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CHECKING THE DANGER STAGE LEVEL OF COVID-19 INFECTION RISK USING A NEURAL NETWORK BASED MODEL WITH LOCKDOWN CONDITION

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Abstract: *For the first time in human history, we're battling an unseen adversary in December 2019: the new corona virus (COVID-19). Wuhan, China, was the first place to see the development of the disease, but it has since expanded to other regions of China as well as a number of other nations. A new form of corona virus is spreading the globe at the moment (COVID-19). In order to avoid a worldwide health crisis, governments are under increasing pressure. Measures to prohibit cross-city travel, contact tracing of cases, counselling and quarantine, and communication to the public are among the necessary efforts performed by local and provincial governments backed by the central government. To begin epidemic control efforts, it is critical to be prepared, transparent, and share information. Using the pandemic data, we want to create a neural network-based algorithm that uses a lockdown condition between hidden layers to determine the likelihood of COVID-19 infection. Due to the prompt execution of the shutdown, India seems to be in a better position than other nations.*

Keywords: Artificial neural network, COVID-19, Corona virus,Lockdown.

I. INTRODUCTION:

The CORONA virus is now posing a huge threat to the global population. It was given the codename COVID-19 by the World Health Organization. In December of 2019, it came from a wholesale seafood market in Wuhan, China. Human-to-human interaction is how COVID-19 was disseminated. Every time an infected person coughs or sneezes, there's a good risk they'll infect someone nearby who is healthy. After two weeks, experts believe the symptoms begin to emerge. On the 30th of January in the year 2020, a case of COVID-19 was discovered in India for the first time. As of this writing, there have been an increasing number of COVID-19-infected illnesses and fatalities in India each week (See Table-2).

Table1:Numberofnewly reportedCOVID-19 casesinIndia

Week	**Number ofCOVID-19 infected Cases**		**Number ofDeathsReported**	
	New	Accumulated	New	Accumulated
26 January–1 February	1	1	0	0
2February–8February	2	3	0	0
9February–15February	0	3	0	0
16February–22February	0	3	0	0
23February–29February	0	3	0	0
1March–7March	31	34	0	0
8March–14March	63	97	2	2
15March–21March	186	283	2	4
22March–28March	635	918	16	20
29March–4April	2154	3072	55	75
5 April–11 April	4457	7529	167	242
12April-18April	7262	14792	246	488
19April-25April	10150	24942	291	779
26 April-02 May	12834	37776	444	1223
03May-09May	21886	59662	758	1981

A significant epidemic in India is a possibility, as seen in Table 1, since the number of new cases and fatalities each week has grown.

COVID-19 preventative medication is currently unavailable. If you want to protect yourself and others from contracting COVID-19, experts say the only options are isolation and quarantine. All nations went into lockdown following the recommendations of experts. Is it possible that the shutdown will assist to halt the spread of COVID-19? How long do you think it should go on for? Public curiosity in the COVID-19 virus has sparked these and other inquiries.

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In the absence of definitive answers, epidemiologists and policymakers rely on mathematical models to guide them through the epidemic and assist them in making crucial choices. Infectious illness epidemiology has benefited greatly from the use of these models, which use current data to forecast the evolution of an infectious disease epidemic. Additionally, these models help professionals determine whether a health system is adequately prepared to deal with the virus in terms of medical people and equipment, according to the head of the Centre for Disease Dynamics, Economics, and Policy.
To regulate human and animal viruses, Anderson & May (1979) and Thieme (2003) say that models and simulations are essential decision-making tools. According to Lloyd-Smith (2007b), maximum-likelihood estimation of k from widely scattered distributions is affected by bias, accuracy, and confidence interval coverage. Disease transmission models, according to Huppert and Katriel (2013), may be relied upon to provide accurate forecasts. There are a number of diseases that can be controlled by the use of mathematical modelling (Zaman et al. 2017). Some defuzzification strategies have been presented and examined by Kumar (2017) in order to improve the theory and practise of the fuzzy system. An artificial neural network-based approach was suggested by Kumar and Giri (2019) for the n-job and m-machine flow shop scheduling issue to find the task sequence that minimises the makespan. Fitzpatrick et al. (2019) came to the conclusion that public health planners would benefit most from modelling that incorporates information from many medical and public health sources, such as microbiologists, immunologists, and epidemiologists. Ongoing disease propagation may be predicted by using a generalised SEIR model, proposed by Al-Hussein and Tahir (2020). Using mathematical modelling, Kim et al. (2020) identify the local transmission patterns of COVID-19 and estimate the epidemic magnitude and the end of the dissemination. According to Guan et al. (2020), three strains of pneumonia — COVID-19, SARS, and MERS — have distinct transmission patterns. Predictive mathematical models, such as the one developed by Bhola et al. (2020), may provide us a glimpse into the virus's future. Prem et al.(2020) used an age-structured susceptible-exposed-infected-removed (SEIR) model using different physical distance measurements to simulate the continuous trajectory of an epidemic in Wuhan. Modeling is critical in understanding the transmission of COVID-19, according to Guan et al. (2020). From 28 infector-infected pairs, Nishiura et al. (2020) estimate the serial interval of new COVID-19. Find the solution to the question by Lamba (2020). What is the rationale for extending the lockdown throughout the country? COVID-19 outbreak in India is studied by Singh and Adhikari (2020) using an age-structured SIR model with social contact matrices generated from surveys and Bayesian imputation.
What follows is an outline of the remainder of the paper. To regulate COVID-19, we'll go through the suggested neural network technique and algorithm in Section 2. For our model and preparation research, we have also drawn out an architectural diagram. Graphs of five nations' computational findings are shown in section 3. According to population density/km2 of the nations, COVID-19 infection risk is also compared. A brief conclusion and further research are included in section 4.

