# Applications of Neurocomputing (KC-LSTM) in prediction fire - A comprehensive study and understanding

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***Abstract*—this paper present predictor model combination between the advantage of Knowledge Constriction (KC) and Long Short-Term Memory (LSTM to find the burned area. The dataset of this case syudy collected from five types of sensors, namely Temperature Sensor (Tmp36), Wind Speed Sensor (010C), Relative Humidity Sensor (RH5X), Rain Sensor (WR2-RFC A553100), and Direct Current (Acudc240). The predictor model consists of four stages, the first stage called pre-process, include (1) check the missing values (2) split dataset into multi-intervals and remove the duplicate; the second stage build knowledge constraints, then split the data set into two parts: training and testing. We'll create the predictor with the training data set while putting the based on five cross validations. The third stage, building predictor dependent on the neurocomputing (LSTM) and knowledge constriction called (4F-DLT), the four-stage using the evaluations measure. As a results the 4F-DLT consider a pragmatic predictor for fire forest area reduce the computation and time at the same time increase the accuracy.***

**Keywords—*Deep Learning, Knowledge construction, Neurocomputing, LSTM, Forest Fires.***

## I. INTRODUCTION

The total area of forests in the world is 4.06 billion hectares or about 31 percent of the total land area. Which is equivalent to one-third of the Earth's surface. providing vital organic infrastructure for some of the planet's densest, most diverse collections of life. Therefore, Forest fires are as old as the forests themselves. They pose a threat not only to the forest wealth but also to the entire regime to fauna and flora seriously disturbing the bio-diversity and the ecology and environment of a region. During summer, when there is no rain for months, the forests become littered with dry senescent leaves and twinges, which could burst into flames ignited by the slightest spark Forest managers can use precise fire probability predictions to create more effective fire-fighting measures,(pham , et., al 2021).

Forest fires (Rasooli, et.al., 2021) are caused by natural causes as well as Man-made causes: (a) Natural causes - Many forest fires start from natural causes such as lightning which set trees on fire. However, rain extinguishes such fires without causing much damage. High atmospheric temperatures and dryness (low humidity) offer favorable circumstances for a fire to start. (b) Man-made causes - Fire is caused when a source of fire like naked flame, cigarette or bidi, electric spark, or any source of ignition comes into contact with inflammable material. (caton et.al., 2019) The benefits of forests can be summarized as air purification and trees absorb odors and polluting gases such as nitrogen oxide, ammonia, sulfur dioxide, ozone, and suspended particles in the air by confining them to their leaves and bark,(Gnusov et.al., 2020), as result, forest density was discovered to have a significant effect on the duration of forest fires and their spread among environmental variables, whereas wind speed only has a significant effect on the fire's duration the spread of the fires could have been influenced by human activity., (Abdi, el.al., 2018),

Deep learning *(*Janiesch et,al.,2021) The most intelligent systems that use machine learning to provide artificial intelligence capabilities. Machine learning refers to a system's ability to learn from training data for a given problem in order to automate the process of creating an analytic model and completing related activities. Deep learning is a machine learning concept that is based on artificial neural networks.is a branch of machine learning. A field in which the computer tests algorithms and programs by learning to improve and develop it by itself (Das and Roy 2019). Deep learning is a sort of machine learning that extracts relevant data via a hierarchical recombination of features and then learns the patterns represented in the data.

Neurocomputing, (Yang & Shami,2020) Algorithms for machine learning have been widely used in a variety of applications and fields. The hyper-parameters of a machine learning model must be modified to fit different tasks. For machine learning models, choosing the appropriate hyper-parameter configuration has a direct impact on the model's performance. It frequently necessitates a thorough understanding of machine learning methods as well as proper hyper-parameter optimization strategies.

The prediction could be defined as the task of data analysis to predict unknown values of the prediction target feature. It includes a classification task for class label prediction and a numerical prediction where the task is to predict continuous values or ordered values. Type of target attribute specifies if the problem is classified with binary values or numerical prediction with continuous values. Many statistical methodologies are used for numerical prediction and regression analysis is most often used (Basavaraju et al. 2019).

Finally, forest fire is one of the most important challenges facing the world today as a result of the development of technology. Where it can be defined from several aspects in terms. This research deals with intelligent predictive design to address this phenomenon.

The issue of forest fire prediction is one of the key issues related directly to people's lives and the continued of healthful life generally. Since the topic of this research is to find a recent predictive way to deal with types of data that is sensitive and performs within the range of data series, in this part of the thesis, this research will try to review the works of past researchers in the same area of our issue and comparing works with seven basis points.

(Wood et. al.,2021) design predictor include two stages prediction process, to predicate the burned forest fires area. the data set handle from three points “Transparent and avoid regression and hidden layers”. In addition, the result was evaluated through two-measure (MEAN absolute error (MAE) and root mean square error (RMSE). This work is similar to research work in terms of prediction but using data matching and mining algorithm. while the research is different by using evaluation measures and different by data using in prediction.

(Elvan et.al.,2021),based on the Food and Agriculture Organization's (FAO's) guide, "Forest Fires and the Law.", prepared by expert lawyers and addresses the basic topics of definitions; institutional setup and inter-institutional coordination planning, monitoring, and assessment; prevention and preparedness; detection and early warning and suppression; participatory and community-based approaches, This work is similar with research work in term of

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prediction but using Fire Detection System with Multifunctional Artificial Intelligence Framework while the research is different by using evaluation measure and different by data using in prediction.

