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Research Article

Deep Learning For Improved Heat Index Using Iot-Based Data

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Abstract: In this era, global warming is the chief cause of climate pollutant produced by CO2 and other chemical emissions. This set of components generates a high temperature and drastically changes the climate. Minimizing carbon-emitting activities can help lower the global warming. as a result of developed technology, almost all the products have carbon dioxide as a major by-product With regard to global warming, a prediction is necessary to avoid catastrophe. Several researchers were examining the projected temperature range based on the yield of crop yields, one of which found an increase. However, algorithms were challenged by a room monitoring or crop yield like application. So, instead, a deep learning is suggested to achieve the task of predicting the heat index in this context. There's a database in the Climate Prediction Center in which the temperature data was collected from the Kaggle dataset. it includes temperature sensor-based time series data, in the Internet of Things Incomplete data is predicted with the long-term memory and deep learning model The effectiveness of the neural network is assessed through accuracy, sensitivity, and specificity, and it is compared to a generalized linear regression. All MATLAB R2020b software is running under Windows 10 in parallel.

Keywords: Global warming, IoT, Time series, forecasting, deep learning.,temperature sensor

1. Introduction

Therefore,as we are all aware, changes in the weather, such as the one that we are experiencing with this winter, also increase precipitation and temperature, which affects the human existence. It causes land loss, human death, and an ecological disaster. On the other hand, it also has an effect on the quality of life, as another factor affecting quality increase of life in the environment. The drying of the planet will affect both biotic and abiotic life. An important quality is predictability. Most accurate temperature prediction methods will need to be developed and incorporated to serve the purposes of measurement as quickly as possible in order to save money and time. At present,universities use numerical weather prediction (NWP) to predict the climate based on current and expected situations (both meteorological and ecological). It's not just what you predict about the weather tomorrow, but how the weather behaves on all the days of the week that this is done. Furthermore, a properly predicted temperature is a great help in weather forecasting models.

Zhang D et al. (2018) postulated that temperature prediction incorporates time-dependent information. Temperature value at particular point in tim As well as the environment time, the user time is also includes data. One special feature of a multi-layer perceptron (MLP) model is that the "sensing" (detecting of ozone levels in cities) does not make it obvious to the user. The model after that was multi-layer deep neural network (DNN) is preferable because it includes data that is not typically found in mathematical models. It is known that other things being equal, prediction models such as this one cannot be expected to give accurate results.

However, according to Huang et al. (2018), extracting data from the features was not required in their CNN method Elements or attributes must be extracted from experience or existing data in order to enter the creative stage. The amount of computing power required for massively equivalent calculation has been on the rise as neural networks continue to advance.

So, is created by Kreutzer et al. (2020) which is a recurrent neural network (RNN). This is because the time dependent nature of the weather influences the data more appropriate for an LSTM network architecture rather than for traditional forward and recurrent networks.

Ling et al. (2019) proposed long-term memory for developing a deep learning network, but these massive amounts of data should be accurate. In this manner, the results are therefore likely to be incomplete. Thus, the proposed model functions to spot missing data on the network. It then restores the data to its original form after finding it. park et al. A long-short term network can have four states: missing, too many, no data, just the required amount, sufficient, lacking, and everything. First, they copy Kaggle's data into the database, then process it, and finally evaluate the model. The project forecasts temperature up to four days ahead of time, utilising previous input data, and is able to produce forecasts every six hours. LSTM networks enable multiple long-term processes on data. Once the operation is complete, there are two gates that follow the flow of data. It's no surprise that everyone

wants to gather accurate and adequate data in this model. We've got a limited amount of time in which to do it. The thermal-location of the data series and the sensor are closely linked. At the end of the day, this sensor will store data from the system predictions and see how accurate they were.

It is very important to monitorable locationally important to monitor the heat levels, as the temperatures are variable constantly short-term memory protects us from change, but long term memory is required to make us more adaptable. Gathered temperature is an environmental model are greatly relied upon for providing accurate forecasts Increasing the spatial resolution becomes even more crucial in urban climatology temperature prediction studies. the highly erratic nature of ambient air temperatures negatively impacts vulnerable populations in different ways The addition of a greater number of sensors brings about improvements in the capability of urban weather monitoring, and this empowers city governments to grapple with urban issues.

