A presentation on engineering strategies for handling covid-19 for environmental health and economic stability

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introduction

- Engineers have an obligation to deliver, using a systematic and workable technique for problem understanding through deductive analysis; and, various techniques for figuring out effective solutions to real life challenges. The current challenge been faced around the world is the covid-19 pandemic which has claimed thousands of life and is still doing so.
- This pandemic affects the environment and also the economic stability of the world causing lots of job scarcity around the world.

About the virus

- Based on current evidence, the COVID-19 virus is transmitted between people through close contact and droplets. Airborne transmission may occur during aerosol-generating procedures and support treatments (e.g. tracheal intubation, non-invasive ventilation, tracheotomy, cardiopulmonary resuscitation, manual ventilation before intubation, bronchoscopy).

Ways of reducing the spread of the virus

- 1. ensuring triage, early recognition, and source control (isolating suspected and confirmed COVID-19 patients);
- 2. applying standard precautions3 for all patients and including diligent hand hygiene;
- 3. implementing empiric additional precautions (droplet and contact and, wherever applicable for aerosol-generating procedures and support treatments, airborne precautions) for suspected and confirmed cases of COVID-19;
- 4. implementing administrative controls;
- 5. using environmental and engineering controls.

Environmental health

- Environmental health is the branch of public health that focuses on the interrelationships between people and their environment, promotes human health and well being, and fosters healthy and safe communities.
- The environmental health is being affected to a very high degree starting from our atmosphere to other natural resources.

Ways of developing the environment against covid-19 with the help of EHS

- Management commitment
- Planning
- Implementation
- Performance measurement and change management
- Management review of EHS management system
- Employee safety training program

COVID-19

How to minimise the spread of COVID-19?

Based on the current knowledge of COVID-19 and evidence available on other viral respiratory pathogens.

Simple measures can reduce the spread of the virus.

1 PERSONAL PROTECTIVE MEASURES

Practice proper hand hygiene

Cough and sneeze into your elbow or a tissue. Throw it into a bin and wash your hands

Healthy people **do not** need to wear masks

Masks should be reserved for healthcare workers and those who care for ill persons at home.

2 ENVIRONMENTAL MEASURES

Frequently clean used surfaces, clothes and objects

Minimise sharing objects

Ensure appropriate ventilation

3 SOCIAL DISTANCING MEASURES

Standing 1 metre away from a visibly symptomatic person

Self-isolation of individuals **with symptoms** of a respiratory infection is one of the most important measures for **reducing disease transmission** and limiting the spread of the virus in the community during an epidemic.

For travel advice or travel recommendations refer to official government advice.

ecdc.europa.eu/en/novel-coronavirus-china

Economic stability

- Sustainable development is considered a key concept and solution in creating a promising and prosperous future for human societies.
- Nevertheless, there are some predicted and unpredicted problems that epidemic diseases are real and complex problems.
- Hence, in this research work, a serious challenge in the sustainable development process was investigated using the classification of confirmed cases of COVID-19 (new version of Coronavirus) as one of the epidemic diseases.