(Singh et. al.,2021), to predicate forest fires depending small data set using three methods of Cascade Correlation Network (CCN), Radial Basis Function (RBF) and Support Vector Machine (SVM) ",the preprocessing depending The SPARK and PySpark were applied to perform the data segmentation and feature selection in the prediction process, this work similar to search by using same data type, while different in the use of the evaluation by using SVM model for forest fire prediction. Pham et. al.,(2020)evaluated multi techniques include Bayes Network (NB), Naive Bayes, and Decision Tree and Multivariate Logistic Regression (MLP) to fire susceptibility mapping and prediction. the dataset was used using data taken from 57 historical fires and a set of nine spatially explicit explanatory variables, ("i.e., elevation, steepness, aspect, mean annual mean, aridity index, river density, land cover, and distance from roads"). A model was evaluated through the receiver (AUC) and seven other performance metrics. Our work differs from this in the techniques used in prediction and evaluation measures but similar with it in work the same challenge related to the forest fire.

(Al-Kahlout et. al.,2020), used automated tools to use local sensors such as those provided by weather stations, and many fire indexes, such as the Forest Fire Weather Index, have been developed to account for this (FWI), It has a high accuracy of, as well as lower data collection costs and better fire resource management, thanks to this data. To predict the burned area of a forest fire, only a neural network (JNN) method has been proposed. This research is similar to previous Forest Fire Database work, but instead of using traditional prediction metrics, it employs a neural network approach.

(Zhang et. al.,2019), proposed a spatial prediction model for forest fire susceptibility, and a set of 14 wildfire influencing factors was mapped using GIS. Proportional stratified samples were used to build training/validation sample libraries Hyperparameters are optimized to improve prediction accuracy. The prediction performance of the proposed model was evaluated using several statistical measures—the Wilcoxon site classification test, receiver operating characteristic curve, and area under the curve (AUC). This work is similar to ours in terms of using the same type of prediction data but different in terms of evaluation using ROC-AUC.

(Park et. al.,2019) suggested use rule-based algorithms or image-based machine learning that can hardly adapt to the changes in the environment because of their static features, propose a new fire detection system with a multifunctional artificial intelligence framework and a data transfer delay minimization mechanism for the safety of smart cities. Since most commercial fire detection systems use a simple sensor, Our work differs with this in the techniques used in prediction and evaluation measures by MAI-FDS AND FDSs but similar with it in work the same challenge related to forest fire detection system.

(Firoz and Laxmi 2018), proposed a method of determination to forest fires using determinants such as shooting frequency. It was broadcast on five networks (with thighs frequency). Monthly average analysis, Rainfall, The speed of the wind, in addition to evaporation, the severity of the climate/weather, Examine the Pearson correlation coefficient, as their work is similar in terms of a data type but differs in its evaluation of climatic anomalies.

(Sazawa 2018) examined the effects of forest fires on the chemical properties of fulvic acid (FA) and humic acid (HA) extracted from unburned and burned forest soils, as well as the increased concentration of low molecular weight dissolved organic carbon in topsoil following forest fires. This research suggests thaforest fires can alter the carbon cycle t in terrestrial ecosystems by denaturing soil organic matter. The data set was similar, but the assessment of chemical properties differed.

## II. MAIN TOOLS

***Internet of Things (IoTs)*** Forest fires are common in many parts of the world, whether caused by natural or man-made weather. Rising temperatures and unusually hot and dry summers have an impact on a large amount of vegetation and are a dangerous fuel for fires, putting these areas at risk of extinction. The magnitude of these disasters will grow as a result of global warming. Wildfires can quickly spread across an area, wreaking havoc. Early detection of these events is critical for firefighting efforts, whether that means bringing in firefighters or evacuating nearby residents. Currently, satellites are used to detect fires in remote areas, but cloud cover can make this approach difficult. Some researchers are proposing a new solution that uses a network of Internet of Things (IoTs) sensors to detect wildfires earlier. The goal is to take into account wildfire losses and damages, as well as human-caused fire detection techniques. Forest fires can be detected in much less time than satellite imaging with the right number of drones and IoTs devices, [Burnade et.al., 2021], In the case of soil erosion, fires, and unwanted sedimentation, IoTs deployment allows for more efficient operations, control, and prediction. It has the potential to be extremely useful in the management and stability of forest ecosystems. IoTs-based forest management can help with species and habitat conservation, timber production, forest soil degradation prevention, and wildfire prediction, mitigation, and control, [Salam et.al.,2020], The development of miniature sensor devices that are low-cost, low-power, and multifunctional has been aided by advancements in hardware and wireless network technologies Thousands or hundreds of thousands of improvised tiny sensor nodes are scattered To form these devices over a geographic area To create a sensing network, these sensor nodes collaborate. By collecting, processing, analyzing, and disseminating data A sensor network, for example, can provide access to information at any time and from any location. As a result, the network contributes to the creation of a smart environment.

***Temperature Sensor (Tmp36)*** Wireless Sensor Network systems use a large number of small devices to monitor the environment, such as temperature sensors and are distinguished. [Abdulsahib et.al.,2018]. The temperature measurement range of the temperature sensors under consideration is 0 C and higher. The temperature sensor TMP36 allows for the measurement of negative temperatures.

