Smart E-Logistics for SCM Spend Analysis

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***Abstract*—Currently, there are many literature reviews on the application of predictive analytics in Supply Chain Management (SCM). However, most of them focus only on some specific functions in supply chain management, including Procurement, Demand Management, Logistics and Transportation, or purely technical aspects. The purpose of this paper is, it aims to provide an overview of the outstanding supply chain managementfunctions (SCMF) that apply predictive analytics. Spend analysisis one of the major areas of SCM, in which predictive analyticsis applied. LSTM model is created which provides a better accuracy for time series data. The results obtained are compared stating why the above mentioned LSTM approach is better. Along with Spend Analysis training of Printed and Handwritten documents for extraction of required fields is also worked upon. Extracting fields from different document templates (Printed and Handwritten Invoices and Proof of Delivery) was a challenge for which we were able to produce better results and accuracy.**

***Index Terms*—Predictive Analytics, Machine learning, Supply chain management (SCM), Long Short-Term Memory (LSTM), Data Augmentation, Image Pre processing, Form Recognizer**

I. INTRODUCTION

Logistics is that part of the supply chain process that plans, implements, and controls the efficient, effective flow and storage of goods, services, and related information from the point-of-origin to the point-of-consumption in order to meet customers' requirements. By sharing data, knowledge, and information with supply chain partners, e-Logistics is a dynamic combination of communication, computing, and collaboration technologies that alter core logistical operations to be customer centric. Delivering the right items to the right customer in the appropriate amounts, at the right time and place, is the ultimate goal of e-logistics. To help decision- makers and foresee certain future events, predictive models employ historical and transactional data to find trends forrisks and opportunities within a given set of circumstances. Predictive solutions can be used for a variety of purposes, but they are most valuable when they are customised for a specific kind of operation and built around a set of rules and guidelines designed just for that business. By using predictive solutions togenerate supply and demand forecasts, companies will be ableto make the right operational decisions in a proactive manner.

This approach can also allow for the re-balancing of assetsacross any logistic network at a minimal cost.

II. LITERATURE REVIEW

Demand management is the most SCM function using predictive analytics [1]. In fact, the reviewed literature demonstrated a number of contributions addressing the analysis of historical datasets and the capture of real-time demand changes for sensing and anticipating need. Demand forecasting is the precise assessment of a product's demand using the relationship between the product and a group of unrelatedinput variables.

Data collection: The process of comprehending and com- piling data on elements connected to SCM operations, such as sourcing risk, demand forecasts, etc., is known as data collection. However, excessive data will take time to normalise, and inaccurate data will skew the system's overall findings. As a result, choosing the right data source is crucial to the system's performance. It is obvious that the phase of data collecting is the most crucial in the entire system.

Feature extraction: The process of extracting some crucial characteristics from a dataset using several techniques, like cross-validation and REF, is known as feature extraction. As a result, a subset that is derived from the original data will produce a result that is more accurate than the original data. Asa result, this feature extraction technique needs to be applied to the acquired data.

Feature selection: The data must be chosen using the feature selection procedure after being divided into subsets with features in order to choose the data with the most crucial characteristic. DT, XG-boost, ACF, and other popular methods could be employed at this stage.

Optimized model generation: After completing the pre- processing steps, the data must now be divided into two sets: the training dataset and the testing dataset. As a result, the training dataset is used to develop the optimised model by identifying the best parameters, and the testing dataset is used to confirm the accuracy of the system output. However, with the exception of partner selection in procurement functions, this dataset decomposition applies to all SCMF research issues. In terms of partner selection, the results will be obtained by directly applying the normalised dataset to a certain methodor model.

Prediction/ Classification implement and Evaluation: To detect and anticipate outcomes, such as a risk prediction for SCRM (source risk management), customer engagement (demand sensing), future demand (demand forecasting), etc., testing dataset will be applied to the optimised model. Additionally, the normalised dataset will be directly put to the method or model for partner selection in order to assess the possible risk of the provider.