A wireless device, according to Trasvina et al., has been developed to check for excessive heat. heat sensors in the Internet of Things temperature results varied during different periods It sends the data via the wireless sensor communication protocol to the CPU.

Xu et al (2019) explains the significance of thermal forecasting for the system is it helps predict system performance. This power system is completely explaining the prediction of heat is done. Methods have been used to increase the accuracy of the power systems: time and load forecasting were employed using real-time and high-precision prediction methods. In the opinion of many of existing methods, it does not show an accurate heat scale Several different neural networks are proposed to handle this challenge, both of analysing the data and correlating it with electricity. By gathering these data it predicts the energy output. the old methods will be surpassed. in the near future, a diverse array of short-term memory methods will be employed in this research. The time series method for temperature forecasting was proposed by Liu et al. Improving the prediction of temperature. Their results show that Ayelle et altemperature .'s predictions are more accurate in all of the methods tested.

As far as the temperature forecasting is concerned, this study is focused on the agricultural fields because those who are engaged in the fields will get that information quickly. For most people, this technique relies mainly on a short-term memory. If your room is warmer than 80 degrees, then it will register a higher temperature on the gauge. through the use of sensors, the control system detects and keeps track of temperature and other levels in the room and building The temperature in the room is quite variable, rising from day to day. That is, after training was complete, the overall functioning of a neural network was computed using the root mean square.

An IOT heat production technique proposed by Ikram et al (2019) It uses a variety of sensors to collect several predicted temperature values. primarily about what the surrounding temperature is going to be like Long- and short-term memory for various temperature forecasting algorithms In the next sections, we have explained the first section: The Idea, the second section: Experiment, and the final section: Discussion.

2. Literature review

According to Manzhu Yu et.al (2021) in the paper, explains the combined model of LSTM and IOT for the prediction of temperature in smart cities. They tell us about a this method is based on Long Short-Term Memory (LSTM) deep learning network to generate daily heat prediction with accuracy. In Their system, the LSTN network was trained in two different ways: using the IoT observations alone, and using the IoT observation and the historical records from weather stations. Their results showed that the proposed framework of integrating historical weather observations significantly improved the predictive performance of the LSTM network, and output formed the other statistical and deep learning-based time series prediction methods.

By Guixiang Xue et.al (2020), in the paper LSTM based heat prediction in IOT: A survey of Xingtai. Energy, they come with the idea of a new intelligent temperature recognizing sensor based on Narrowband Internet of Things (NB-IoT) to collect the temperature from inside the houses and send the data to the "heat exchange station or heat user" from this method of temperature calculation using the ALSTM Algorithm they get the result of the accuracy of 90%. In their algorithm, they have used the Kalman filter algorithm to diagnose the fault and anomalous data.

TAO LIN et.al (2020), introduced a new algorithm that prediction of heat load by integrating the novel notion method of smart district heating system (SDHS) this system help to removing and decreasing the high amount of heat prediction.The long short term memory method to store the previous data operations and to find the weight and factors which are influencing the process increases the accuracy in the heat prediction.In this paper it shows

high accuracy in heat prediction compared with the previous methods and also several features like temporary behaviours,mechanisms which increases the performance.Also it concentrates to integrate artificial intelligence with LSTM.

According to Juan Yin et.al (2020), in the paper prediction of short-term daily changes of temperature is kept under non-functional variables which are limited using the two wat long short term memory ,they have come with the idea of finding the temperature that happened in the underground of the plant. This helps them to crop failure by the lack of water. By this method, they will recognize what is the level of temperature and what amount of water they need to survive. They have used the Penman-Monteith method to estimate the ET0. But in this model, they need a greater number of metallurgical values. Therefore, they have come with the idea of the two directional-LSTM model; this helps them to provide the result in a daily routine manner. They got the benefit of using three metallurgical values for predicting the result. They use maximum temperature, minimum temperature, and sunshine duration for calculation. Sunshine helps to provide a high correlation.

According to Goodness Oluchi Anyanwu & Cosmas Ifeanyi Nwakanma (2020), they come with the paper of emission of temperature from IoT devices. In this, they have told us about a method of filtering the data produced from the IoT devices. They have mentioned that most of the data captured through IoT devices are varied and unfiltered formats. in their system, they show the quality of the data products and in their proposed way they have shown the accuracy of results obtained from outside and inside a room. This system will show the difference of the values that get from the IoT devices by the system.