Range of temperature measurement, °C, - 40... + 125
mV=500 output voltage offset
mV/°C=10 as a scaling factorm
V=750 output voltage at +25°C

***Wind Speed Sensor (010C )*** The Wind Speed Sensor 010C measures horizontal wind speed, as well as provides accurate and detailed information data. The three-cup anemometer is used in almost every application that requires a Be low start and fast reply, Main features of *010C*:

- starting point is low.
- An internal heater is included for the longest service life.
- Blurred design reduces "sensor confusion".
- The ratio of damping.
- the design is low-profile to reduce "sensor turbulence."
- a brief gap in time connector with a quick disconnect
- Electronic components that can be swapped out in the field
- Level 65 Ingress Protection (IP65)

The 010C is Stainless steel and anodized aluminum are used in its construction. it is more Sensors that are more functionally reliable than others its type:

Near-miss lightning, static fields strikes, as well as inadequate grounding systems are all greatly reduced by built-in electrical field surge protection.

The internal heater (AC only) from Met One Instruments ensures positive clean aspiration through the bearings, extending their life significantly.

use in freezing rain, ice, and low wind conditions, an external de-icing heater sleeve is an option.**Error! Hyperlink reference not valid.**

***Relative Humidity Sensor (RH5X)*** To operators who use wind energy in the electrical system, power generation operators who use wind power require precise wind energy prediction. Know of the climate of the area in question is required to comprehend the forecasting difficulty and the sources of uncertainty in forecasts. Monsoon and wind patterns during the day, as well as the weather phenomenon they Observations from meteorological towers, surface weather stations, and wind turbines, are used to determine the cause.. The wind speed on the axis height increases when the setting is to the north. A polymer resistor sensor is used in the RH5X, which provides excellent linearity and sensitivity, as well as a quick Long-term stability and response time It attaches to the bottom of a shelter box. and comes with1.5 m (5') of cable, one hose clamp, and a mounting bracket. Measurement Relative humidity ranges from 0% to 100%. (noncondensing) Type of Signal Analog voltage that is linear Default Slope for Transfer Function: voltage x 20 Output: 0 Offset: 0 For 0 to 100 percent RH, signal 0 to 5 V. 10 V to 30

v DC supply A typical voltage is 12 V at 2.6 mA. supply current. Mounting A hose clamp is attached to a sheet metal bracket. is used For stable shelter box to the tower., [Naegele et,al.,2020].

***Rain Sensor (WR2-RFC A553100 )*** The weather has been fluctuating a lot recently. The ***changing*** weather can cause problems for ***outdoor***

activities, especially in open areas with little shelter. Although it is now very easy to obtain weather forecast information, the rain sensor can be used because it provides a warning in the event of heavy rain, for example, and it is more organized and comprehensive so that the tool can function properly[Chandra et.al.,2020].

- The Rain Bird Wireless Rain and Freeze Sensor were installed by one person.
- It's a piece of cake to program.
- The signal strength is sufficient to detect rain and turn off the water sprinklers as necessary.

**Direct Current** (**Acudc240** ) : AcuDC240 is a measurement of DC power, which is used for measuring controlling, getting, and saving data measured in real-time. Used for measuring significant parameters in an effective way such as current, power, energy, and voltage.

The main features of this sensor

- Display data in real-time.
- Measures with high accuracy.
- The input range for direct voltage measurement is 0-1000V and for current is 0-±10A.

***Knowledge Contraction*** Frequent Forest fires are only a result of the negative effects of climate change worldwide, as well as the increase in drought periods in different parts of the world, which is one of the dangers of climate change to the environment. Forest fires may be caused by natural causes such as the melting of glaciers around the world, the rapid rise in sea levels, the intensification of hurricanes around the world, or greenhouse gases (gases that exist naturally in the atmosphere), Forest fires are one of the world's most serious environmental problems, with fires spreading quickly and alarmingly over large distances. These fires can last months, not just days, and cause numerous environmental risks, including the release of toxic gases such as carbon monoxide, as well as massive losses of wood, plant, animal, and human wealth, The positive benefits of forest fires lie in their ability to shape ecosystems; this is because it plays a major role as an agent of renewal, change, and air conditioning through transpiration and climate conditioning: tempera; however, the negative benefits of forest fires lie in their ability to distort and damage the aesthetic and tourist values in those areas, and the toxic gases resulting from these fires extend to neighboring countries and do not stop at the borders of a particular country, but on the other hand, the negative benefits of forest.

***Prediction Techniques of Neurocomputing*** Neurocomputing, in a more formal sense, a neurocomputing is an intelligent machine built on the structure of neural networks in the brain, with xeromorphic devices that mimic the functionalities of neural networks. Brain-like intelligence and artificial general intelligence are implemented using biological neurons and synapses. In a more formal sense, a neurocomputing, or xeromorphic computer, is an intelligent machine built on the structure of neural networks in the brain, with xeromorphic devices that mimic the functionalities of neural networks. Brain-like intelligence and artificial general intelligence are implemented using biological neurons and synapses, Guoli et. al., 2019 [17]. Artificial intelligence makes use of symbols, associative behavior, statistics, and mimicry, - Nguyen et al.2017[20], Neurocomputing model as shown in figure 1 is considered a foundation for achieving independent artificial general intelligence because it is efficient and powerful for processing spatial and temporal information while maintaining the dynamic nature of information while AI is improving quantitatively, it is not improving qualitatively, Nguyen et al.2017[20], compare among this techniques shown in table 1.