The datasets included in this paper display a wide range of properties and formats. The variety of datasets originates from various supply chain functions, ranging from text databases to time-series historical datasets and numerical, historical statistics datasets. The time-series dataset is utilised during the data gathering phase as the main data attribute for anticipating demand. Original or raw datasets frequently include unstructured information, redundant attributes, and confusing, incorrect attributes. In order to normalise raw data or pickthe data with the most significant characteristics, numerous strategies and algorithms have been utilised during the pre- processing stage, particularly during the Feature selection phrase. The transmission method and differences between the original dataset and the optimised featured/normalized dataset are, however, only fully demonstrated in three studies. The forecasting process can be divided into processing stages.[2] Typically, it may consist the following: •An initial examination of the original time series is conducted with the intentionof obtaining high-quality, reliable data after identifying any gaps in the data or the need for time series interpolation; the choice of interpolation technique influences the outcomes of subsequent calculations (i.e. correlation or similarity analysis).

•the use of preprocessing algorithms (for example, to retrieve valuable information, to noise reduction, to extract specific components from processed time series). • an implementation of chosen forecasting algorithm(s) across a predetermined time horizon. • Dedicated error measurements are used to analyse the quality of the prediction findings (for example, root mean square errors, RMSEs). The latest value of the processed series serves as the best predictor in the Wiener process (random walk), which treats daily increments as stationary sequences of independent random numbers, particularly for short-term prediction horizons. The zero order-hold (ZOH)and first order-hold (FOH) approaches can be applied for this purpose. Zero Order denotes a constant function; to fill up the gaps, we interpolate the same value. First order indicates that we can interpolate using a linear function (Line with a slope). Hold refers to keeping the parameters constant untilthe following sample. Time series with a trend and a random component are smoothed and predicted using the Holt's model.The linear trend in the series "yn" is expressed by the first- order polynomial. Exponentially smoothing is used to control the variable level and its increments. The adaptive Holt's model can be applied by the parameters (weights) adaptationin a moving window. p-step prediction of time series y at the time n is calculated as: In order to produce a Newton series that matches the data, polynomial extrapolation is often done using Lagrange interpolation or Newton's method of finite differences. The generated polynomial can be applied to the data to extrapolate it. Use high-order polynomial extrapolationwith caution. With additional k-fold cross validation, the erroris reduced and the outcome is obtained considerably more quickly. [3] A class called K-Fold enables you to divide your data into K folds. The advantage of LSTM is that each cell tries to retain the most important information in the data. By using a memory unit known as a cell unit or cell memory for a network, LSTM was developed to correct the exploding and vanishing gradient during training RNN. The model can learn from every output of the sequence data since cells are allowed to remember the results. The most essential three gates of LSTM model: update, forget and output gates.

$$\hat{c}_t=\tanh(W_c[a_{t-1},x_t]+b_c) \quad (1)$$

$$u_t=\sigma(W_u[a_{t-1},x_t]+b_u) \quad (2)$$

$$f_t=\sigma(W_f[a_{t-1},x_t]+b_f) \quad (3)$$

$$o_t=\sigma(W_o[a_{t-1},x_t]+b_o) \quad (4)$$

$$c_t=u_t*\hat{c}_t+f_t*c_{t-1} \quad (5)$$

$$a_t=o_t*\tanh(c_t) \quad (6)$$

A candidate is calculated using equation 1. The weightwc and bias bc are the candidate t's own parameters. The weight wu and the biasbu are the parameters of the update gate ut, which is calculated in Equation 2. By utilising a sigmoid function, they assist the model in determining whento update the memory cell; if the output of the sigmoid function is close to one, it is updated, and if it is close tozero, it is disregarded. The parameters of the memory cellwill be updated by multiplying the output of update gate ut and candidate t. The forget gate operates in a manner similar to that of the update gate. Equation 3 demonstrateshow the model can decide when to erase the data stored in a memory cell by using the forget gate. The weight w0and the bias b0 are the specifications for the forget gate ft. Equation 4 calculates the output gate ot by adding the biasb0 and weight w0 to the current input. By multiplying the update gate by the candidate t and adding it to the forgetgate, which is multiplied by the previous cell state ct-1, anew cell state c t is computed and passed to the followinglayer using Equation 5 to update the parameters to cell state.

A common metric for determining how accurately a model predicts quantitative data is the root mean square error (RMSE).

Comparing ARIMA and LSTM-based algorithms, the pre- diction was improved by an average of 85Comparison of the effectiveness of ARIMA and LSTM models in terms of lowering error rates is added, and it is a generalisation ofthe more straightforward Auto Regressive Moving Average. Because the data that was gathered and analysed are non- stationary, ARIMA is chosen to serve as a proxy of conventional forecast modelling. The LSTM approach is employed similarly and as a representation of deep learning-based algorithms due to its use in maintaining and training the features ofgiven data over a longer duration. A type of recurrent neural network called long short-term memory (LSTM) is able to retain values from earlier stages for use in the future.

