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The International Journal of Advances in Computer Science and Cloud Computing (IJACSCC) is a peer reviewed Journal in the field of Computer Science and Engineering. IJACSCC is an international forum for scientists, researchers and engineers involved in all aspects of Computer Science and Cloud Computing to publish high quality, referred papers. The Journal offers survey and review articles from experts in the field, promoting insight and understanding of the state of art, and latest trends in the field. The content include original research and innovation ideas, applications from all over the world. All published papers are also available freely with online full-text content.

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Simulation Model for Crop Diversification in Indian Punjab

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ABSTRACT

The ideal utilize of soils is the premise of all types of economical land utilize, that is, farming area utilize that remaining parts profitable in the long haul. There are numerous advantages of an ideal utilization of soils, for example, a reduction of provincial destitution, watershed insurance, expanded biodiversity, and more supportable agrarian creation. Maintainable agrarian soil utilize requires making the land accessible for cultivating as gainful as could be expected under the circumstances while considering the ecological effect of the development procedure. Under regular conditions, soils present synthetic confinements for crop improvement. Diversified crop models are used to find out the suitable soil for the good production of the crop. As indicated by the prerequisites of products to be developed, it is regular to modify soil concoction qualities, changing the amount of supplements and acidity through fertilizing and liming, making profitable agribusiness conceivable however if farmer is going to select the soil according to the crop requirement then no need to add extra fertilizers which will reduce the production cost. The model proposed by author will help to select the optimal crop according to the soil components.

Keywords - Simulation, Crop, Model, Diversification, Soil

I. INTRODUCTION

Crop diversification is a process that simulates complex soil–plant relationships, which in turn determines the most beneficial crop patterns. To simulate the soil–plant systems, a computer-based model with a new mathematical optimization technique is an effective tool to facilitate crop diversification planners to make sound decisions prior to each crop season. An objective of crop diversification is to produce various crops instead of only one or two and select the crop in such a way so that it gives maximum production with minimum investment.

A plausible reason for diversification can be attributed to the fact that under multiple cropping systems, crops not only compete for nutrients but can mutually benefit each other. However, such agronomic benefits of crop diversification include improvement in soil fertility, tendency to reduce diseases, weed and insect build up and possibility to reduce erosion. Parallel to this farmer will get more experience for growing more than one crop. Moreover positive impact will be on the performance and production of another crop in the region.

Optimization techniques are generally utilized for taking care of complex handy issues in asset portion, transportation and coordination's, venture choice, arranging and scheduling. Although these problems are well-known in manufacturing and business sectors, there exist similar optimization problems in agricultural systems such as crop selection [2], country-wide crop planning [4], irrigation planning [5], vegetable production [6], and sugarcane transportation [7]. As seen in these papers, the optimization problems were formulated as mathematical programming models and then solved using a variety of

optimization methods. These models range from single to multi-objective, and from direct to non-straight forms. The optimization methods used in the studies range from conventional methods to computational intelligence (CI) techniques such as genetic/evolutionary algorithms.

Computer engineers using information technologies, such as evolutionary algorithms, will play an important role in natural resource management and crop production to meet the new challenges. An EA is a search procedure that uses random choice as an effective means of directing a highly exploitative search through a numerical coding of a given parameter space.

Evolutionary algorithms have been used successfully to solve optimization problems, from the domain of operations research, in recent years. There are many favorable reasons for choosing evolutionary algorithm in solving optimization problems. Due to the inherent parallelism, self-organization, adaptation and self-learning features of the EAs, they have been applied successfully to solve many problems where the classical approaches are either unavailable or generally lead to unsatisfactory results.

The paper is organized as follows. After introduction, the crop soil planning and problem model is introduced and its mathematical model is discussed. In Section 3, Materials and methods has been discussed. Solving the crop-planning model has explained in section 4. In the end result is summarized.

II. CROP-SOIL PLANNING AND PROBLEM MODEL

In this section, we introduce a crop-soil planning issue. Cropping arranging is identified with numerous elements, for example, type of land, yield rate, climate conditions, and accessibility of the agricultural information sources, crop demand, capital accessibility and the expense of yield. A portion of these variables are quantifiable and can be evaluated. In any case, factors like rainfall, climate condition, surge, twister, and other normal catastrophes are hard to anticipate. Nonetheless, if the accessible data can be used appropriately, it might give profitable. The yield rate, the expense of generation, and the return from crop are elements of soil attributes (fertility and other soil factors), area, the product being delivered, cropping pattern and strategy (crop being produced and their sequence, water system, non-water system, and so on). Our main focus in this paper will be the utilization of land for appropriate crops. For a solitary cropped land, there are various alternative crops from which the crop to be developed in a year might be picked. Correspondingly there are a wide range of blends of yields for double cropped and triple-cropped lands. Distinctive combinations give diverse yields. To provide guidelines for crop diversification, a simulation model developed. Mathematically speaking, it is possible to write optimization problems in the generic form

Minimize
$x^{\varepsilon}R^{d}$

$$f_i(x), (i = 1, 2, \ldots, M), \quad (1)$$

Subject to

$$h_j(x) = 0, (j = 1, 2. \ldots J), \quad (2)$$

$$gk(x) \leq 0, (k = 1, 2, \ldots, K), \quad (3)$$

Where $f_i(x)$, $h_j(x)$ and $g_k(x)$ are functions of the design vector

$x = (x^1, x^2 \ldots x^d)^T$. (4)

Here the components x_i of x are called design or decision variables, and they can be real continuous, discrete, or a mix of these two.

The functions f_i (x) where i = 1, 2. . . M are called the objective functions or simply cost functions, and in the case of M = 1, there is only a single objective. The space spanned by the decision variables is called the design space or search space Rd, whereas the space formed by the objective function values is called the solution space or response space. The equalities for hj and inequalities for g_k are called constraints. It is worth pointing out that we can also write the inequalities in the other way, ≥ 0, and we can also formulate the objectives as a maximization problem. In a rare but extreme case where there is no objective at all, there are only constraints. Such a problem is called a feasibility problem because any feasible solution is an optimal solution.

Model Development

Inputs Subjects:

n crop suitable for production
m a crop combination made up from n
o soil type

Attributes:

k1 number of alternative crops Kharif season
k2 number of alternative crops for Rabi season
$K1_m$ a crop in each m for Kharif Season, m =1, . . ., k1
$K2_m$ a crop in each m for Rabi Season, m =1, . . ., k2
YR_{nmo} yield rate that is the amount of production per unit area for crop n of crop combination m in land type o
VCP_{nmo} variable cultivation cost required per unit area for crop n of crop combination m in land type o
MP_n market price of crop n per metric ton
B_{onm} gross margin that is the benefit that can be obtained per unit area of land from crop n of crop combination m in land type o
S_o available land type o
A area suitable and available for crop n when o=1
X_{nmo} area of land to be cultivated for crop n of crop combination m in land type o

Output: The best crop selection fulfilling the stop criteria.

Objective Functions

First objective Function is to maximize the farmer's income per acre according to the yield rate for crop n of crop combination m in the land type o for Kharif season.

$$\underset{K1}{\text{Maximum}}\ Y1_{\text{Kharif}} = \sum_{n=1} \sum_{m \in k1} YR_{nm(o=1)} MP_{nm(o=1)} \quad (1)$$

Second objective Function is to maximize the farmer's income per acre according to the yield rate for crop n of crop combination m in the land type o for Rabi season.

$$\text{Maximum } Y1_{\text{Rabi}} = \max_{K2} \sum_{n=1} \sum_{m \in k2f} YR_{nm(o=1)} MP_{nm(o=1)} \quad (2)$$

Third objective function is to minimize the variable cultivation cost required per unit area for crop n of crop combination m in land type o for Kharif season.

$$\text{Minimum } Y2_{\text{Kharif}} = \sum_{n \in k1f}^{K1} VCP_{nm(o=1)} \quad (3)$$

It will be minimum if land is suitable for a crop, if land is not according to the type of crop then value of this function will be more which will not suit to the farmer.

Fourth objective function is to minimize the variable cultivation cost required per unit area for crop n of crop combination m in land type o for Rabi season.

$$\text{Minimum } Y2_{\text{Rabi}} = \sum_{n \in k2f}^{K2} VCP_{nm(o=1)} \quad (4)$$

Checks

Price Constraint: Price is a major constraint as outcome of any crop in terms of money depends on the market price per ton.

$$\sum_{n \in k1k2f}^{K1K2} MP_n \quad (5)$$

After the selection of the land for a crop, market price will be the deciding factor in selection of a crop. A farmer will go for a crop which will have more price than others if production parameter is equal.

Land Constraint: Land used for the production of the crop should be suitable according to specific crop.

$$\sum_{n \in k1k2f}^{K1K2} X_{mo(n=1)} \quad (6)$$

This constraint plays a major role in selection of a crop.

III. MATERIALS AND METHODS

In this section mechanism to select a particular crop for a given piece of land will be explained. There are number of crops available in the market and according to season crops are classified into two groups: Kharif and Rabi. So selected combinations of the crops will be within the group only. To select an

optimum crop for the given land, it depends on various factors such as production of that crop for that type of land (will give more yield if land is suitable for that crop), market price etc. So in this way first aim is to find out suitable piece of land for a selected crop. In this paper, we will consider two objectives: to maximize farmer's income per acre and minimize variable cost for crop production. One can achieve these two objectives only if a piece of land is suitable for a crop. This means that the chemical and physical properties of the soil suits the growing conditions for a particular crop, then that crop will give good yield in that type of soil. This can be possible by comparing the pre-request growing soil conditions for that crop and properties of that piece of land. If required conditions of the crop are matching with land this means that soil will be suitable for a crop. So in this way less fertilizers and others manures will need to get good crop production, ultimately variable cultivation cost will be less. Mathematically one can explain this by using below mentioned function.

$$F(x) = \sum_{b=1}^{t} f_b(x) \quad (7)$$

Here $f_b(x)$ is a b^{th} objective function having t number of objectives.

3.1 Data Set

3.1.1 Crop- Soil data

To develop a model one need the record of various required crops and different types of the soil data. As we have already discussed that crops are classified into two groups: Kharif and Rabi seasons. So for this the properties of the soil's parameters required which will predict the suitable crop for that soil. In this way from the soil's data set, farmers can easily predict suitable crop for their fields by giving the inputs of the soil's parameters in the model. By giving the weights to the different parameters of the soil one will be able to find out the sequence of the crops to be selected for field according to their production. We can get the record of more crops for more dataset by getting the data of the physical properties of the soil.

It depends on the need and diversification factors to include more crops. In the next sub-section the information of the variable cost and market price of the different crops is given.

3.1.2 Variable Cost and Market Price

information of the variable cost and market price of the different crops is given.

Other parameters which play an important role is market price and variable cost (Includes expenditure of seed & seed treatment, Manures & fertilizers, Pesticides, Weedicides & Fungicides, Irrigation, Man power etc). Variable cost which directly or indirectly depends on the type of soil. If type of soil is suitable for a particular crop then variable cost will be less. So here main concern is main product value (market value). So by comparing the market value of all the crops and type of soil one can predict the suitable optimum crop by apply this proposed algorithm.

Crop	Average Yield (q/acre)	Gross Returns	Total Variable Costs	Returns Over Variable Costs
Paddy	29	42050	16733	25317
Basmati	14	29575	17968	11607
Maize	20	28500	15249	13251
Bt Cotton	10	43025	26103	16922

Desi Cotton	9	40320	18089	22231
Sugarcane Planted	334	103780	56120	47660
Sugarcane Ratoon	250	78650	29851	48799
Groundnut	10	41300	18466	22834
Bajra	15	21825	12138	9687
Moong	4.7	23595	11873	11722
Mash	3.6	17650	11577	6073
Arhar	5.8	30075	12783	17292
Soybean	7	19400	12758	6642
Sesame	2.7	13690	9568	4122

Table 2 Comparative Enterprise Budget of Kharif Crops, 2016

Note: The enterprise budgets are based on P.A.U. recommendations [13] (Rs /acre)

Crop	Average Yield (q/acre)	Gross Returns	Total Variable Costs	Returns Over Variable Costs
Wheat	20	36500	13807	22693
Barley	16	22600	9541	13059
Winter Maize	32	46600	20096	26504
Spring Maize	29	42625	19096	23529
Gram	7	25760	14618	11142
Lentil	5	18260	10917	7343
Field Pea	7.5	21375	12594	8781
Summer Moong	4.5	22665	11571	11094
Summer Mash	4.25	20856	12388	8468
GobhiSarson	7	24150	12579	11571
Toria	5	17000	11435	5565
Sunflower	7.9	30020	13967	16053
Linseed	4.7	16345	13782	2563
Mentha	50 Litre Oil	50000	24593	25407
Celery	5.5	26400	15230	11170
Fennel	4.5	24750	10246	14504
Coriander	2.75	15125	11200	3925

Table 3 Enterprise Budgets of Rabi Crops 2016-17

Note: The enterprise budgets are based on P.A.U. recommendations [13] (Rs /acre) Gross Returns, total variable cost, returns over variable cost of different crops per acre are given in the table 2 and table 3 according to the kharif and Rabi seasons. By applying the proposed algorithm on this dataset (physical properties of soil, Gross returns, variable cost), one can suggest appropriate crop for a specific field to the farmer. A sequence order of the different crops can be shown as an output according to the maximum returns over the variable cost.

