DECISION SUPPORT SYSTEM FOR PREDICTION OF COVID-19

Summer Internship -2020
SAPIO ANALYTICS

By
Saransh Gupta
Roll No. 17QM30005
4th Year, Bachelor & Master of Technology

Department of Industrial and Systems Engineering
Indian Institute of Technology
Kharagpur-721302

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CONTENTS

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Introduction to DSS

❖A decision support system is an information system that supports business or organizational decision-making activities

❖In the scenario of COVID-19 pandemic, knowing the current extent and future prediction of the problems can help the decision makers take the right measures to implement situations like lock-downs smoothly and to decide its extent and its enforceability in a particular area within the city

❖**Input Required**: Name of the State and City

❖**Output**: Graph of prediction of COVID – 19

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Objective

With the help of the real time data available, we have created models that can help make the right decisions by understanding the extent of the problem.

This industrial training involves **two main targets** to be accomplished to implement the model for DSS:

- ❖Prediction of the COVID-19 cases per day at a hyper-local level
- ❖Predict the peak for the places at hyper-local level for COVID-19

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Introduction to SEIRD Model

Approach to implement the DSS involves execution of Machine Learning driven **Susceptible - Exposed - Infectious – Recovered – Died (SEIRD)** model.

By applying this model, we aimed to forecast the trend of COVID-19 epidemic at hyper-local level

SEIRD model based on the clinical progression of the disease, epidemiological status of the individuals

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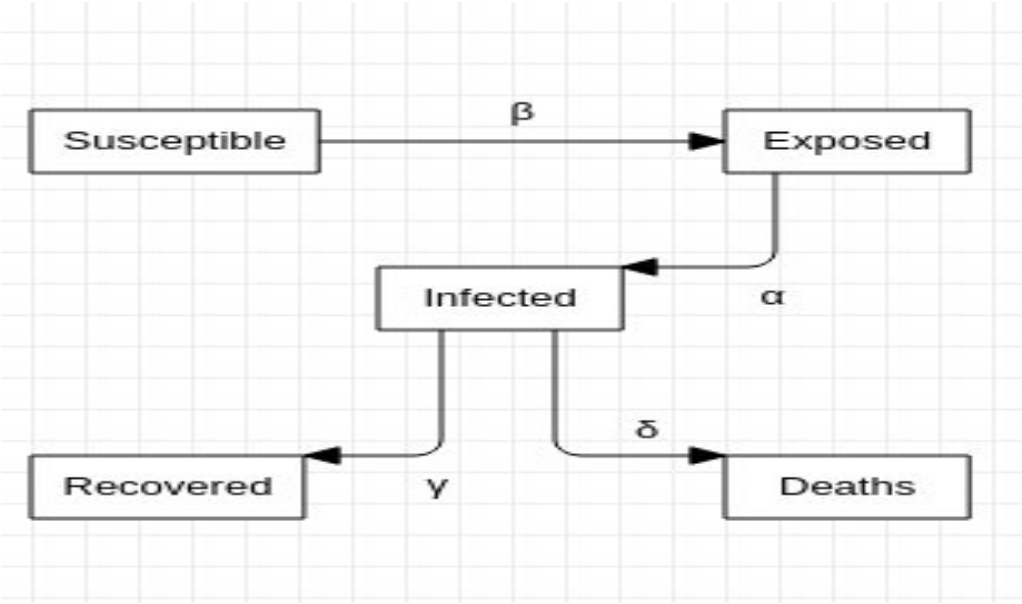

Interpretation for different processes Of SEIRD model

$$dS(t)/d(t) = -\beta S(t)I(t),$$
$$dE(t)/d(t) = \beta S(t)I(t) - \alpha E(t),$$
$$dI(t)/d(t) = \alpha E(t) - \gamma I(t) - MI(t),$$
$$dR(t)/d(t) = \gamma I(t),$$
$$dD(t)/d(t) = MI(t)$$

ODE for different processes of SEIRD model

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Notations:

S: number of individuals those are susceptible to the disease but not infected at time ***t***
E: the number of individuals those are exposed to the virus or infected but not yet infectious
I: the number of infected individuals who can spread the disease through contact with susceptible
R: the number of individuals those have successfully gained immunity from the disease
D: the number of individuals those are removed due to death from infection