LSTM-based algorithm improved the prediction by 85% on average compared to ARIMA. There are five major stages in OCR. They are as follows: [5]

1. Digitization
2. Pre-processing
3. Segmentation
4. Feature Extraction
5. Post-processing

• Converting handwriting or text documents into electronic format is what is meant by digitization. The pre-processing stage is the next step for the image. • Location segmentation and noise reduction involve smoothing, thinning, fixing breakages, de-skewing, etc. of the image as part of pre-processing. •Segmentation is the process of removing individual characters from an image. • Following character separation, each charac- ter's unique features—including diagonal, intersection, transition, direction, curve fitting, etc.—are retrieved and transmittedfor post-processing. • Character grouping and error detection are included in the post-processing

OCR recognition rate can be greatly improved using Beizer Curve. [6]

Less than 30% of the actual number of characters in the textimage can be recognised before repair, and there are numerous mistakes. All characters may be recognised in the text image after correction, and there are fewer mistakes. Traditional paper text, especially books, will generate apparent bending distortion during the picture collecting process, affecting the recognition accuracy of OCR. This paper suggests a text repairtechnique based on a bezier curve. As part of a deep learning strategy, text regions are detected by utilising ROI to construct border boxes, and text is then retrieved using convolutionneural networks. [7]

The following phases make up the suggested strategy:

Image acquisition: In image acquisition, images that willbe processed are stored in a local file and read one at a timeas they are processed. The RGB channel is used to store the images.

Pre-processing: A unique dataset with 467 photos is made for an experiment. Phases for testing and training are separated from the dataset. 258 photos from the collection are tested, and209 images are trained for text extraction and identification. Results from the data set are assessed in light of these.

Images are grayscaled at the pre-processing stage. The image is changed to grayscale by multiplying the RGB values by 0.29, 0.587, and 0.114, respectively. The Otsu methodis used for dimensionality (shape, width, and height) and layer reduction to identify each pixel. The algorithm outputs a single intensity threshold that divides pixels into two groups, foreground and background.

Binarization:

Binarization is the process of taking a grayscale image and turning it into one that is incredibly differentiating, thereby reducing the amount of information it contains from 256 shades of grey to one that is extremely contrasting and disguised as a binary image.

By measuring background brightness and the depth of the black area along the line, adaptive binarization can determine the best binarization parameters for each individual line segment. Higher acknowledgement precision will be attained asa result of the lines and words being precisely separated.

Segmentation:

The text region will be recognised and detected during the segmentation phase utilising the region of interest. By assembling related pixels with comparable attributes, text and non- text regions are separated. The text is detected from the region of interest (ROI) by constructing a border box once the text region has been identified by taking into account the x, y planeof the text region.

Edges in the text section of the image are found using width and height, which are expressed as pixel coordinates, and returned to ROI. Bounding boxes are drawn using pixel coordinates.

Feature Extraction:

Convolution and pooling procedures of CNN are used in feature extraction to identify the optimum features. Before extracting the text from the blurred and unblurred photos, the system is trained on the images. With the aid of a convolution neural network, the text will be retrieved (CNN). Each char- acter in the text created by the bounding box is recognised and displayed over an image using trained characters.

The two operations that make up a traditional CNN are convolution and pooling, and the input picture can instantly be convolved with different convolution kernels. The output of this operational series is typically linked to a fully linked layer, which is fundamentally comparable to a multilayer perception neural network (MCP)

III. PROPOSED ARCHITECTURE

A. INVOICE RECONCILIATION MODULE:

Upload the scanned copy of POD (Proof of Delivery) and Invoice.

Image Uploaded to Blob Storage. (Blob storage is a feature in Microsoft Azure that lets developers store data in Microsoft's cloud platform).

Image accessed from the Blob storage and OCR (Optical Character Recognition) is applied on the uploaded POD and Invoice.

Text from the upload POD or Invoice is extracted and isprinted in form of output.

Once the data from both the uploaded documents is collected, they are compared and based on which the match confidenceis calculated and along with that the accuracy on which the field is extracted by the OCR.

B. STEPS

1. Model Training and Testing:

Labelling and training models using Form Recognizer andtesting for the same

Form Recognizer:

Creation of a project

Uploading the images to be trained to the blob storage.Labelling the data

Label.json and Ocr.json files would be created after the modelis trained.

