



APPLICATION OF A.I IN FOREX TRADING
‘FOREX MARKET PREDICTION USING DEEP LEARNING TECHNIQUES’ -
A REVIEW OF ETHICAL IMPLICATION

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ARTIFICIAL INTELLIGENCE ETHICS AND APPLICATIONS

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ABSTRACT

The ethical issues are analyzed when the predication model is implemented on the 'Forex trading' using deep learning algorithm. The dataset of EUR/USD pair is taken for the duration 2010-2020 and the analysis is made to detect the daily changes in the prices. The dataset was processed and subjected to LSTM, a type of deep learning algorithm model. The accuracy and performance of the algorithm was closely monitored. The ethical issues arising through the process were closely observed and the detailed explanation is given in this report. Large amount of data are used through the process and utmost care was taken to verify the data because any unqualified data if sent for processing will lead to serious problems. As this cause a negative reputation for the firm and regulatory issues. Improper methods of dealing with data poses serious ethical issues and a team with technically strong personnel should be employed. All the team members including the board members should know the overall design pattern of the process so the ethical issues can be avoided.

INTRODUCTION

Background

Forex market is the world's largest financial market. It is even bigger than the stock market which is valued at around \$2.4 Quadrillion as per the latest data taken in 2020. The price of different currencies depends on various external factors which includes growth rate, interest rates, political stability and current account deficit to name a few. Different methodologies are employed by the money managers and hedge funds to predict the variation in prices. Fundamental and technical analyses are two methodologies which the Forex traders have traditionally employed for prediction. Artificial intelligence has applications in various sectors including trading systems which are modeled to act on their own with less human intervention. M.L and D.L algorithms are constantly deployed to develop these models. Because historical data on Forex prices is a time series, prices in the past will influence prices in the future when anticipating them. Several research studies have shown that Long Short-Term Memory (LSTM), a deep learning model, outperforms traditional machine learning techniques when modelling time series.

REVIEW OF RELEVANT LITERATURE

Prediction of Price Changes in the Forex Market using various Technologies

The largest financial market, the foreign exchange market, outperforms the value of other trading financial instruments. The number of traders in the Forex market is increasing at a rapid phase [1] as various players from central banks to exporters need to either buy or sell the currency for their daily operations. As a result, large amounts of investments are made around the world and the trading volume approaches a daily volume of \$ 6.6 trillion [2].

'EUR/USD' represents the Euro currency versus the US dollar. In similar, various currencies trade against each other in pairs like 'EUR/GBP' or 'GBP/USD'. Traditional methods such as fundamental and technical assessments are carried out by the traders for prediction. Fundamental analysis is based on the financial reports, growth rates, fed rates, economic announcements, social and political dynamics [3].

Traders and retail investors utilize the pricing charts to predict the future prices based on the historical prices which provides a rough indication on the expected market movement. Then the technical indicators are also applied to forecast the price movements as it is the simplest method used for prediction [4]. Momentum refers to a price which changes constantly and if the uptrend is expected to continue, it resembles a favorable trend. When a downturn continues indefinitely, it is called a negative trend [5].

Artificial Intelligence (AI) is widely used in numerous fields in specific to the financial sector to make smart decisions for the past two decades and its applications has been enormous due to the latest advancements. Support Vector Machine [6], Artificial Neural Network [7] and Recurrent Neural Network [8] are the popular AI algorithms which were used in the previous research. Rolling window LSTM model was used by Huisi et al [9] to forecast the Bitcoin prices in the year 2008. The data inputs used are global currency ratios, economic and block chain data. Some of the elements to consider include the length of the input, the proper volume of training data as well as the frequency of the model is updated to make it flexible.

MATERIALS AND METHODOLOGY

Methodology - Long Short - Term Memory Model

The model is an advancement of Recurrent Neural Network, a deep learning method which is particularly effective for Time series analysis where the past events has influenced a future activity [10]. RNN sends the inputs to all the nodes present and these nodes perform their own mathematical functions to execute the calculations. As shown in the figure, the outputs will be transferred to the next node for further calculation.

