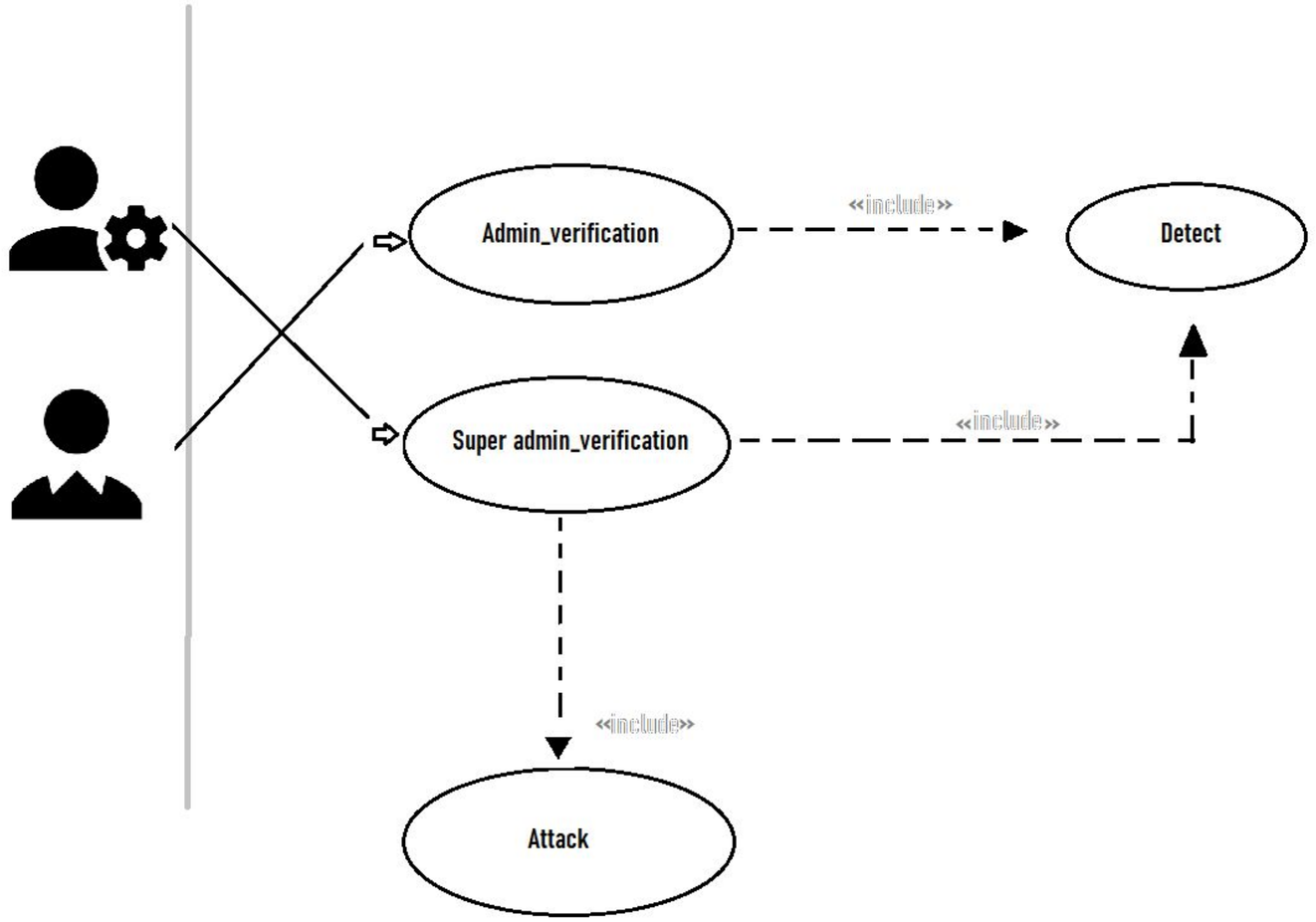
Fig. 2. The proposed LSTM-based flight trajectory prediction.

Software Flow

15 min.



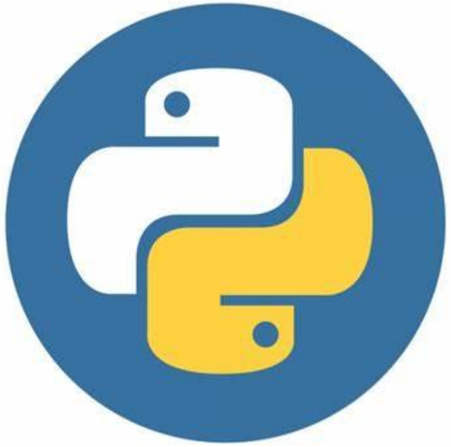
Use Case

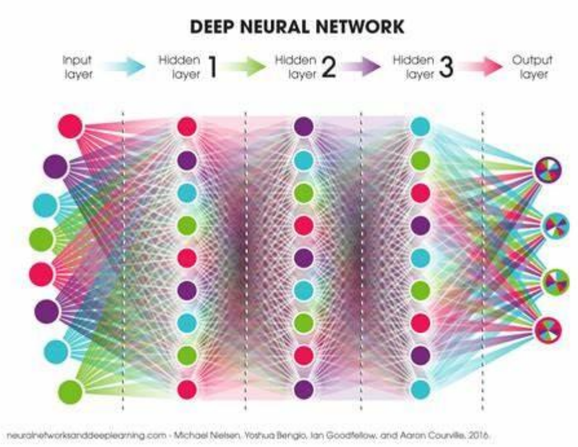

Admin_verification
«include»
Detect
Super admin_verification
«include»
«include»
Attack

Dependencies and Show Stopper

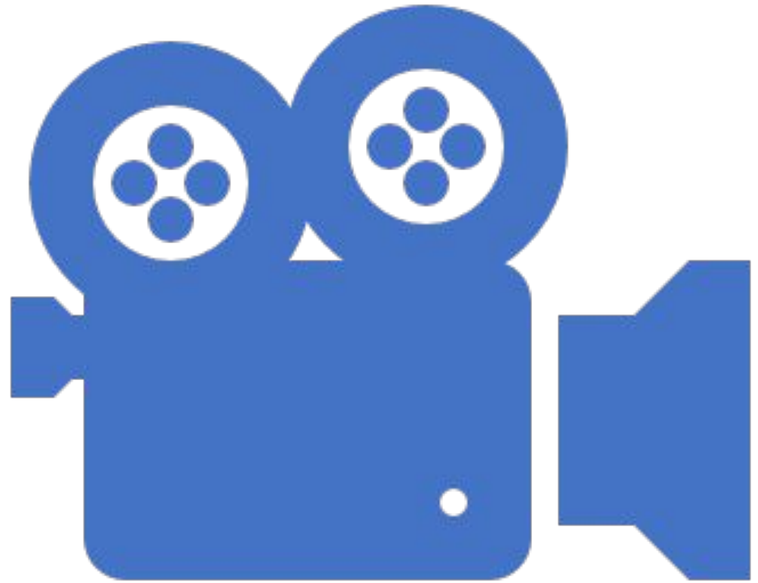
1. **Dependencies** include access to the classified data such as data of all the flying object in INDIA (latitude, longitude, altitude and time).
2. **Show stopper** - The dataset for training a model has not been provided in the description of the problem statement so we are unable to proceed forward. As of the theoretical part we are ready.

Technology Stack / Tool





ANIMATED MODEL




BOOM!

Thanks for viewing our presentation

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