2. Data Cleaning:

Cleaning the extracted data from new trained models

3. Combine Test And Restructure:

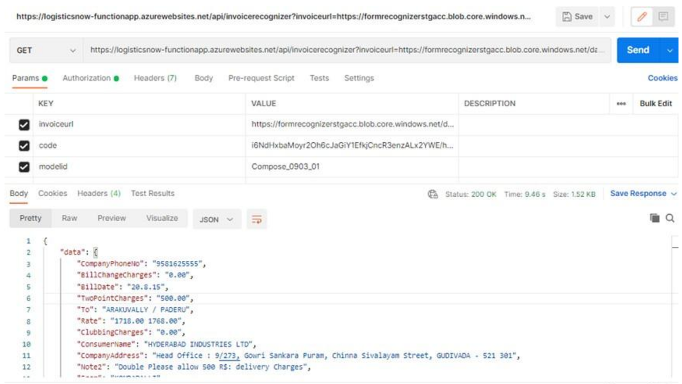
Combine the model with existing model, test for the same.Restructure the data sent to UI

4. Comparison of Values:

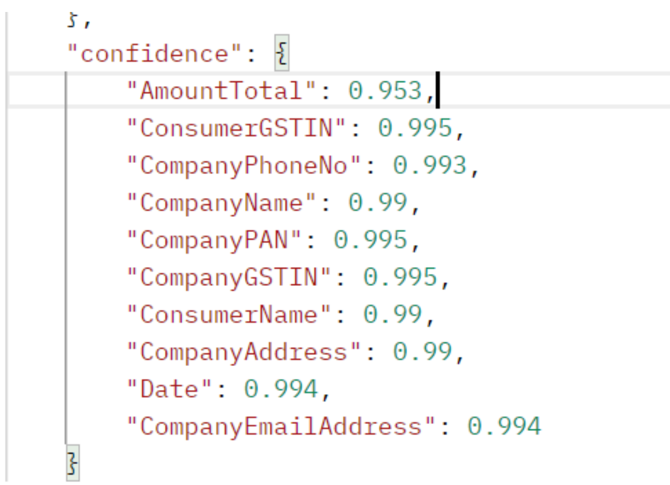
Compare the Invoice and POD, get accurate results.Compare extracted values with Freight Master

5. Match Confidence Calculation:Calculation of match Confidence

For Printed Document: Output: Extraction of Fields



Accuracy Obtained:



The above image states that the fields extracted from the handwritten documents do not obtain desired accuracy. Hence, to deal with this issue two approaches were considered.

C. PREPARATION OF SINGLE MODEL

The Invoices and Proof of Delivery available in real world do not follow a single template. There and multiple templates and multiple different fields which are required to be extractedand placed at different positions.

Creation of a single model decreases the accuracy of the model.

Tag	Estimated Accuracy
Date	100.00%
From	58.30%
InvoiceID	100.00%
To	75.00%
TotalAmount	100.00%
VendorName	100.00%

The above image shows the accuracy of each field extractedwhen two different types of documents are trained together.

Tag	Estimated Accuracy
Date	100.00%
From	77.80%
InvoiceID	100.00%
To	66.70%
TotalAmount	100.00%
VendorName	100.00%

The above image shows the accuracy of each field extracted when three different types of documents are trained together.

To overcome this issue we came up with a solution of creation of different model for different types of documents and then combine them together to form a single master model.

This approach provided us better accuracy.

D. METHODS

Method 1:

1. Application of Data Augmentation to increase the datasetfor training and testing purpose, to get more accurate results.
2. Application of Image Pre-processing Techniques.
3. Then train the obtained images with the help of FormRecognizer.
4. Analyse the Results.
5. This approach did not provide much better accuracy.

Method 2:

1. Train the Model using the Form Recognizer.
2. Analyse the output.
3. If the output is not as accurate as required.
4. Prepare a set of keywords, create an excel file for thesame.