The feed forward network uses RNN where the output values are passed onto the next node without being remembered. BP should go back many steps through various nodes where a problem is caused due to back-propagation (BP) and error calculation after the node terminates which is called the Vanishing gradient problem [11].

To avoid the vanishing gradient problem, LSTM recognizes the prior data using memory cell state. Input, Forget and Output gate forms the LSTM architecture. Input gate decides whether to allow the additional input and when a data is no longer required, the forget date deletes it. Output gate produces output at the present moment.

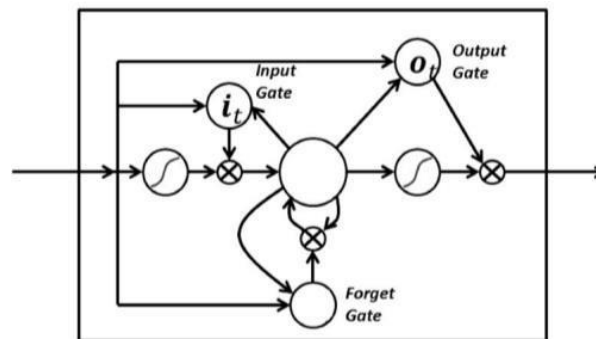


Fig : LSTM Model

EXPERIMENT

Sequence of One to many prediction method was used to create a predictive model as its fits well with the way python programming tools are used to formulate problems.

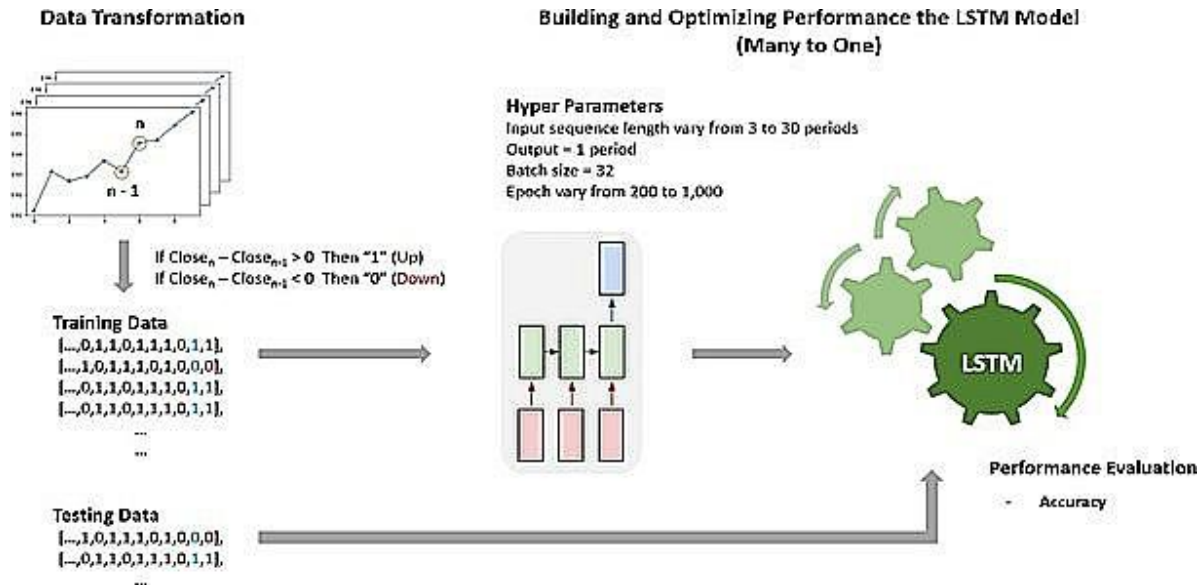


Fig: Flow of LSTM Process with Forex Data

The Dataset

The historical data of EUR/USD pair was extracted (source: uk.investing.com) for the period from May 2010 to Dec 2019 for training with the LSTM model. To test the model, Jan 2020 to Oct 2020 data was used.

