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Contents

Assessment of Software Reliability by Object Oriented Metrics using Machine Learning Techniques

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ABSTRACT

Reliability of software is a distinct feature of reliability engineering. Software reliability models are used to assess reliability by fault prediction. Reliability is a real-world phenomenon with many related real-time problems. For easy, reliable and effective solution, many computational techniques have been developed. Though non-functional but significant feature of any Software is its "Quality", which is not contented by many software products. Software defect prediction models with object-orientated metrics are used to measure the quality by identifying its defective classes. This research empirically analyses the defective classes by modelling with software failure data using the machine learning techniques and object-oriented metrics. Various models using Machine Learning algorithms like Logistic regression (LR), Decision Tree (DT), Support Vector Machine (SVM), Naïve Bayes Classifier (NB), k-Nearest Neighbour (KNN), Random Forest (RF) and Stochastic Gradient Boosting (GBM) have been developed. The fault proneness is detected for the classes of Marian Jureczko (MJ) Data sets. After analysis of Marian Jureczko Data set, it is found that RF provides optimum values for accuracy and ROC-AUC. The built RF model lies in outstanding category .

Keywords: Software quality; Reliability; Object-Oriented Software Metrics; Classifiers; ROC; Fault Proneness

1. INTRODUCTION

Day by day it is becoming tough to develop the software without faults due to the escalation of complexity, applications and limitations under which software is developed. Software failures decreases the software reliability. These failures are generally due to faulty classes which leads to increase the development and maintenance costs [1]. Earlier for the prediction of a software fault different classification techniques have been explored by the different researchers. It is observed that the result of several such techniques changes for software to software and no single technique has always given a good result for various datasets. The process of detecting defective modules in software is "Software defect prediction". It eases testing efficiency and subsequently gives chance of improving software quality. It enables a timely identification of fault-prone modules. Early detection of software defects and corrections can reduce the high maintenance phase costs if defects are detected in later stages of SDLC.

Different studies have developed variety of metrics model for evaluation of software quality. These metrics models have a minimum threshold value above which their weighted relevance in developing the model becomes significant [2]. Previous researcher's analysis says that Ensemble over the base learner is often more accurate and are less affected by noise in datasets, also achieving lower average error rates than any of the constituent classifiers which shows a boost in the performance results. Using different performance measures and under different circumstances and inconsistencies existing in these various experiments, the performance of learning algorithms may vary. Hence need to improve the

performance by feature selection is the prime importance, which reduces unnecessary data from the dataset and improves the classifier for software defect prediction. Object-oriented design metrics can be validated in early stage of software development considering design phase using statistical methods and machine learning algorithms.

This study comprises the performances of models built on various algorithms. The study includes base-learner, bagging and boosting models evaluated using different performance measures on validated defect MJ datasets. Hence the objective of this research is to develop an early software defect prediction model for software reliability assessment. This paper is organized as Section 2 Related work, Section 3 proposed work later Section 4 Research outcome and Discussion and lastly Section 5 Conclusion and Future work.

2. RELATED WORK

The defect prediction classifiers using machine learning methods are currently used by all the researchers. Initially the classifier is trained by the defect dataset of previously developed software and then used to predict another defect dataset. Yun Zhang et al have shown in their research the effectiveness in terms of F-measure and cost effectiveness of seven machine learning composite algorithms using cross project defect prediction technique CODEP [3]. Marian Jureczko et al prepared a dataset as combined dataset and used all metrics expressed in Correlation matrix by which the number of defects were created. Hence Pearson correlation coefficient (ρ) was used for Stepwise linear regression model construction and this was validated using performance measure accuracy. All contributing variables are used for model building and dependent variable is used for training and testing the prediction of the model [4].

Further T. Mende et al. have expressed that the traditional estimation approaches like precision, recall, ROC curve overlook quality assurance costs, therefore expanding the need to review the module. This hence led them to finding accuracy which was truly needed for the actual test [5]. S. Shivaji et al. in their research paper have naturally considered the numerous features gathering techniques, NB and SVM classifiers, for classification-based defect prediction. This expertise eliminates less significant functions for developing more constructive classification result [6]. Sunghun Kim et al in their work they first classified file changes as buggy or non-buggy by using the source code terms and change information features terms. Apart from that the work includes change classification by an assessment of the relative contributions of various feature groups. Use of SVM through feature selection, existing noteworthy enhancements in contrast to the F-measure, precision-recall of the classification in the failure prediction are made [7].