β**:** transmission rate of disease from susceptible to exposed

α: the rate of latent individuals becoming infectious

ɣ = Recovery rate (1/D), is determined by the average duration, D, of infection

δ: the rate of infectious individuals died due to infection

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Assumptions:

- Alfa(α) → onset rate = 0.2
- Gamma(ɣ) → Removal Rate = 0.1
- M → Mortality Rate = 0.029 (depends upon the area)
- **N → epidemic size** (This value is calculated by the optimizing algorithm, but initial guess is 7.45842445e+03)
- P → identification rate (assumed 0.09)
- **Beta → Infectious rate** (calculated by the optimizing algorithm, but the initial guess is 0.01)

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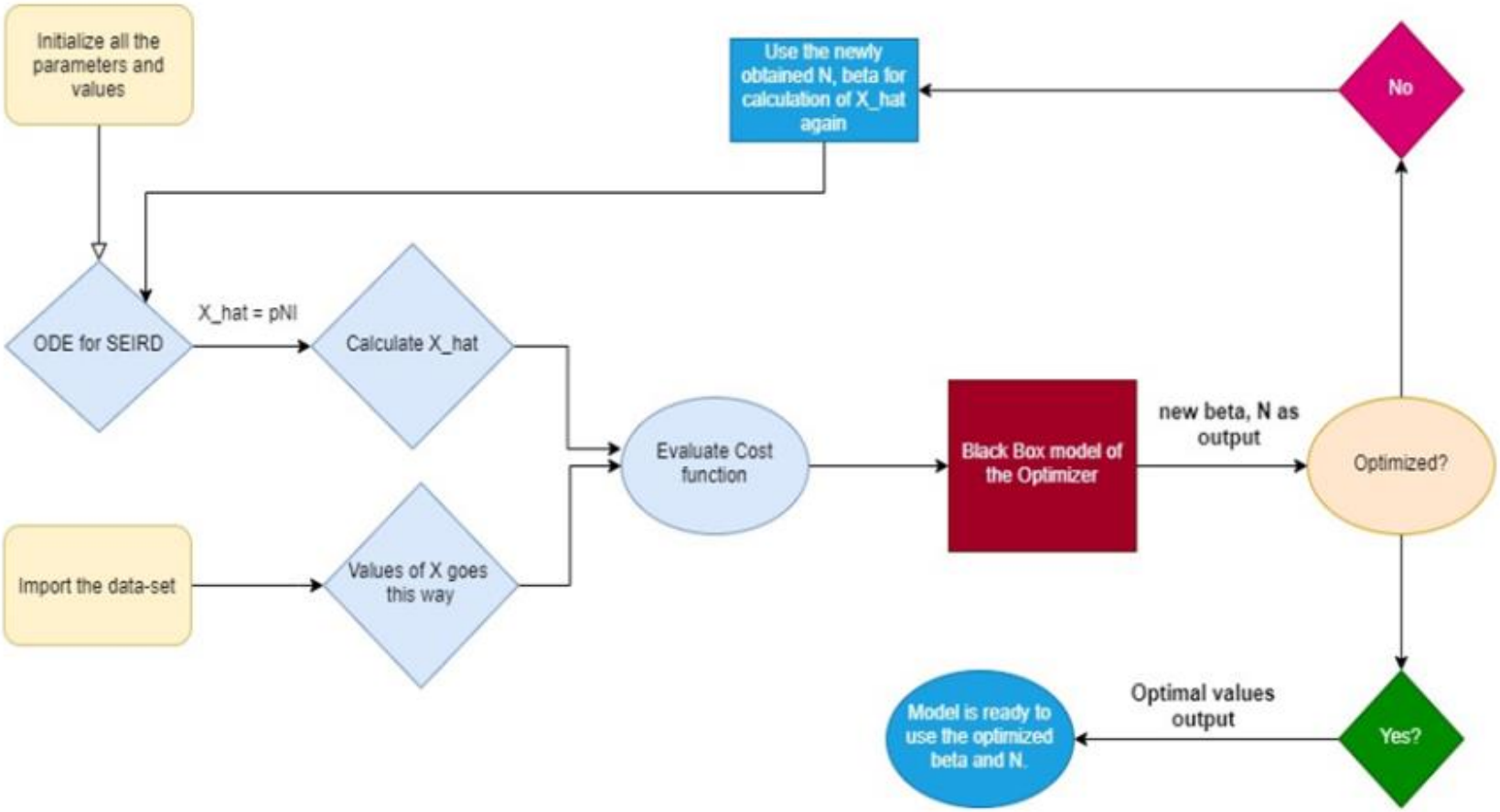
Workflow



