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Research Article

COVID-19 Recovery Rate Prediction in India with Cellular Automata

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Abstract

COVID-19 recovery prediction is pronounced as one of the toughest problems that the world is facing now. The variations of deaths and recovery rates are changing drastically. There is an increase in the recovery rate and a decrease in the relative death rate with time. Very few researchers have focused on the recovery rate. The datasets are collected from Kaggle and processed with Non-Linear Cellular Automata to predict the recovery rate in India. The developed classifier is compared with the existing standard literature like Support Vector Machine(SVM), Random Forest(RF) and K-Means(K-ME) algorithm. Our classifier reports an accuracy of 89.94%, which was considerably better at this moment.

Keywords: COVID-19; Cellular Automata; Recovery Rate

Introduction

COVID-19

COVID-19 is termed as Corona Virus is one of the dangerous diseases the world has witnessed. It was identified in China in 2019. Since then, the spreading of the disease is very drastic, resulting in many deaths. World Health Organization and many voluntary organizations have come up with various techniques [1-5] and precautions to mitigate the effect of COVID-19. Some of the machine algorithms are proposed to monitor the practice of social distancing. A few scientists have focused on a prediction of whether the people are practicing the use of masks or not using deep learning techniques. Many image processing algorithms are proposed to predict death variations by processing several chest X rays.

Cellular Automata (CA) is an Artificial Intelligence (AI) technique which can act as a natural classifier. Many classifiers with CA are developed to address various problems in Bioinformatics, Networks, Image Processing, etc. We have considered non-linear hybrid rules to develop a classifier, which can act as a natural robost classifier.

Methodology

Design of the classifier

The design of the proposed classifier is shown in figure 1. We have collected 56, 00,528 different datasets from Kaggle database [6] about COVID-19 [7] records of India. These datasets will be processed by three as the rule design of CA was done in terms of three. For example, the rule in CA looks like <56, 85,152>. After the initial processing, the rules are applied and classified. A fitness function is applied to measure the strength of each rule. The sample rules are listed in table 1. Rule 152 represents, if it wishes to move from one state to another state, it has to depend on the right neighbor [8]. Once the rules are applied, the classifier adopts the intelligent non-linear CA algorithm to classify the data and gives the rate of recovery.

For example, take the input encoding as 0.35, 0.5, 0.6 if we apply rule 152, the next state will be 0.35,0.5,1.0 as the 152 rule depends on the right neighbor.

S. No	Cell-Rule	Matrix Representation
1.	3	$q_{i-1} + q_i$
2.	5	$q_{i-1} + q_{i+1}$
3.	51	q_i
4.	152	q_{i+1}
5.	15	q_{i-1}
6.	85	q_{i+1}

Table 1: Rules of CA with matrix representation.

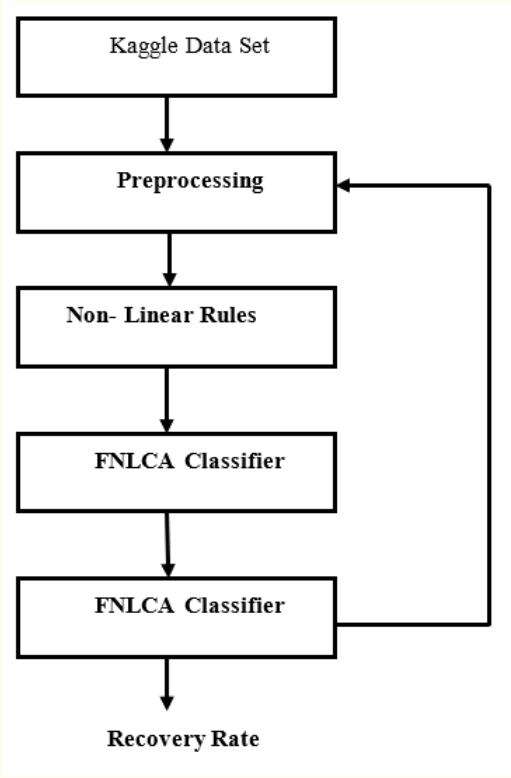

Figure 1: The design of the CA-classifier.

Results and Discussion

The proposed classifier is thoroughly trained and tested for more adaptability. After a thorough experiments we have identified, the classifier is reaching an accuracy of 90% after 60 epochs with an error rate of less than 7% as shown in figure 2. Figure 3 shows the danger zone in the red and safer zone in green for three prominent areas of the location Kakinada. Figure 3 indicates as one as the most critical zone among the three. The third is the zone of recoverability.

Figure 2: Accuracy of the developed classifier in testing.

Figure 3: Safe and danger zone display.

The performance of the developed classifier is compared with the existing literature like Support Vector Machine, Random Forest, and K-Means algorithm. SVM performs better with an accuracy of 84.3%, while CA reports nearly 90% accuracy in predicting the trends, as shown in figure 4. Figure 5 indicates the various predictions regarding confirmed, recovered, and deaths.

Figure 4: CA accuracy comparisons with existing literature.

Figure 5: Trend prediction of COVID-19.

Conclusion

We have successfully developed a versatile classifier to predict the recovery rate of people suffering from COVID-19 with an accuracy reaching 90%. The predictions were almost accurate wrt to the current scenario. We have employed intelligent CA rules to process and classify large sets of data for prediction. It will be the first research work to address this issue with a response time of fewer than 0.57 nanoseconds. This work can be extended by employing fuzzy rough sets for employing more dynamism into it.

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