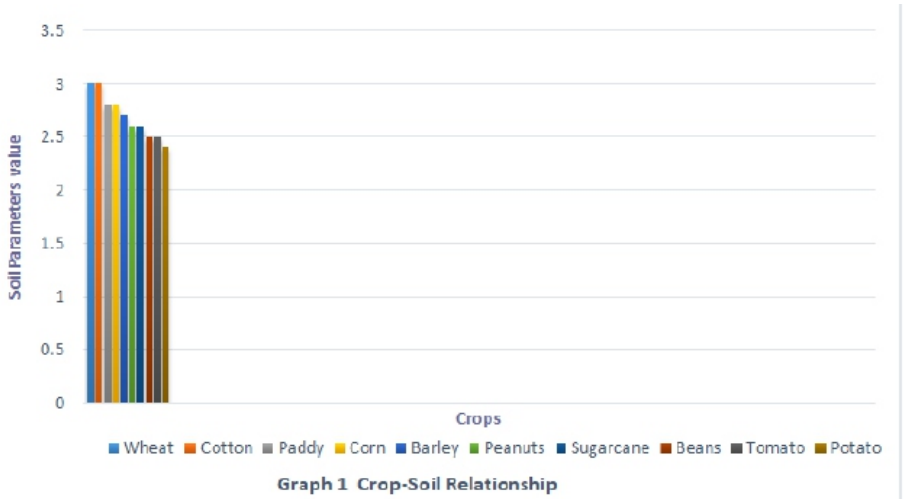
1. Solving the crop-planning model

There are more than 30 crops which can be grown in the fields of the Indian Punjab. Crops are divided in two major categories Kharif and Rabi. So depending upon the season one can give the suggestion of the

appropriate crop. According to the given algorithm the crop selection depends on returns over variable costs. Further variable cost depends directly or indirectly on the soil properties. According to the given algorithm to check the appropriate crop for the field, first thing is to check the properties of the soil of the given field, this can be possible by checking the soil in the laboratory, once a farmer will get the soil report of the soil parameters, then all those soils' parameters will be input for the algorithm. After processing the values of all those given soils' parameter, one will get the out of the crops in a particular sequence according to the production of the crops for the given soil. After getting the list of crops as an output from the algorithm, then that list will be input to the next step. In this step returns over variable costs will be calculated according to the previous years' variable cost and current market price of the crop. Whatever the list of the crops was in the first step that will be compared with the output of the second step. Now in the third step one will be able to get the list of crop which will be according to the soils' properties and returns over the variable costs. Now output of the third step will be the list of crop for those the given soil is suitable for the good production and will give maximum return according to the given market price & returns over the variable costs. In this way farmer can easily find out the suitable crop for his fields from production as well as price point of view by taking help from GUI based model.

IV. RESULTS

By using soil parameter values to find out the suitable crop, one has to find the values of all the required soil parameters by testing the soil in laboratory. After getting the values of the soil's parameters, one will give input to the method for comparisons, on the basis of the values, a list of crops in the descending order will display as a shown in the graph. A farmer will select any crop from the first three four from the list. In this way a farmer can go for the crop which will suit the field. In Indian Punjab farmers are growing only paddy and wheat, paddy consume more water, so in this way ground water's level is going down day by day. To save the ground water farmers have to go for other crops than paddy, now by using this method when farmer will get more options of the crops for their fields then they will go for other alternative crops. In this way crop diversification can be achieved by using this method, which is need of hour.



Graph 1 Crop-Soil Relationship

V. CONCLUSION

Crop diversification is regarded as a phenomenon which has attracted considerable interest among peasant farmers around the globe because of, as a potential risk management tool against uncertainty, Income and employment generation opportunity, Ability to reduce diseases, weed and insect build up, and Possibility to increase soil fertility and among others. So when a farmer has choice to select the appropriate crop for a particular soil then he can get the benefits of the points which ae discussed above.

In this way Punjab's farmer can save ground water by growing the other alternative crops instead of paddy, other option he can get by using the above mentioned method. Using widely available computer programs, the techniques farmers can get knowledge to implement the process.

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Machine Learning- based Feature Data Analysis for Top Cloud Computing Service Providers

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ABSTRACT

This research paper describes the machine learning-based feature data analysis for top cloud computing service providers to establish the future strategies to get their competitive advantage. We use the public data (12,422 cases) that the cloud computing service providers announced for their marketing purposes since 2015 using LDA(Latent Dirichlet Allocation) tool. We also perform keyword network analysis to check the relations among keywords. In order to predict the future the computer learned the trends based on the training data using H2O GBM(Gradient Boosting Model) algorithm provided by Python. The accuracy is 85.7% in all service providers case.

Keywords - Cloud Computing Service Providers, Competitive Advantage, LDA(Latent Dirichlet Allocation) Tool, Machine Learning, Big Data.

I. INTRODUCTION

This research paper describes the machine learning-based feature data analysis for top cloud computing service providers to establish the future strategies to get their competitive advantage. We use the public data (12,422 cases) that the cloud computing service providers announced for their marketing purposes since 2015 using LDA(Latent Dirichlet Allocation) tool. We also perform keyword network analysis to check the relations among keywords. In order to predict the future the computer learned the trends based on the training data using H2O GBM(Gradient Boosting Model) algorithm provided by Python.

II. LITERATURE REVIEW

A. Methodologies for data analysis

There are many methodologies for data analysissuch as Fayyad's KDD(Knowledge Discovery in Database) in 1996, CRISP-DM(Cross Industry Standard Process for Data Mining), Step-wised Process Model, and Microsoft's TDSP(Team Data Science Process). From these models we use Step-wised Process Model and Microsoft's TDSP(Team Data Science Process) to end up with our own research model. Step-wised Process Model includes Planning, Preparing, Analyzing, Developing, and Deploying. Microsoft's TDSP includes Business Understanding, Data Acquisition & Understanding, Modeling, Deployment, and Customer Acceptance.

B. Research model

Based on the combination of Step-wised Process Model and Microsoft's TDSP we finalize our research model as following Fig. 1.

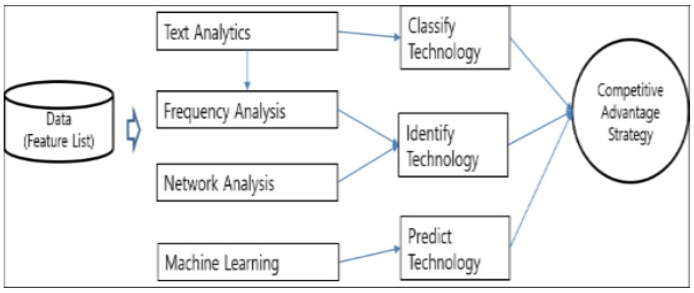

Figure 1. Research model

III. FEATURE DATA ANALYSIS

A. Text Analytics

This research analyzed 12,422 text documents published by top cloud computing service providers from 2015 to August, 2020 to end up with topic modelling results using LDA(Latent Dirichlet Allocation) as shown in Table 1.

Topic	Keywords
Topic 0	resource, cluster, api, documentation, group, information, apis, console, management, tag
Topic 1	storage, page, operation, datum, premium, lake, disk, volume, snapshot, hour
Topic 2	service, container, app, task, customer, information, product, plan, message, email
Topic 3	application, deployment, developer, environment, tool, integration, infrastructure, development, workspace, serverless
Topic 4	model, image, content, video, job, pipeline, capability, custom, processing, language
Topic 5	table, query, cost, search, usage, number, report, change, feature, result
Topic 6	access, user, policy, management, control, feature, client, ad, domain, identity
Topic 7	customer, solution, business, team, partner, platform, technology, tool, enterprise, product
Topic 8	device, function, event, CloudWatch, metric, log, lambda, action, step, console
Topic 9	instance, performance, memory, pricing, cost, availability, scale, size, workload, capacity
Topic 10	region, network, customer, endpoint, availability, traffic, connection, gateway, location, documentation
Topic 11	security, account, manager, configuration, rule, compliance, customer, management, organization, resource
Topic 12	datum, database, data, service, storage, migration, compute, analytic, scale, MySQL
Topic 13	system, file, support, version, server, machine, update, release, feature, window

Table 1. Topic modelling results

We can visualize the data in the above table as the following Fig. 2. It shows the topic number and the number of documents counted which belongs to each topic.

Figure 2. Visualization of the topics and the documents

B. Identifying the key cloud computing technologies based on the Frequency Analysis

Fig.3 shows the increasing number of documents about cloud computing technologies. 2831 documents are counted until August 2010.

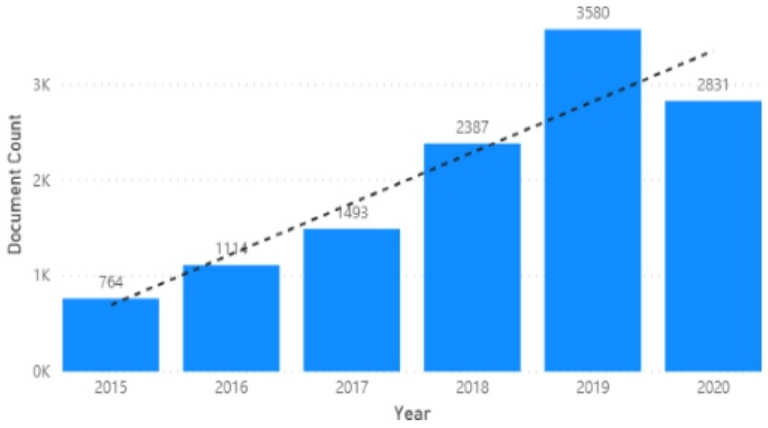

Figure 3. Increasing number of documents about cloud computing technologies through years

Fig.4. Increasing number of documents about cloud computing technologies through years and months

This research analyzed monthly number of documents of top 3 topics announced by cloud computing service providers as shown Fig.4.

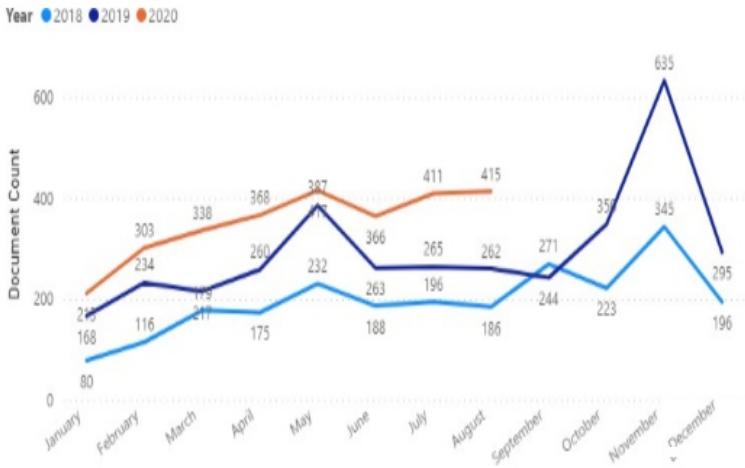

Figure 4.Monthly number of documents of top 3 topics

We also performed keywords analysis using the word cloud technique.

Figure 5. Keyword analysis based on the word cloud technique

C. Network Analysis

This research extracted the key words from the title columns and identify the network relationships among them Python network packages and Microsoft Power BI as shown Fig.6.