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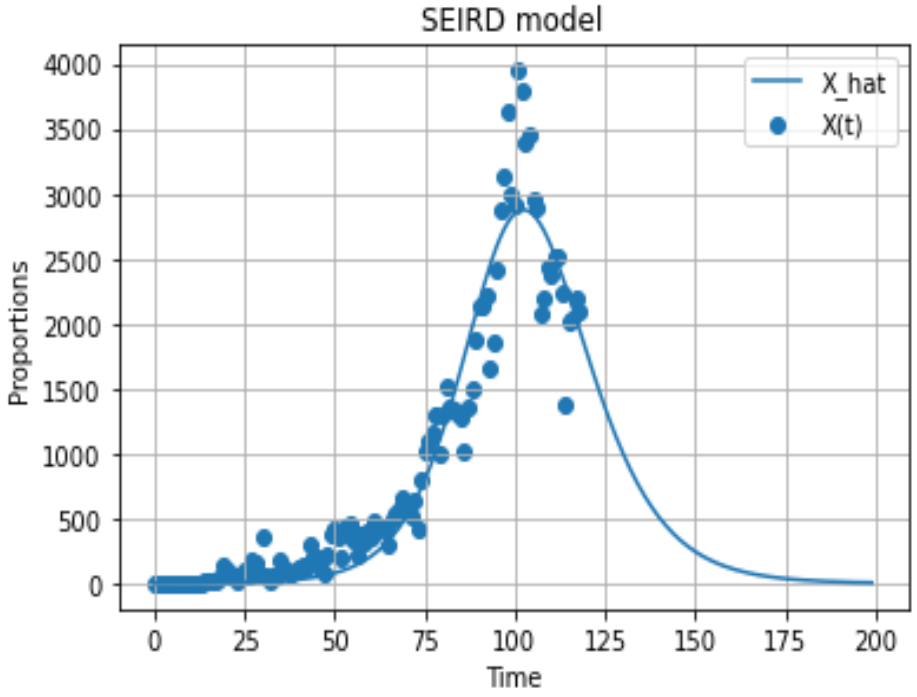
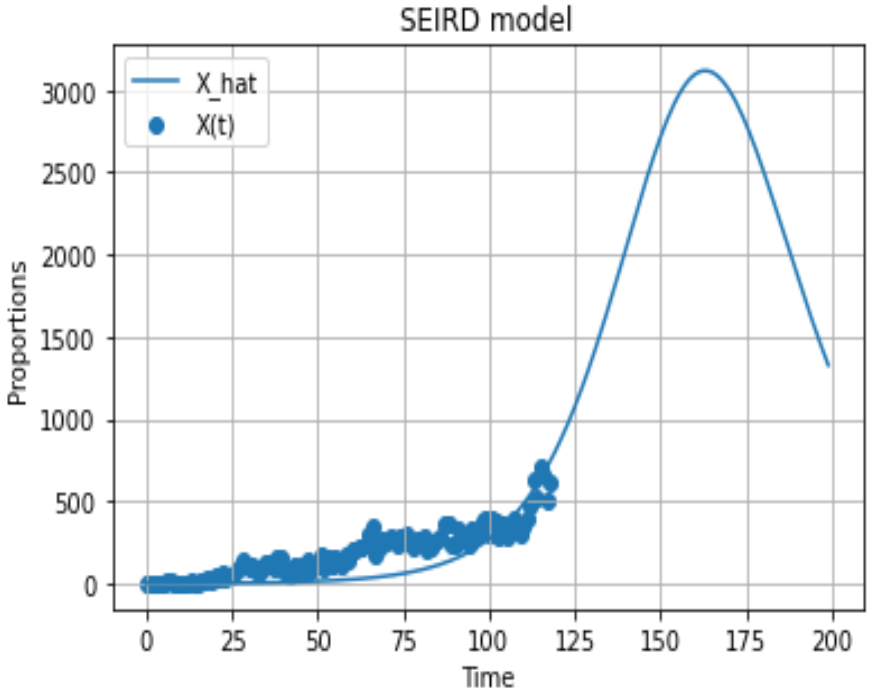
Some Outputs