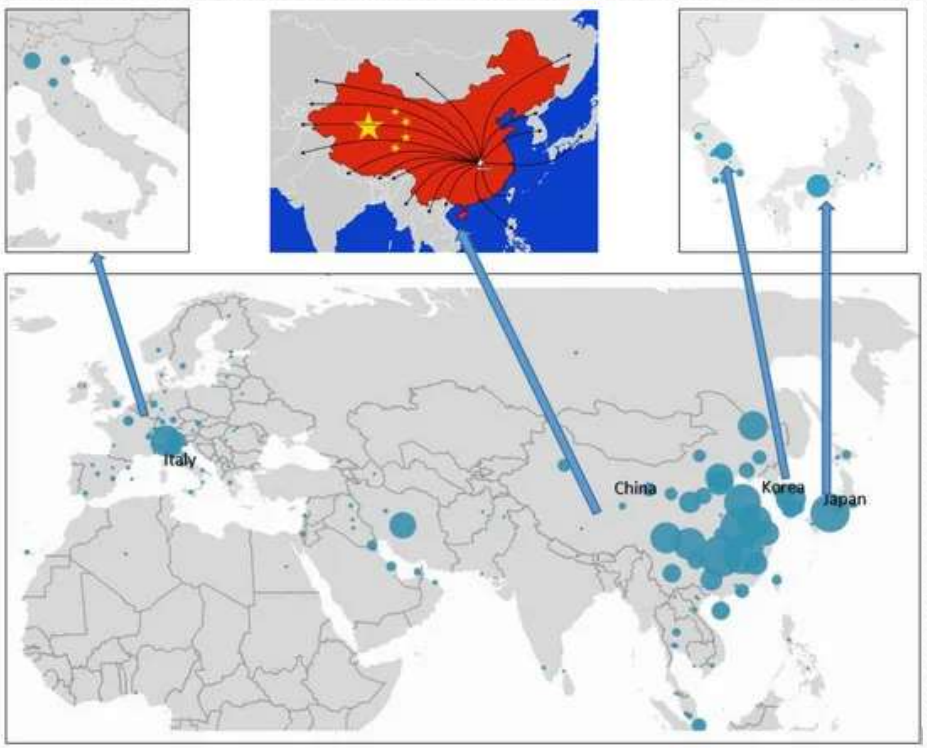
Method of study

Two approaches were used in the current study, as follows:

- The possible correlations among the trends of confirmed cases in different case studies were investigated, and then a binary classification model was constructed to predict and classify using the group method of data handling (GMDH) algorithm based upon some critical factors; maximum, minimum, and average temperature, the density of a city, relative humidity, and wind speed were considered as the input dataset and the number of confirmed cases was selected as the output dataset for 30 days.
- Regression analysis was used, and a trend of the confirmed cases of COVID-19 analysed in the five provinces with the highest confirmed cases, including Hubei, Guangdong, Henan, Zhejiang, and Hunan, and the daily fluctuations of confirmed cases were compared with fluctuations of weather parameters.

Conditions for analysis

- The environmental and urban parameters in the analysis included density, sex ratio, average age, elevation, maximum, minimum, and average temperature, relative humidity, and wind.
- For daily analysis of the possible trend between confirmed cases of COVID-19 and environmental factors, the data of Hubei province was used.
- The climate data is based on the stations situated in the capital of the provinces or regions because the population is generally higher in these areas.
- The analysis period was from 28 January 2020 to 26 February 2020 (30 days).
- The analysis of the possible correlations about trends of confirmed cases in different case studies was based on the average values in one month.



Location of the case study been done

GROUP METHOD OF DATA HANDLING (GMDH)

- Artificial Intelligence includes a wide range of methods and algorithms that work based on machine intelligence and has many applications in various fields of science [40], including fuzzy logic theory and application [41,42,43,44,45,46], artificial intelligence techniques and sociology [47,48,49], risk assessment and hazard identification [50,51], machine learning [52,53,54,55,56,57], and meta-heuristic algorithms and clustering techniques [58,59,60,61,62]. The group method of data handling (GMDH) type of neural network is one of these algorithms that was proposed by Ivakhnenko [63]. GMDH is a self-organization algorithm that has been used successfully for pattern recognition, optimization of complex systems modelling, and prediction problems, and it is also called the polynomial of the Ivakhnenko equation [63,64]. This algorithm can predict the value of from an approximate function ( ), for each input vector (X), which is shown in Equation (1). The basic form of a relation between input and output data can be declared as a discrete type of the Volterra functional series, referred to as the Kolmogorov–Gabor polynomial.

