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COVID-19: Update, Forecast and Assistant - An Interactive Web Portal to Provide Real-Time Information and Forecast COVID-19 Cases in Bangladesh

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***Abstract*—Since December 2019, Novel coronavirus disease has been shown an extensive impact on social, mental, personal, and economic fields throughout the world. In this pandemic situation, people are worried and interested to know what is going on in the upcoming days. Therefore, it is very important to provide relevant information about how many people are affected and will infect in near future. Moreover, they need to know how to spread different symptoms and prevention steps of this disease. Hence, we developed an informative and prediction-based web portal named COVID-19: Update, Forecast and Assistant which provides real-time information on COVID-19 cases in Bangladesh and worldwide. In this model, we also provide a machine learning-based short-term forecasting web tool that is used to predict infectious and fatality cases in an upcoming couple of days. Also, we provide precaution steps against coronavirus, emergency contacts of testing, and treatment centers for individuals.**

***Index Terms*—COVID-19, web portal, infectious cases, fatalities, forecasting**

I. Introduction

Novel coronavirus disease was first identified in Wuhan, China on December 2019 that has been spread rapidly throughout the world [1]. The World Health Organization (WHO) has been defined it as "COVID-19" [2]. Also, it was declared as Public Health Emergency of International Concern (PHEIC) on January 30, 2020, and was characterized as pandemic on March 11, 2020 [3]. On 3 February 2021, almost 104,414,139 cases have been reported across 221 countries resulting more than 2,263,171 individuals have been died and 76,292,397 people were recovered [4]. Disease transmission is split into 4 stages considering the condition of expansion and time [5]. The virus is outspread among persons with close contact, droplets produced by coughing, sneezing, and talking [3]. After 2 to 14 days, the symptoms of COVID-19 are exposed from persons who have already infected this disease [6]. The first COVID-19 case has been found on 8 March 2020 in Bangladesh confirmed by the Institute of Epidemiology Disease Control and Research (IEDCR) [7]. Most of the people are unconscious, hence the number of COVID-19 cases has been increased day by day. The government is trying to increase awareness about COVID-19, but people are not obeying the rules and regulations. Also, the lack of essential contents has been combated to make consciousness about this disease. There were developing many web portal/dashboard that provides present information and reduces mental stress of this situation. For example, Dong et al. [8] built a web interactive dashboard, provided by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University, to visualize and track simultaneous COVID-19 cases. Wissel et al. [9] gathered the information of multiple resources and visualized COVID-19 data of 188 metropolitan areas in the United States. Berry et al. [10] created an individual-level data set including demographic characteristics, location, report date, travel history, and exposure source of COVID-19 confirmed and presumptive positive cases in Canada. Hamzah et al. [11] built an online platform named CoronaTracker that gave the latest and reliable reports and predicted COVID-19 cases through Susceptible-Exposed-Infectious-Recovered (SEIR) predictive modeling. Arora et al. [12] developed a dashboard where hundreds of global SARS-CoV-2 serological studies have been monitored and investigated their results. In this perspective, most of the existing works were not feasible to understand the epidemic condition properly in Bangladesh. However, we developed a web portal named "COVID-19: Update, Forecast and Assistant" that have been represented real-time data from multiple resources using application programming interface (API) and shown precaution steps to warn people and the contacts of the COVID-19 help center. This concurrent data is very useful to understand the upcoming situation of Bangladesh compared to the worldwide situation.

However, a machine learning-based short-term forecasting model has been used to predict the number of affected people for the next 7/15 days utilizing various regression models. Therefore, general people and municipalities can take proper decisions to realize this estimation. The contribution of this work is constituted as follows:

- The organization of real-time data assists individuals to perceive the current situation.
- This system is helped to realize the pandemic situation in Bangladesh.
- Short-term forecasting model predicts epidemic conditions of upcoming days and accommodates to take further actions.
- The brief description, symptoms, and prevention steps are useful to learn about COVID-19 within a few moments.
- This system is provided emergency contact services in Bangladesh.

II. COVID-19: Update, Forecast and Assistant

The main purpose of this portal is to promote information sharing about COVID-19 using the following link (http://corona.nstu.edu.bd/). This section is organized into several parts which are described as follows:

A. Real Time Dashboard

We extract real-time information and instances to represent upcoming conditions of COVID-19. Multiple API and resources have been used to collect information for this system. This dashboard contains three parts such as:

- **Home:** In home section, the number of total infectious, fatalities and recovered patients of COVID-19 with growth rate are represented all over the world. Again, various infectious, fatal, and recovery cases of the last 24 hours are shown in Bangladesh. This real-time data have been collected from Novel COVID API (https://github.com/disease-sh/API). Then, the case studies of the last seven days are illustrated for Bangladesh and worldwide respectively.
- **Infectious cases in Bangladesh:** There are incorporated division and district-wise infectious cases respectively. The "Division-wise COVID-19 confirmed cases" are shown how many people have been infected with COVID-19 of different divisional regions in Bangladesh. Then, "District wise COVID-19 confirmed cases" have been represented COVID-19 cases of districts in each divisional zone. In this task, we used a public API to access district-wise data and daily statistics (https://github.com/ahmedsadman/covid19-bd).
- **World cases:** It contains two subsections such as world map and infected case. It repeats the number of world infectious, fatalities, and recovery patients with a rate like home section. Then, the world map is represented worldwide geographical location where anyone can get affected, death and recovered cases of the specific zone when the user touches this map. Then, all records of affected countries are shown in the case table using ten variables such as flag, countries, cases, today cases, death, today deaths, recovery, active, critical, and last update timestamp respectively. In this perspective, Novel COVID-19 API has been used to extracted instances of COVID-19.

B. Short Term Forecasting Model

In this work, we prepared a machine learning-based short-term forecasting model that estimates infectious cases and fatalities for an upcoming couple of days using sci-kit learn library [13] in Google Colab platform [14]. Then, these outcomes have been shown via a cloud server and predicted real and estimated COVID-19 cases in Bangladesh along with worldwide using x-y plot. Consequently, this forecasting is required to take sudden actions against COVID-19. Besides, traditional epidemiological models are not manipulated for more accurate results because the outcomes are dependent on the reproduction number which is not similar all times [15]. Numerous machine learning regression models [16], [17], [18] such as linear regression (LR), polynomial regression (PR), support vector machine (SVM), multilayer perceptron (MLP), polynomial multilayer perceptron (Poly-MLP), and prophet model were used to predict infectious cases and fatalities respectively. Many related works [19], [5], [15], [20] were widely implemented these kinds of regression models. In this circumstance, these models are trained last 25 days instances and predicted next 7 days records. Hence, this system was estimated the pandemic condition of COVID-19 in Bangladesh and worldwide. For instance, we considered time-series instances from 15^{th} November to 9^{th} December 2020 where different regression models were implemented and compared their performance of infectious and fatality cases using root mean square error (RMSE), mean absolute error (MAE) and R^2 squared. Hence, Table I shows the results from the perspective of Bangladesh as well as worldwide. In this comparison, most of the models were shown larger error rates and only the prophet method generated the lowest error rate and the highest R^2 squared values. If various time intervals have been taken, many cases prophet showed more accurate results than others to forecast infectious and fatality cases. The forecasting curves of infectious and fatality cases are shown at Figure 1(a) and 1(c) for Bangladesh including 1(b) and 1(d) for worldwide using prophet method. Therefore, it estimates infectious cases and fatalities from 10^{th} December to 16^{th} December 2020.

- **Root Mean Square Error (RMSE):** It indicates how the predicted result is adjusted with real instances properly by avoiding unexpected error.

$$RMSE = \frac{1}{n}\sum_{j=1}^{n}(y - \hat{y})^2 \tag{1}$$

Where n denotes the number of tuples along to y_i and $\hat{y}_i$ represents the primary and estimated instances respectively.