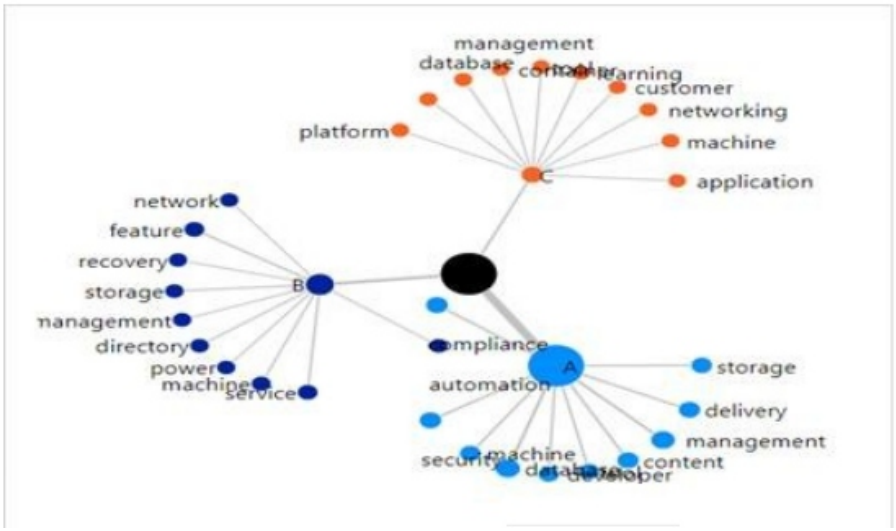

Figure 6. Network relationships among the key words of cloud computing service provider A, B, and C

Figure 7. Word clouds of the key words shown in Fig.6.

From the network analysis of the key words we end up with two most significant key words which are "available" and "support".

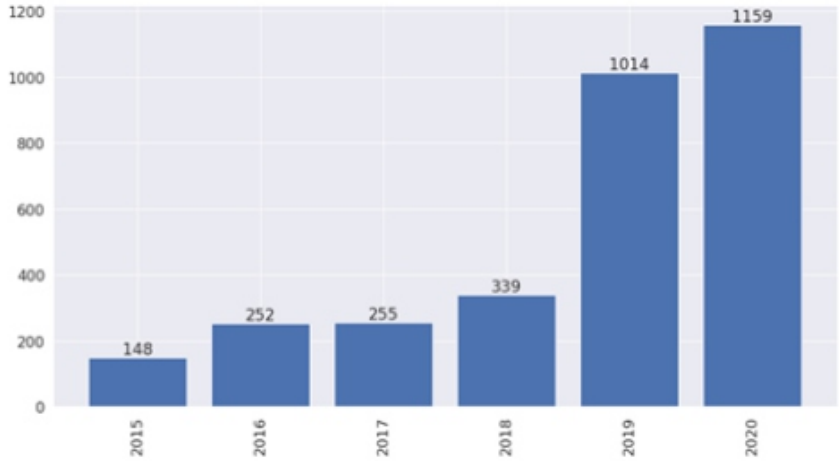

Figure 8. Annual frequencies of two most significant key words which are "available" and "support"

D. The Prediction of Key Cloud Computing Technologies Based on Machine Learning Analysis

In order to predict key cloud computing technologies based on machine learning analysis we need the train data set and test data set as shown in Table 2and 3.

Company	Category	Published Date	Published
A	Databases	05-01-2018	1
A	Databases	24-06-2019	1
A	Databases	02-10-2019	0
	~		
A	Analytics	12-01-2018	1
A	Analytics	14-08-2018	1
A	Mobile	08-05-2019	0
A	Mobile	12-03-2020	1
B	App Service	08-01-2018	1
B	App Service	01-03-2018	1
B	Virtual Machines	10-12-2019	0
B	Virtual Machines	01-09-2020	1
B	API Management	02-03-2018	0
	~		
B	API Management	16-12-2019	0
B	API Management	28-10-2020	0
C	AI & MACHINE LEARNING	02-07-2018	0
C	AI & MACHINE LEARNING	20-02-2019	0

Table 2. Train Data Set Sample

In Table 2 company B published the cloud computing technology of API management on October 25, 2018, but did not publish the similar cloud computing technology of API management on June 28, 2019. We consider that the published technology means the new trend of the cloud computing technology, because these companies are top 3 cloud computing service providers in the world.

In Table 2 company B published the cloud computing technology of API management on October 25, 2018, but did not publish the similar cloud computing technology of API management on June 28, 2019. We consider that the published technology means the new trend of the cloud computing technology, because these companies are top 3 cloud computing service providers in the world.

Company	Category	Published Date
A	Databases	01-01-2020
A	Databases	02-01-2020
A	Databases	03-01-2020
A	Databases	04-01-2020
~		
B	App Service	01-01-2020
B	App Service	02-01-2020
B	App Service	03-01-2020
B	App Service	04-01-2020
~		
C	AI & MACHINE LEARNING	01-01-2020
C	AI & MACHINE LEARNING	02-01-2020
C	AI & MACHINE LEARNING	03-01-2020
C	AI & MACHINE LEARNING	04-01-2020

Table 3. Test Data Set Sample

We used the train data for 3 years and made the prediction for the next year using the test data to calculated the accuracy after comparing the test data with real data of the next year. In the train data we assigned number “1” for the published technology and we assigned number “0” for the unpublished technology.

This research also analyzed all of the data from top 3 cloud computing service providers in the world and analyzed the data from only top cloud computing service provider, company A, too.

In order to predict the future the computer learned the trends based on the training data using H2O GBM(Gradient Boosting Model) algorithm provided by Python. We estimate the accuracy and AUC(Area Under Curve) using cross validation metrics summary as shown in Table 4. In general, the accuracy of case with all of Company A,B,C data is 85.7% and the accuracy of case with Company A data only is 78.7%.

Company (top 3 cloud computing service providers)	Train Data	Accuracy	AUC(Area Under Curve)
	2015-2017	0.8570468	0.78914696
Company A,B,C	2016-2018	0.86278874	0.82833946
	2017-2019	0.8483931	0.834755
	2018-2020	0.8630143	0.82766765
	2015-2017	0.7854099	0.7687092
	2016-2018	0.818712	0.79619604
Company A	2017-2019	0.77038366	0.79142106
	2018-2020	0.7732189	0.8090694

Table 4. The accuracy and AUC(Area Under Curve) after the prediction

Cloud computing service providers could establish the competitive advantage based on the machine learning analysis about other companies' strategies.

The prediction result for monthly publish counts for Company A,B,C is shown as Fig.9. We used 2015~2017 train data and 2018 test data for the prediction.

Figure 9. The prediction result for monthly publish counts

The prediction result for publish counts for major categories of Company A, B, C is shown as Fig.10. We used 2015~2017 train data and 2018 test data for the prediction.

Figure 10. The prediction result for publish countspublish counts for major categories

The prediction result for monthly publish counts for Company A,B,C is shown as Fig.11. We used 2016~2018train data and 2019test data for the prediction.

Figure 11. The prediction result for monthly publish counts

The prediction result for publish counts for major categories of Company A, B, C is shown as Fig.12. We used 2016~2018 train data and 2019 test data for the prediction.

Figure 12. The prediction result for publish countspublish counts for major categories

The prediction result for monthly publish counts for Company A only is shown as Fig.13. We used 2015~2017 train data and 2018 test data for the prediction.

Figure 13. The prediction result for monthly publish counts

The prediction result for publish counts for major categories of Company A only is shown as Fig.14. We used 2015~2017 train data and 2018 test data for the prediction.

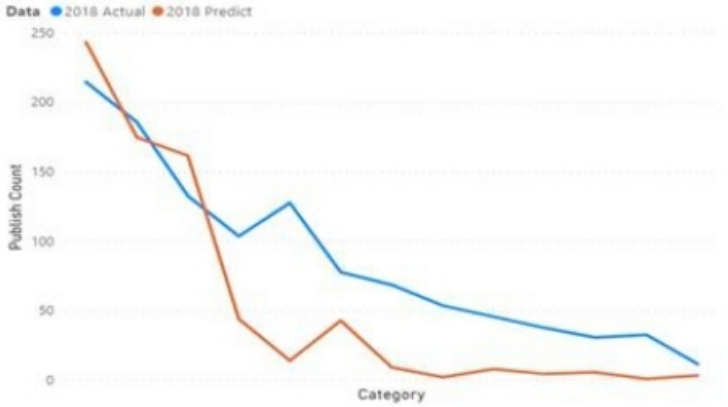

Figure 14. The prediction result for publish countspublish counts for major categories

The prediction result for monthly publish counts for Company A only is shown as Fig.15. We used 2016~2018train data and 2019test data for the prediction.

Figure 15. The prediction result for monthly publish counts

The prediction result for publish counts for major categories of Company A only is shown as Fig.16. We used 2016~2018 train data and 2019 test data for the prediction.

Figure 16. The prediction result for publish counts publish counts for major categories

IV. CONCLUSION

In order to establish the competitive advantage in cloud computing service providers' market, this research paper describes the machine learning-based feature data analysis for top cloud computing service providers to establish the future strategies to get their competitive advantage. We use the public data (12,422 cases) that the cloud computing service providers announced for their marketing purposes since 2015 using LDA(Latent Dirichlet Allocation) tool. We also perform keyword network analysis to check the relations among keywords. In order to predict the future the computer learned the trends based on the training data using H2O GBM(Gradient Boosting Model) algorithm provided by Python. The accuracy is 85.7% in all service providers case.

We also analyzed all data from top 3 cloud computing service providers as well as top cloud computing service provider only to understand the trend of could computing technologies more effectively. The approach will help us find out better position in the disruptively changing environment.

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Enhancement of Security Issues in Cloud Computing using Honey Encryption Technique

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A B S T R A C T

The ideal consequence of this paper is to learn distinctive security issues of disseminated computing (cloud computing) and a short time later discussion about a hybrid encryption framework which incorporates Honey Encryption/Decryption Algorithms(Distribution Transforming Encoders) for encryption and interpreting of data.

The Goal of this paper is to research and survey the most noteworthy security frameworks for data affirmation in disseminated computing. I am cheerful that another procedure called "Honey Encryption" will deter software engineers by introducing fake data for each mixed up guess of the key code.

Keywords - Asymmetric Encryption, Distribution Transforming Encoders, Decryption, Encryption, Honey Encryption/decryption Algorithm, Hybrid Encryption, Symmetric Encryption.

Abbreviations - CC, Cloud Computing; DTE, Distribution Transforming Encoders; HE, Honey Encryption;

I. INTRODUCTION

Cloud computing is another computing perspective that benefit by the passed on advantages for deal with tremendous extension computing issues. During the latest couple of years, cloud computing has grown rapidly as promising business suspected in the IT business in view of its characteristics, for instance, cost decline, flexibility, accommodation, and versatility. Incredibly, there are a couple of issues which decline the cloud computing improvement, for instance, loss of security, assurance, and control. The security issue is seen as a primary thought that could prevent the improvement of cloud computing. [1][3] At this moment, will explore the cloud computing gathering, troubles, and openings. Moreover, I will review and discussion about the cloud computing security issues. Clients' need guarantee that their data which is taken care of on cloud won't be gotten to by various clients. To accomplish security on cloud there are such countless strategies and computation accessible. A bit of these strategies are Authentication measures: In this methodology, a login framework is used to check that the fundamental approved customer is getting to the cloud data. It requires making a customer name and mystery express.

Approval rehearses: An overview of Authorized client is used to recognize, who can move to data set aside on cloud system. Regardless, various people despite everything stress that data got a good deal on a far off amassing structure could be gotten to by various clients and they will alter it. . Software engineers could moreover try to take the physical machines on which data are taken care of Encryption: In this methodology complex calculation are utilized to cover the fundamental data with the help of encryption key. The information is changed over into incomprehensible structure called figure content and a brief time frame later put aside on far off worker hoarding. Encryption combines checks like TRIPLE

DES","RSA", "BLOWFISH", "TWOFISH", "AES" . I am sure that another technique called "Honey Encryption" will redirect developers by introducing fake data for each mistaken gauge of the key code.

