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Machine Learning Methods for Beyond 5G

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ABSTRACT

In today's world, wireless communication systems are extremely important for applications related to entertainment, business, commerce, health, and safety. The deployment of fifth generation (5G) wireless technologies is currently taking place all around the world as these systems continue to advance from one generation to the next. Beyond 5G wireless systems, which will represent the sixth generation (6G) of the evolution, are already being discussed in academia and industry. The application of artificial intelligence (AI) and machine learning (ML) to such wireless networks will be one of the primary and essential elements of 6G systems. According to our present understanding of wireless technologies up to 5G, every component and building block of a wireless system, such as the physical, network, and application layers, will involve one or more of them. The importance of ML approaches in various upcoming wireless systems, including 6G, is reviewed in this overview paper in an up-to-date manner. We specifically describe a conceptual model for 6G and demonstrate how ML approaches are used and play a part in each layer of the model. In the context of wireless communication systems, we examine some traditional and modern ML techniques, including supervised and unsupervised learning, Reinforcement Learning (RL), Deep Learning (DL), and Federated Learning (FL). In the paper's conclusion, we discuss some potential future uses and research directions for ML and AI in 6G networks.

KEYWORDS:

Artificial Intelligence, Machine Learning, Wireless Systems, Federated Learning, Deep Learning.

1. INTRODUCTION

Sixth Generation (6G) wireless technology is a fresh field of study for many academics and researchers. The key benefits of 6G are that they will be made available to users and wireless networks alike. Using AI and ML techniques, 6G will also offer improvements in technical metrics including fast throughput, supporting brand-new, high-demand applications, enhanced radio frequency band use, and many more. DL, one of the main ML technologies, is one of the important technologies for 6G due to its significant applications in learning from more human-like scenarios. Determining which 6G access point to connect to and which resource controller has more resources available, for instance, is up to DL. It's intriguing to consider that. Zhenyu Zhou served as the assistant editor who oversaw the assessment of this submission and gave final approval for publication. Although it has been successfully applied to classification issues and has produced positive results, its applicability in wireless networks is still investigated. But in this article, we give a wide review of ML techniques, including DL, and discuss how they might be used in upcoming 6G communication systems.

Wireless technology is constantly developing and improving to help consumers with more sophisticated needs with more and more useful applications [4]. In the 5G mobile communication system, there is an increase in data rates, a decrease in energy consumption of devices connected with latency and energy, coupled with more precise localisation [2], [5] [8]. Many academics believe that greater attention should be paid to achieving latency and energy goals by strengthening the current wireless system from many angles due to the current increase in data quantity and usage. This inspired me to create an application that uses machine learning methods to classify 5G services.

2. EXISTING SYSTEM AND ITS LIMITATIONS

In the existing system there was no proper method to identify the prediction of 5g services in appropriate area by using data mining algorithms. The following are the main limitations in the existing system.

LIMITATION OF PRIMITIVE SYSTEM

1. More Time Delay in finding the prediction of 5g services in appropriate area.
2. There is no accurate prediction.
3. This is not efficient method to predict the 5g services in appropriate area
4. All the primitive methods use manual approach for predicting 5g services in appropriate area.

3. PROPOSED SYSTEM AND ITS ADVANTAGES

This overview paper, presents an up-to-date review of future wireless system concepts such as 6G and role of ML techniques in these future wireless systems. In particular, we present a conceptual model for 6G and show the use and role of ML techniques in each layer of the model. We review some classical and contemporary ML techniques such as supervised and un-supervised learning. Hence we try to use some algorithms which can predict the restricted areas as well as possibility of finding access locations based on network and other parameters which are present in that region

ADVANTAGES OF THE PROPOSED SYSTEM

1) By using data mining techniques it takes less time for the prediction of 5g services in appropriate area

2) In this paper we survey different papers in which one or more algorithms of data mining used for the prediction of 5g available services.

3) Result from analysis clearly state that the Random forest gives best result in very less time.

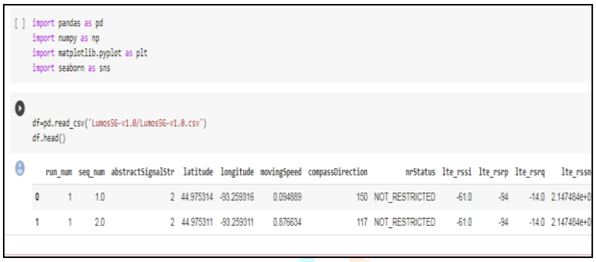
4. IMPLEMENTATION PHASE

Implementation is the stage where the theoretical design is converted into programmatically manner. In this stage we will divide the application into a number of modules and then coded for deployment. The front end of the application takes Google Collaboratory and as a Back-End Data base we took UCI Heart Patients Records as dataset. Here we are using Python as Programming Language to implement the current application. The application is divided mainly into following 5 modules. They are as follows:

1. Import Necessary Libraries
2. Load Dataset Module
3. Data Pre-Processing
4. Train the Model Using Several ML Algorithms
5. Find the Performance of ML Algorithms

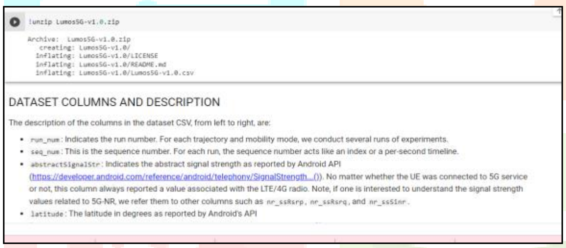
1) IMPORT LIBRARY MODULE

In this module initially we need to import all the necessary libraries which are required for building the model. Here we try to use all the libraries which are used to convert the data into meaningful manner. Here the data is divided into numerical values which are easily identified by the system, hence we try to import numpy module and for plotting the data in graphs and charts we used matplot library.