	index	date	time	open	high	low	close	volume	shift_close
0	9774	2010.05.04	00:00	1.31884	1.32131	1.29629	1.29718	48690	1.28182
1	9775	2010.05.05	00:00	1.29702	1.29956	1.27891	1.28182	57402	1.26296
2	9776	2010.05.06	00:00	1.28191	1.28557	1.25270	1.26296	73442	1.27518
3	9777	2010.05.07	00:00	1.26296	1.27973	1.25860	1.27518	83142	1.27864
4	9778	2010.05.10	00:00	1.29299	1.30934	1.27588	1.27864	78501	1.26328
...
2713	12487	2020.10.13	00:00	1.18120	1.18155	1.17305	1.17446	40707	1.17452
2714	12488	2020.10.14	00:00	1.17452	1.17712	1.17195	1.17452	41998	1.17073
2715	12489	2020.10.15	00:00	1.17452	1.17576	1.16882	1.17073	46911	1.17153
2716	12490	2020.10.16	00:00	1.17073	1.17460	1.16939	1.17153	41413	1.17656
2717	12491	2020.10.19	00:00	1.17181	1.17929	1.17023	1.17656	50490	1.17694

2718 rows x 9 columns

Fig : Overview of Dataset

Data Preprocessing

The 10 years dataset was selected and normalized by cleaning, scaling and data was reshaped. The selected dataset has been converted to 'Numpy Array' format to make the preprocessing step faster and versatile. Then Data was Spitted into train and test sliding windows technique [13] for long prediction evaluation.

Quantitative Data Analysis

The Data was visualized to understand the changes in the opening and closing price based on the years and other factors using power BI tool as shown in images below.