From	To	ConsumerName	ConsumerAddress	CompanyName	CompanyAddress	Branch
Kondapalli	Paderu	M/S MARICO LIMITED	MENONPARA ROAD, JIKODE, PALAKKAD -678621.	ADITYA SAI LOGISTICS	9/273, GOWRI SANKARA PURAM, CHINNA SIVALAYAM STREET, GUDIVADA - 521 301	HARIDWAR
Kanjikode	Trichur	M/S. JYOTHY LABORATORIES PVT. LTD.	B BLOCK 8TH FLOOR NO.173 NELSON MANICKAM ROAD AMINJIKARAI CHENNAI 600 029	A.S. TRANSPORT PRIVATE LIMITED	BLOCK, 8 TH FLOOR NO.173, NELSON MANICKAM ROAD, AMINJIKARAI, CHENNAI - 600 029.	JAMMU
Coimbatore	Arakuvally	HECTOR BEVERAGES PRIVATE LIMITED	330 FINCHLEY CASTLE OUTER CIRCLE DODSWORTH LAYOUT WHITEFIELD BENGLURU KARNATAKA 560066	S.P. GOLDEN PVT. LTD.	AMBALA 846/4C, 1ST FLOOR, OPP HARYANA MOTER MARKET, G.T.ROAD,AMBALA CITEY-134003	VARANASI
K.G. Chavadi	Ahmedabad	HIL	M/S. JYOTHY LABORATORIES LTD. AMBALA	ANAND ROAD LINES	S-5, ANAND-DEEP BUILDING, GWALIOR - 474011 H.O .: 601, DEEPALI BUILDING, 92, NEHRU PLACE, NEW DELHI 110019	
Navakarai	K.G. Chavadi	HBPL	M/S. JYOTHY LABORATORIES LTD. JAMMU	FORD SMART MOBILITY PVT LTD	2ND FLOOR, PLAT NO. 22, TRENDZ ETERNITY BUILDING, GREEN LAND COLONY, GACHIBOWLL, HYDERABAD, TELANGANA, 500032	
AMBALA	Nagpur	HYDERABAD INDUSTRIES LTD	NEW INDUSTRIAL DEVELOPMENT AREA MENONPARA ROAD KANJIKODE 678 621 DIST PALAKKAD KERALA	WESTERN CARRIERS	67/28 STRAND ROAD KOLKATA-6 B.O:709,VIKASDEEP BUILDING LAXMI NAGAR DISTT CENTER DELHI 110092	
BARI	Pune		NO. 42 A. C/O SVA LOGISTIC PVT LTD ROAD NO.3. 1ST PHASE JIGANI INDUSTRIAL AREA BENGALURU (BANGALORE) RURAL KARNATAKA 562106	BALAJI LOGISTICS	128/3/140, YASHODA NAGAR, KANPUR -208 011	
BRAHMAN	Raipur		HECTOR BEVERAGES PVT LTD KADAKOLA INDUSTRIAL AREA MYSORE DIST KARNATAKA	B.D. C & F AGENCIES	K-67/85-21 BHARAT MILAP COLONY NATI IMLI, VARANASI-221001	
COIMBATORE	Banglore		C/O CRYSTAL MARKETING CORPORATION RAMANTHAPUR HYDERABAD 500039	MATHRUSHREE ROAD CARRIERS	NO. 107, 2ND FLOOR, 4TH CROSS, KALASIPALYAM NEW EXTENSION, BANGALORE - 560 002	
Mysore	BHIWANDI		STRAND ROAD KOLKATA B.O VIKASDEEP BUILDING LAXMI NAGAR DISTT CENTER DELHI 110092	FAMOUS ROAD LINES	D.NO.6-84/1, MUTHANGI VILL, PATANCHERU MDL, SANGAREDDY DIST, TELANGANA - 502319	
ROORKEE	HOWARH		HINDUSTAN SUPPLIERS MAIN ROAD SIMDEGA SIMDEGA 953223 JHARKHAND (INDIA)	KONARK ROADLINES LLP	DEVASHISH CO.OP. HSG. SOC. LTD ., A-304, KOLSHET ROAD, OPP.DHOKALI POWER HOUSE, THANE (W)- 400 607	
JAMMU	KOLKATA		DODSWORTH LAYOUT WHITEFIELD B'LORE 560-066	SOUTHERN CARGO CARRIERS INDIA	NO.52 ,2ND CROSS KALASIPALYAM NEW EXTENSION BANGALORE -560002.	
Phoolpur	KANPUR			GANGA JAMNA CARRIERS	F-6,SHIVAN PLAZA, POCKET B & E MARKET, DILSHAD GARDEN, DELHI-110095	
VARANASI	RANCHI			M.R.S ROADWAYS	REGUS TEJAS ARCADE, OFFICE NO 311, RAJAJINAGAR - 560010. BANGALORE, KARNATAKA	
MYSORE	BANGALORE			HIL	JASIDIH - 844142 JHARKHAND	
PAITHAN	ROHTAK			VARUNA INTEGRATED CARRIERS	SHAHJAHAN PUR ROAD, SHYAMGANJ,BAREILLY. (U.P.) 243005	
Sathariya	Goa			TCI FREIGHT	NO. 205-7, ASHOKA BHOOPA CHAMBERS, S.P. ROED, SECUNDERABAD-500003	
MYS	Bengaluru			HEENA ROADLINE	JAIN SPINNER STOP, ADARSHNAGAR, M.I.D.C.PAITHAN DIST. AURANGABAD-431148	
KADAKOLA	Bhubaneshwar			ATHARV LOGISTICS	PLOT NO. 96, PHASE-II, INDUSTRIAL AREA (RAM DARBAR), CHANDIGARH-160002.	