P. L. Li et al. noted on ABB's knowledge in applying field, failure prediction is about how to choose the exact modelling technique and how to assess the real accuracy of predictions for numerous versions of the time-period. They evaluated that the utility of the prediction depends on the proficient view. They recognized the component as vulnerable by an expert [8]. Researchers like Satwinder Singh, Niclas Ohl and Thomas J. Ostrand concluded upon the fact that early fault prediction improves quality of software through their many case studies on failure prediction in industry record [9,10,11]. Arsalan Ahmed Ansari et al in their research used heterogeneous defect prediction by using an ensemble classifier in voting technique with effective pre-processing methods for getting the promising results [12]. Dharmendra Lal Gupta et al have done bug prediction by investigating the data and assessed relationship between metrics by calculating the accuracy of the proposed model using different datasets to show the relationship between object-oriented metrics and have done bug defect prediction. [13].

Bassey et al analysed and presented. from 29 relevant empirical studies complexity, coupling and size to be strongly related to FP [14]. Mabayoje M.A et al given SDP from Effect of Feature Selection and Ensemble Methods [15]. J Rashid et al studied Software Metrics and its Impact on Software Quality [16]. Mashooque Ahmed Memon et al, summarised Defects Prediction and Prevention Approaches for Quality [17]. Three Levels Quality Analysis done by Mustafa [19], J. Rashid, T. Mahmood, M.W. Nisar summed up Software Metrics and its Impact on Software Quality [20]. Yun ZHANG on Crossed project [18] and J. Chang, et al Defect Prediction done from Heterogeneous nature [21].

3. PROPOSED WORK

The research is carried out using the dataset of the projects having object-oriented deficiency. Marian Jureczko data sets is identified and which is available at http://madeyski.e-informatyka.pl/tools/software-defect-prediction/. Dataset consists of instances of the projects of similar kind, which has each instance with the corresponding metrics sets and associated bug values. Further, the Object-Oriented metric suits being used for model building consists of metrics: WMC, DIT, CBO, RFC, COM, CA, CE, NPM, COM3, LOC, DAM, MOA, MFA, CAM, IC, CBM, AMC, MAX-CC and AVG CC as independent variables. Prediction of dependent variable bug as 0 or 1, i.e. binarization, is done by every instance in the presence of the mentioned independent variables above. To build software defect Prediction models with object-oriented metrics and machine learning techniques, following is the proposed algorithm suitably used for this type of Data Sets.

3.1. Proposed Algorithm

1. Input: A set of datasets VDS (validated Combined Dataset) 1.1 Select datasets of similar kind of project as combined dataset.

1.2 Combined datasets in the form of Validated dataset VDS = ΣD1+D2+D3…. Dm.
1.3 Identify and remove Near Zero variance metric.
1.4 Check the missing values in each metrics.
1.5 Replace it by measures of central tendency.
1.6 Check the outliers and treat.

2. A set of metrics (MT = MT1, MT2, MT3…, Mtn)

3. A set of classifiers (CL1, CL2, CL3…, Clz).

3.1 Split data into Train and Test (70:30).
3.2 Use different classifiers CL1, CL2, ..., CLz) using Train Dataset & Validate using Test Dataset
3.3 Build Model with significant metrics MT1, MT2, …Mtn
3.4 Use of Ensemble techniques (Bagging & Boosting) to improve the accuracy and related measures for evaluation.

4. Output: Proposed model based on Accuracy, Area Under-ROC, Confusion Matrix.
4.1 Generate Confusion matrix
4.2 Apply Performance Measure to calculate Accuracy, Sensitivity, Specificity, PPV, NPV and AUC-ROC for each classifier.
4.3 Re-experiment by applying k-fold cross validation technique on same VDS (K=10)
4.4 Generate Confusion matrix
4.5 Apply Performance Measure calculate Accuracy, PPV, NPV, AUC-ROC for each classifier on VDS
4.6 Select foremost Classifier with Maximum Accuracy and better in ROC-area under curve for prediction of software reliability.