Hence Honey encryption is another encryption plan that gives re-silience against monster power attacks by ensuring that messages decoded with invalid keys yield a generous looking message

II. RELATED WORK

Improvement of security issues in cloud computing based symmetric and asymmetric key cryptosystem for encryption and decryption of information have talked about by, Dimitra A. Geogiou in 2017, Shen et al., Sarojiniet.al in 2016, Neisse et al. [2] , Chen et al. [6] and others.

Considering the different security issues of cloud computing and different strategies to adapt them ,we will propose to build up another Hybrid Encryption methods that includes Honey Encryption and Decryption Algorithm (Distribution Transforming Encoders).

In asymmetric encryption, otherwise called public- key encryption, a substitute key for encryption and disentangling is nevertheless Attacker will be in a general sense charmed for the unscrambling key, since that will enable him to get access of ordered data. Honey Encryption in any case has tantamount functioning as the conventional symmetric encryption and thusly symmetric encryption will be discussed extra here. [4]

III. METHODOLOGY

Honey Encryption(HE) contains another scheme for the encryption cycle called DTE. The Proposed algorithm follows the beneath referenced advances: The encryption we will do require five sections:

(i) Cipher text ©:- Cipher text is the consequence of Encryption performed on plaintext .

(ii) Plaintext (P):- It is the coherent material that is Converted into the cipher text

(iii) key K :- The key is a snippet of data (a boundary) that decides the useful yield of a cryptographic Algorithm.

(iv) Encryption (E):- This capacity is liable for Encryption.

(v) Decryption (D):- This capacity is answerable for Decryption.

Honey Encryption

To produce the intermediate cipher, plaintext is encrypted by using the cipher(E) encryption function
C = E(K;P)
Where c is the cipher text.

K is the key used , Key space is important part of encryption, the key space follows the formula of 2n where n is the amount of bits used for the encryption key.

P is the plain text that is to be encrypted.

Honey Decryption

To produce the plaintext(P) back ,cipher text(E) is decrypted by using the decryption(D) function.
P = D(K;C)

Where p is the plaintext K is the key used,

In the event that symmetric encryption is utilized, a similar encryption key is utilized in the two procedures (at encryption and decryption) in any case, in asymmetric plans the public key is utilized for encryption and the private key is utilized for decryption. C is the cipher content created during encryption process.

IV. ALGORITHM

The DTE is the crucial idea behind honey encryption. Honey encryption manages the space of plaintext through DTE. Let the probability transport over the message space be pb over the message p. The scattering changing encodes the message p as a K bit seed S ∈ {0, 1}K and unravels the message by talk DTE strategy, disentangle/translate (S) =p. DTE is a good model of the message scattering. The internal structure of the HE consolidates DTE encryption and DTE decryption .The two algorithms portrays the net working of the Honey Encryption.

1. Honey Encryption Algorithm:

H ⇓ Enc(k, p)
S ⇓ $ encode (p) R ⇓ $ {0, 1} n
S‟⇓ H(R, k)
C ⇓ S ⊕**S**

2. Honey Decryption Algorithm:

H ⇓ Dec(k, (R, C)
S‟⇓ H(R, k)
S ⇓ C ⊕S
L ⇓ decode(S)

H is a cryptographic hash work, k is a key, L is a message, S is a seed, R is an arbitrary string, C is a cipher content and ⇓$ shows that Honey Encryption algorithm may utilize some number of uniform irregular bits. At the point when the Honey Encryption is applied to the plaintext message p, it initially encodes the message p to S and afterward scrambles S by a key k utilizing reasonable symmetric encryption algorithm. The above algorithms portrays these means unmistakably, high message recuperation security is given by Honey encryption.[7]

Honey encryption using DTE (Distributed Transforming Encoding) working Kerckhoffs rule says that security can't rely upon the way that the assailant won't know nuances of the crypto system (Oppliger, 2011, p.1).

Let us consider the security of encryption should rely upon secure key, as such In honey encryption we shouldn't rely upon the way that the attacker doesn't have the foggiest thought regarding that honey encryption exist. An assailant thusly will understand that honey messages are made as such to slyness the attacker Let's accept the aggressor contemplates precarious honey messages, therefore he won't be

duped by essentially watching them. This won't have any effect, in light of the fact that the attacker won't benefit as he won't prepared to isolate among certifiable and counterfeit. Thusly the assailant won't advantage for basically considering honey messages he can't get to the structure at any rate. Key space is huge bit of encryption and the one factor that has created as new encryption algorithms are made. By and large the key space follows the equation of 2n where n is the measure of bits utilized for the encryption key. E.g. if n = 4, the potential keys could be:

0000 0001 0010 0011 0100 0101 0110 0111
1000 1001 1010 1011 1100 1101 1110 1111

The likelihood of speculating the right key can be determined as $1=2^n$ (Aumasson, 2017), where n is the no of bits. This makes the likelihood of speculating the wrong key $1-1/2^n$

Also, in the model utilized over the likelihood will be [1/24] = 0.0625. Presently, if the encryption key would be 50-bits, the likelihood of speculating the right key ascents to 1/250 also, with 250 bits, the probability/likelihood ascends to 1/2250

Which is very near to 0. So the likelihood for picking the wrong key aimlessly is near 1.

In brute-force attack, attacker can take a stab at each and every one of them(guess) and in the long run he will get the right one. Likelihood for getting the right key if the attacker experiences all prospects is essentially 1, and that is what is troubling. So as to keep this from occurring, the key space must be sufficiently large with the goal that it requires some investment to experience them all.

The time expected to break the encryption with only 4-bit key would not take that long. Utilizing the algorithm introduced a, the equation/formula would be:
$|k|\, t / 2p = 8t/2$

for simplification reasons we have just a single processor so p is 1. So to what extent does it take to play out a solitary decryption? What is the t? By and large it has been recommended that one activity takes one billionth of a second, proportional to nanosecond, to perform. (Aumasson, 2017) Symmetric encryption was grown sooner than asymmetric encryption and it utilizes the same key to encrypt and decrypt data/information (Gisin et al., 2002). The essential thought has been introduced by Gisin et al. (2002), where m is the message, $\oplus$ is expansion modulo 2 and C is the cipher content/text.

$m \oplus k \lozenge C$

Example showing functioning of Encryption/decryption.
This working can be portrayed by a model scrambling natural product drinks. This model incorporates five natural product beverages, for example, Apple, Mango, Orange, papaya and water melon. These encoded things will have a three bit string, for example, {000,001,010, 011,100.101, 110,111} etc

Honey encryption can be depicted by the accompanying model. How about we accept tom need to scramble his top pick natural product drink p= Mango that will be send to kinza under a secret key =0000 that is imparted to kinza. tom builds a organic product drink DTE that maps the message p into the space of 3-bit strings {000,001,010, 011,100.101,110,111}. The working resembles through DTE the encoded

Apple will have the worth 000, encoded Orange will have the worth 010 or 011, encoded papaya have the worth 100 or 101 or 110 and encoded water melon have the worth 111,which is arbitrarily picked .The message encoded by tom that is Mango is having the worth 001. tom chooses an irregular string R and figures S =H(R, k) and expect that S=(R, 0000) =111 and afterward the tom figures C=111⊕001=110 and it is sent to kinza.

Kinza unscrambles C by the key that has been shared by the tom that is key k=0000. So S=H®, 0000) =011, and S=C ⊕ S=110 ⊕ 111=001 and the encode (001) = Mango and the message is effectively recouped by the kinza. Assume an assailant Rom attempts to decode it. He doesn't realize the key that is utilized so he expect key to such an extent that of 1432, H=(R, 1432) =000 and afterward S=C⊕S=010, and by decoding it he will get decode (010) = orange. Along these lines the attacker is fooled by this new sort of encryption.

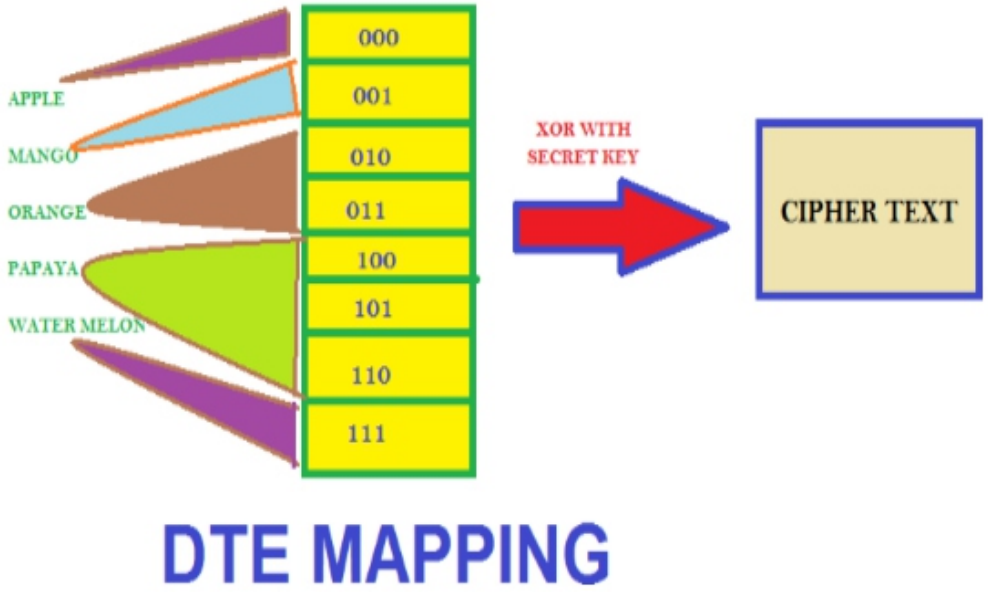

Figure 1: Distribution Transforming Encoder[5]

The message “apple” (with pb = 1/8) maps to 000, mango (with pb = 1/8) maps to 001, and “orange” (with pb = 1/4) maps to {010, 011}; pb is a probability distribution over the message space.

V. RESULT AND DISCUSSION

At the present time we applied honey Encryption frameworks (DTE) .Above we saw that Honey Encryption is generally fitting in the conditions where the mixed data is gotten from the passwords. exactly when an attacker endeavors to finish savage force attack by then using the Honey Encryption security contraption makes it entrapped for an assailant to know whether he has adequately estimated a mystery expression or encryption key. right when Honey Encryption has been used, by then regardless, a wrong theories of an aggressor makes tantamount results that radiate an impression of being real. Since each mixed up hypothesis makes a possible looking result, therefore the attacker is misled by honey Encryption. For a model, if an attacker endeavors to get a Master card number by making 500 undertakings, by then for all the 500 undertakings he will get 500 fake Visa numbers. Each decryption will look as possible as other. The attacker has no genuine method to perceive from the previous which is correct.

VI. CONCLUSION

Private data should be guaranteed to avoid adversity on account of spillage and misuse. The current mystery state based encryption (PBE) techniques used to guarantee private data are exposed in case of monster power attacks, as the aggressor can choose if the hypothesized key is correct or not by looking at the yield of the decryption method. The honey encryption methodology is a countermeasure for such a shortcoming. At this moment, arranged and executed a honey encryption instrument for passwords. Applications with reliably circled message spaces and with symmetric key encryption instruments are organized and executed. The presentation of our honey encryption framework was surveyed and an improvement was proposed to address the overhead issue.

VII. FUTURE SCOPE

Honey encryption plot has been executed for passwords. There is a basic prerequisite for HE to be balanced for various settings, for instance, Credit Card Numbers, impersonations for human made message, for instance, messages, convincing fakes to confront spying attack during online talking, etc.

This assessment has raised various issues requiring further assessment. Thusly, we propose further examination in the accompanying zones:

a) Common Language Processing in Honey Encryption: How might we get the specific properties of language? How might we model the human language itself as a reasonable instrument for arranging convincing interruptions?

b) How might we honey encode (produce fakes) without revealing the structure of the message?

c) How might we make interruption/honey messages that bonehead machines and human from recognizing veritable messages from trap messages?

d) How might we handle battering and shield adversaries from learning partial information of the primary message from the phony during an intensive key-search?

e) How might we address syntactic mistake issues in the H.E plot? This issue requires fast thought and wide exploration even before any execution of the HE plot.

CONFLICT OF INTEREST

The creators articulate that we have no beyond reconciliation conditions with rest of the Research.