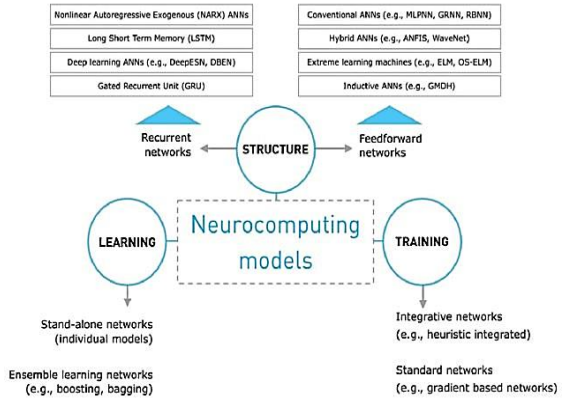


Fig 1: Neurocomputing Models

***A convolutional neural network (CNN):*** is an image processing method that has had a lot of success with images and other types of data. The properties of the input data are extracted through the filters in the CNN convolutional layer, which contains a large number of them. The pooling layer extracts the local properties after that, [kim,et.al.,2021], CNN architecture, one of the most popular deep learning approaches, has made significant advances in the field of medical imaging. CNNs, unlike traditional machine learning methods, can learn features from domain-specific images automatically, which explains their success. A common CNN architecture training strategy is to transfer knowledge from a previously trained network that has completed one task to a new task. Many researchers prefer to use this method in medical imaging because it is faster and easier to implement without the need for a large annotated data set for training, [Abbas et,al.,2021], Alex Nets, GoogLeNet, and ResNet50 are the most popular convolutional neural networks for object and object detection Category classification of images,

***Recurrent Neural Networks:*** Modeling sequences with recurrent neural networks is a powerful tool. It's a flexible tool that can hold a variety of data, including organization. In image recognition tasks, this information about context and specialization is very useful. The unit is affected by the larger and larger neighborhood as the time steps increase, [ Donkers et,al.,2017] there are RNN-based techniques such as connectionist temporal classification (CTC),Gated recurrent unit(GRU),long short term memory(LSTM).

***Multitask Neural Network***: Deep networks can multitask, resulting in multiple predictive outputs from the work of a single neural network. It outperforms its competitors in terms of performance, speed, and time spent on a single task. Excellent efficiency and performance. It is known that multitasking networks are difficult to train, and network parameters must be carefully balanced. Convergence of strong common features that benefit all is a simplified concept of deep learning with the benefit of parallelism [Chen et,al.,2018], The system learns to perform the two tasks simultaneously such that both the tasks help in learning the other task. more helpful as it helps in resource and parameter sharing across tasks reduces training time for training two models separately.

***Temporal Convolutional Machines (TCMs)*** is a temporal sequence learning architecture with convolutions. TCMs are especially useful for representing temporal sequences statistically. When the incoming data is noisy, statistical modeling is appropriate.

***Stacked Auto encoders:*** A neural net made up of a series of sparse auto encoders is known as a stacked auto encoder. An auto encoder is a form of neural network that uses back propagation for unsupervised learning. For a particular activation function, The number of active neurons is measured by sparsity, or have inputs that cause them to produce an output. One layer's outputs feed into the next. As you proceed from input to output, The number of nodes is dwindling.

***Generative Deep Learning:*** Using generative deep learning, a neural network may learn patterns and then create whole new material. A generative deep learning network can produce essays, paintings, images, and a variety of other content.

***Recursive Deep Learning is*** a version and extension of recursive deep learning. Over a structured input, the same set of weights for neural nodes is recursively applied. That is to say, not all of the inputs are batch-processed. When data arrives at multiple periods, and you want the most accurate estimate available at the moment without the need to evaluate all of the data at the same time, Recursion is a well-known concept, strategy in common usag estimating.

***Long Short-Term Memory Networks (LSTMs)*** is meant to prevent relying on outdated data. The structure of a conventional RNN is repeating. A repeating structure is also present in an LSTM, although There are four levels to each element. The layers of the LSTM determine which old data should be passed on to the following layer. It could it's all or nothing of the above. There are numerous options. different types of LSTM, but they're all there. have the potential to forget things. As explain in algorithm LSTM[1]

## III. BUILDING PREDICTOR

A prediction system build to find the burned area and we use Neurocomputing techniques represented by the use of LSTM , which is distinguished from others in that it uses memory and the name of the predictor used is (New Predictor Based On Knowledge Constriction-LSTM( KC-LSTM)) as shown in algorithm KC-LSTM. The main goal is to find the burned area based on 17 characteristics, and we collected data from five types of sensors, namely Temperature Sensor (Tmp36), Wind Speed