3.2. Proposed Framework

The proposed framework in the following Figure 1 indicates that the modelling and assessment of software reliability can be accomplished using various machine learning algorithm on historical data by using the 70:30 proportion of training and test data for optimal results. The experiment will be carried out with the various classifiers like Logistic Regression, Decision Tree, Support Vector Machine, Naïve Bayes and K-Nearest Neighbor to improve the accuracy. Further in this framework two more techniques Gradient Boosting and Random Forest have been added from the Ensemble classifier. Results of all these classifiers have been compared to suggest the best model using various performance measure.

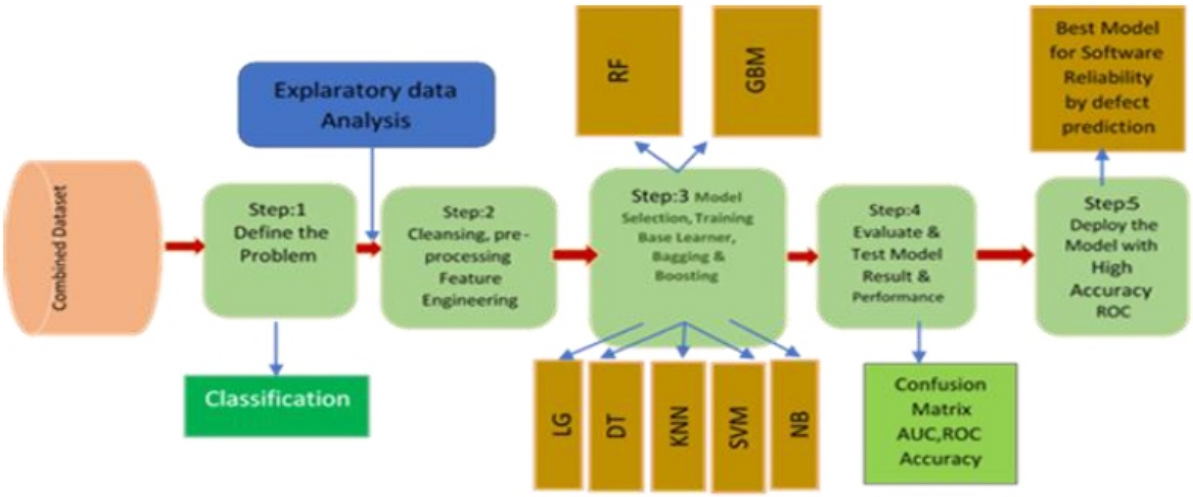

Figure 1. Framework for Modelling and Assessment

3.3. Data Pre-processing

An initial pre-processing method is applied on validated data where binary classification is done which involves the binarization of class variable. The dataset having identical data should be deleted excluding one entry. Any other error-based attributes are also required to be removed to ensure correct classification. Further, the attributes having zero or near zero variance values are to be removed. Hence in this work the attribute NOC is removed before application of classifier and building of model. In the data, it is difficult to handle missing values for many learning techniques hence it is better to treat the missing data by replacing this data by measures of central tendency. The descriptive statistics has shown the lot of variation hence all the metrics brought in one rage of values.

4. RESEARCH OUTCOMES & DISCUSSIONS

The main aim of most classifiers is to perform binary classification, i.e., Faulty (bug) or Non-Faulty (no bug). The performance metrics used here are accuracy, confusion matrix, Area under the ROC curve. AUC is specified an improved result for software defect detection. ROC curve area ranges between 0 and 1. Spacman gave the classification and performance measure by threshold value range for ROC curve, as follows – No Discrimination for range Below 0.5, "Poor category" for $0.5 < AUC < 0.6$, "Good classification" for the range of $0.6 < AUC < 0.7$ and "Acceptable classification" category for $0.7 < AUC < 0.8$, "Outstanding category" for $0.8 < AUC < 0.9$ range and "Exception category" for the 0.9 above [2,9].

The confusion matrix is used to get the results of binary classification. Which are calculated using the various performance measures Accuracy, sensitivity, specificity etc. Research activity for model building and performance measures were conducted in R tool for Machine learning techniques using various classification algorithms.