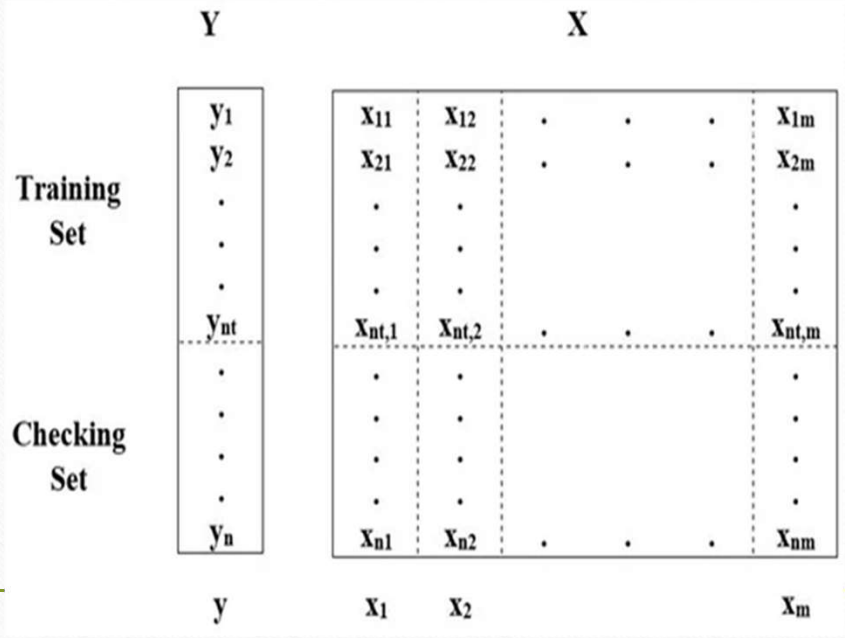


Figure 2. Schematic of input and output variables of the group method of data handling (GMDH) algorithm.

Results Obtained

The data generated were analyzed using two methods:

- Binary Classification Modelling Using GMDH
- Regression analysis

Binary Classification Modelling Using GMDH

- Initially, evaluating the parametric correlation of each independent input dataset is necessary for carrying out reliable modeling [70,71,72,73]. Hence, before modeling, a correlation analysis was conducted using Pearson's correlation coefficient among the dataset for five independent input data, including maximum, minimum, and average temperature, relative humidity, and wind speed.
- Secondly, determining the control parameters of the algorithm is an important task because it plays a key role in the fast convergence of the algorithm. There are no specific relations about most of these parameters, and they are determined based upon previous studies, experts, and trial and error. . It is worth mentioning that the confusion matrix is used as the measure of accuracy to evaluate the performances of the binary classification model by the GMDH algorithm.

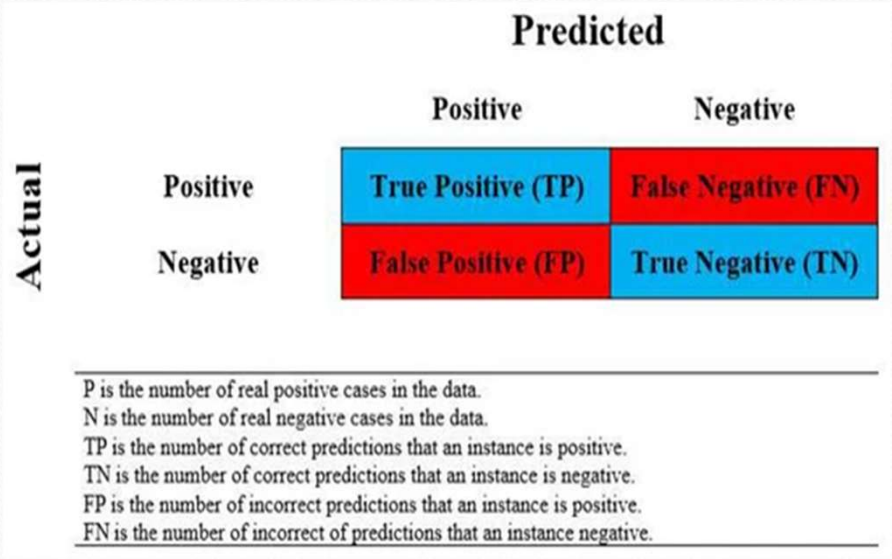


Figure 3. Schematic of the confusion matrix.