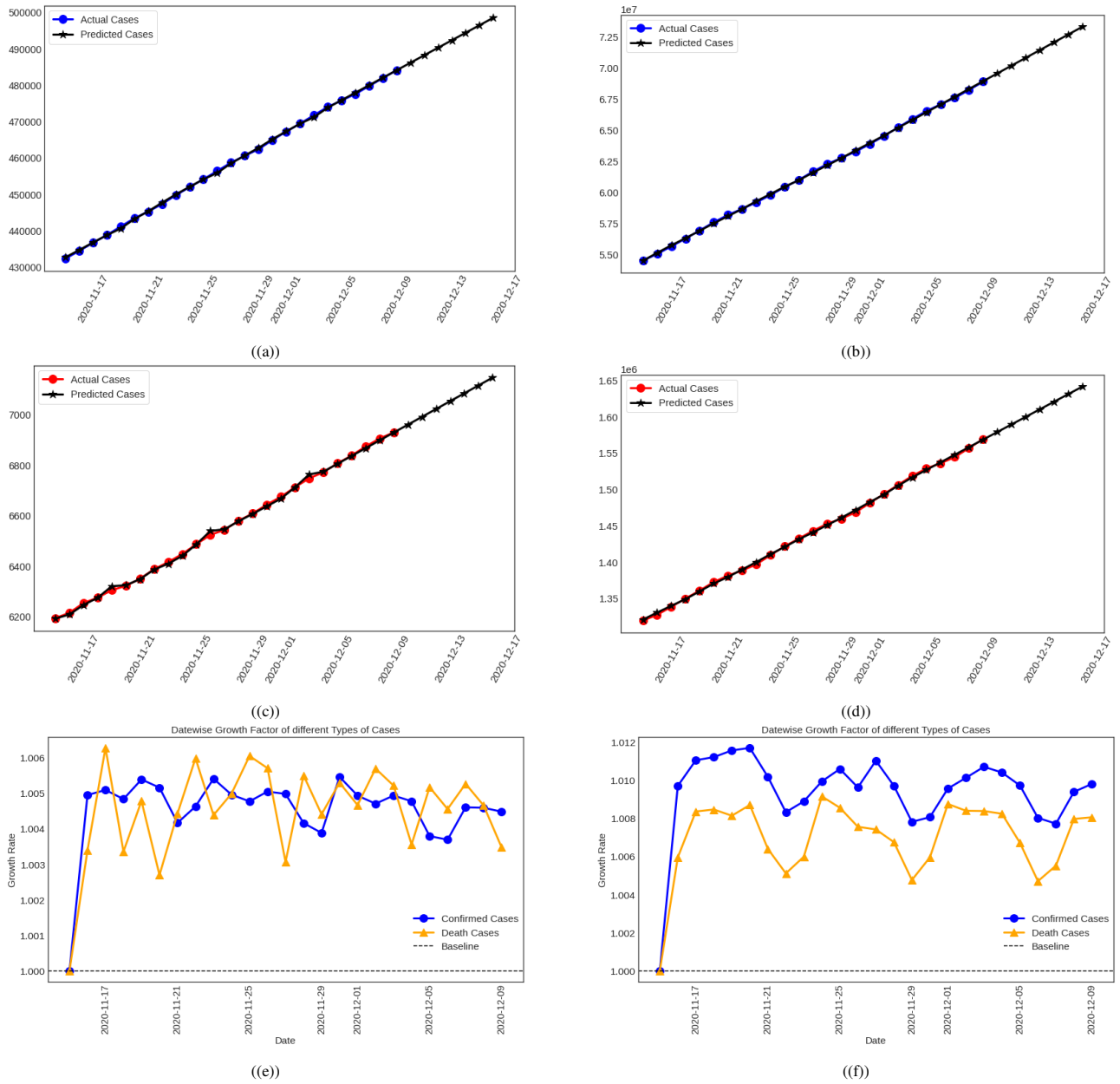

Figure 1: Infectious cases forecasting for (a) Bangladesh (b) worldwide; Fatality forecasting for (c) Bangladesh (d) worldwide; Manipulation of Growth factor for (e) Bangladesh (f) worldwide

- **Mean Absolute Error (MAE):** It manipulates average inaccuracy and not depending on trending issues where the matrix values of MAE are begun from 0 to infinity.

$$MAE = \frac{1}{n}\sum_{j=1}^{n}|y_j - \hat{y}_j| \tag{2}$$

Where n is the number of instances together to y_i and $\hat{y}_i$ that indicates real and estimated records correspondingly.

- **R-Squared** It represents the association among responses and models where the degree around the prediction line is perfectly fitted with it.

$$R^2 = 1 - \frac{SS_{RES}}{SS_{TOT}} = 1 - \frac{\sum_i (y_i - \hat{y}_i)^2}{\sum_i (y_i - \bar{y})^2} \tag{3}$$

where SS_{RES} and SS_{TOT} presents the sum of regression and total sum of regression error. Besides, y_i, $\hat{y}_i$ and $\bar{y}$ denotes as real, predicted and mean values, respectively.

Again, the growth factors are estimated the daily rate of infections and fatalities for both Bangladesh and worldwide. For instance, Figure 1(e) (for Bangladesh) and Figure 1(f) (for worldwide) show the growth factor of infectious and fatalities individually where the blue curve denotes infectious cases and the yellow curve indicates fatality cases. In Figure 1(e), the