Sensor(010C ), Relative Humidity Sensor( RH5X), Rain Sensor( WR2-RFC A553100 ), Direct Current(Acudc240 ), If the construction of the model is correct, the results are correct, the prediction law is built in such a way that the result is acceptable, otherwise the result is virtual (NPKC-LSTM), The model is built of five stages the first stage using the data and definitions that collecting from several sensors in dataset[22]. The second stage, is preprocessing, which include (1) handling the missing values by drops and normalized through mean or median for the database (2) split to interval (3) remove the duplicate value. The third stage is creating a predictor based on the development of LSTM to achieve that goal. Then, based on 17 features, divide the dataset into two parts: training and testing. We'll utilize the training dataset to develop the predictor While putting dataset evolution to the test The readings from the sensors are used to determine the findings of the data set evaluation. The fire will occur if all of the prerequisites for burning the woodlands are met. Otherwise, nothing happens. If the readings from the sensors differ, this indicates that the sensors are defective. The four stages, building dependent to the Neurocomputing and knowledge constriction presented the sensors using LSTM, the five stage using the evaluation measure. Frequent forest fires are only a result of the negative effects of climate change worldwide, as well as the increase in drought periods in different parts of the world, which is one of the dangers of climate change to the environment. Forest fires may be caused by natural causes such as the melting of glaciers around the world, the rapid rise in sea levels, the intensification of hurricanes around the world, or greenhouse gases (gases that exist naturally in the atmosphere), Forest fires are one of the world's most serious environmental problems, with fires spreading quickly and alarmingly over large distances. These fires can last months, not just days, and cause numerous environmental risks, including the release of toxic gases such as carbon monoxide, as well as massive losses of wood, plant, animal, and human wealth, The positive benefits of forest fires lie in their ability to shape ecosystems; this is because it plays a major role as an agent of renewal, change, and air conditioning through transpiration and climate conditioning: tempera; however, the negative benefits of forest fires lie in their ability to distort and damage the aesthetic and tourist values in those areas, and the toxic gases resulting from these fires extend to neighborincountries and do not stop at the borders of a particular country. In general; figure 2 explain KC while Figure 3 shown Predictor Techniques from Both Sides' Datamining and Neurocomputing. In addition; Figure 4 block diagram of KC-LSTM.

TABLE I: COMPARE AMONG THE NEUROCOMPUTING TECHNIQUES [1][2][3]

| *PT* | *Advantage* | *Disadvantage* |
|---|---|---|
| *CNN* | speed<br>perfect when orthology matters<br>great for short texts (e.g., headlines) | more difficult with long texts<br>- does not have the benefits that some of these larger transformer models |
| *RNN* | classification of recurrent neural networks as "feedback" networks. it can contain signals that travel forward and backward, may contain different "loops" in the grid as numbers or values are fed back into the grid | the reason why it is difficult to train them is because they are advanced neural networks. |
| MULTI NN | data: gathers the massive amount of the data<br>-algorithms: popular due to the advancement made in the algorithms itself.<br>ability to work with incomplete information<br>fault tolerance<br>dynamic: good to model with nonlinear data with a large number of inputs<br>parallel processing ability<br>- computational power: | black box<br>amount of data:<br>computationally expensive<br>determination of proper network structure<br>the duration of the network is unknown<br>- |
| TCM | learning temporal sequences in the bias terminology, a convolution function is utilized to produce a trainable envelope of time sensitivity.<br>provides a flexiblframework for building gradient-based temporal generative model training algorithms | the requirement to boost the learning rate derives from the fact that the learning rules are dependent on prediction errors, and as these errors are decreased through training, it becomes helpful to amplify the error signal.<br>phoneme identification, real-time visual processing, and signal processing are all key issues. |
| STACKED | boost performance<br>high accuracy<br>deal with traditional supervised classification and the pretrained<br>neural network can be fine-tuned using backpropagation, | further training |
| GENERATIVE DEEP LEARNING | educating machines in the arts of painting, writing, composing, and playing<br>recent breakthroughs have taught a computer to excel at human tasks like sketching, making music, and completing tasks by generating an awareness of how its actions affect its surroundings. | learn how to create generative models that can learn to paint, write, and complex in a reinforcement learning environment to complete tasks<br>. . |
| RECURSIVE DEEP LEARNING | jointly learn classifiers and continuous feature representations for variable-sized<br>accurate, large scale natural language processing inputs. in order to improve a specific prediction on the training data, the cost function is optimized. | additional analysis |
| LONG SHORT-TERM MEMORY NETWORKS | is a type of recurrent neural network (rnn),<br>the best results have been achieved, [1]<br>because time series data can have unknown lags, lstm networks are well-suited to categorizing, analyzing, and making predictions based on it.<br>lstms were created to address the exploding and vanishing gradient problems that can occur when using regular rnns to train them. | lstms require more memory to train<br>lstms takelonger to train<br>lstms are easy to overfitting dropout is much harder to implement in lstms<br>lstm contains a huge number of parameters when dealing with an enormous number of data |

**Algorithm#:LSTM [1]**

1: **Input:** Dataset of burned area, x0=0.1,x1=0.2.

2: **Output:** prediction value of parameters $W_o$ $b_o$, where o stands for output.

3: ***Initialization:*** input gate allows new information $W_i$,$b_i$where i stands for input,memory cell $W_c$,$b_c$where c stands for cell, forget gate $W_f$,$b_f$ , where f stands for forget.