Regression analysis

The impact of weather parameters and confirmed cases was analyzed with the multi linear regression (MLR) technique. The analysis is based on the weather data of Wuhan.

The result shows the R^2 in the first case is equal to 0.44, and in the second case, 0.65, which shows an increase. In addition, according to the results of collinearity diagnostics of the regression analysis from Equation (11), the obtained results show that relative humidity, maximum daily temperature, average daily temperature, wind speed, and the minimum daily temperature had the highest to the lowest share in the expression of changes of output (confirmed cases), respectively. Since the data in the second case started from 5-Feb, which is about 14 days after the Wuhan lockdown on 23-Jan, it seems that the rate of confirmed cases from 5-Feb might be affected more by the environmental factors.

The Correlations Among The Trends Of Confirmed Cases And Weather Parameters

Figure 7. Daily Confirmed cases of COVID-19 in Hubei and wind speed.

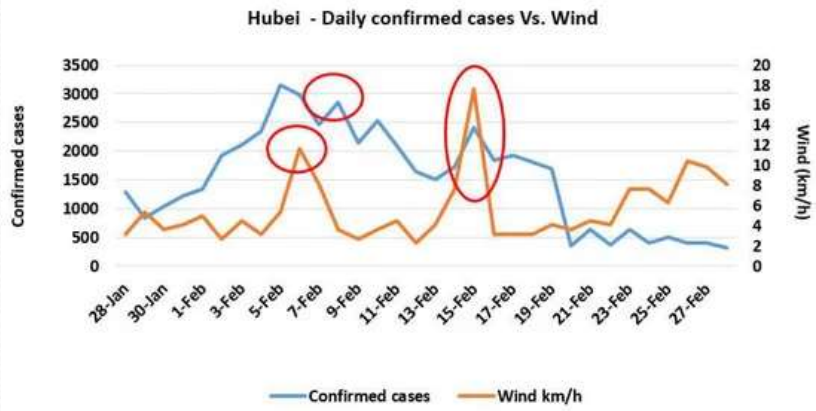


Figure 8. Daily Confirmed cases of COVID-19 in Hubei and average temperature.

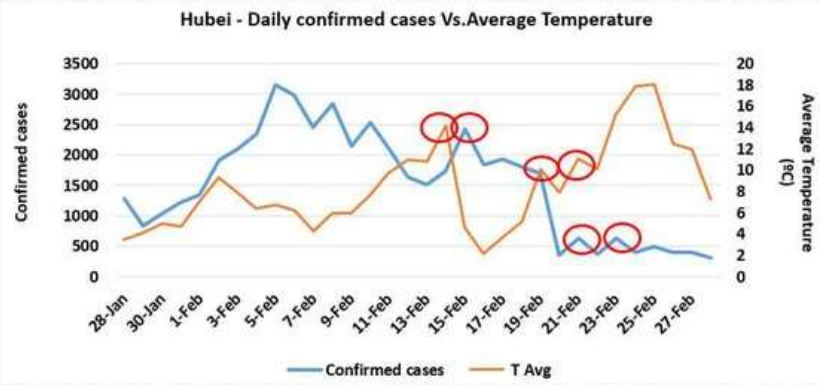


Figure 9. Daily Confirmed cases of COVID-19 in Hubei and Humidity.