2) LOAD DATASET MODULE

In this module we try to load the dataset which is downloaded or collected from google repository. The description of dataset is as follows:



Each and every attribute contains some information which are tested and collected from 5th generation networks.

3) DATA PRE-PROCESSING MODULE

Here in this section we try to pre-process the input dataset and find out if there are any missing values or in-complete data present in the dataset. If there is any such data present in the dataset, the application will ignore those values and load only valid rows which have all the valid inputs.

4) TRAIN THE MODEL

Here we try to train the current model on given dataset using several ML classification algorithms and then try to find out which algorithms suits best in order to identify and classify the input dataset accurately and efficiently. Here we try to use following algorithms on input dataset such as:

1. Support Vector Machine
2. K-Nearest Neighbours
3. Random Forest
4. XGBoost

5) PERFORMANCE ANALYSIS MODULE

Here in this module we try to compare each and every classification algorithm on given input dataset and then try to find out which one suits best for finding the accurate results. Finally we will identify the best algorithm which give accurate results in very less time. Here we can see **Random Forest** gives more accurate result compared with other ML Algorithms.

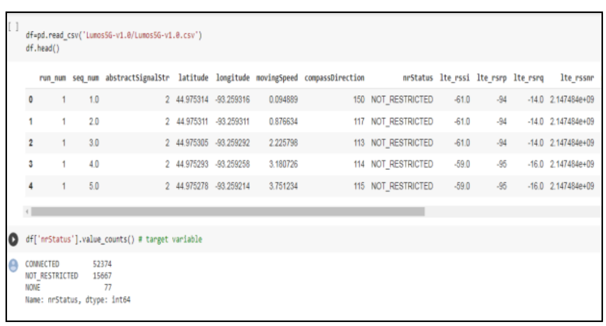
5. EXPERIMENTAL RESULTS

In this section we try to design our current model using Python as programming language and we used Google Collab as working environment for executing the application. Now we can check the performance of our proposed application as follows:

IMPORT LIBRARIES

The above window clearly represents the list of several modules used in our application.

PRE-PROCESS THE DATA



From the above window we can see DATA is pre-processed and any incomplete data is removed.

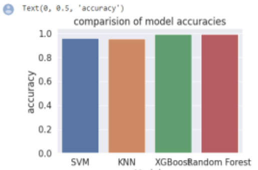
CLASSIFICATION ALGORITHMS

```
X_train shape is (54494, 18), y_train shape is (54494,)

[ ] class_names=['NOT_RESTRICTED','CONNECTED']

from sklearn.svm import SVC
from sklearn.metrics import confusion_matrix,accuracy_score,precision_recall_fscore_support
svm=SVC()
svm.fit(X_train,y_train)
svm_acc=svm.score(X_test,y_test)
print('accuracy of the svm is ',svm_acc)
y_svm_pred=svm.predict(X_test)
arr=(confusion_matrix(y_test,y_svm_pred))
prec=precision_recall_fscore_support(y_test,y_svm_pred)
print('precision is ',prec[0].mean())
print('Recall is ',prec[1].mean())
print('f1 score is ',prec[2].mean())
print('support is ',int(prec[-1].mean()))
print(arr)
df_cm = pd.DataFrame(arr, class_names, class_names)
# plt.figure(figsize=(10,7))
sns.set(font_scale=1.4) # for label size
sns.heatmap(df_cm, annot=True, annot_kws={"size": 16},fmt='.1f') # font size
```

From the above window we can clearly see classification algorithms are applied.

COMPARISION OF ML-ALGORITHMS

```
results=pd.DataFrame(data=[[svm_acc,knn_acc,xgb_acc,rf_acc]],columns=['SVM','KNN','XGBoost','Random Forest'])
# results.head()
sns.barplot(data=results)
plt.title('comparision of model accuracies')
plt.xlabel('Models')
plt.ylabel('accuracy')

Text(0, 0.5, 'accuracy')
```



From the above window we can clearly the comparison of several algorithms and we can see XGBoost and Random Forest are having more accuracy.

6. CONCLUSION

We have covered a variety of ML approaches in this article and how they operate. We have also discussed the 6G communication system's acceptance, as well as its difficulties and potential. We have outlined how ML at the application and infrastructure levels can be more productive to meet the upcoming 6G challenges after outlining the 6G future vision. The current need for 6G is compared and examined in terms of the state-of-the-art. In comparison to infrastructure level, it is determined that applications are more suited to fill in the gaps created by 6G problems. The case study-biometric application has been discussed after best fit. The case study demonstrates how smart biometric applications operate at the infrastructure and application levels. In order to do this, we have determined the future directions for applying ML to channel modelling, data reduction, and resource management. When paired with a 6G wireless communication network, numerous ML approaches can be used effectively. As a result, in order to improve smart applications for both present ML and future 6G, we need to provide a solution to address current difficulties including latency, power allocation, privacy, security, and model interoperability.

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