Predictions for Delhi



Predictions for Rajasthan

Here: Time = 0 means the date: ***2020-03-14***

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Integration of Model

To integrate the model with the backend and the frontend, model can be considered as a black-box model, which takes input as the real data, outputs the results

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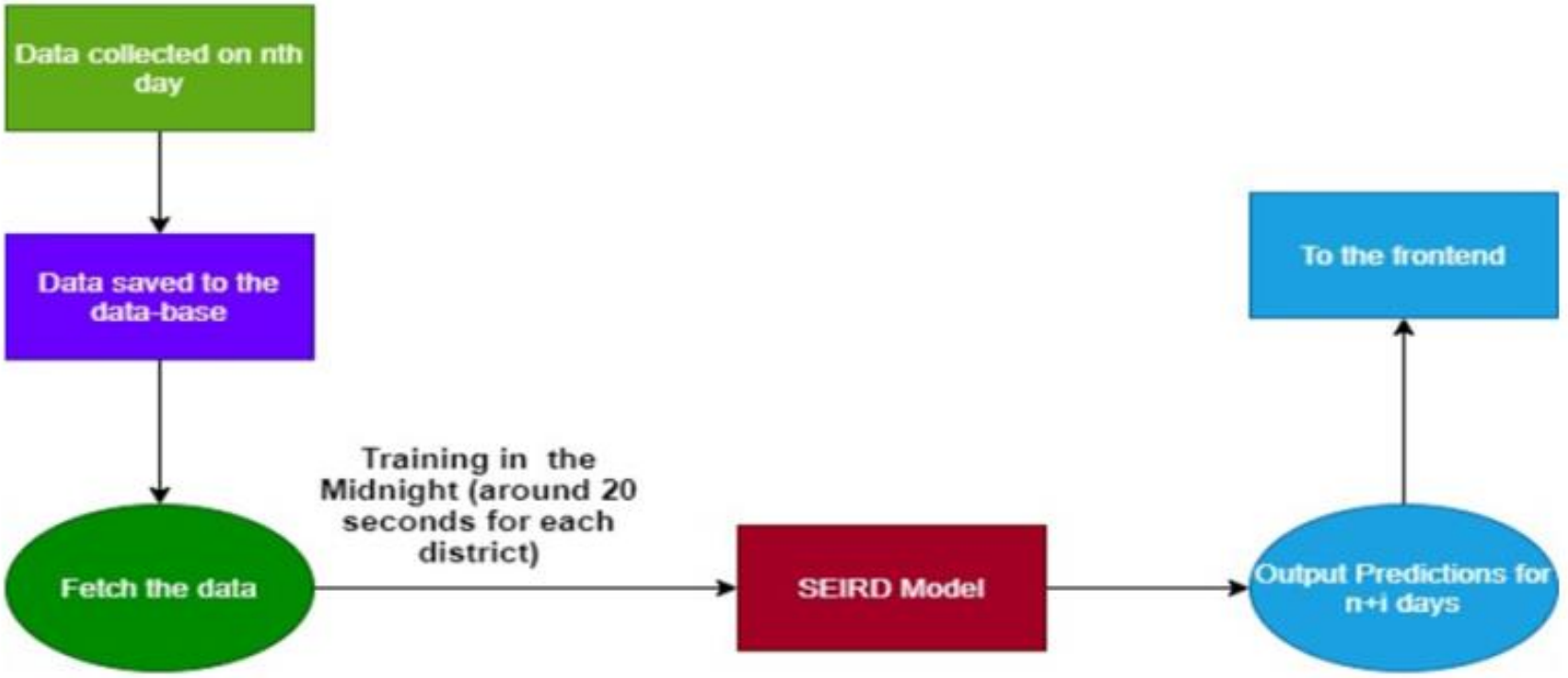
Record the data of a particular day, feed that to the data-base, now using the total data, model is trained at midnight. The obtained predictions would then be displayed on the frontend.