II. DESCRIPTIONOFTHEPROPOSEDARTIFICIALNEURALNETWORK BASEDAPPROACH:

It is incredibly difficult to get correct information during an ongoing epidemic, as we have seen with COVID-19. COVID-19 sickness is a major public health concern at the moment, and it's imperative that we find a way to stem the disease's spread. Mathematical models are increasingly relied upon to make public health and economic choices throughout the globe as COVID-19 expands. A neural network approach with a lockdown condition is presented in the current research, which will allow us to anticipate the degree of COVID-19 infection risk in various nations worldwide based on the previously confirmed cases in any country. There are three levels in this model, one input layer, and one output layer. There are two input neurons in the input layer, which are the total number of COVID-19 patients in any nation during the first two days. l, m and n are the number of COVID-19 patients in various l, n and m days, respectively, in the three buried layers. The COVID-19 illness is controlled by a lockdown condition in this model. Finally, the output layer provides the ultimate output value for the experimentation process. Figure 1 depicts the neural network model's architectural diagram: Figure 1.

Figure1:Architecture diagram of proposedneural network

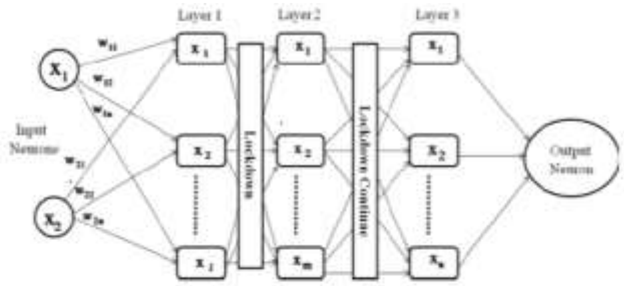

Figure 1: Architecture diagram of proposed neural network

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□

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□

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i□1

Step6: Findtheoutputvaluefromlayer2by:

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O_2□

\1

1□(y_{inp2})

□

Fsymptomsofsuspectedpatientarepositivethenquarantinethem

Step7: CalculatetheinputIvalueforthelayer3by:

y_{inp3}□x_1□w_{13} □x_2□w_{23} □...x_m □w_{m3} □□ x_i□w_{i3}

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fsymptomsofsuspected patientarenegativethen

Step8: Findtheoutputvaluefromlayer3by:

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Step10: Findtheoutputvaluefromthefinaloutputlayer4by:

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Step11: End
COVID-19patientcasecouldnotstop.
COVID-19 infection risk is always a number between [0, 1] in the final result value. A lower output value indicates a reduced chance of infection with COVID-19, whereas a higher output value indicates a greater risk of infection with COVID-19 There must be stricter rules and procedures to manage COVID-19 if the level of COVID-19 infection risk is high in one nation. One way to determine which nations are safe from COVID-19 infections and which countries are more at risk is to look at the amount of infection risk in each country.