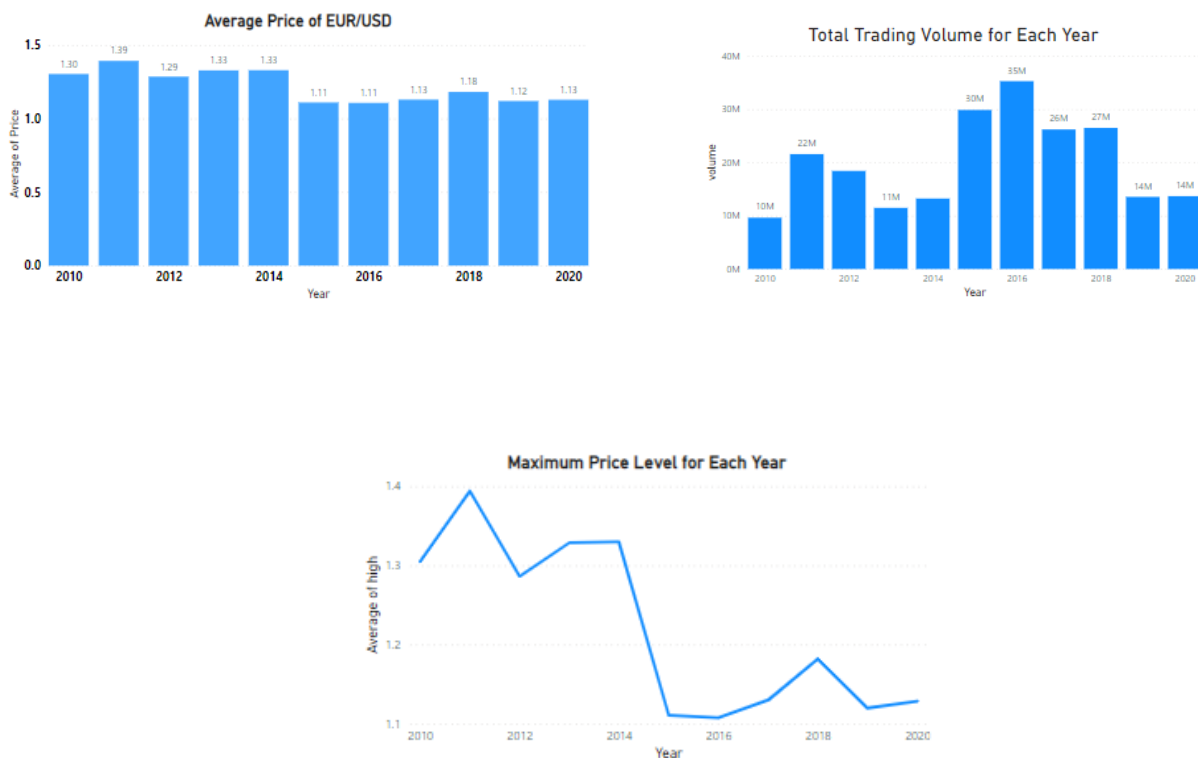


Fig : Price Changes Based on Year

Ethical Concern in Data Processing

A semi-structured qualitative study indicates that the most ethical issue is related to handling of Forex market prediction data. Another ethical concern is the information security and confidentiality. As the developments in A.I & Data science is moving at a rapid pace, the Forex trading methods are continuously changing. Training and building the model requires large amount of data which cannot be removed completely. There might be a possibility of bias if the data sample does not replicate the real world.

LSTM Model Implementation

The model is implemented in Python with Keras and TensorFlow [12] – [14], is a strong tool from FXPro's Meta Trader 4 (MT4) trading platform. The daily quotation period frame begins with 2,718 records. The models are designed with input sequences of 9 years data which is used to predict the Hourly and Daily Based Prediction output with batch size of 64.

Performance Evaluation

The suggested LSTM model is evaluated in terms of model error in quantitative data by using RMSE (Root Mean Square Error). The equation used is shown below,

$$RMSE = \sqrt{\frac{\sum_{i=1}^N \|y(i) - \hat{y}(i)\|^2}{N}},$$

where N represents the no of data points, $y(i)$ for i-th measurement, and $\hat{y}(i)$ for its corresponding prediction. The below Fig shows the Calculation of RMSE

```
#calculate RMSE
mse = mean_squared_error(testY,predictedTest, squared=False)
print(mse)

0.006240098868928466
```

Fig: Root Mean Square Error in quantitative data

RESULT ANALYSIS

Performance of LSTM based on Daily Timeframe

The accuracy of the LSTM prediction model was assessed using data from various time periods over the course of a year (2020). The training and validation data for the models show there is a lower loss with high accuracy as shown in the below figure.

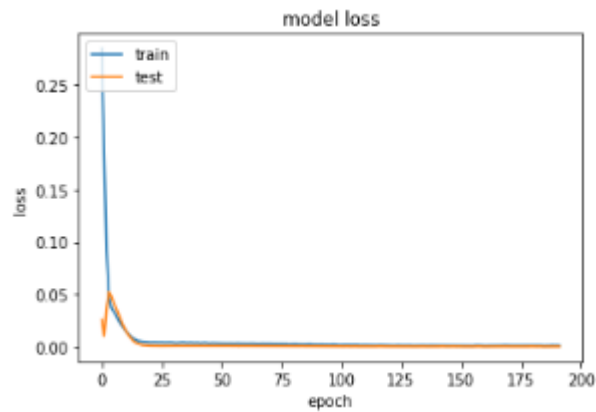


Fig: Less Model loss

As a result, we chose 9-year intervals of data used as input for model training in order to forecast daily changes in the Forex market for the 2020 year.