Deployment process to the System

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Proposed Modifications

Based on lockdown and migration, two modifications were suggested into governing differential equations and comparison were done based on the previous outputs and new outputs(after modifications)

dS/dT = -beta*S*I

dE/dT = (beta*S*I - alfa*E)+mi*S*I

dI/dT = alfa*E - gamma*I - M*I +(1-mm[t])*E*I
OR
dI/dT = alfa*E - gamma*I - M*I +(1-colors[color])*E*I

dR/dt = (gamma*I)

dD/dt = (M*I)

mi = %migration (influx/ outflux) and mm[t] = % lockdown with time.

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Assumptions in Modified Model

- Percentage migration was considered to be constant as 9% (in all zones of region)
- Percentage lockdown is considered to be based on color of zone
- Red Zone: 70% lockdown
- Orange Zone: 50% lockdown
- Yellow Zone: 30% lockdown
- Green Zone: 10% lockdown

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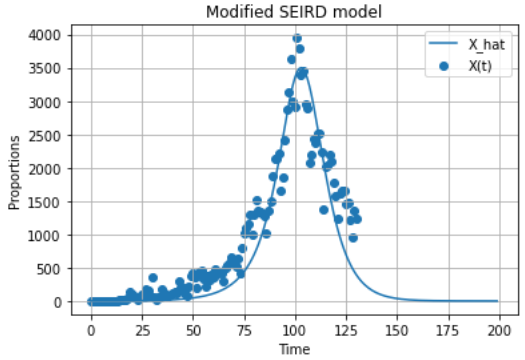
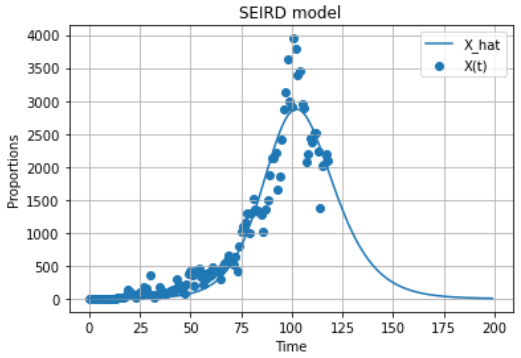
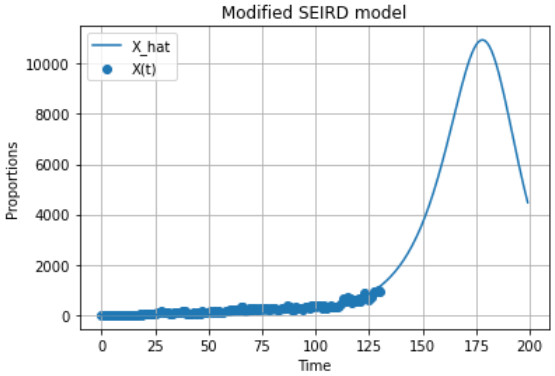
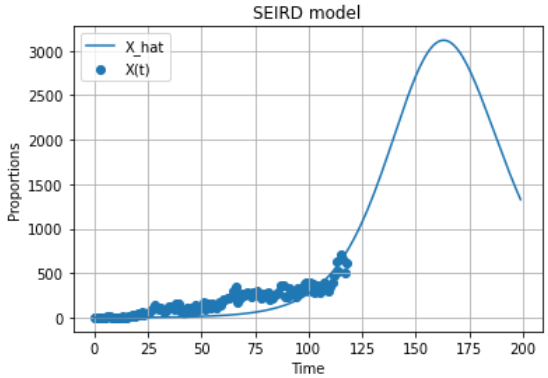
Output comparison





Comparison in the case of Delhi





Comparison in the case of Rajasthan

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Media Coverage

https://timesofindia.indiatimes.com/india/how-tech-interventions-can-help-battle-covid-19/articleshow/74808438.cms

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https://telanganatoday.com/telangana-to-use-data-analytics-for-covid-19-related-decision-making

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