4: ***For*** each time (t) in a dataset of burned area //Compute: $C_t$, $I_t$ , $F_t$, $O_t$ $State_t$, $out_t$

5: $C_t = \tanh(W_c . X_t + U_c . out_{t-1} + b_c)$ // MemorCell

6: $I_t = \sigma(W_i . X_t + U_i . out_{t-1} + bi)$ // Input gate

7: $F_t = \sigma(W_f . X_t + U_f . out_{t-1} + b_f)$ // forgategate

8: $O_t = \sigma(W_o . X_t + U_o . out_{t-1} + b_o)$ // Output gate

9: $State_t = C_t \Theta i_t + f_t \Theta State_t$ // internal state

10: $out_t = \tanh(State_t) \Theta o_t$ //output cell

11: ***End*** for

12: ***For*** each time (t) update

13: $\delta out_t = \Delta t + \Delta out_t \; statet = \delta out_t \Theta ot \Theta ( 1 - tanh\, 2 (state_t )) + \delta state_t + 1 \Theta f_{t+1}$

14: $\delta a_t = \delta state_t \odot i_t \odot (1 - a^2)$ //update memoy cell

15: $\delta i_t = \delta state_t \odot a_t \odot i_t \odot (1 - i_t)$ // update input gate

16: $\delta f_t = \delta state_t \odot state_{t-1} \odot f_t \odot (1 - f_t)$ //update Forgetgate

17: $\delta o_t = \delta out_t \odot \tanh(state_t) \odot o_t \odot (1 - o_t)$ //update *Outputgate*

18: $\delta x_t = W^t . \delta state_t$ //update input

19: $\delta out_{t-1} = U^t . \delta state_t$ //update output

20: ***END*** *for*

21: ***End LSTM***

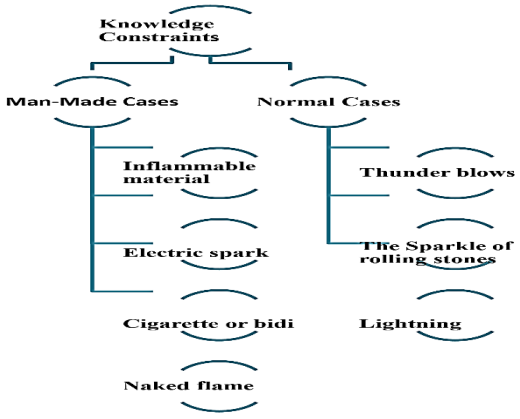


FIG. 2 KNOWLEDGE CONSTRAINTS

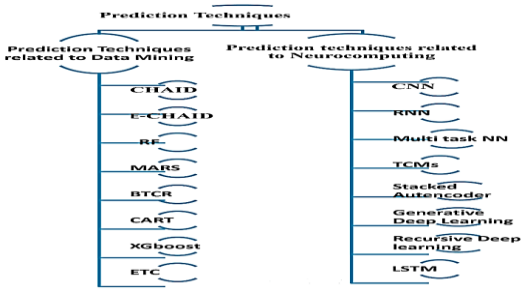


Fig. 3 Predictor Techniques from Both Sides' Datamining and Neurocomputing

**Algorithm#: KC-LSTM**

***Input:*** ***Dataset include x,y,dc,rh,rain,wind,temp***

***Output:*** ***predict the area***

***// pre-processing stage***

***1:*** ***For each row in the dataset***

***2:*** ***Call split interval***

***3:*** ***For each column in dataset***

***4:*** ***Call handle missing values***

***5:*** ***End for***

***6:*** ***For each column in dataset after handling missing value***

***7:*** ***Call Normalize***

***8:*** ***End for***

***9:*** ***End for***

***// build DLSTM***

***10:*** ***For Each I in -dataset***

***11:*** ***For i in rang (i: total number [i – in dataset]***

***12:*** ***Split dataset according to 5- Cross-Validation into***

*Training and Testing dataset*
13: *End for*
14: *For each Training and Testing*
15: *Call DLSTM*
16: *End for*
17: *For each Testing part not used*
18: *Test stopping condition*
19: *End for*
*End for*
*//Evaluation stage*
*20 Call Evaluation NPKC-LSTM*
*End NPKC-LSTM*