The values of train data in table-1 reflected in Figure 2-A recaps the accuracy performance of the various classifiers built on the various classifiers in which the RF classifier achieved the highest accuracy scores as related to other classifiers, whereas the minimum value was 73.76% of NB classifier. The scores accomplished by all contributing classifiers are shown in Table 1 and reflected in Figure 2-A bagging with RF classifier attained the highest ROC-AUC scores, achieving 0.9472. The ROC-AUC score of RF classifier was the best among all the classifiers, while the lowest value was 0.6152 was attained by the DT. The SVM, GBM Boosting, SVM, KNN classifiers achieved the better ROC-AUC scores.

Table 1. Performance Evaluation of Classifiers on Train and Test Data

	LR (%)		DT (%)		NB (%)		SVM (%)		RF (%)		GBM (%)		KNN (%)	
	Train	Test	Train	Test	Train	Test	Train	Test	Train	Test	Train	Test	Train	Test
Accuracy	74.99	75.00	74.45	74.59	73.76	74.00	78.19	77.56	93.34	80.43	76.16	76.02	82.95	79.14
Mis-classify	25.01	25.00	25.55	25.41	26.24	26.00	21.81	22.44	06.66	19.57	23.84	23.98	17.05	20.86
Sensitivity	95.99	95.85	97.99	98.03	92.80	92.69	97.28	96.79	99.15	91.93	96.18	96.26	94.21	92.09
Specificity	18.22	18.61	10.79	11.22	22.28	23.47	26.58	25.55	77.65	49.34	22.03	21.30	52.51	44.11
PPV	76.04	76.10	74.81	74.91	76.35	76.61	78.18	77.85	92.30	83.07	76.93	76.79	84.28	81.67
NPV	62.68	62.39	66.53	67.78	53.39	54.27	78.31	74.63	97.11	69.32	68.06	67.82	77.05	67.35
Prevalence	73.00	73.00	73.00	73.00	73.00	73.00	73.00	73.00	73.00	73.00	73.00	73.00	73.00	73.00
Kappa	63.87	65.04	58.32	59.37	18.48	19.68	30.13	28.18	81.97	45.39	23.14	22.41	51.93	40.62
AUC	0.6936	0.6936	0.6152	0.6095	0. 6487	0.6544	0.7824	0.7624	0.9472	0.7622	0.7250	0.7230	0.8067	0.7451
CI (95%)	0.7452, 0.7546	0.7427, 0.7571	0.7397, 0.7492	0.7386, 0.7531	0.7328, 0.7424	0.7327, 0.7472	0.7774, 0.7863	0.7636, 0.7824	0.9307, 0.9361	0.7976, 0.8108	0.7569, 0.7662	0.7531, 0.7673	0.8254, 0.8336	0.7846, 0.7981

The positive predicted values, an indication that Random Forest classifier again have a highest i.e. 92.30%. In Negative predictive value is the possibility that class with a negative showing test truly don't have the bugs. The recordings for Naïve Bayes, SVM, GBM, KNN are 53.39%, 78.31%, 97.11%, 68.06%, 77.05% respectively.