Rosemary E. Alden et.al, proposed an idea of LSTM prediction for temperature electrical uses in homes (2020). In that, they consider the daily usage of electrical energy in the houses. For that, they have implemented an LSTM algorithm-based system to evaluate how much energy is consumed by each home in a particular area. From that, they have mentioned that they get high accuracy results from that.

By Md. Zabirul Islam, et.al in the paper a LSTM is operate together with convolutional neural network for predicting the current scenario call COVID (2020). The prediction of this virus is estimated from the images. They have introduced a deep learning technique based on the combination of a convolutional neural network (CNN) and long short-term memory (LSTM) to predict COVID-19 automatically from X-ray images. In this system the CNN and LSTM done in two operations that are the feature extraction and detection.A collection of different X-ray images, including 1525 images of COVID-19, were used as a dataset in this system. The experimental results show that our proposed system achieved an accuracy of 98.4%, AUC of 97.9%, a specificity of 96.2%, sensitivity of 95.3%, and an F1-score of 97.9%.

In the paper, temperature cooling and value of heat index in public places and buildings (2020): Review, Mohammed Bakri Bashir and Abdullah Alhumaidi Alotaibi. They have provided a critical review of recent models used in cooling and heating load prediction by focusing on model performance and accuracy. Also, they have mentioned what are the input parameters needed and the techniques that are used in the system models. From the review, the innovators get what are the advantages of this particular system.

According to Arun Chakravarthy R et.al (2020) in the paper temperation prediction using internet of things at agricultural areas and also tracking the temperature status at various agricultural farms. In this paper introduces a new approach that the predicted temperature data is linked into the networks with the help of internet of things for easy accessing. Their proposed system should measure parameters like Temperature, heaviness,atmospheric pressure, and wetness using sensors. The controller device acquires the data. The collected temperature data is stored in to the cloud for further accessing. By their system, wire-based testing and tracking using analog tools can be reduced. Therefore, a wireless sensor network is used to test and track weather parameters to overcome this problem.

According to H. A Kusuma et.al (2020), in the paper,a new method introduced for monitoring weather forecasting that is GSM.This method achieves through internet of things.It also measures the quality of atmospheric air. In, this system they used to obtain the area which has high temperature to monitor the quality of air using a very low proceses. After finishing the process the performance and evoluation is drawn in the form of graphs and this graph can be accessed by local areas and also remote areas.The components which are used to develop this system is like Arduino Uno as the main processor, Real-Time Clock DS3231 to provide timely information, anemometer to provide wind speed, DHT22 used as humidity and temperature sensor, MQ-2 used for smoke detection and CO level, and SIM900 as GSM shield for sending data to the server. They used Think Speak an IOT application to collecting the data in the system.

Apart from all, Zao Zhang and Yuan Dong (2020) in the paper predicting the heat by using an neural network and accessing the data from the temperature at different time.This system compares with the past temperature data to the present data.The neural network is comes from the existing convolutional recurrent network is formed from convolutional networks and recurrent convolutional networks. This model can obtained the temperature occurred time and the affected locations from the data collected to the recurrent networks . For the particular temperature calculation model, they use altitude, barometric pressure, heaviness, and even mass of population as the parameters.

Guixiang Xue et.al, (2019), come with an idea of the prediction of heat weight.This process is done with the help of an long short term memory on the feature fusion.In this algorithm the heat related data is taken from the dataset and the accuracy of this prediction follows some necessary conditions such as controlling the temperature by using the SDHS process.This process increases the accuracy and efficiency of heat prediction also it decreases the wastage of heat from the prediction.This method saves the energy while performing the heat prediction model.This feature help to find the temperature at different intervals and increases the prediction of accurate value of temperature .It provides a great challenge that to achieve the prediction methods at multiple time zones.They introduced a new prediction algorithm that is the long short term memory adds a feature fusion into it and forms feature fusion long short term memory.From this method they provides maximum performance , accuracy , specificity.These three characteristics helps us to improve our prediction results to be more accurate.