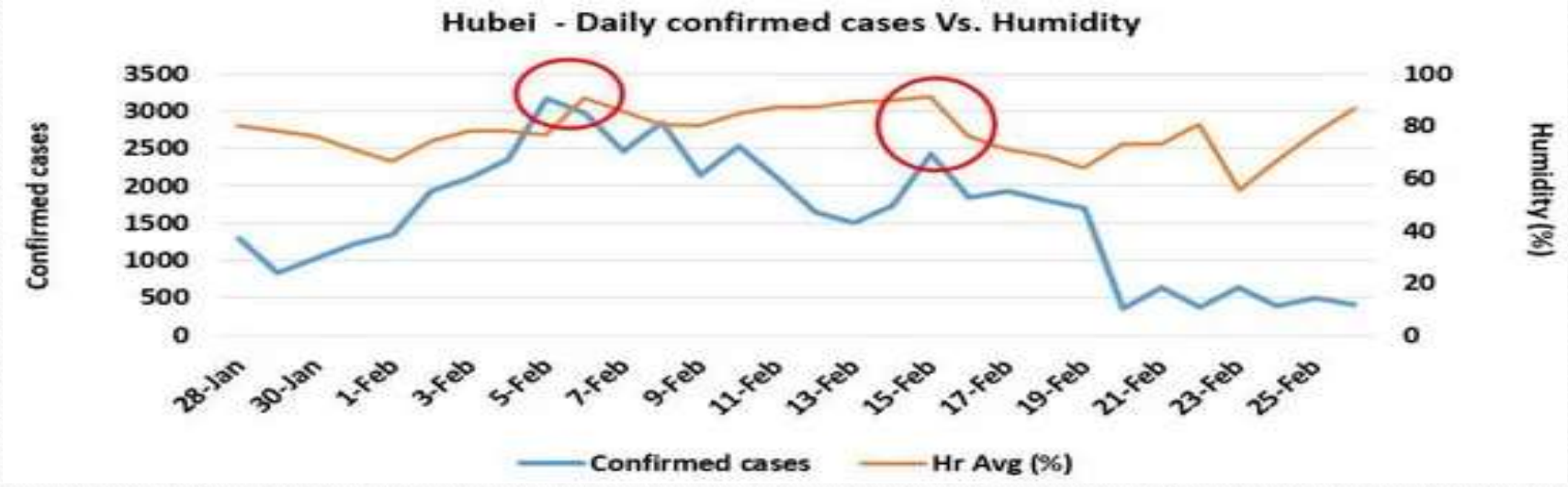


Figure 10. Confirmed daily cases in Guangdong, Henan, Zhejiang, and Henan

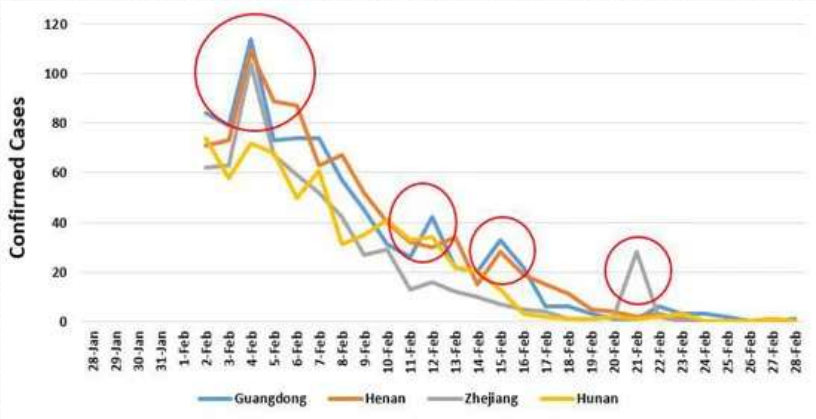


Figure 11. The average daily temperature in four case studies.

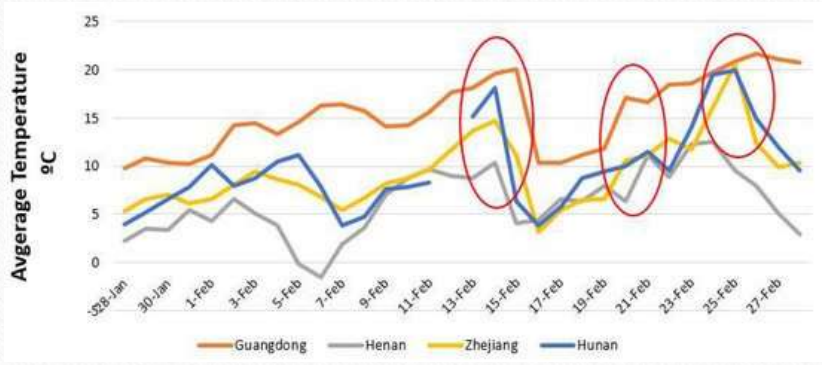


Figure 12. The average daily wind speed in five case studies.