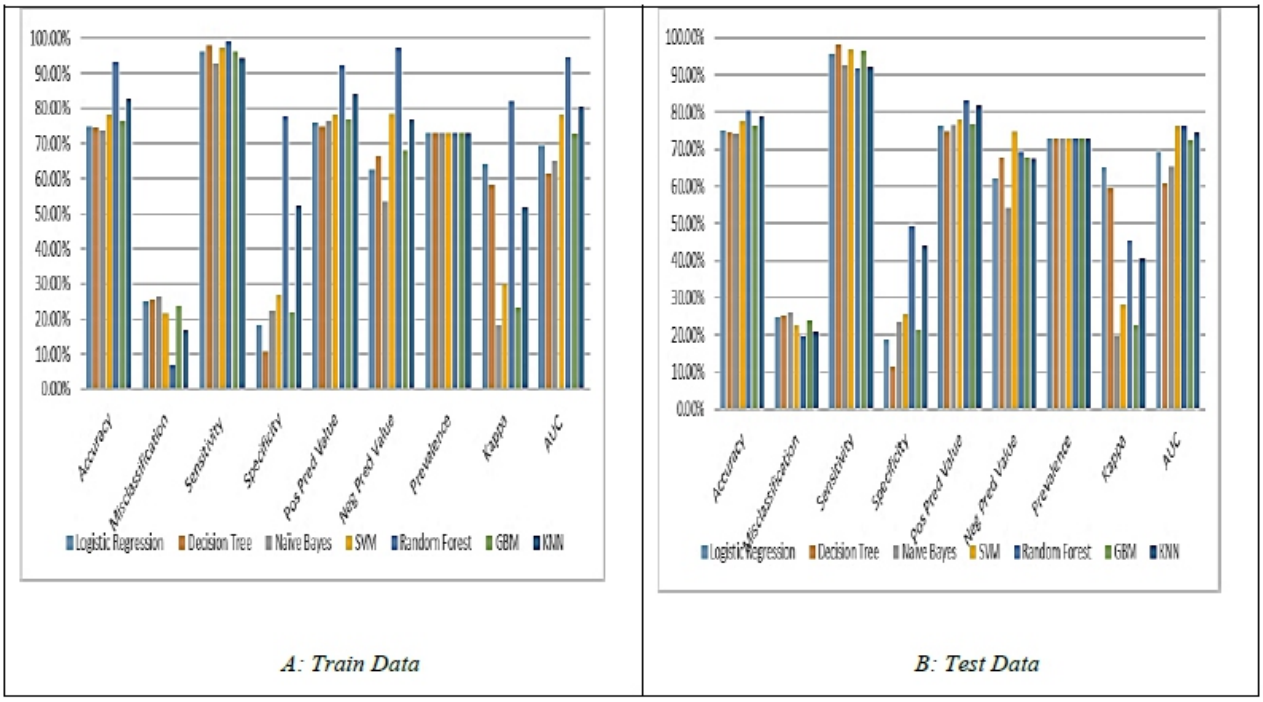

Figure 2. Performance Evaluation of Classifiers on Train and Test Data

The results obtained for test data expressed in Table 1 and represented in Figure 2-B the RF classifier achieved the highest accuracy scores as related to other classifiers. Furthermore, the testified scores in Table 1 and Figure 2-B show that the bagging classifier with VDS as a base learner performed well as compared to the other classifiers. The highest ROC-AUC scores, achieving 0.7622. The other algorithm as base estimator did fine in terms of ROC-AUC scores, success 0.6936, 0.6095, 0.6544, 0.7624, 0.7230, 0.7451 to LR, DT, NB, SVM, GBM, KNN respectively. The ROC-AUC score of RF

Table 2. Performance Evaluation of Classifiers on Train and Test Data After 10-fold Cross Validation

	LR (%)		DT (%)		NB (%)		RF (%)		GBM (%)		KNN (%)	
	Train	Test	Train	Test	Train	Test	Train	Test	Train	Test	Train	Test
Accuracy	74.95	75.15	75.58	75.49	74.81	74.45	94.34	80.43	78.21	77.92	84.24	78.94
Mis-classify	25.05	24.85	24.42	24.51	25.19	25.55	06.66	19.57	21.79	22.08	15.76	21.06
Sensitivity	96.11	96.03	94.65	94.51	94.47	94.62	99.15	91.93	95.39	95.53	94.38	91.13
Specificity	17.76	18.69	23.69	24.37	21.66	19.90	77.65	49.34	31.76	30.31	56.83	45.99
PPV	75.96	76.15	77.03	77.16	76.53	76.16	92.30	83.07	79.08	78.75	85.53	82.02
NPV	62.77	63.50	62.08	62.15	59.16	57.78	97.11	69.32	71.80	71.48	78.89	65.71
Prevalence	73.00	73.00	73.00	73.00	73.00	73.00	73.00	73.00	73.00	73.00	73.00	73.00
Kappa	17.91	18.93	22.77	23.35	20.15	18.31	81.97	45.39	32.93	31.56	56.15	40.99
AUC	0.7090	0.7210	0.6182	0.6211	0.6784	0.6697	0.9472	0.7976	0.7544	0.7512	0.8221	0.7387
CI (95%)	0.7448, 0.7542	0.7442, 0.7586	0.7502, 0.7595	0.7442, 0.7586	0.7434, 0.7528	0.7372, 0.7517	0.9307, 0.9361	0.8040, 0.8108	0.7776, 0.7865	0.7722, 0.7860	0.8384, 0.8463	0.7826, 0.7961

classifier was the best among all the classifiers, while the lowest value was 0.6487 was attained by the NB. The SVM, GBM Boosting, SVM, KNN classifiers achieved the better ROC-AUC scores.