Similarly, by Meiyu Wen et.al, in 2019, the heat prediction can also done in internet of tings with the integration of long short term memory at internet of things.This paper has come to an idea of predicting the need for cooling in the hotels or other industries to keep their food and cooling materials safely and securely. For that, they have found the processing of abnormal value and the missing value of temperature and humidity according to the sensors receiving time. They use Long Short-Term Memory (LSTM) model is for temperature and humidity time series prediction. Also, the result is compared with the prediction result using the traditional statistical model of Autoregressive Integrated Moving Average (ARIMA). It can also predict the temperature of the next 10 times according to the historical data.

3.

4. Proposed method

As a result, our proposed system gives a precise and easy to understand representation of the possible scenarios, while doing so in an efficient and good manner. we use the heat parameters in our proposed system Using these data, we will be able to calculate heat using the LSTM with accuracy and specificity.

The proposed method scenario is as follows:

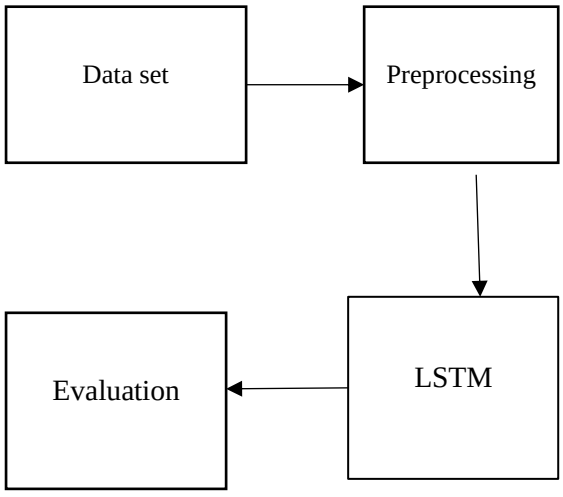

FIGURE 1 :Proposed system

5. DATA SET:

Letting people know about the dataset Usually, the data set will include fields and attributes in relation format. in this cell is the heading for the cell in the table, in this column denotes the text, and in this cell the values of the

table for example, it prints the student data such as ID and name. Each value has a unique identifier. the dataset can have 1 or many datasets, depending on the number of tubs that it takes to hold the combination The data set that we mostly gather from Kaggle is for getting data While Kaggle supports a variety of data format types, we strongly encourage the use of primary data files. this can be used to show the temperature required in a particular area, and that helps to determine the overall system output to extract the data, we must use Kaggle

This helps us to Kaggle allows users to:

- Create processing and searching the data
- Finding and constructing the data for the domain of web development
- Join and cooperate with other technical leaders at different domains
- Start a competition with higher technicians for fastest completion

Here the Kaggle dataset provides data about the weather data and the temperature data. Using the Kaggle dataset, we get a heat index value. Based on this value evaluate the heat index by minimum temperature and maximum temperature. Kaggle dataset is mainly used for machine learning.

6. PRE- PROCESSING:

In common understanding, Pre-processing is a step that transforms machine data into a more understandable form for mining. Data is problematic in the real world; it is incomplete, non- and non-standard, and probably incorrect. Clearing data without errors involves the use of data pre-processing techniques. Under our plan, data collection model, data must be taken from connected IoT devices and the Kaggle dataset. Thus, the results are more vulnerable to error. Thus, we have to erase any information that is unwanted, and we must remove any zero values from the data. This will improve the system's performance and effectiveness when working with the dataset. As a result, this yields a consistent process and an effective process.

Because our system handles the country, region, city, month, and state, we require the region and country and state data to be collected If we collect the date information from the system, and have an error in the data for Year, day, and month, then it will lead to an error in the system. To express that particular error, we need to first normalise the data. It gave an exceptionally high-precision result.

7. Long-Short Term Memory:

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This is LSTM network is another form of recurrent neural network it has the ability to understsnding the step by step operation done in the prediction models. It is a method based on the deep learning concepts under the artificial intelligence. It has a feedback process and it operates not only the single data it operates in multiple data in a neural network. It consists of cells with input and output. LSTM networks are mainly used to analyzing data and make predictions. However, there is a chance to get a lag between the events done in the cells.This method is most efficiently used in machine translation, speech recognition, and more. Developing LSTMs is a very difficult process in the domain of deep learning. It can be difficult to implement the LSTMs are, and how terms its performs the step by step operations at one directional and two directional fileds.