Table I: Performance Analysis of Different Regression Models

Method	Degree	Neuron	RMSE	MAE	R2-Square	Degree	Neuron	RMSE	MAE	R2-Square
			Worldwise					Bangldesh		
			Infectious Cases					Infectious Cases		
LR			89182.462	77973.570	0.983			559.902	559.745	0.948
PR	1		89182.462	77973.570	0.983	4		582.643	582.147	0.943
SVR	3		3421862.591	3421784.500	-24.116	2		21102.647	20295.816	-73.422
MLP		20,10,5	89182.418	77973.521	0.983		20,10,5	1475.339	1216.666	0.636
Poly-MLP	1	20,10,5	89182.380	77973.479	0.983	1	20,10,5	560.033	559.876	0.948
Prophet			6.83E-09	5.59E-09	1.000			4.12E-11	2.91E-11	1.000
			Fatality Cases					Fatality Cases		
LR			1548.480	1257.080	0.985			9.880	9.397	0.918
PR	1		1548.480	1257.080	0.985	3		5.329	4.429	0.976
SVR	2		40338.847	40301.750	-9.252	1		144.683	139.600	-16.517
MLP		20,10,5	1548.431	1257.018	0.985		20,10,5	431.211	392.277	-154.601
Poly-MLP	1	20,10,5	1548.424	1257.009	0.985	1	20,10,5	441.780	400.886	-162.322
Prophet			1.80E-10	1.16E-10	1.000			5.39E-11	4.84E-11	1.000

highest growth factor (1.005461) for the confirmed case is found on 30 November 2020 and the highest growth factor for death case (1.006275) is found on 17 November 2020 for Bangladesh. In worldwide cases, the maximum growth factor (1.011691) for the confirmed case is represented on 20 November 2020 and the highest growth factor (1.009147) for death case is denoted on 24 November 2020.

C. Precaution Section for Public Awareness

The best way to prevent community transmission is considered to be well informed and get warned about COVID-19. Numerous resources are used to maintain precaution steps, but they are not interpreted as well. Instead, these pictorial contents have been shown more flexible way whereas the user can view them in very short periods (e.g. 10-15 minutes review). In this work, various topics such as how coronavirus spread, symptoms, and protection steps were identified which are described as follows.

- **How to Spread Corona Virus:** This section shows how people affect COVID-19 in various ways [21]. In this case, anyone touches contaminated hands to the eye, nose, or mouth and causes this disease. Also, it outspreads from person to person through droplets from coughs, sneezes, etc.
- **Symptoms:** The pictorial signs of COVID-19 such as fever, cough, muscle pain, tiredness, shore throat, and shortness of breath [21] have been illustrated in this section. Consequently, the spreading timelines of COVID-19 and how its symptoms appear from time to time have been given [22]. Therefore, the signs of this disease are almost the same as other diseases such as cold and influenza [23].
- **Stay Safe:** For making aware of the people, some precaution steps such as wash hands with soap and water, covering cough with tissue and place it into the trash, apply hygienic rules when traveling, avoid contact with infectious people, ignore touching eye, nose, and mouth as well as clean objects and surfaces frequently [21] are provided in the stay safe section. Also, the meaning of isolation and quarantine [24] is defined briefly. If anyone is infected with coronavirus, then they should seek medical care, follow CDC and stay home.

D. COVID-19 Detection Test Result

From the local perspective, these web apps can be capable to publish upcoming (e.g., last 24 hours) COVID-19 testing and statistical analysis of the local center. For instance, we get permissions of regular COVID-19 positive and negative results generating by Dept. of Microbiology, NSTU respectively. Besides, total collected and testing samples, identification of COVID-19, and its rate have been provided in the last 24 hours. In this case, the identification of COVID-19 and its rate has been derived from current and existing instances.

E. Emergency Help Line

Common people are struggling to get contact information about COVID-19 testing labs, hospitals. Hence, we accumulated all corona test centers, their contacts, and associated addresses of this country. Therefore, they will be able to find out the testing and treatment center of COVID-19 easily.

III. Discussion

In this pandemic situation, it needs to know how many people had been infected and died in COVID-19. Again, other precaution steps such as the spread of coronavirus, symptoms, prevention steps are required to know. But, this information has been scattered and people gather them from different resources. Sometimes, the emergency contacts of COVID-19 testing and treatment centers are not available. Moreover, we

developed a web portal which contains various significant information and helps people to understand these topics more easily than existing application as well [9], [10]. On the other hand, the growth factor of infectious and fatalities cases indicates what is the current rate of COVID-19 cases than the previous one. Machine learning forecasting algorithms have been investigated and estimated upcoming cases in the next couple of days. Again, the government and municipals are warned to realize this situation and take necessary steps. Hence, this web portal shows the testing result of the last 24 hours and manipulates statistical analysis of different COVID-19 testing centers.

IV. Conclusion and Future Work

Due to the lack of information, we cannot analyze significant features and get remediation steps from this disease. In this paper, an informative web portal has been developed which is not only provided upcoming aspects but also predicted COVID-19 cases in recent days. Hence, it generates a short-time forecasting curve and estimates these conditions of the next couple of days. It is helpful to represent, extract information and take necessary steps against COVID-19. Sometimes a long-term prediction procedure is needed to make a proper decision, nevertheless, it generates only short-term forecasting. In the future, we will reduce the limitations of epidemiological models using the machine learning model and develop a long-term model along with a short-term model.

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