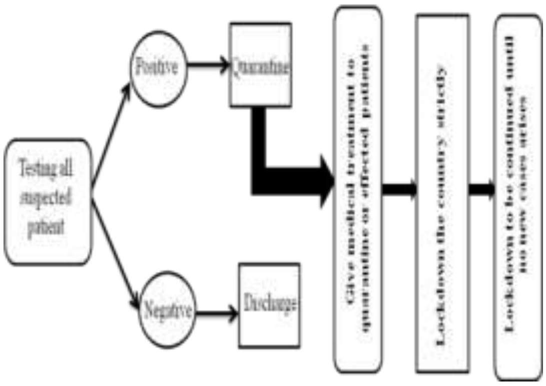

Figure2:Workflowdiagramofprecautionsandpreparedness

The following are the many processes involved in the working process of our suggested algorithmic artificial neural network model:

Algorithm:

Step1:xandxdefinetheinputto layer 1

Date	Number ofCOVID-19 ActiveCases	Date	Numberof COVID-19 ActiveCases
2 March	5	5April	3577
3 March	6	6April	4281
4 March	28	7April	4789

I. IMPLEMENTATION
Example1. Table 2 shows the number of confirmed cases of the COVID-19 illness in India between March 2 and May 8 of this year.
Table2:NumberofCOVID-19infectedcasesinIndia
1 2
Step2: The following weight function may be used to calculate the weights of the connecting links:
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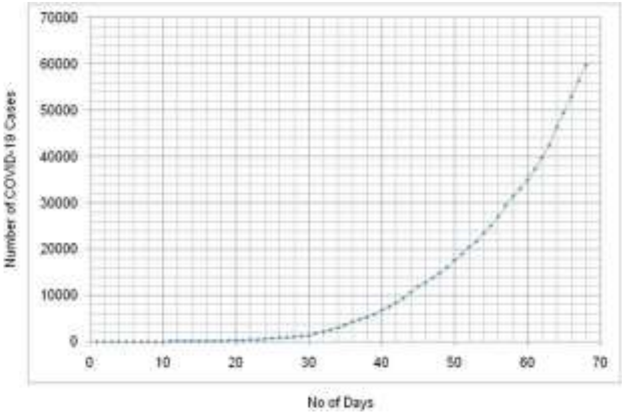
1

Inputvalue
Step3: Computetheinputvaluesforlayer1by:
y □x□w □x□w □□x□w
inp1 1 11 2 21 i i1
i□1
Step4: The activation function for layer 1 may be used to get the output value.

5 March	30	8April	5274
6 March	31	9April	5865
7 March	34	10April	6761
8 March	39	11April	7529
9 March	44	12April	8447
10 March	50	13April	9352
11 March	60	14April	10815
12 March	73	15April	11933
13 March	81	16April	12759
14 March	97	17April	13835
15 March	107	18April	14792
16 March	118	19April	16116
17 March	137	20April	17656
18 March	151	21April	18985
19 March	173	22April	20471
2 0 March	223	23April	21700
2 1 March	283	24April	23452
22 March	360	25April	24942
23 March	434	26April	26917
24 March	519	27April	29451
25 March	606	28April	31324
26 March	694	29April	33062
27 March	834	30April	34863
2 8 March	918	1 May	37257
29 March	1024	2 May	39699
30 March	1251	3 May	42505
31 March	1397	4 May	46437
1 April	1834	5 May	49400
2 April	2069	6 May	52987
3 April	2547	7 May	56351
4	3072	8 May	59695



Number of COVID-19 infected cases Vs No. Ofdays

From March 2 to March 22nd, the data in the above chart covers the time before the lockdown and from March 23rd to May 8th, the data in the table covers the period after the shutdown. In the following table, you can find the data dates for each layer.

Table3:Data datesfordifferentlayers

S. No.	Layer	DataDates
1.	Inputlayer	02 March-03March
2.	Firsthidden layer	19 March-22March
3.	Secondhidden layer	01 April-06April
4.	Thirdhidden layer	29 April-08May