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Resource Provisioning for Dynamic Requests in Mobile Cloud

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ABSTRACT

Cloud has the high computation capability while mobile devices have very less computing power and battery life. Mobile devices require resources from the cloud for its high computing operations. The requests from the user are of different types, some are delay-tolerant and some are delay-sensitive. Delay-sensitive requests are required to be executed with less response time. Priority wise scheduling of requests helps to execute high priority requests such as delay-sensitive requests with less delay. Mobile users request resources from cloud, this induces communication delay and causes delay in response. Communication delay is the major issue addressed in order to reduce the overall time required for the delay- sensitive requests. Mobile edge computing is proved to be ideal paradigm for resource provisioning as it reduces the communication delay involved in cloud. The resource provisioning framework with multiple mobile edge clouds, is proposed to minimize the communication and computation delay induced in handling the dynamic requests with priority. Requests are forwarded to the nearest edge cloud followed by request handling using Priority wise virtual machine allocation and Prims algorithm to find the minimum communication delay node. Three different resource provisioning policies network-based, utilization-based and hybrid are designed. The priority wise virtual machine allocation and prims algorithm are used in these policies. These cost-efficient algorithms are used to reduce overall delay in the network and minimize the cost required for the framework. In order to evaluate the proposed algorithms simulation experiments are conducted using EdgeCloudSim tool, considering multiple edge hosts and mobility of users. The results are proved to be more efficient as compared to single edge host and cloud resource provisioning algorithms.

Keywords - Mobile Edge Computing, Resource Provisioning, Communication and Computational Delay

I. INTRODUCTION

The ongoing development in services and applications has resulted in high rise in information storage and handling resources. Cloud computing has been more popular in the previous decade as it has the enormous computation and storage capacity. With the huge development in internet and cell phone technologies combined with innovations like Internet of Things (IoT), the focus has moved towards increasing continuous reactions for data storage and portability. Because of the delays induced on the Wide Area Network (WAN) and area wise provisioning of resources on the cloud, there is a need to bring the services of the cloud nearer to the users. This prompted the introduction of the Edge Computing which intends to give data storage and computing at the edge host.

Mobile edge computing (MEC) is a perfect paradigm to address these issues. The communication delay can be reduced by deploying edge hosts within the wireless access network so that users can access computation resources with less delay. MEC is defined as an execution of requests such as computational storage abilities at the edge host inside the Radio Access Network to decrease delay and improve quality of service. The MEC hubs or servers are normally co-situated along with the Radio

Network Controller or a large-scale base-station. The servers run different operations of MEC using different virtual machines with varying computation and storage capabilities. With the increasing need for better response, it is required to give efficient service for the delay-sensitive requests of the users. Priority wise scheduling gives better response time for the delay-sensitive requests. Priorities are assigned in a certain range. The incoming requests are arranged in increasing order of priority and are processed respectively. The delay-sensitive requests are assigned high priority so that they are executed first, whereas delay-tolerant requests are assigned low priority as compared to delay-sensitive requests.

Many new mobile applications are emerging which are delay-sensitive and computation-intensive. These applications require less response time and sufficient computation capability. As mobile devices have limited performing capability, mobile users request the resources from the cloud through the internet. The request passes through the internet which induces the delay, noise and causes degradation of the quality of service for these delay-sensitive applications, such as online gaming, live video streaming etc. Requesting the resource from the cloud includes the WAN delay, which is high as compared to WLAN delay. So, the main issue is to reduce this communication delay for more efficient and deadline driven resource provisioning. The Mobile-edgecloud are deployed in local proximity to act as the intermediate between the user and cloud. With the nearness of these mobile- edge clouds, the estimation of the load at the cloud and the communication delay is decreased as portion of the requests are coordinated to cloud and other to edge which do not require intervention from the cloud. This thus, decreases the idleness in handling the requests and permits real-time treatment of a subset of requests. Because of the more availability and geographically distributed nature edge devices support mobility. The deployment cost of edge host also increases with the number of mobile edge hosts and computation power of virtual machines. Considering monetary cost and overall delay the optimal resource provisioning algorithms are proposed.

II. RELATED WORK

Mobile Edge Computing (MEC) provides mobile and cloud computing capabilities in the access network. Hongxing Li discussed the challenges for the deployment of the Mobile Edge [1]. The quality of service is degraded by the Wide Area Network (WAN) delay and due to the noise present in cloud computing. Mobile Edge Computing helps to reduce the WAN delay by executing requests in local proximity. They have proposed a platform, named WiCloud, to provide edge networking, proximate computing and data acquisition for various services. Many such resource provisioning algorithms can be developed to overcome these challenges in MEC. Xiao Ma proposed a Cloud Assisted Edge Computing (CAME) framework to lease the cloud resources enhancing the computing capability [2]. The optimizat-ion of delay and cost of the system is focused in this framework. For minimizing the system delay queuing network is used. The system cost involves the edge cost and outsourcing cost.

Queuing theory is used for the calculation of system delay. System delay involves the communication and computation delay. The system delay for the delay- tolerant requests includes the computation delay and communication delay in the network. For delay- sensitive requests includes only the computation delay as they are executed at edge host in the local proximity. The system cost involves edge cost which includes the purchasing cost of the server. Also, the increase in the number of servers increases the computation power of edge hosts. The optimal resource provisioning algorithms are developed for on-demand, reserved and hybrid resource requests using the gradient descent of the system cost. While the cloud occupancy cost for on-demand instances are charged by every hour or even every second without long haul reservation. Reserved instances give clients a significant value markdown contrasted and on-

demand cases, while a one-year or three-year responsibility is requested. All the delay-sensitive requests and some delay-tolerant requests are executed on edge host. Cloud executes the delay- tolerant requests dynamically. The delay-tolerant requests are distributed to edge host and cloud proportionately based on the computation capability. In this paper they have used only one edge host, this is one of the major limitations.

Xu Chen addressed the resource-efficient computation offloading problem for each individual user [3]. Directed acyclic graph is generated for the tasks of each user, satisfying the control dependencies. On the generated graph topological sorting is performed. Based on the node ordering by topological sorting, the delay-aware task graph partition problem is solved by the principle of backward induction. In this the optimal execution location of the last node is determined first, then based on that the optimal execution locations for other nodes are determined by moving backward. Then the optimized formulation of the resource demanding strategy is obtained, guaranteeing task can be completed within the given completion time deadline. Whereas, the user's mobility patterns are not considered in this paper.

M. Aazam and E. Huh have proposed a service- oriented resource management framework for fog computing [4]. In this framework the resource request prediction is done. Based on the predictions the resources are reserved and the pricing is handled. Kiani et al. have introduced hierarchical capacity provisioning in edge computing [5]. They have proposed 2-tier edge computing architecture and the computation capability and resource provisioning challenges have been solved by stochastic ordering and optimization problems.

In this paper, we have proposed a resource provisioning model with multiple edge hosts having sufficient computation capacity. Also, the mobility of the user is considered. Considering all these aspects the proposed model minimizes communication delay and computation time required for the resource request handling.

III. PROPOSED MODEL

The proposed model is comprised of mobile devices, base-station, mobile-edge cloud and central cloud. Mobile-edge cloud is located near the base-station. Mobile-edge cloud has the resources required for the mobile users. WLAN, MAN and WAN delays are present in the network. Further the model is explained in detail.

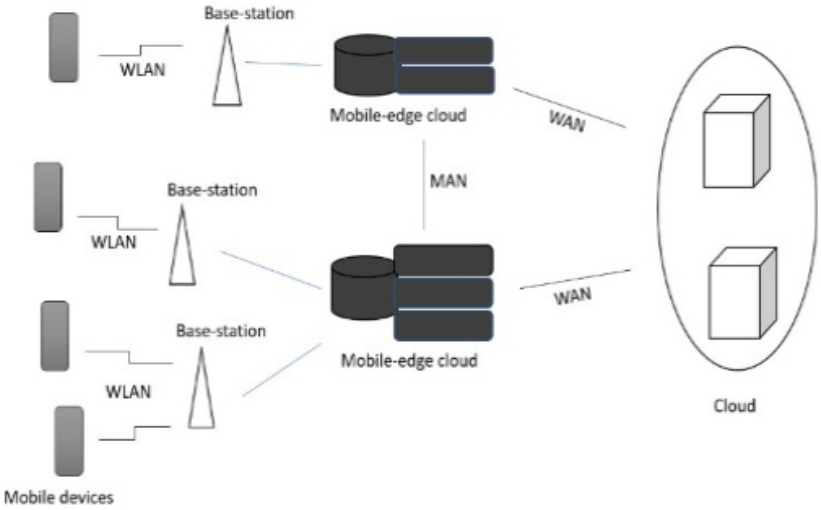

Fig. 3.1. Resource Provisioning for dynamic requests

- We consider there are B base-stations B= {1, 2, …, b} and M mobile-edge clouds M= {1, 2, …, m} in the model.
- Every mobile-edge cloud and global cloudhas varying number of virtual machines P= {1, 2, …, p} for the computations of the tasks.
- Base-station bi is connected to the mobile-edge cloud mj which is geographically closest to it.
- The N number of mobile users N= {1, 2, …, n} will send the requests to base-stations, base-stations will forward the request to closest mobile-edge cloud for the completion of the computation task requested by the user.
- The completion time Tn is dependent on the quality of service requested for the resource by the user.
- The problem is to minimize the maximum total completion time Tn, i.e., reduce the response time and the amount of the monetary cost for providing the resources.

The requests from the user are of different types, some are delay-tolerant and some are delay-sensitive. So, the priority assignment is done to the incoming requests based on the resource requirement. The priorities are assigned in a certain range. The incoming requests are arranged in increasing order of priority, the request having high priority is assigned less value and vice versa. This helps in processing the high priority requests faster than low priority requests.

The mobile devices send a resource request to themobile-edge cloud which forwards the request to the cloud if the resource is not available locally. The Edge clouds are distributed in areas such as supermarkets, commercial, and the main market areas. Thus, the cooperation among base-stations and edge is inseparable. The mobile devices are the clients, which requests the edge server and the cloud for the resource. The response time required for the client's request includes the communication delay and computation delay. Communication delay is the network delay and the computation delay include the time required for the computation of the task at edge cloud/cloud/locally on the device.

A. Computation of Communication Delay

The mobile devices send the request to the nearest base station, which includes the Wireless LAN (WLAN) delay. The network link quality varies with the number of mobile devices present in the network. If at a time a greater number of mobile devices are using the link then it will degrade link quality resulting in the increase in communication delay. The source and destination are the mobile device in this scenario. The WLAN delay is calculated for each user request. It is given as,

$$\text{WLAN delay} = \frac{\text{taskinput(Kb)}}{\text{bandwidthforwlan(Kbps)}}$$

If the mobile-edge host have the sufficient resource then the computation is performed with the help of virtual machine and the result is returned. The virtual machine p on which the computation is performed is chosen by the priority wise VM allocation algorithm. This algorithm allocates VM with the help of priorities of the incoming requests and computation power of VM. The computation power of VM includes the number of cores present in the VM, processing speed measured in mips, ram and storage. The weight is assigned to each VM based on its computation power. The VM having more computation power is assigned more weight so that it can handle more requests compared to VMs having less weight. The incoming requests are arranged in increasing order of priority, a request with high priority has less value. The high priority request is assigned to the VM having more weight i.e. more computation power. The load and the threshold of the VM is calculated based on the utilization to check if the VM is overloaded. The load of VM is calculated as given below

$$\text{Load (L)} = \frac{(\text{total capacity} - \text{utilized capacity})}{\text{total capacity}} \times 100$$

Threshold is also calculated for each VM, to identify whether it is capable of processing the request or not. Threshold can be calculated as,

$$\text{Threshold (T)} = \frac{C}{C} \times 0.9$$

where C is the computation power of all virtual machine on the mobile-edge host.

$$C = \sum_{i=0}^{p} c_i$$

where cis the computation power of the virtual machine at the mobile-edge host and0.9 is percentage utilization of a virtual machine

If L(Load)>= T(Threshold), Overloaded

If the load of the virtual machine is greater than threshold it is overloaded, it cannot handle the incoming requests. If the load is less than threshold it is capable of handling the requests.