Figure 3. Performance Evaluation of Classifiers on 10-Fold Train and Test Data

The values of train data in Table 2 depicted in Figure 3-A recaps the performance of the various classifiers built on the classification using 10-fold cross validation. The accuracy on LR, DT, NB, SVM, RF, GBM, KNN classifier achieved accuracies of 74.95%, 75.58%, 74.81%, 93.34%, 78.21% and 84.24% respectively for the validated combined datasets. In addition, it is obvious that the RF classifier achieved the highest accuracy scores as related to other classifiers, signifying better predictions of defective instances performed by the RF classifiers in these datasets.

Furthermore, the testified scores in Table 2 and Figure 3-A show that the bagging classifier with VDS as a base learner performed well as compared to the other classifiers. Secondly in ranking KNN has given the better results after the RF classifier. In Table 2 and Figure 3 it is clear that the RF classifier obtained the highest accuracy scores for all datasets, whereas the minimum value was 74.81% of NB classifier. The scores accomplished by all contributing classifiers are shown in Table 2 and Figure 3-A bagging with RF classifier attained the highest ROC-AUC scores, achieving 0.9472. The other algorithm as base estimator did fine in terms of ROC-AUC scores, success 0.7090, 0.6182, 0.6784, 0.7544, 0.8221, to LR, DT, Naïve Bayes, SVM, GBM, KNN respectively. The ROC-AUC score of RF classifier was the best among all the classifiers, while the lowest value was 0.6182 was attained by the DT. The LR, NB, GBM Boosting, KNN classifiers achieved the better ROC-AUC scores. Table 2 shows the performance of the various classifiers built on the classification using 10-fold cross validation on test data. The accuracy on LR, DT, NB, RF, GBM, KNN classifier achieved accuracy of 75.15%, 75.49%, 4.45%, 80.43%, 77.92% and 78.94% respectively for the validated combined datasets.

In Table 2 and Figure 3-B it is clear that the RF classifier obtained the highest accuracy and the minimum value was 74.45% of NB classifier. The scores accomplished by all contributing classifiers are shown in Table 2 bagging with RF classifier attained the highest ROC-AUC scores, achieving 0.7976.

Table 3. Classification AUC- ROC of models

Classifier	ROC (AUC)	Model Validation	Classifier	ROC (AUC)	Model Validation
DT	0.6211	Good	LR	0.7210	Acceptable
NB	0.6697	Good	RF	0.7976	Acceptable
KNN	0.7387	Acceptable	GBM	0.7512	Acceptable

The Table 3 indicates the average ROC-AUC area under curve on train and test data for the models build for predicting software reliability. The classification is given as per the threshold value mentioned by Spacman and used in previous researches [2,9].

The categorization by making comparison with the threshold values given by Spacman the proposed models compared with threshold values and results are obtained in Table 3, hence LR, DT, NB, SVM models are in the range of “Good”, GBM, KNN & Random Forest are in “Acceptable” range and the highest result given by the RF model.

Table 4. Comparative Analysis of Results

Author	Algorithms used	Measures and Outcome
Yun ZHANG et al, 2018[3]	LR, BN, RBF network, MLP, AD Tree, and DT	ROC-AUC 0.65 to 0.75 F-measure 0.21 to 0.41
Marian Jureczko, 2011[4]	Pearson's correlation coefficient for metrics validity with simple Models	Accuracy 80%
Arsalan Ahmed Ansari [12]	LR, DT, RF, NB, SVM, XG-Boost, NN	ROC-AUC 0.67 to-0.93 F1-Score 0.61 to 0.81
Dharmendra Lal Gupta and Kavita Saxena 2016 [13]	Logistic Regression	Average Accuracy 76.27%
Proposed	LR, DT, RF, NB, SVM, GBM, KNN	ROC-AUC 0.61 to 0.94 Accuracy 74.95% to 94.34%

The comparative analysis of result is depicted in Table 4 indicates the performance measures of various researchers and proposed analysis has given highest accuracy of 94.34% which is graphically indicated in the Figure 4