The input values are now 5 and 6, and the weights on the connecting connections from the input layer to the first hidden layer are 0.2 and 0.167, respectively, after executing the steps of the proposed technique. First hidden layer yinp1[2.002] = 0.33311 after executing the algorithm's third step. They have a 0.00578, 0.00443, 0.00353 and.00277 weight on the connecting connections from the first hidden layer to the second hidden layer As an example, yinp2 = 3.99517 is the input value from the first hidden layer to the second hidden layer, and yinp2 = 0.20019 is the output value. There are now 0.00054, 0.00048, 0.00039, and 0.00032 weights on the connecting connections from the second hidden layer to the third hidden layer. The input value from the second hidden layer to the third hidden layer is yinp3 5.91027, while the output value is 0.14471 after executing step 7 of the method. There are now 0.00003024, 0.00002868, 0.00002684, 0.00002518, 0.00002352, 0.00002153, and 0.00002024 weights on the connections connecting the third hidden layer to the output layer.
0.00001887, 0.00001774and0.00001675respectively.
The input value from the third hidden layer to the output layer is 9.99804931, and the output value is 0.090925215, after executing step 9 of the method. As a result, India has an infection risk from COVID-19 of 0.090925215.
Example2. Table 4 shows the number of confirmed cases of the COVID-19 illness in the United States, Italy, Spain, and the United Kingdom from March 2 to May 8, 2013.

Table4:NumberofCOVID-19infectedcasesinfourcountries

Date	USA	Italy	Spain	UnitedKingdom
2March	100	2036	120	39
3March	124	2502	165	51
4March	158	3089	228	87
5March	221	3858	282	116
6March	319	4636	401	164
7March	435	5883	525	209
8March	541	7375	674	278
9March	704	9172	1231	321
10 March	994	10149	1695	383
11 March	1301	12462	2277	460
12 March	1630	15113	3146	590
13 March	2183	17660	5232	798
14 March	2771	21157	6391	1140
15 March	3617	24747	7988	1391
16 March	4604	27980	9942	1543
17 March	6357	31506	11826	1950
18 March	9317	35713	14769	2626
19 March	13898	41035	18077	3269

2 0 March	19551	47021	21571	3983
2 1 March	24418	53578	25496	5018
22 March	33840	59138	28748	5683
23 March	44189	63927	35136	6650
24 March	55398	69176	42058	8077
25 March	68905	74386	49515	9529
26 March	86379	80589	57786	11658
27 March	105217	86498	65719	14543
2 8 March	124788	92472	73235	17089
29 March	144980	97689	80110	19522
30 March	168177	101739	87956	22141
31 March	193353	105792	95923	25150
1April	220295	110574	104118	29474
2April	250708	115242	112065	33718
3April	283477	119827	119199	38168
4April	317994	124632	126168	41403
5April	343747	128948	131646	47806
6April	375348	132547	136675	51608
7April	409225	135586	141942	55242
8April	441569	139422	148220	60733
9April	475515	143626	153222	65077
10April	509604	147577	158273	73758
11April	539942	152271	163027	78991
12April	567708	156163	166831	82279
13April	594693	159516	170099	88621
14April	621953	162488	174060	93873
15April	652474	165155	180659	98476
16April	682454	168941	184946	103093
17April	714822	172434	190839	108692
18April	743901	175925	194416	114217
19April	770014	178972	198674	120067
20April	798145	181228	200210	124743
21April	824229	183957	204178	129044
22April	854385	187327	208389	133495
23April	886274	189973	213024	138078
24April	925232	192994	209764	143464
25April	960651	195351	223759	148377
26April	987160	197675	226629	152840
27April	1010356	199414	229422	157149
28April	1035765	201505	232128	161145
29April	1064194	203591	236899	165221
30April	1095023	205463	239340	171253
1 May	1131030	207428	242979	177454
2 May	1160774	209328	245589	182260
3 May	1188122	210717	247122	186599
4 May	1212835	211938	248301	190584
5 May	1237633	213013	250561	194990
6 May	1263092	214457	253681	210101
7 May	1292623	215858	256855	206715
8 May	1321785	217185	260117	211364

A neural network method based on data from the four nations described above has been used to generate the output values shown in the following table 5.

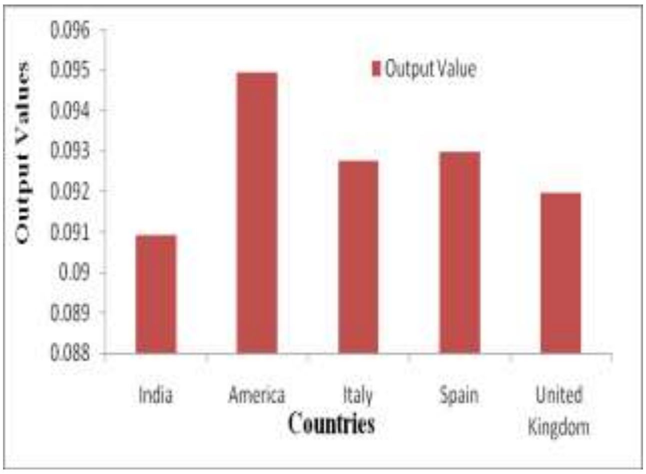


Figure4:Graphicalrepresentationoftheresults

Figure 4 shows the outcomes of the experiment. In compared to the other four nations studied, India had the lowest probability of COVID-19 infection. From the data, it is evident that lockdown has been very successful in India. breakthechainofCOVID-19diseaseincomparisonofotherfourcountries.