5. Once the value is extracted, it will pass through all the keywords present in the list for that particular key.

6. Algorithm will compare the entire extracted string with the keywords and the output which is more similar will be considered.

7. This approach is not mentioned in any of the papers, no paper talks about extracting the proper output if not recognised properly.

Output: Extraction of Fields For Handwritten Documents:


```
"ConsigneeName": "SAMRIDDHI ENTERPRISES AWASTHI GALI IBRAHIMGANT CHHIBRAMAU KANNAUJ 209721",
"CompanyName": "B.D. C & F AGENCIES",
"Date": "27/03/2022",
"GSTIN": "09ABYPA4380NIZX",
"CompanyHeadOffice": "K. 67/85-21, Nati Imli, Varanasi - 221001",
"From": "PhoolpurVNS",
"To": "KANNAUJ",
"CompanyAddress": "S. 8/119 B-1, Sudhakar Road, Khajuri, Varanasi - 221002",
"FSSAINo": "12719038000832",
"TruckNo": "HR46D-4471",
"CompanyBranchOffice": "Vir Bahadur Singh, New Transport Nagar, Gidda, Gorakhpur Mob .:
    8874111101 A-9, Site No. 5, Uddyog Kunj, Panki, Kanpur Mob .: 9335747474, 9307371176 B-5,
    Industrial Area, Naini, Prayagraj - 211008",
"InvoiceNo": "2899",
```


The above image states that the fields extracted from thehandwritten documents obtain the desired accuracy.

E. IMPLEMENTATION OF STACKED LSTM:

STEP 1: The transporter Dataset

The dataset contains fields such as symbol, date, spend, high rate, low rate., open rate, volume, average close, average high, average open and average volume. It contains “1257”rows of data.

STEP 2: Plot the obtained dataset and application of Min

– Max scaler. Plot the graph for the gathered dataset usingthe matplotlib library and get an overview of the data.

Using the Min – Max scaler function convert all the outputs present in the dataset in a range of 0 to 1. 0 represents the smallest value and 1 represents the maximum value and restof the values present and adjusted between the given range.

STEP 3: Splitting the dataset into test and train dataset. Splitting the dataset into test and train data is an important task. The data being time- series data cannot be distributed across testing and training data randomly.Data used for training and testing Is distributed sequentially.

STEP 4: Converting the array into a dataset matrix. Convert the array into dataset matrix and reshape the same.

STEP 5: Reshaping the input which is required as perLSTM.

You always have to give a three-dimensional array as aninput to your LSTM network. Where the first dimension represents the batch size, the second dimension represents the number of time-steps you are feeding a sequence. And the third dimension represents the number of units in one input sequence.

STEP 6: Creating a stacked LSTM Model

An LSTM model comprised of multiple LSTM layers.

```
### Create the Stacked LSTM model
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import LSTM
```

```
model=Sequential()
model.add(LSTM(50,return_sequences=True,input_shape=(100,1)))
model.add(LSTM(50,return_sequences=True))
model.add(LSTM(50))
model.add(Dense(1))
model.compile(loss='mean_squared_error',optimizer='adam')
```