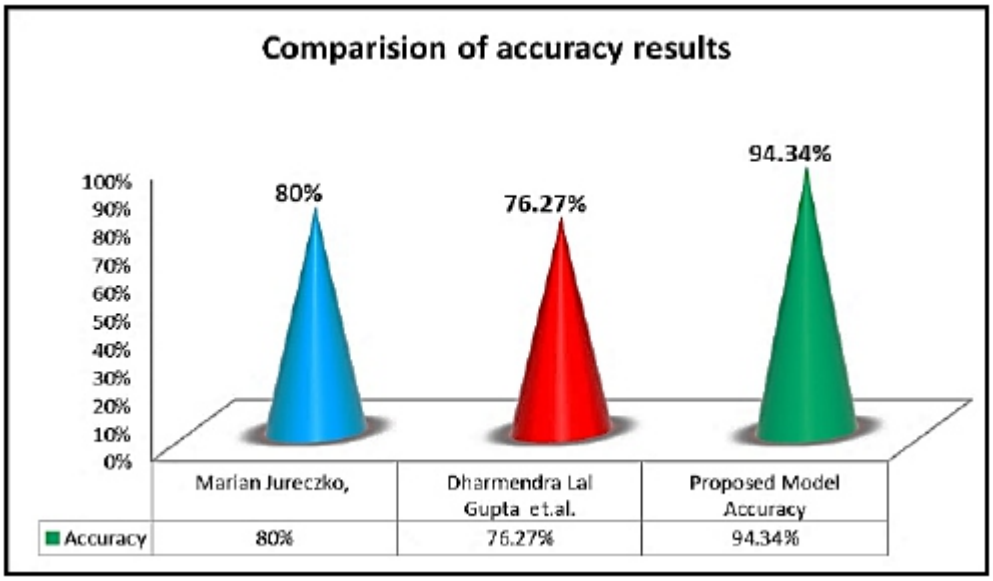

Figure 4 Accuracy Result Comparison

The values of area under ROC Curve from Table 3 indicates the maximum area under curve 0.7976 obtained by the proposed model developed using Random Forest classification algorithm.

5. CONCLUSION AND FUTURE WORK

At early phases of software development, the defect prediction is beneficial to develop good quality software. Through experimental work performance of the classifiers calculated in this paper is based on the well-known dataset. The results are obtained with various metrics by measuring the performance of the base learners, boosting, and bagging classifiers. The performances of different algorithms were evaluated using classification measures with accuracy, confusion matrix, and ROC-AUC curve. The outcomes of the conducted experiment exhibited that LR, DT, NB, SVM, Boosting with GBM, KNN are on average scale and Random Forest has performed well with highest Accuracy. ROC-AUC curve categorized the models LR, DT, NB, SVM in the category of "Good", RF, GBM & KNN are in "Acceptable" category and the most excellent result given by the model Random Forest for the data under consideration.

Exciting future extensions comprise reviewing the effect of various feature assortment approaches for the optimal set of features for Software Defect Prediction and ultimately software reliability. One future path is to examine and compare the performance of ensemble classifiers. Ultimately to assess the reliability of software through performance evaluation.

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Prevent the Source Code from Software Reverse Engineering using Hybrid Techniques

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ABSTRACT

Here a new Hybrid Obfuscation Technique is proposed to prevent prohibited Reverse Engineering. The proposed hybrid technique contains three approaches; first approach is string encryption. The string encryption is about adding a mathematical equation with arrays and loops to the strings in the code to hide the meaning. Second approach is renaming system keywords to Unicode to increase the difficulty and complexity of the code. Third approach is transforming identifiers to junk code to hide the meaning and increase the complexity of the code. An experiment is conducted to evaluate the proposed Hybrid Obfuscation Technique. The experiment contains two phases; the first phase was conducting reverse engineering against java applications that do not use any protection to determine the ability of reversing tools to read the compiled code. The second phase was conducting reverse engineering against the proposed technique to evaluate the effectiveness of it. The experiment of the hybrid obfuscation technique was to test output correctness, syntax, reversed code errors, flow test, identifiers names test, methods, and class's correctness test. With these parameters, it was possible to determine the ability of the proposed technique to defend the attack. The experiment has presented good and promising results, where it was nearly impossible for the reversing tool to read the obfuscated code. Even the revealed code did not perform as well as original and obfuscated code.