In this algorithm the high priority request gets assigned to the high weight virtual machine. So, the requests are processed faster, reducing the response time. In priority wise request handling the starvation of the low priority requests is the main issue. To overcome this issue the priority of such request is decreased by one after certain number of iterations have occurred. In this paper, we have considered after 5 number of iterations.

Algorithm 3.1:Priority wise VM allocation algorithm

1. Get the priority wise sorted list of incoming requests.
2. Get the requiredVMCapacity of the high priority process from the list
3. Get the VM list on the edge host ID or cloud ID
4. For i=0 to number of VMs

a. Assign weight to each VM based on the processingpower,VM with more processing power has more weight.

b. VMs are arranged in the order of decreasing weight from high to low

5. For i=0 to number of VMs from the list arranged in decreasing order

a. Calculate load and threshold of the VM

b. If the load >= threshold, VM is overloaded

i. continue

c. Else if the load of VM is less than threshold

i. totalVMutilized= get_totalutilizedPercentage(i)

ii. targetVMCapacity = 100-totalVMutilized

iii. ifrequiredVMCapacity<= targetVMCapacity

1. selectedVM = i
2. break

6. Process the high priority request on the selected VM
7. If the low priority request is waiting for more than fixed number of iterations

a. Decrease the priority of the waiting request by one

If the mobile-edge host is busy or the required resources arenot available then the request is forwarded to the remote mobile edge host. This includes the Metropolitan Area Network (MAN) delay. The remote edge host is chosen based on the proximity. Consider a network topology graph consisting of m mobile-edge hosts as a weighted undirected graph.

$$V = \{v_1, v_2, v_3, \ldots, v_m\}$$

V is a vertex set, where vi is the set of mobile-edge hosts and m is the number of mobile-edge hosts.

$$E = \{e_{v1,v2}, \ldots, e_{vi,vj}, \ldots, e_{vm-1,vm}\}$$

is an edge set, where $e_{vi,vj}$ is the communication link between edge hosts v_i and v_j. t_{vivj} is the communication delay, that is, Metropolitan Area Network (MAN) delay between the edge hosts v_i and v_j.

$$\text{MAN delay} = \frac{\text{taskinput(Kb)}}{\text{bandwidthforman(Kbps)}}$$

We consider the weighted undirected graph of mobile-edge hosts. Communication delay is considered as the weight between the nodes, where nodes represent the mobile-edge hosts. For getting the minimum weight i.e. minimum communication delay node from the current node we use the shortest path Prims algorithm. It generates a minimum spanning tree. The time complexity of Prims algorithm is O((V+E) log V).

The pseudo code for Prims algorithm is given below. In this algorithm we make two sets of vertices S and S-T. S contains the vertices which are visited and S-T contains the vertices which are not visited. Step by step, we shift vertices from set S-T to set S by connecting the least weight edge.

Algorithm 3.2: Prims algorithm for minimum communication delay

1. D = {}
2. S = {v_i}
3. while (S ≠ D)
a. let (s, d) be the lowest MAN delay edge such thats ∈ S anddϵ D – S
b. D = D U {(s, d)}
c. S = S U {d}

If the edge hosts are not sufficient to handle the request or the resources are almost utilized then the request is forwarded to the global cloud. This includes the Wide Area Network (WAN) delay. The cloud has more computation capacity and resources.

$$\text{WAN delay} = \frac{\text{taskinput(Kb)}}{\text{bandwidthforwan(Kbps)}}$$

The WAN delay is more so most of the tasks are executed on edge host and the edge host has given the sufficient computation capability and resources with the virtual machines to carry out efficient computation. The number of virtual machines can be increased on the edge hosts if the load is increasing at the time of certain event or news outbursts.

B. Estimating the Computation Time

The computation time is the execution time of the resources or the task. We should increase the computation power of mobile-edge hosts so that more requests are handled on the edge, which may reduce the communication delay induced in forwarding the request to the cloud. We suppose that the computation power of each mobile-edge host v_i is C_{vi}.

$$C_{vi} = \sum c_{vi,p}$$

where $c_{vi,p}$ is the computation power of the virtual machines {1,2,…, p} at the mobile-edge host v_i.

The computation time is calculated in terms of number of instructions to be executed divided by the speed of VM instructions per second, given as

$$\text{comp\_time} = \frac{\text{no. of instructions to be executed (MI)}}{\text{speed of VM (MIPS)}}$$

C. Policies used for Resource Provisioning:

Three different policies for resource provisioning are discussed in this section.

a. Network-based

In the network-based policy, bandwidth is considered. If the WAN bandwidth is greater than the threshold, then the request is forwarded to the cloud, otherwise the request is forwarded to the edge host. If the bandwidth is greater than threshold it indicates the number of clients or users are less at that time and the WAN delay is comparatively less still it gives overall high communication delay.

Algorithm 3.3:

```
1.  if wan_bandwidth> threshold
2.  get cloud_ID
3.  get least loaded VM on the cloud_ID as given in
    algorithm 3.1
4.  calculate comm_delay = WAN delay
5.  calculate comp_time
6.  total_delay = comm_delay + comp_time
7.  else
8.  get edge_host_ID
9.  get least loaded VM on the edge_host_ID as
    given in                algorithm 3.1
10. calculate comm_delay = WLAN delay
11. if remote edge host
12. Prims algorithm to get minimum MAN delay as
    given in algorithm 3.2
13. comm_delay += MAN delay
14. calculate comp_delay
15. total_delay = comm_delay + comp_time
16. return total_delay
```

b. Utilization-based

In the utilization-based policy, the overall utilization of the edge host threshold level is maintained. If the overall utilization is greater than 80% then the request is forwarded to the cloud otherwise executed on edge host. As the edge host is almost utilized it will only increase the communication delay by forwarding request from one remote host to another.

Algorithm 3.4:

```
1.  edge_utilization = get_utilization()
2.  if edge_utilization> 80%
3.  get cloud_ID
4.  get least loaded VM on the cloud_ID as given in
    algorithm 3.1
5.  calculate comm_delay = WAN delay
6.  calculate comp_time
7.  total_delay = comm_delay + comp_time
8.  else
9.  get edge_host_ID
10. get least loaded VM on the edge_host_ID as
    given in algorithm 3.1
11. calculate comm_delay = WLAN delay
12. if remote edge host
13. Prims algorithm to get minimum MAN delay as
    given in algorithm 3.2
14. comm_delay += MAN delay
15. calculate comp_delay
16. total_delay = comm_delay + comp_time
17. return total_delay
```

c. Hybrid

It is the combination of both network and utilization- based policies. Both of the bandwidth and utilization factors, are considered in this approach. If the network bandwidth is greater than the threshold and overall utilization is greater than 80% then the request is forwarded to the cloud otherwise executed on edge. The threshold of bandwidth is decided based on the requests arriving at a time in the network.

Algorithm 3.5:

```
1.  edge_utilization = get_utilization()
2.  if wan_bandwidth> threshold and
    edge_utilization> 80%
3.  get cloud_ID
4.  get least loaded VM on the cloud_ID as given in
    algorithm 3.1
5.  calculate comm_delay = WAN delay
6.  calculate comp_time
7.  total_delay = comm_delay + comp_time
8.  else
9.  get edge_host_ID
10. get least loaded VM on the edge_host_ID as
    given in algorithm 3.1
11. calculate comm_delay = WLAN delay
12. if remote edge host
13. 13. Prims algorithm to get minimum MAN
    delay as given in algorithm 3.2
14. comm_delay += MAN delay
15. calculate comp_time
16. total_delay = comm_delay + comp_time
17. return total_delay
```

IV. IMPLEMENTATION AND RESULTS

The simulation is done on the EdgeCloudSim to evaluate the proposed algorithms. The queuing network is used to handle the requests in the EdgeCloudSim. In this simulation fourteen edge hosts are considered.

These hosts are created inside the data center. Data center specifications are x86 architecture, Xen virtual machine monitor (VMM) and Linux operating system. Edge hosts are assigned with eight virtual machine having different computation power. Each consisting of Linux operating system and specifications such as number of cores, million instructions per second (mips), storage and ram assigned accordingly.

Cloud is assigned with forty virtual machines. The configurations of Edge hosts and VM used in the implementations are as shown in Table 4.1 and Table 4.2.

No. of cores	MIPS	Storage	RAM
16	90000	400000	16000

Table 4.1: Configurations of Edge hosts

No. of cores	MIPS	Storage	RAM	VMM	Weight
2	8000	50000	2000	Xen	1
2	10000	50000	2000	Xen	2
2	11000	50000	2000	Xen	3
2	13000	50000	2000	Xen	4
2	15000	50000	2000	Xen	5

Table 4.2: Configurations of Vms

The priorities are assigned in the range 1-10 to the incoming requests. The task input size and output size are generated using exponential distribution. In this simulation, the mean of the task input size is set to 20 KB and task output size is set to1200KB.

The number of devices which can request resource are set varied from 200 to 1200 with increments of 200. The number of devices is increased to check the performance of the three policies at various kinds of load. As the number of devices increases the overall delay also increases. Network-based, Utilization-based and Hybrid are three policies implemented for evaluation of the communication delay and computation time.

In Fig. 4.1, computation time of network-based, utilization-based and hybrid policy is compared. As we can see the computation time of network-based policy is least as compared to other two, this is because for a smaller number of devices the bandwidth is highly available for cloud communication.

As cloud has more resources and computation power the computation time required is less as compared to edge, but higher communication delay is induced. While edge host has less computation power compared to cloud, it handles requests in other two policies resulting in more computation time. The communication delay induced is less due to edge hosts.

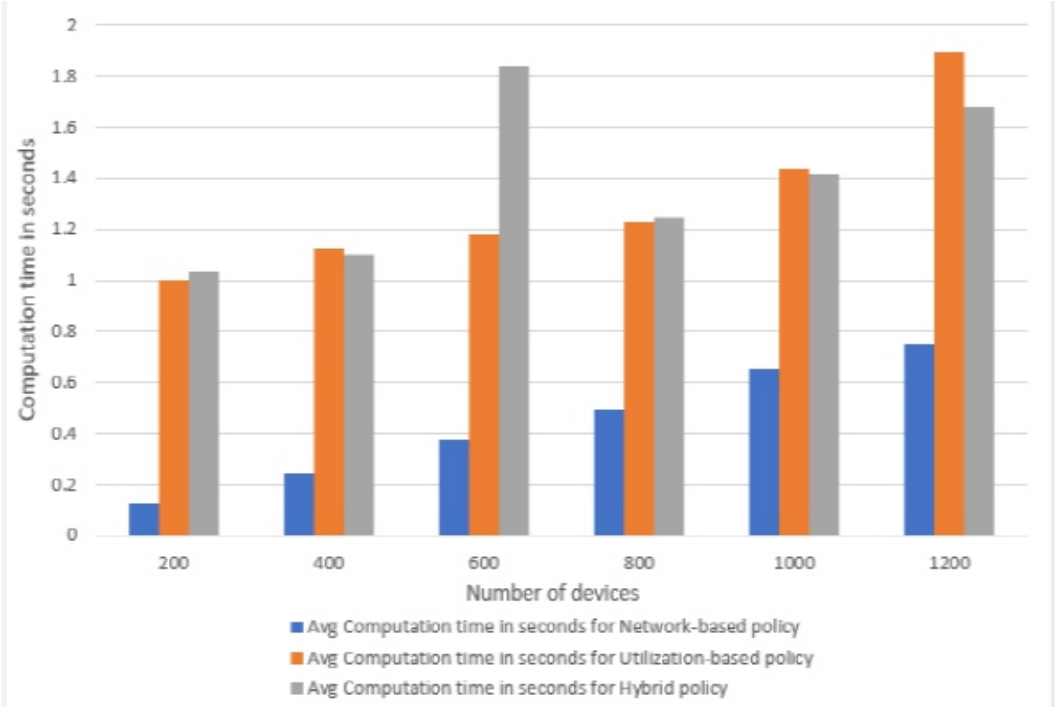

Fig. 4.1. Comparison of Computation time using three different policies with the increasing number of devices