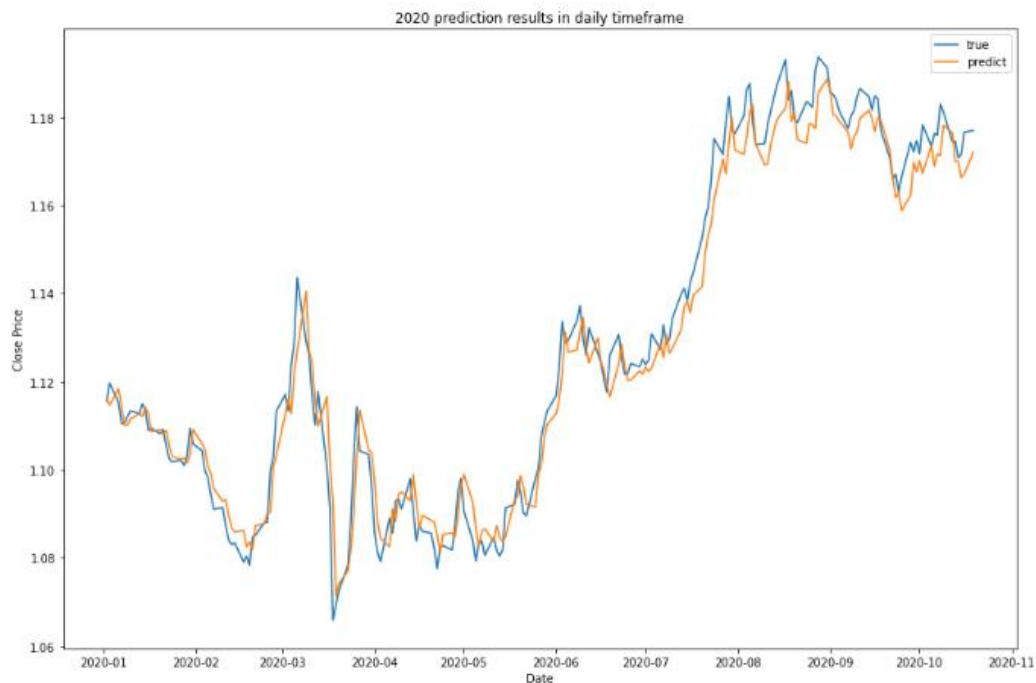


Fig : Result of 2020 Forex Market Daily changes

Performance of LSTM based on 1 Hour Timeframe

The training data for a 1 Hour Timeframe was taken with time column, with the market changing every 1 hour. As used above, the same dataset with hourly changes was used for training and validation. The results of the model provide higher accuracy with a lower loss as shown below.

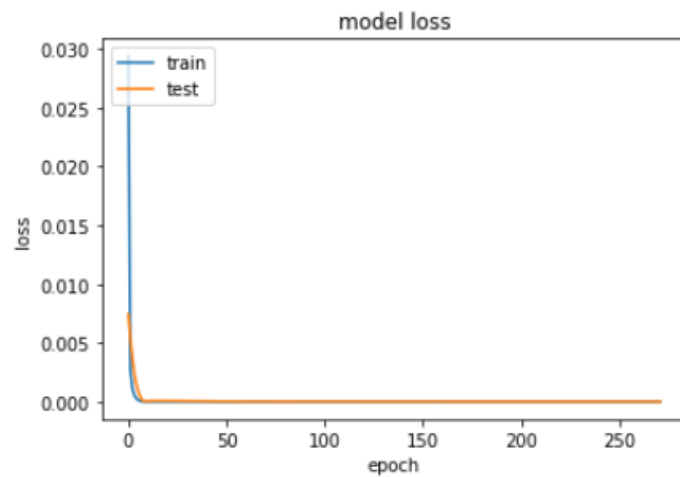


Fig: Less Model loss

The Hourly Timeframe for the year 2020 is shown in below image. It shows the prediction about the hourly changes in the Forex market.