The above diagram 1(a) that the block diagram for long-short term memory and the 1(b) architecture for heat prediction in LSTM. The architecture in heat prediction consists of one input , two LSTM layers, and one output. Also, there are N hidden nodes in the model (N = 192), which is set based on exhaustive experiments There are three LSTM models, for every six hours in a daya for the input layer depending on the prediction periods (H in the figure) of after every six hours. Besides, each LSTM layer has one cell, as shown in Figure 1(a). The performance and development environment of the three LSTM models are similar to those of the neural network models.

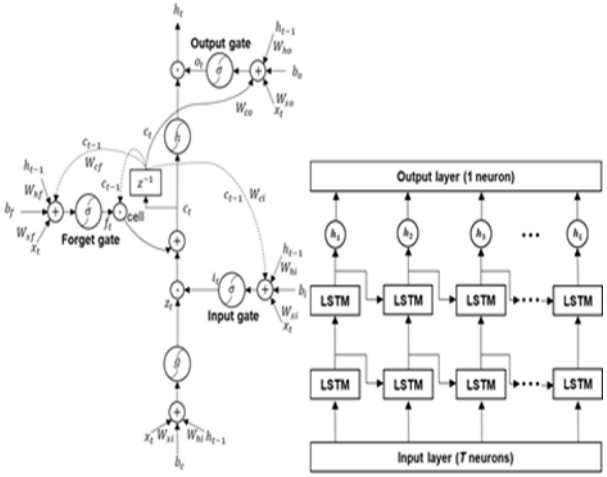

FIGURE 2(a): LSTM block diagram FIGURE 1 (b) Architecture

The LSTM block diagram consists of three different gates like input , output , forget. The mathematical expression for LSTM to find the heat index is given below in table 1.

TABLE 1: Variable description

Value	Description
t	time
yt	Input value
At-1	Previously hidden state value
Bt-1	Previous cell value

For a given time, t, the gates in the LSTM calculate the gate values with the input, yt, the last hidden state value, At−1, and the previous cell value, Bt−1, by the following equations:

$$d_t = \sigma(W_{xd}y_t + W_{hd}A_{t-1} + W_{cd}B_{t-1} + b_d) \quad 1$$

$$m_t = \sigma(W_{xm}\, y_t + W_{hm}\, A_{t-1} + W_{cm}\, B_{t-1} + b_m\,) \quad 2$$

$$n_t = \sigma(W_{xn}y_t + W_{hn}A_{t-1} + W_{cn}c_t + b_o), \quad 3$$

where d_t, m_t, and nn_t are the input, forget, and output gate values, respectively, for the present time, t. Also, σ is an sigma function which is used for the performance activation, values begins from 0 to 1. Further, the W_{xd} in Equations denotes the overall weight of the values inside the gate. For example, is a weight value connecting the input, yt , to the input gate d_t. Lastly, b_d, b_m, and b_o are the biases that are added to each gate to adjust the spaces of trained data in centered locations.

Deletes new input data by applying an activation function, $g(\cdot)$, which is developed by the LSTM cell takes a method to check whether the input value removes the all past memory or tangent function. Consequently, the cell value at time *t* is computed as,

$$Z\,t = tan\,a\,(Wxcyt + WhcAt - 1 + b\,c), \quad 4$$

$$C\,t = m\,t\,Bt - 1 + d\,t\,z\,t, \quad 5$$

Where,b_m , $b_{d.}$, b_o -is a biases for the cell.

That is, the memory of LSTM is stores the overall multiplication done in completed attribute value, B_{t-1}, and the ignore gate value, m_t, as well as the half amount of the input gate value, d_t, on the central controlling by z_t. Next, the attribute value, c_t, is used to take the secret values from the attributes, h_t, by applying an activation function,$g(\cdot)$, to c_t, which is also a hyperbolic tangent defined as $g(\cdot) = \tan g(\cdot)$, such as

$$h\,t = o\,t\,tan\,h\,(c\,t). \qquad 6$$

The three different gates in the LSTM has monitors the deletion of the length of the data operation properly.This feature helps to remove gradient problem with a less operational costs..

8. Performance of LSTM model

The performance evaluation of different models can be specified in table 2 with different parameters like the value of the statistical error and precipitation error with two metrics like symmetric perfect percentage error and root mean square error.