Table5:Outputsbyproposedmodelalgorithmofdifferentfive countries

S. No.	Country	Data date	Level ofCOVID-19 infectionrisk
1	India	2March-30April	0.090925215
2	USA	2March-30April	0.094942317
3	Italy	2March-30April	0.092771036
4	Spain	2March-30April	0.092983172
5	United Kingdom	2March-30April	0.091975423

Comparative level of COVID-19 infection risk accordingto populationdensity/km^2

Many nations and regions throughout the globe have been struck badly by COVID-19. The virus's ability to spread is presumably influenced by a variety of variables, including population density. The COVID-19 pandemic's rapid spread is mostly due to dense populations. If r countries are included in the COVID-19 research, then the following formula may be used to calculate the relative risk of infection with COVID-19 based on population density/km2:

Comparative COVID-19 infection risk for i-th country = i-th country's population density

ComparativelevelofCOVID-19infectionriskfori-thcountry= $\frac{1}{1+(y_{inp4})} \cdot \left[1 - \frac{D_i}{\sum_{i=1}^{r} D_i}\right]$

where$D_i$isthepopulationdensityforthei-thcountry

Thepopulationdensityoffivecountriesisgivenbelowinthefollowingtable 6.

Table6:Populationdensityoffivecountries

S. No	**Country**	**tion Density/Km^2**
1.	India	460
2.	USA	36
3.	Italy	206
4.	Spain	94
5.	UnitedKingdom	274

Table 7 shows the relative risk of COVID-19 infection for each of the nations studied.

Table 7: Comparative level of COVID-19 infection riskfordifferent five countries

S.No	Country	Comparative level ofCOVID-19infectionrisk
1	India	0.051835870
2	USA	0.091747996
3	Italy	0.074910444
4	Spain	0.084814556
5	United Kingdom	0.068422838

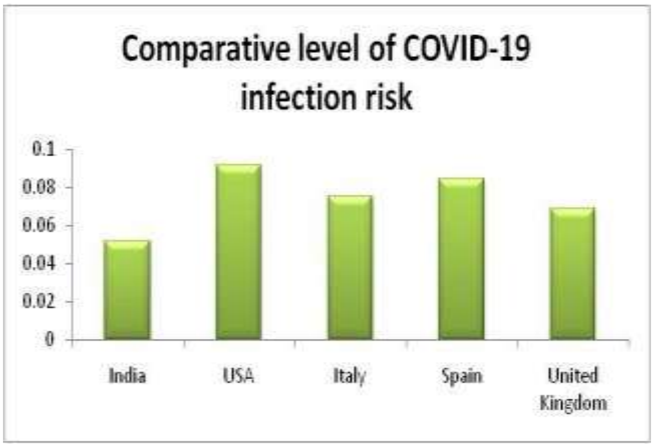


Figure5:GraphicalrepresentationofcomparativelevelofCOVID-19infectionrisk

Table7andfigure5showthatIndiahaslessCOVID-19

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9. Infection risk among the five countries even though thepopulation density/km^{2}ofIndiaismaximum.This year, the United States has the greatest risk of contracting COVID-19. India was able to control the spread of COVID-19 more successfully than the other four countries because of its robust border closure. For the COVID-19 virus, lookdown is an effective prophylactic measure. Until a vaccination is created, lockdown is the best method to keep COVID-19 from spreading.

II. CONCLUSIONANDFUTURESCOPE:

1. Real-world problems have been solved using artificial neural networks. An artificial neural network model was developed in this study to estimate the risk of contracting COVID-19 infection. A multilayer neural network

with a lockout condition between hidden layers may be used in this research to evaluate the risk of COVID-19 infection in any country using previously confirmed cases (up to 8 May 2020). Comparisons of COVID-19 infection risk were made using the population density of the affected countries. COVID-19 infection can be stopped only by a rapid shutdown, as shown by the results of data from countries throughout the world.

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