STEP 7: Checking the model summary after training

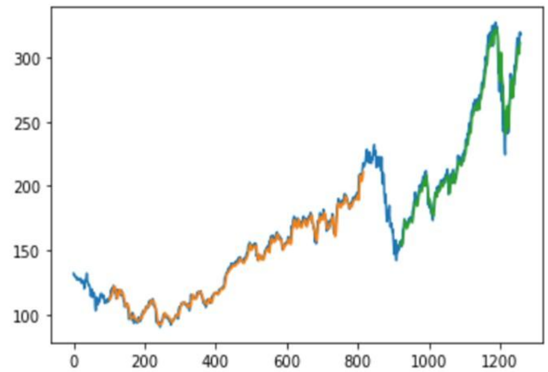
```
model.summary()

Model: "sequential_3"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_7 (LSTM)                (None, 100, 50)           10400
_________________________________________________________________
lstm_8 (LSTM)                (None, 100, 50)           20200
_________________________________________________________________
lstm_9 (LSTM)                (None, 50)                20200
_________________________________________________________________
dense_3 (Dense)              (None, 1)                 51
=================================================================
Total params: 50,851
Trainable params: 50,851
Non-trainable params: 0
_________________________________________________________________
```

STEP 8: Predicting and checking the performance metrics STEP 9: Calculating the RMSE (Root Mean Square Error)

It is required to judge a model's performance, whether it be during training, cross-validation, or monitoring after deploy- ment

STEP 10: Plotting the predicted output

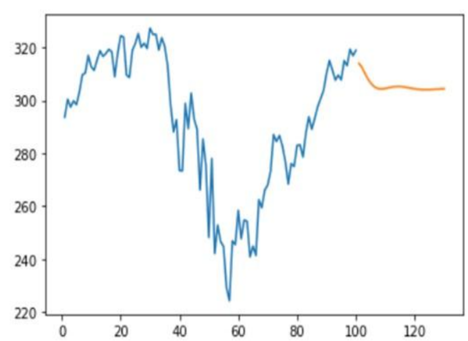


IV. RESULTS AND DISCUSSION

The result obtained after training a model using stackedLSTM is stated below:

```
plt.plot(day_new,scaler.inverse_transform(df1[1158:]))
plt.plot(day_pred,scaler.inverse_transform(lst_output))
```

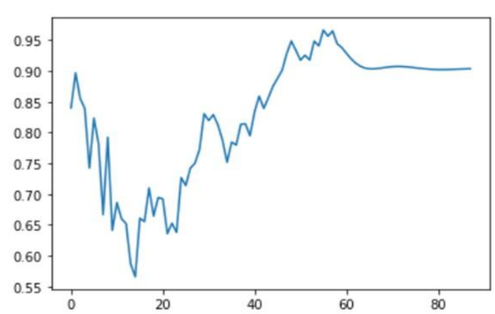
```
[<matplotlib.lines.Line2D at 0x2d1b0f352b0>]
```



Comparison of result with the original data plotting tocheck the accuracy of the trained model in graphical format:

```
df3=df1.tolist()
df3.extend(lst_output)
plt.plot(df3[1200:])
```

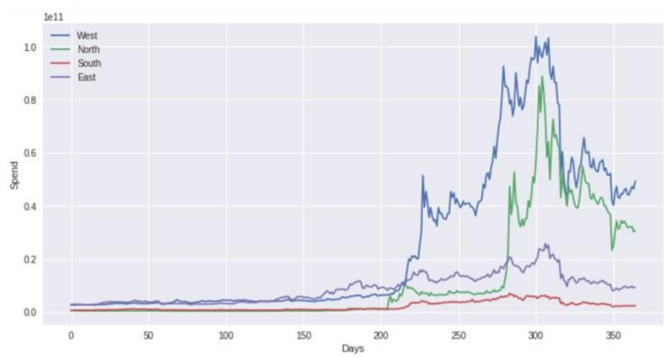
```
[<matplotlib.lines.Line2D at 0x2d1b0f55ac8>]
```




```
df3=scaler.inverse_transform(df3).tolist()
```

V. CONCLUSION AND FUTURE WORK

The LSTM model provides a better accuracy comparedto other models as stated by different authors, LSTM model was never used in the Supply Chain Management for model creation and prediction. We have created a Stacked LSTM model. It comprises of sequential layer, LSTM and Dense Layer. The total accuracy obtained after using LSTM model is 84%. The dataset fetched was a medium sized dataset, can usebig dataset to get more accurate results. The results obtained from above paper are for spend analysis, along with that we can even use predictive analysis for Demand Forecasting.



The above graph shows an analysis of spend in every zone before and after the Covid Pandemic.Days after 200 showsthe peroid when the Covid Pandemic was in better control and the days starting from 0 shows the period when the pandemic was at its peak.