TABLE 2: Performance evaluation of LSTM

Criterions	**values**
The symmetric mean perfect percentage error	480.7812
Root mean square error	617.5835
Error in statistical data	1.786
Error in percepitation	1.245

9. An Advanced LSTM based Temperature prediction model

Due to the huge amount of data, more data may be lost. To solve this problem a proposed LSTM model which will restore the missing temperature data. So the proposed method has two processes explained below:

Investigation of weather factors related to temperature.

Proposed refinement function using LSTM

Selection of hyperparameters of LSTM.

10. EVALUATION

Use the LSTM expression to find the heat index day by day. Here the values substitute in the equation get a heat index value. Based on the heat value we can classify the heat into different types as follows in table 3.

TABLE 3: Evaluation of heat index

Types	**Heat index**	**Effects**
Alert	80°F - 90°F	Feels tiredness in material activity
Maximum alert	91°F - 107°F	Heat hypothermia, heat restriction, or heat fatigue
Risk	107°F - 125°F	Heat restrict or heat fatigue
High risk	125°F or higher	Heat hypothermia

Here the variations in the heat will affect the environment and human beings. The mapping is done with the help of an LSTM to be useful to take precautions for handling the heat. The increased amount of heat due to global

warming will harm the environment. If you get a heat index, we can take further action on it. By exceeding the heat value above 103°F, it will be very dangerous. Also, the index value becomes 80°F it needs some alert to maintain the heat. From LSTM we can predict the heat index level, which will affect or not.

11. Experiments and discussion

With the highest and lowest base value Using the functions of kaggle results in getting data from the dataset. This system uses a long-term memory algorithm for the data as well. A reinforcement learning algorithm does a better job than using a convolutional net in this case (CNN). Given the long short-short training memory network model, it can interpret valuable information in the older data, and filter out unneeded information by using memory, while enhancing it by accepting more useful information with the use of a new gate. The experiments have shown that the LSTM module can deliver temperatures that are close to the true heat index values.

In contrast, the pattern recognition models, such as ANN, can divide the current patterns by local trends, which can be represented as convolution. As stated in the book, the studies describes in CNN (computer-based network) method, which will help locate the load and project that won't be suitable for heat forecasting. The LSTM module will improve the stability, accuracy, and specificity. According to our LSTM model, the heat index will be very close to the CNN algorithm in the experiments.

Furthermore, the new model has been segmented into eight sub-variants to ensure its overall capability is met. the separated convolution and short-based net works on parts and less frequently but it is an excellent performance even when you take into account all the partitions It indicates a difference in capability between the proposed model and neural networks. The data prove that the model is accurate in temperatures and makes better predictions. This paper proposes a new sequence forecasting method based on LSTM and CNN integration. This study will improve the accuracy of the electrical load prediction by way of LSTM and CNN.

TABLE 4: Comparison between CNN and LSTM

Parameters	Existing method(CNN)	The proposed method(LSTM)
Accuracy	85	96
Sensitivity	80	92
Specificity	50	73

From table 4 the results show. To a certain extent, these new measurements are more accurate, more sensitive, and more specific than the previous technique. Data is more reliable in heat index with the use of LSTM.

Use the CNN algorithm; use different angles to predict the same coordinates. Daily heat index can be calculated using the LSTM model. Another key advantage of this approach is to providing an accurate index.

12. conclusion & future work

This procedure is sequence-oriented and maximizes the dataset's effective use. Data was fed into the LSTM model, and an accurate heat index was thus achieved. in this research, a neural networks have been proposed to maintain a 12-hour change in temperature based on day-to-to-day temperature changes. The new long short-term memory (LSTM) model, which can help with accurate data A recurrent long short-term memory (LSTM) network can help restore the missing weather data as well. The new LSTM model was then calculated for different forecasts. Temperature was also refined to project decades at a time frame of the future To begin with, the data is obtained from Kaggle and then it is subjected to the necessary processing. And, lastly, the accuracy of the conventional LSTM and CNN-based models was evaluated. Predict heat in different ways Based on these observations, we can lower the temperature in the surrounding environment. By contrast, the proposed LSTM-based model obtained more accurate, more precise, sensitive, and specific results According to the model, when conditions such as weather or temperature unexpectedly change, predictions no longer hold up to date. However, the long-term aim is to integrate weather-related data and the various weather variables into the neural networks to support the following work. These weather conditions not only include climate, temperature, but also data about soil and other factors as well. Also, it helps to recall information that has been lost due to short term memory loss.

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