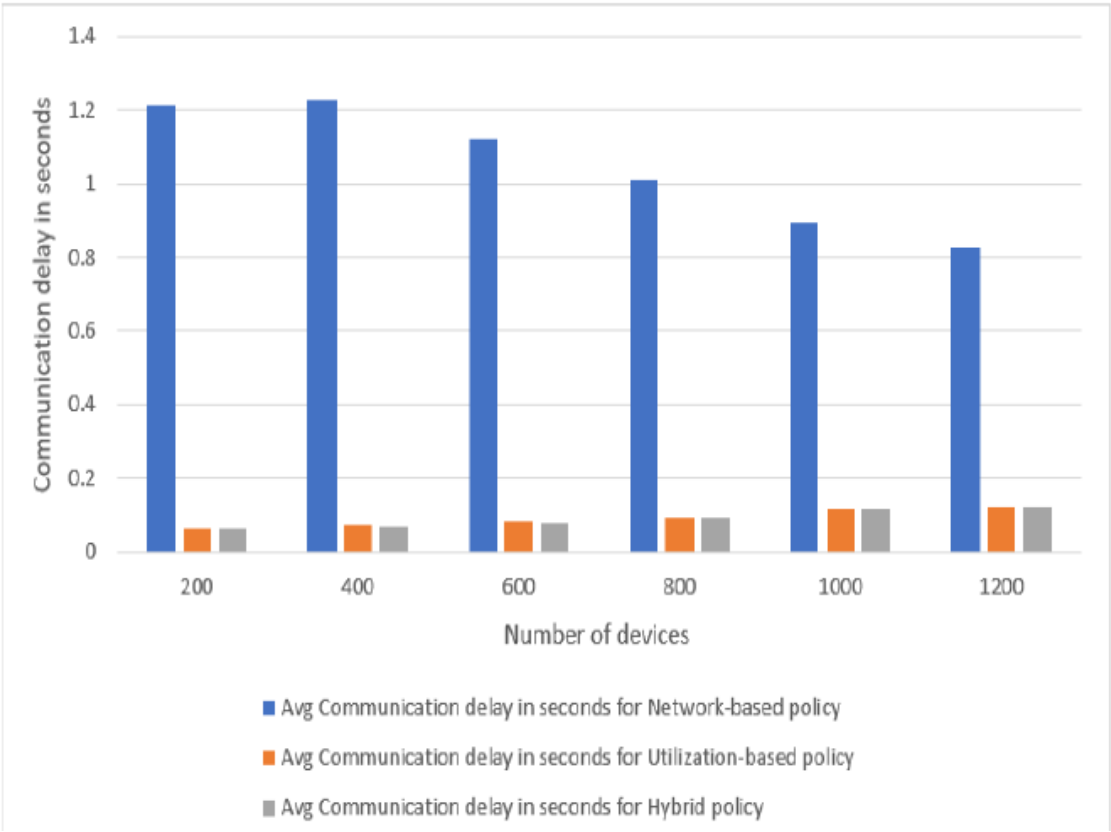

Fig. 4.2. Comparison of Communication delay using three different policies with the increasing number of devices

Comparison of Computation time and Communication delay using three different policies with the increasing number of devices, as shown in the Fig. 4.1 and Fig. 4.2, the network-based policy has the

least computation time as requests are executed on cloud which has high computation power but it has the highest communication delay as WAN delay is induced in this policy. So, the overall delay is not much reduced due to communication delay overhead. In the utilization-based policy computation time is more than the network-based policy and the delay increases as the number of devices increase.

But in this policy as most of the requests are executed on edge hosts the communication delay is considerably less than the network-based policy, it makes the overall delay less than the network-based policy. The hybrid policy has greater computation time than network-based policy but less than the utilization-based policy as the number of devices increases. Also, the communication delay of hybrid policy is much lesser than the network-based policy and almost equal to the utilization-based policy as the requests are distributed to edge host and cloud based on bandwidth of network and utilization of edge hosts. The overall delay of hybrid policy is less as compared to network-based and utilization-based policy. Thus, the hybrid policy gives the efficient response time for the resource provisioning. It can be verified from the results obtained with the simulation. Also, the high priority requests are executed with better response time using priority wise VM allocation algorithm.

The proposed hybrid resource provisioning policy is compared with respect to average completion time with single edge host and cloud resource provisioning algorithm. The completion time includes the computation time and communication delay. The cloud resource provisioning algorithm has highest average completion time because the communication delay includes WAN delay for every request. The single edge host resource provisioning algorithm has single edge host, thus once the edge host is completely utilized the requests are forwarded to the cloud. Also, the edge host has limited computation power as compared to cloud thus its average completion time is more than the proposed hybrid resource provisioning algorithm. The proposed algorithm has multiple edge hosts so the requests are forwarded to remote edge hosts if required, thus it induces less communication delay as compared to other two. Average completion time is plotted with increasing number of devices in the network. As shown in Figure 4, comparison of average completion time, the hybrid resource provisioning policy is proved to be more efficient as compared to single edge host and cloud resource provisioning algorithm.

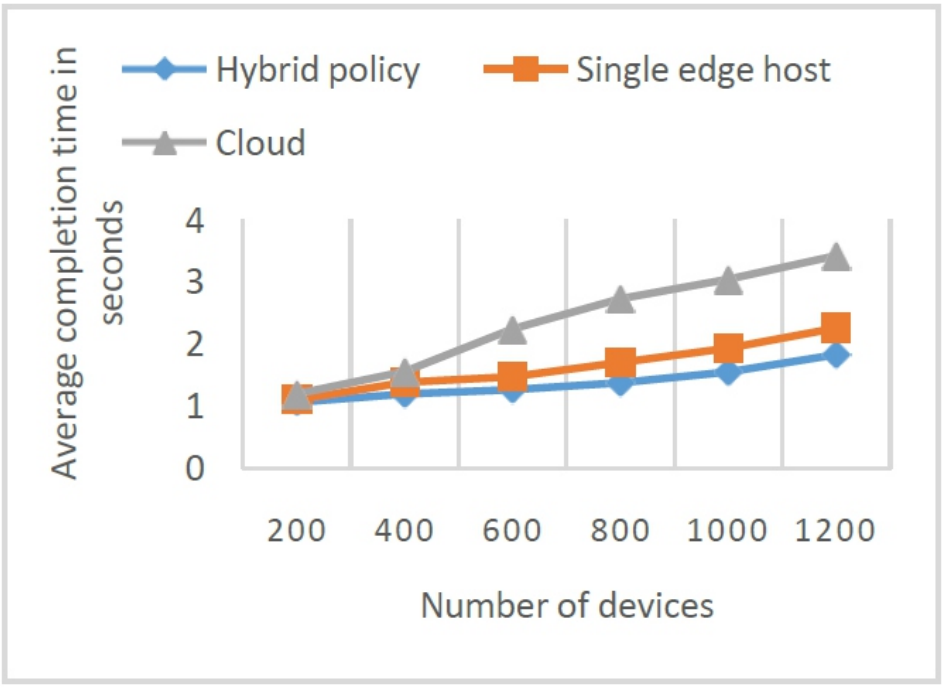

Fig. 4.3. Comparison of average completion time

The monetary cost for the edge cloud is also reduced by using different configuration virtual machines. The virtual machine with high computation power is used for high priority requests and others for low priority request. With this the monetary cost is balanced by using different configuration virtual machine. As the delay-sensitive requests are executed on the high weight virtual machine with better response time. Thus, this optimizes both cost and the overall completion time. The communication delay is minimized as compared to single mobile edge host and cloud but the deployment cost of edge host is more as multiple edge hosts are used in the proposed model.

V. CONCLUSION AND FUTURE WORK

In this work the computational time and communication delay of user's resource requestis optimized. The hybrid resource provisioning policy gives the optimized results for overall completion time in handling user requests. This policy is proved to be more efficient as compared to single edge host and cloud resource provision ing algorithm. Also, the high priority requests are executed with better response time using priority wise VM allocation algorithm. The monetary cost for the edge cloud is also reduced by using different configuration virtual machines. Thus, the proposed algorithm proves efficient for the optimization of overall completion time and monetary cost. In future work the cost optimization for the resources can be done. The heuristic algorithm can be designed which is efficient for both cost and response time optimization problem. The algorithm can be modified considering dynamic priority changes at runtime in the future.

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Auto Generative Adversarial Network using Crow Search Algorithm for Human Activity Recognition

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ABSTRACT

This paper presents a new technique of high-quality human activity recognition (HAR) system using the neural architecture search (NAS) as a combined technique using the generative adversarial networks (GAN) and the crow search algorithm (CSA). The new technique can improve the total accuracy of HAR system compared to any previously used methods such as artificial neural network (ANN) and convolution neural network (CNN). The previously used methods could not classify between much of overlapped objects within some of data sets. The new technique used the wideness of the search space and the evolutionary search abilities to detect the overlapping objects in an accurate methodology. Automl tools are used broadly to improve the accuracy of the classical machine learning methods in detection and segmentation of the independent and overlapped objects.

Keywords - Central Force Optimization (CFO); Modified Central Force Optimization (MCFO); Fuzzy Logic Controller (FLC); Side Lobe Level (SLL)

I. INTRODUCTION

In recent years, deep learning and feature engineering techniques are most important methods for computer vision field. The neural networks are used broadly in this field using multiple generations of them (e.g. Artificial Neural Networks (ANNs), Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs) and Generative Adversarial Networks (GANs)). GANs are one of the main categories of neural networks used mainly to learn generative models from complicated real-world data and also for other classification tasks [1]. In this work, GANs and its modified methods train a discriminator to distinguish normal samples in the training dataset from abnormal ones which can be synthesized by the generator. The training procedure continues until the generator wins the adversarial game in which the discriminator cannot make a better decision than randomly guessing whether a particular sample is normal or abnormal [1].GANs and its variants have recently been applied to image generation, image editing, video prediction, and many other tasks [2].

On one hand, GANs and its modified techniques have been utilized to modelling real-world datasets, such as CelebA, LSUN and ImageNet. They suffer from various training problems such as instability and mode collapse as a large-scale optimization problem [1]. Mode collapse means that the generator can only learn some limited patterns from the large-scale target datasets, or assign all its probability mass to a small region in the space [3]. On the other hand, many recent efforts on GANs have focused on overcoming the pre-discussed optimization difficulties by developing various adversarial training objects.

In this paper, a new combined technique is built based on AutoGAN and Crow Search Algorithm (CSA) as an evolutionary algorithm [2]. This technique treats the adversarial training procedure as an evolutionary problem. It is an algorithm which requires a well-defined search space and heuristic or objective function to perform well [NAS-CSA]. Generally, AutoGAN-CSA algorithm depends on the

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Keywords - Central Force Optimization (CFO); Modified Central Force Optimization (MCFO); Fuzzy Logic Controller (FLC); Side Lobe Level (SLL)

Neural Architecture Search (NAS) domain, in which, the GAN architecture is defined by properties of the structure and training attributes, collectively called Hyperparameters, such as Number of Layers (Depth), Number of Neurons in Layers (Width), Activation Function and Optimizer.

This paper is organized as follows: a brief introduction of the related works to new proposed techniqueis discussed in details in section 2. In section 3, the results are presented. Finally, in section 4, the new combined technique and its usage for video recognition is concluded.

II. BACKGROUND

In this section, AutoGAN is discussed which has more competitive performance than other types of GANs, and then the CSA is briefly presented which shows faster convergence rate compared than other evolutionary algorithms.

A. Auto-Generative Adversarial Networks (Auto- Gan)

Generally, adversarial training strategy achieved promising performance for deep learning applications (e.g. classification tasks). AutoGAN has been produced after multiple stages of GANs development. Firstly, classical GAN provides a good framework of learning deep generative models. It is easily trained by updating a single generator and a discriminator using the backpropagation algorithm. So, GANs and its variants produce better samples than other generative models [2]. However, there are some problems in the GANs training process. Multiplemodified versions of GANs are produced to eliminate these problems. Among these modified GANs are Designed Specified Network Architectures (DCGAN), Energy-based GAN and least- squaresGAN which improve the overall training stability, in practice, the network architectures and training are required for imprecise design to maintain the adversarial training strategy between discriminator and generator [2]. Another developed network is called mixture GAN which overcomes the mode collapse problem by training multiple generators to specialize in different data modes [2].

Finally, the auto machine learning tools (AutoML) are very efficient to be used in the image classification tasks. So, an AutoGAN is produced which introduced an efficient NAS algorithm [4]. For this neural network, the search space is defined for the generator architecture using a RNN controller to guide the search, with parameter sharing and dynamic-resetting to accelerate the process [4].