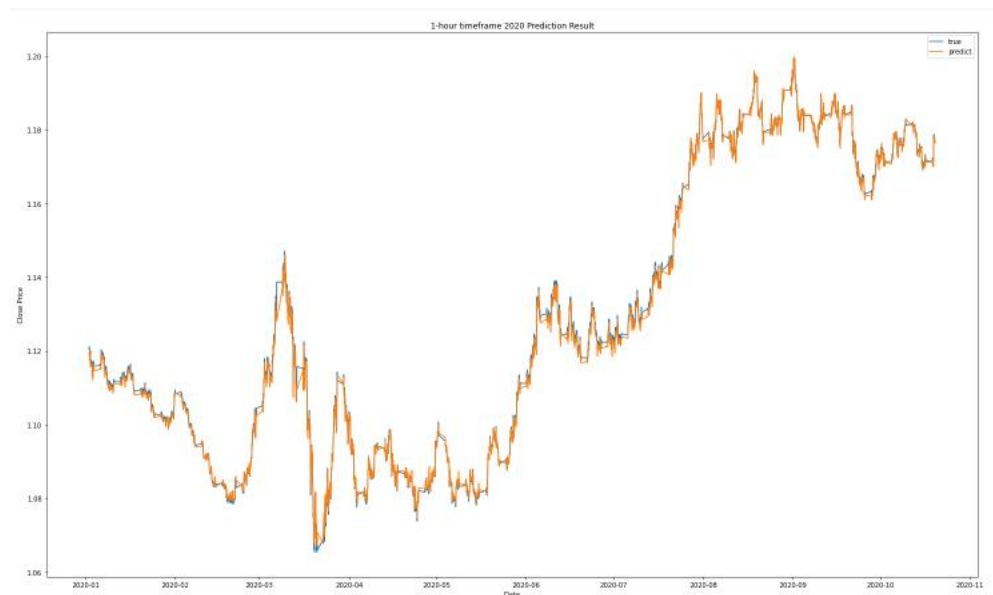


Fig : Result of 2020 Forex Market Hourly changes

The accuracy of 'Hourly Timeframe' is better when compared to the 'Daily Timeframe' data. The accuracy of training and testing matched better in hourly based model. The accuracy in Daily Timeframe data shown in the graph has minor fluctuation which means the prediction accuracy is lower compared with Hourly Timeframe.

DISCUSSION

The findings of the experiment led to the following conclusions.

1. Training model with short-term period (1 hour timeframe) is preferred over lengthy time period.
2. Infusing fresh data into model by retraining it on monthly basis can improve performance
3. The Last LSTM model can estimate the pattern of daily price fluctuations in the Forex market.

In the future, model's performance can be improved by fine-tuning structure of LSTM model.

ETHICAL CONCERNS

1. An A.I LSTM model can be biased when the decision can be prejudiced against certain group
2. The accountability is a major challenge when using trading systems and a limited human intervention is always required to mitigate the consequences
3. Lack of transparency as the underlying logic of systems is even hidden from the developers which pose the most ethical and legal concerns. The prevalence of black box models is also a major factor.
4. Privacy and data protection is also a major factor causing ethical issues. The trading systems need to be compliant with the latest regulations of the respective country.
5. In Forex trading, security is also a serious ethical concern. Because of the system's complexities, hackers may try to introduce inaccurate data into it, affecting the system's decision-making output.

RECOMMENDATION AND CONCLUSION

Risks Associated with DL in Forex Price Changes Prediction

1. The dataset used should be clear which is used for A.I to train on and get deployed. If the systems are not traded using the right data, then it can lead to inaccurate results. All the stake holders of the business should work in conjunction with the A.I service provider and know the flow of the model. So, the entire process including the evaluation model used by A.I tool and decision-making process should be well informed.
2. Each business needs to follow the regulators advice to have the complete knowledge on the systems, its internal mechanism and the way of operation. It's important to know where & how the data is stored and algorithms used. The knowledge of these will help the business to identify the erroneous data and can be traced.
3. It is important for the team to integrate all the fair practices according to the regulators requirement so possible issues can be avoided. Regular updates should be provided to the board and under their advice the reviews should be done frequently.
4. Teams or individuals with expertise skills are required to engage with the A.I team or service provider. Appropriate developers in the team should be able to review and monitor the entire process. This ensures that the Data protection and security are sufficiently managed.
5. In addition to regulatory protections against algorithmic bias, modernized regulatory approval in the form of ad hoc guidance is needed to maintain the safety and effectiveness of DL-based algorithms.