Invoice List	
Invoice Types	Accuracy Obtained
Printed	92
Handwritten	84

The above table gives a proper representation of the typesof invoices trained and accuracy obtained after extraction of all the possible fields from the document.

The results obtained can also be used for:

- Calculation of percentage of mode which is used the most.
- The truck which is most in demand.
- Which industry uses the system most.
- In which areas the demand of truck is the most.
- Calculation of the amount saved by the company on everyorder
- To predict how much the company can save for other ordersbased on prediction model.
- Which area has the greatest number of transporters.
- Help transporters to gain more business.

REFERENCES

[1] Pham, Xuan Vy, et al. "Predictive analysis of the supply chain manage- ment using Machine learning approaches: Review and Taxonomy." 2020 5th International Conference on Innovative Technologies in Intelligent Systems and Industrial Applications (CITISIA). IEEE, 2020.

[2] Pełech-Pilichowski, T. "On adaptive prediction of nonstationary and inconsistent large time series data." 2018 41st International Conven- tion on Information and Communication Technology, Electronics and Microelectronics (MIPRO). IEEE, 2018.

[3] Sarah, Alkharif, Kyungyong Lee, and Hyeokman Kim. "Lstm model to forecast time series for EC2 cloud price." 2018 IEEE 16th Intl Conf on Dependable, Autonomic and Secure Computing, 16th Intl Conf on Pervasive Intelligence and Computing, 4th Intl Conf on Big Data Intelligence and Computing and Cyber Science and Technology Congress (DASC/PiCom/DataCom/CyberSciTech). IEEE, 2018.

[4] Siami-Namini, Sima, Neda Tavakoli, and Akbar Siami Namin. "A comparison of ARIMA and LSTM in forecasting time series." 2018 17thIEEE International Conference on Machine Learning and Applications (ICMLA). IEEE, 2018.

[5] Marne, Mrunal G., et al. "Identification of optimal optical character recognition (OCR) engine for proposed system." 2018 Fourth Interna- tional Conference on Computing Communication Control and Automation (ICCUBEA). IEEE, 2018.

[6] Li, Yu, et al. "Research on Improving OCR Recognition Based on Bending Correction." 2020 IEEE 9th Joint International Information Technology and Artificial Intelligence Conference (ITAIC). Vol. 9. IEEE, 2020.

[7] Duth, Sudharshan P., and H. L. Rahul. "Identification and Extraction of Text in Non-Blurred and Blurred Image Sequences." 2020 4th International Conference on Intelligent Computing and Control Systems (ICICCS). IEEE, 2020.

[8] Tseng, Ming-Lang, Kuo-Jui Wu, and Thi Thoa Nguyen. "Information technology in supply chain management: a case study." Procedia-Social and Behavioral Sciences 25 (2011): 257-272.

[9] Wankhede, Poonam A., and Sudhir W. Mohod. "A different image content-based retrievals using OCR techniques." 2017 international conference of electronics, communication and aerospace technology (ICECA). Vol. 2. IEEE, 2017.

[10] Munir, U., and M. O¨ztu¨rk. "Automatic character extraction from handwritten scanned documents to build large scale database." 2019 Scientific Meeting on Electrical-Electronics Biomedical Engineering and Computer Science (EBBT). IEEE, 2019.

[11] Khiari, Jihed, and Cristina Olaverri-Monreal. "Boosting Algorithms for Delivery Time Prediction in Transportation Logistics." 2020 Interna- tional Conference on Data Mining Workshops (ICDMW). IEEE, 2020.

[12] Mainkar, Vaibhav V., et al. "Handwritten Character Recognition to Obtain Editable Text." 2020 International Conference on Electronics and Sustainable Communication Systems (ICESC). IEEE, 2020.

[13] Yuan, Wen-Jing, et al. "Forecast of logistics demand based on grey deep neural network model." 2018 International Conference on Machine Learning and Cybernetics (ICMLC). Vol. 1. IEEE, 2018.

[14] Gupta, Nitin, and Neha Goyal. "Machine Learning Tensor Flow Based Platform for Recognition of Hand Written Text." 2021 International Conference on Computer Communication and Informatics (ICCCI). IEEE, 2021.

[15] Darapaneni, Narayana, et al. "Handwritten Form Recognition Using Artificial Neural Network." 2020 IEEE 15th International Conference on Industrial and Information Systems (ICIIS). IEEE, 2020.