B. Crow Search Optimization Algorithm (CSA)

In recent years, evolutionary algorithms are introduced to produce efficient solutions for many deep learning problems. They have achieved high success for almost computational tasks such as modelling, optimization and design [5-6]. In contrast to AutoGAN which alternately update a generator and a discriminator. So, a Crow Search Algorithm (CSA) is introduced as an efficient evolutionary algorithm that can evolve a population of generators(s) {G} in a given environment (i.e. the discriminator {D}) [2]. CSA is considered as a nature inspired optimization algorithm which proposed in 2016 by Askarzadeh [7]. It is a population-based metaheuristic method inspired by the natural and intelligent behaviour of crows for hiding their food and following other birds to steal their prey [8]. In this case, crows use their own experience of having been a thief to predict the behaviour of a pilferer, and determine the safest course to protect their catch [8]. Generally, the principles of CSA are listed as follows [7]:

- o Crows live in the form of flock.
- o Crows memorize their hiding places.
- o Crows follow each other to do thievery.
- o Crows use their experience to protect their catch.

• **Mathematical Formulation**

For the definition of the search space, a d- dimensional environment is assumed to be included a number of crows (N). The position of a crow i at time iter (iteration) in the search space can be defined by the following vector [8]:

$$x^{i,iter} \ (i = 1, 2, \ldots N ; iter = 1, 2, \ldots, iter_{max}).$$

Where:

$$x^{i,iter} = [x_1^{i,iter}, x_2^{i,iter}, \ldots, x_d^{i,iter}]$$

$iter_{max}$ is the maximum number of iterations.

Each crow i stores the location of the hiding space in its memory. The position of its hiding place of it can be denoted as $m^{i,iter}$ at iteration iter. The memory of each crow i represents the best position that crow i has obtained so far [8].

Now, crow j can decide to visit its hiding place, mi,iter, and crow i follows the crow j to approach to its hiding place. There are two cases for that:

Case 1: The crow j does not know that crow i is following it. So, the crow i flies towards the hiding place of crow j. Consequently, the new position of crow i is calculated as:

$$x^{i,iter+1} = x^{i,iter} + r_i \times fl^{i,iter} \times (m^{j,iter} - x^{i,iter}) \qquad (1)$$

Where:

The flight length in that direction varies randomly ($fl^{i,iter}$ is the maximum flight length of crow i at iteration iter, r_i denotes to a random factor varying between 0 and 1.

Case 2: j crow knows that i crow is following it. So, the j crow can protect its catch by fooling the i crow and runs to a random position in search space, instead of going to its actual hiding place. Both cases can be expressed as:

$$x^{i,iter+1} = \begin{cases} x^{i,iter} + r_i \times fl^{i,iter} \times \left(m^{j,iter} - x^{i,iter}\right) r_j \geq AP^{j,iter} \\ a\ random\ Position \qquad\qquad Otherwise \end{cases} \quad (2)$$

Where r_j is a random number that refers to $0<r_j< 1$ and $AP^{j,iter}$ refers to the probability of awareness of j crow at the iteration (iter).

The small values of f_l lead to local search (at the vicinity of $x^{i,iter}$) and the large values of results in global search (far from $x^{i,iter}$). The Figure 1 explains these two states and their effect on the search capability [8].

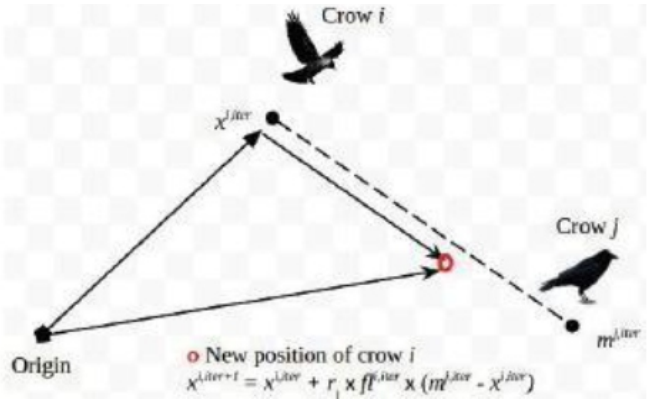
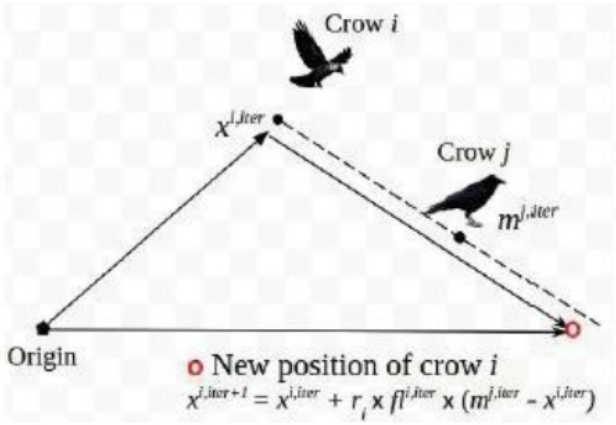


Figure 1 : (a) If fl<1, the next position of crow i is located on the dash line between $x^{i,iter}$ and $m^{j,iter}$[8]



(b) If fl>1, the next position of crow i is located on the dash line which may exceed $m^{j,iter}$[8]

III. AUTOGAN-CSA TECHNIQUE

In the proposed technique, we consider that we have a type of an E-GAN model that has some of generators {G} which are regarded as the evolutionary population and a discriminator {D} which acts as an environment. For each evolutionary step, the generators are updated using different objectives to accommodate the current environment [2]. The process of the evolution follows the CSA strategy in the search as follows:

Step 1: The AutoGAN defines the optimization problem which concludes the decision variables and constraints. Then, the adjustment parameters of the CSA (i.e. flock size (N), maximum number of iterations (itermax), flight length (fl), awareness probability (AP) is processed.

Step 2: N crows are created with randomly assigned hyperparameters for the AutoGAN network. Each set of hyperparameter represent a unique position in a d- dimensional search space. The d number of hyperparameters is used as the decision variables.

So, the crows' memory is initialized to assume their hidden food positions concluded in the following matrix:

$$Crows = \begin{bmatrix} x_1^1 & \cdots & x_d^1 \\ \vdots & \ddots & \vdots \\ x_1^N & \cdots & x_d^N \end{bmatrix} \quad Memory = \begin{bmatrix} m_1^1 & \cdots & m_d^1 \\ \vdots & \ddots & \vdots \\ m_1^N & \cdots & m_d^N \end{bmatrix}$$

Step 3: For each i crow, the AutoGAN model based on set of appropriate hyperparameters at its position $x^{i,iter}$ compiled and trained. Then, the quality of $x^{i,iteris}$ evaluated by the test accuracy of the compiled model.

Step 4: Each i crow is assigned another j crow to follow in the flock. Then, the pre-mentioned criteria is introduced for the position updating of the i crow to calculate the required hyperparameter vector. The new hyperparameters set are considered as another location in the search space. Consequently, this process is repeated for each crow [8].

Step 5: After checking the feasibility of the hyperparameters set, the new calculated one is assigned to the crow's position to compile an AutoGAN model.

Step 6: By compiling and training the new AutoGAN model, the fitness is evaluated for the new position.

Step 7: If the new position's fitness (or test accuracy of new model) of a crow is better than fitness of the memorized position, then each crow updates its memory by the new position.

$$m^{i,iter+1} = \begin{cases} x^{i,iter+1} & f\left(x^{i,iter+1}\right) \text{ is better than } f\left(m^{i,iter}\right) \\ m^{i,iter} & Otherwise \end{cases} \quad (3)$$

Where $f(x^{i,iter+1})$ refers to the objective function value.

Step 8: Until the $iter_{max}$ is reached, steps 4-7 are repeated.

Finally, the best position of the memory after final iteration is considered as the efficient solution of the optimization problem [8].

IV. SIMULATION RESULTS

For the proposed method, the AutoGAN-CSA is processed for a specified data set which results are obtained as shown in Fig. (2). The new approach is tested on UMN dataset which publicly available dataset of normal and abnormal crowd video from the University of Minnesota [9].

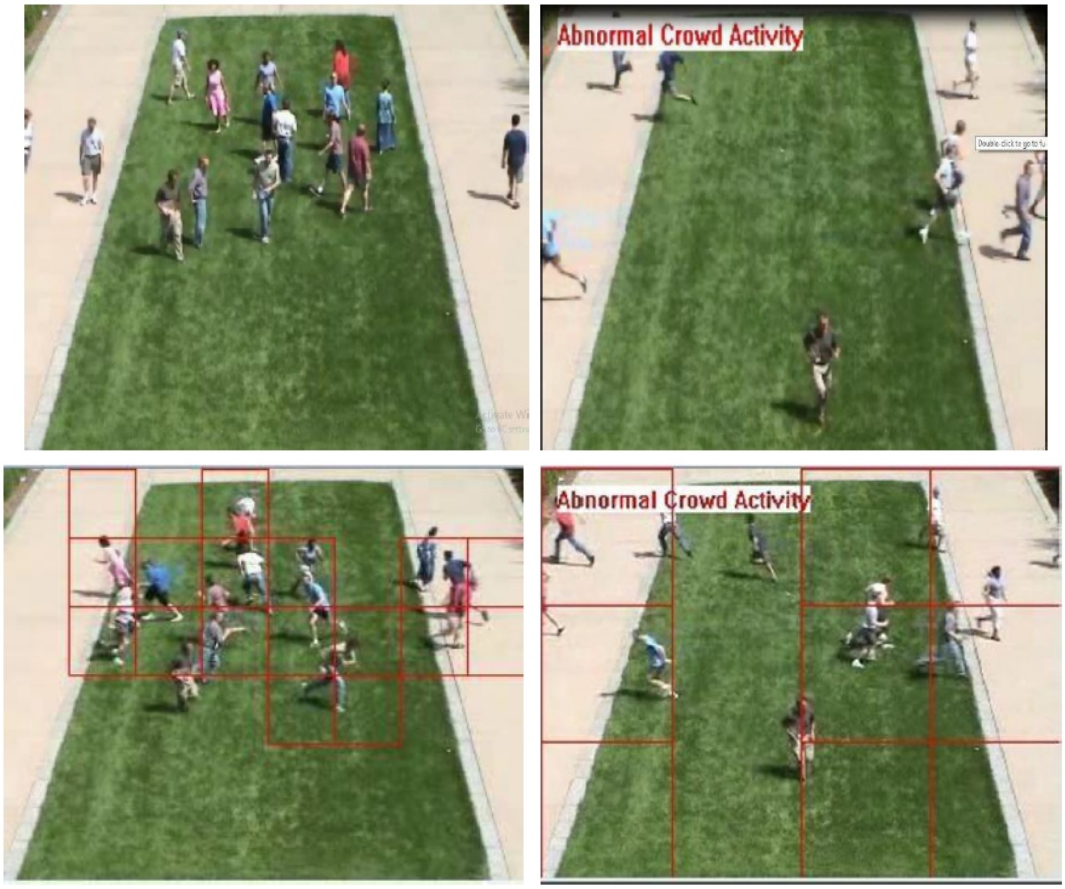


Figure 2: Output Sample frames of the UMN dataset: Normal (left) and abnormal (right)

Experiments show that AutoGAN-CSA improves the training stability of AutoGAN models and achieves convincing performance in several image classification tasks. After processing the optimal decision parameters of AutoGAN-CSA, the effects of corresponding network's variables can be compared with results obtained in the case of applying pure optical flow and social force methods [10] as shown in the following table:

Approach	Area Under ROC
Pure Optical Flow [10]	0.84
Social Force [10]	0.96
AutoGAN-CSA	0.98

Table 1. The comparison of the usage of the proposed AutoGAN-CSA method with each of pure optical flow and social force methods for the detection of the abnormal behaviours in the UMN dataset.

V. CONCLUSION

In this paper, we presented a new evolutionary AutoGAN framework (AutoGAN-CSA) used for improving normal/abnormal HAR. Generally, the AutoGAN could challenge NAS for image classification through video streams due to the high stability and hyperparameter sensitivity of GAN training itself. Consequently, CSA has lot more potential which combines the heuristic based approach with random selection that is computational efficient to make the process of architecture search faster and more accurate for HAR.

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