ETHICAL CONCERN IN APPLYING DEEP LEARNING IN FINANCE

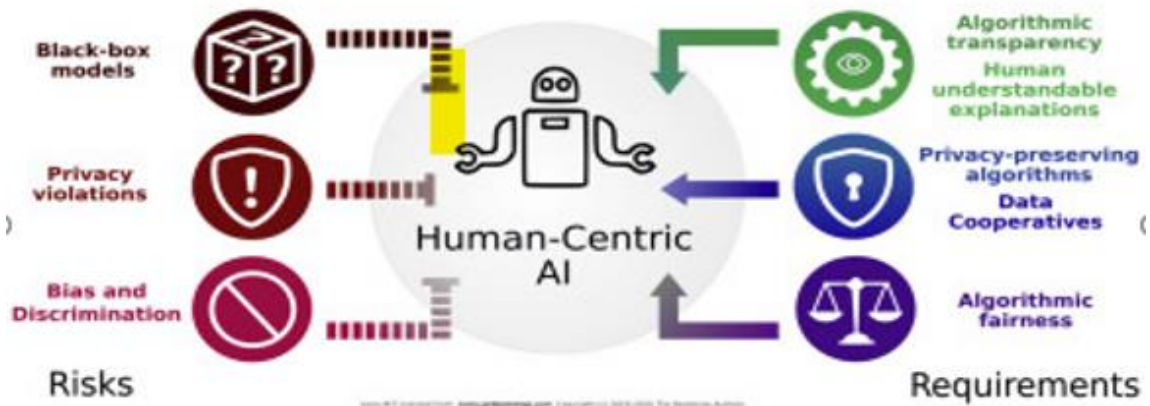


Fig : Ethical issues in Finance

RECOMMENDATION

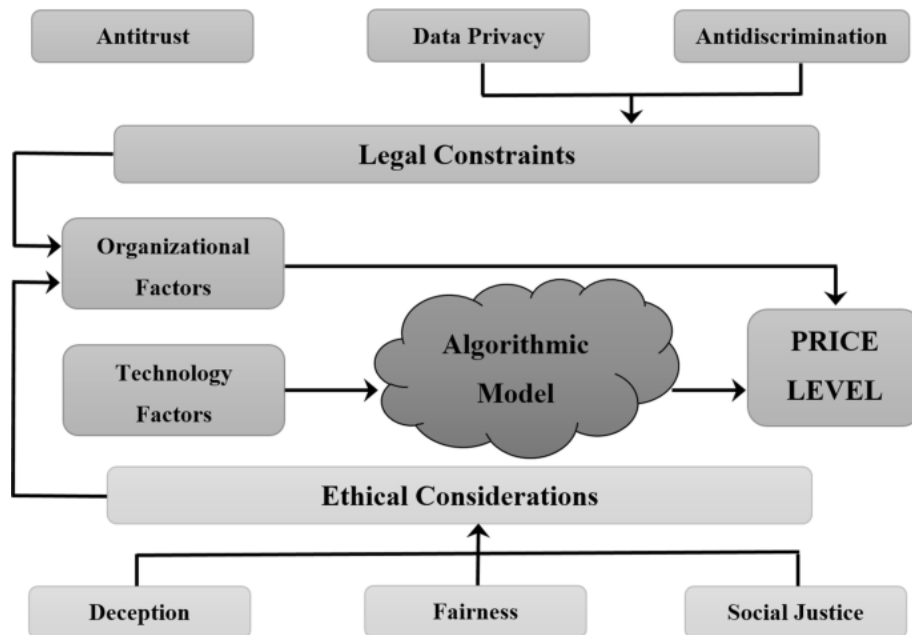


Fig : Recommendation and Consideration

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APPENDIX

Abbreviations

ML – Machine Learning

DL – Deep Learning

AI – Artificial Intelligence

LSTM – Long Short-Term Memory

RNN – Recurrent Neural Network

SVM – Support Vector Machine

RMSE – Root Mean Square Error

MT4 – Meta Trader 4 (Trading Platform)

BP – Back Propagation

ANN – Artificial Neural Network