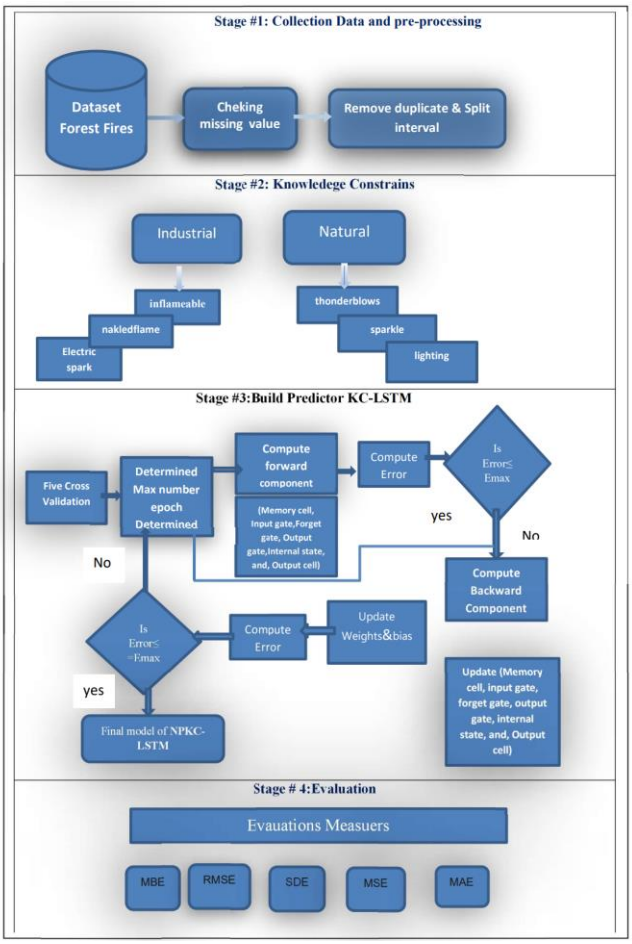


FIG. 4: BLOCK DIAGRAM OF KC-LSTM

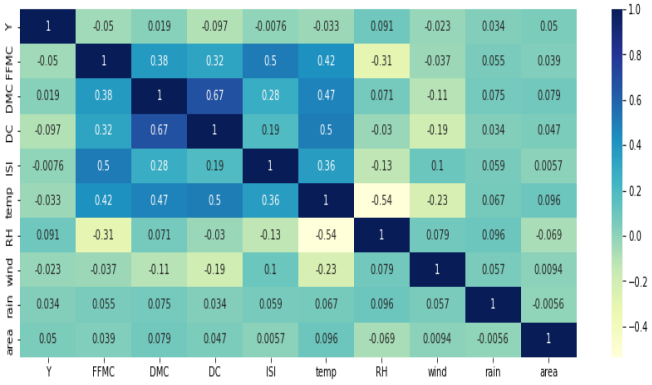


Fig. 5 Correlation Coefficient among

## IV. RESULTS

The following section will explain the main results obtain from each steps of the proposed method that description in section four.

### A. Description of Dataset

In this section, we present compute the dataset contains of 58 6 rows and 13 columns containing the features X , Y, month , day , FFM C, DMC, DC , ISI, temp , RH , wind, rain , area And this data is relat ed to forest fires to predict the burned area ,

### B. Pre-processing

This stage consists of several steps, each dealing with a different data set of the problem

- **Correlation of features to the dataset**

The correlation coefficient is a statistical measure of how closely two or mo re variables are linked. Positive correlation suggests that these variables inc rease or decrease in lockstep, whereas negative correlation means that one variable increases as the other decreases. The results of this steps shown in Figure 5.

- **Remove Duplication of data**

We have data in the database. The number of inverters for each reflector ranges from 1 to 316, bearing in mind that there are 215 different inverters.

### C. Knowledge Constrains

Forest fires may be caused by natural causes such as the melting of glaciers around the world, the rapid rise in sea levels, the intensification of hurricanes around the world, or greenhouse gases (gases that exist naturally in the atmosphere), Forest fires are one of the world's most serious environmental problems, with fires spreading quickly and alarmingly over large distances. These fires can last months, not just days, and cause numerous environmental risks, including the release of toxic gases such as carbon monoxide, as well as massive losses of wood, plant, animal, and human wealth, The positive benefits of forest fires lie in their ability to shape ecosystems; this is because it plays a major role as an agent of renewal, change, and air conditioning through transpiration and climate conditioning: tempera; however, the negative benefits of forest fires lie in their ability to distort and damage the aesthetic and tourist values in those areas, and the toxic gases resulting from these fires extend to neighboring countries and do not stop at the borders of a particular country, but on the other hand, the negative benefits of forest. the section explain The Impact of a Single Meteorological Factor on Forest Fires such as the maximum temperature,.Daytime temperature, daytime humidity, diurnal temperature range, wind speed precipitation and the synthesis of these substances The role of meteorological data is discussed in this section.Using a single evaluation model.

***The Contribution of the Daily Maximum Temperature***

$$CMT = \begin{cases} \left\{1/\left(1+\left(\frac{1}{5(20-temp)}\right)^4\right)\right\} \; if \; Temp < 20 \\ 1 \qquad\qquad otherwise \end{cases} \quad (1)$$

The temperature is low at 14:00, especially in the following 8°C, thus there is little chance of fire; The temperature is between 8°C and 12°C, and the risk of fire is progressively rising. The rapid variations in temperature occur between 12°C and 20°C.In the risk function, fire should pay special attention at the low to high transition period.Above 20°C, additional attention will be paid to the possibility of fire.

**The Contribution of Diurnal Temperature Range**

$$CTR = \begin{cases} \{1/(1+(1/10(20-(temp-temp^{-}))^6\} \; if \; (temp1-temp^{-}) < 25 \\ 1 \qquad\qquad otherwise \end{cases} \quad (2)$$

When the weather is $(temp - temp^{-})$12°C, cloudy, rainy, and foggy, it is more difficult to light; while $(temp - temp^{-})$ is between 12°C and 20°C, there is a significant rise in the risk of fire; When $(temp - temp^{-})$>20°C, the weather is dominated by high pressure.pressure situation, sunny performance, daytime extreme warming, afternoon The fire maintains a higher state as the wind speed increases.

**The Contribution of Diurnal Temperature Range**

$$CRH = \begin{cases} \{1/(1+(1/10(RH-20))^4\} \; if \; RH > 15\% \\ 1 \qquad\qquad otherwise \end{cases}$$

A fire is unlikely to occur when relative humidity exceeds 45 percent. The ratio of high fire risk begins to increase between 10% and 45 percent. Fires are also more likely to occur when the relative humidity is less than 15%.