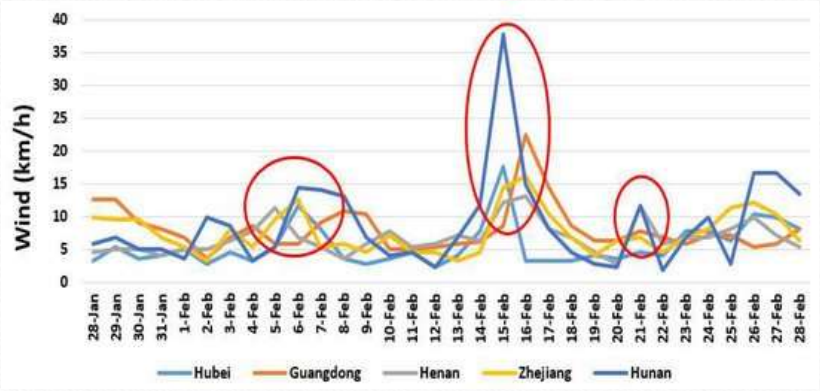
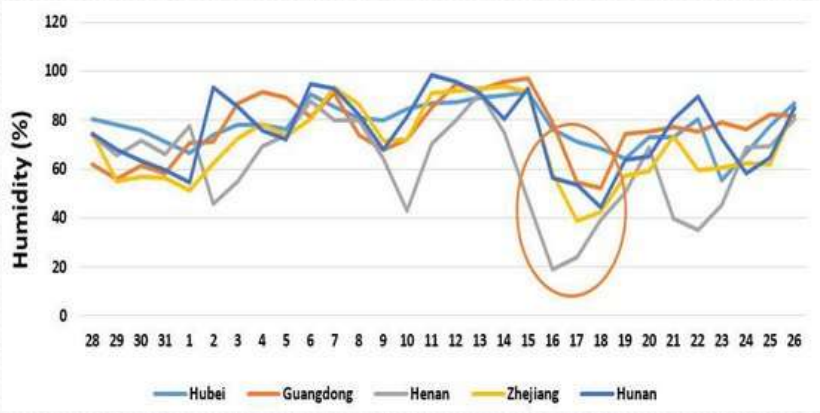


Figure 13. The average daily humidity in five case studies.



Discussion of result

- According to the regression analysis, no correlation was found among the different case studies in four countries, which might be because of the policy and type of restrictions in different countries in confronting the issue. Therefore, the prediction for the trend could be case by case and based on the countries policy.
- The GMDH algorithm had an appropriate performance to predict and classify, with reliable accuracies equal to 95.7% and 85.7% for the training and testing datasets, respectively. It should be noted that the proposed model and its obtained results are unique and should not be used to evaluate directly in other cities. The GMDH algorithm showed reliable result in the selected case study. Hence, the problem of collecting data and incomplete data could affect the analysis in case studies facing insufficient data, and the use of other artificial intelligence method algorithms like the naive bayes classifier can be useful. In addition, other qualitative and quantitative factors may be significant, such as policies of governments, accessibility of health and hygiene facilities, education level, and food culture.
- The comparisons among the trends of confirmed cases and daily weather parameters (wind, humidity, and average temperature) show similar fluctuations that could approve the role of weather parameters on the epidemic rate of COVID-19.

Conclusion

- Recognizing that some policies, practices, and technologies designed to promote sustainability and economic development may have unintended adverse environmental health effects, and attempting to prevent or mitigate these before they are implemented.
- From the result on the regression analysis, the weather condition plays a vital role in the spread of the pandemic around the world which makes it more deadly than we know. It is therefore advised that we should always put on safety equipment and work from home.

Thank you