**The Average Relative Humidity of the Air Three Days**

$$C3RH = \begin{cases} \{1/(1+(1/10(RRH-20))^3\} \; if \; RRH > 20\% \\ 1 \qquad\qquad otherwise \end{cases} \quad (4)$$

When the three-day average relative air humidity is larger than 40%, the risk of fire is reduced; when the relative humidity is between 20% and 40%, the risk of fire increases; and when the

relative humidity is less than 20%, the risk of fire increases, high danger

**The Contribution of 24 Hours of Precipitation**

$$CP = \begin{cases} \{1/(1/(1+(rain)^3\} \; if \;\; rain > 0 \\ 1 \qquad\qquad otherwise \end{cases} \quad (5)$$

The precipitation curve showed a smooth decreasing trend, with higher precipitation lowering the fire hazard index. You are in a high fire hazard zone when rainfall is less than 1mm, and the fire trend will not change. Significantly lower. If precipitation decreases at this time, it will reappear, There is a lot of fire.

**The Contribution of Wind Speed**

$$CWS = \begin{cases} \{1/(1/(1+1/12(7-wind))^{14}\} \; if \;\; wind < 7 \\ 1 \qquad\qquad otherwise \end{cases} \quad (6)$$

In the north, wind and precipitation usually occur at the same time, hence wind speed is a factor. Measurements were taken to eliminate the impact of the precipitation. When the wind picks up Wind speeds of 3 m/s or less have minimal impact on the occurrence of forest fires; winds of 3 m/s or more have a significant impact.The International Journal of Smart Homes is a publication dedicated to the advancement of smart homes

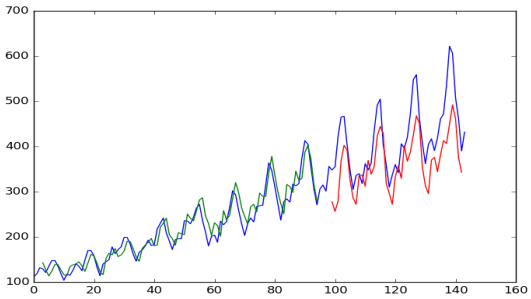


**Figure 6:** Results of KC-LSTM) to Forecasting Fire Frost for Training and Testing Dataset

## V. EVALUATION

The performance of the test of all models was checked, and we applied the specified metrics to the characteristics in the database such as ((RMSE, MAE, MBE, SDE, MSE, Pearson correlation (ρ), and the following became clear, as shown in the table below, to predict the land in forest fires, Note: smaller value preferred and ideally, it should be zero. A positive value gives the average amount of overestimation in the calculated value and vice versa.

Table II: Evaluation Metrics on Dataset

| | DMC | TEMP | WIND | RAIN | ISI |
|---|---|---|---|---|---|
| **RMSE** | 0.463 | 0.191 | 0.088153 | 0.473 | 0.099 |
| **MAE** | 0.281 | 0.649 | 0.708 | 0. 622 | 0.672 |
| **MBE** | 0.658 | 0.852 | 0. 556 | 0.021 | 0.714 |
| **SDE** | 0.861 | 0.633 | 0.593 | 0.678 | 0.685 |
| **MSE** | 0.481 | 0.838 | 0.850 | 0. 162 | 0.609 |

## VI. CONCLUSION

The primary contribution of meteorological elements from forest fires occurs above analysis point of view, there are certain factors that affect every single occurrence of forest fires, but forest fire causes can only be one factor in the choice. a variety of outcomes as a result of multiple factors interacting In this section, quite a few statistical measures are presented to evaluate the performance of the proposed models. Moreover, it was proved that the (KC-LSTM) model gives the best results according to the evaluation scales related to the area burned in forest fires as shown in figure 7. Through the application of the specified criteria, we found that (DMC, TEMP, ISI) is the most influential for the occurrence or increase of the probability of a forest fire. This paper found answer for the following questions:

*How knowledge contractions can be useful in building a recurrent neural network (RNN)?* Fire forecasts are usually generated from any data available for a given area without taking into account the cases of no fires for that forest, depending on the nature of the area. Therefore, the determinants of knowledge had a significant impact in reducing the effort to build these systems, as the nature of the probability of the occurrence or non-occurrence of fires was determined. before building a forecaster.

How to build a multi-layer model with a combination of two technologies) Neurocomputing with Knowledge contraction)? A network was characterized as containing several layers by mixing those parameters represented by one or more parameters for that layer, which increased the accuracy of the prediction model that was built, despite this, in turn, it led to an increase in the number of calculations that were performed, but it reduced the training time of the network and its access to the solution. More accurate in less time.

*Is used evaluation measure enough to evaluate the results of suggesting predictor?* determinants of knowledge have been identified. The main purpose of using more than one measure is to more accurately prove the results that have been reached.

*What is the beneficial result from building predictor by a combination between KC and LSTM?* The determinants had a significant impact on increasing the accuracy of the results and the speed of training, while the network itself was distinguished by its advantages that made it very useful for predicting forest fires, including its containment of memory, as well as the possibility of working with data collected in real time.

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