INDEX TERMS: Obfuscation techniques, reverse engineering (RE), anti-reverse engineering, intellectual property, software security, piracy.

I. INTRODUCTION

Intellectual property theft is one of the most challenging problems of technological era. According to the Business software alliance, global software piracy rate went noticeably high which lead to a loss of $53billion in 2018. Due to the lack of security, software vendors have implemented security algorithms, techniques, and tools, but with the help of reverse engineering tools, software reversers are able to reveal the security algorithms to extract the original code from the source file [1].

IT industry loses tens of billions of dollars due to security attacks such as reverse engineering. Code obfuscation Techniques experienced such attacks by transforming code into patterns that resist the attacks. The use of popular languages such as java increases an attacker's ability to steal intellectual property (IP), as the source program is translated to an intermediate format retaining most of the information such as meaningful variables names present in source code. An attacker can easily reconstruct source code from intermediate formats to extract sensitive information. Hence, there is a need for development of techniques and schemes to obfuscate sensitive parts of software to protect it from reverse engineering attacks [2]. Every organization is having its own intellectual property and it is a big challenge for them to protect their data from software piracy or reverse engineering. Reverse Engineering may damage the software purchaser's business directly. General ways to protect intellectual property, legally or technically. Legally, such as getting copyrights or signing legal contracts against

creating duplicates. Technically where the owners techniques try to hide the structure and the behavior information embedded in the identifiers of a Java program by replacing them with meaningless or confounding identifiers to make more difficult the task of the reverse engineer. It is worth noticing that the information associated with an identifier is completely lost after the renaming.

Furthermore, by replacing the identifiers of a Java byte- code with new ones that are illegal with respect to the Java language specification, such techniques try to make the de-compilation process impossible or make the de-compiler return unusable source code. Such effects will not be easily countered by the existing de-compilation technologies forcing the cracker to spend lots of time to understand and debug the decompiled program manually. According to the power of obfuscation techniques, it is effective to delay Reverse Engineering. However, there are certain limitations that appear in current techniques.

List	Limitation
• **Logistic map** • **Cipher block chaining** • **Symmetric cipher [19]**	Chaos stream is the main factor in these techniques. Mathematical equations used to replace the text in the string with chaos stream. Secret key and mathematical equation used for the encryption. If the reverser were able to guess the key, then there a possibility to use the key to decrypt

Table 1. Current obfuscation limitation.

Table 1 displays some of the limitations. The above techniques are common protection. An ordinary user will not be able to break in the software program, but the reverser will be able to break in easily. These techniques do

2.1 String Encryption Approach

A mathematical equation with character array and loops were used to encrypt the strings in the source code. Encrypting the strings create confusion during de-compiling. The reversing tool will not be able to translate the symbols created by the mathematical equation. The compiler will not be able to translate the symbols which were converted to byte code during compiling time. The purpose of the string encryption is to create a chaos stream in the source file and in the reversed file after decompiling. The advantage of string encryption is that the mathematical which was used to create the chaos stream can be used N times in the source code, also several X amounts of mathematical equations can be used in the same source file. The more chaos stream created in the source file the more confusion created during decompiling.

The mathematical equations that were used in the source file for the sake of this research were derived from the concept that Java programming language provides the feature where the mathematical equation can be used to convert the characters into different symbols.

Usually, the equation will contain a fixed value to ensure accurate output. For the sake for this research, the fixed value for the equation is 2 that can be considered as the value of X. There are other two values in the equation that are the values of Y and Z. The values of Y and Z must be carefully declared and assigned to produce the accurate output.

If the value of Y is 17 then the value of Z is 2. If the value of Y is 18 then the value of Z is 3. If the value of Y is 16 then the value of Z is 1.

According to the above conditions, if the value of Y increments by 1 value then the value of Z must increment by 1 value as well. The assigned value of X is 2, it can be changed as well to increment by 1 value, and then the value of Y must decrement by 3 values to get the calculation right for accurate output. The result of calculating the three values must be always 17, therefore the value of X is fixed but it can decrement by 1 value, to increment the value of Y by 1 value as well. To prevent errors the value of X was fixed at 2. The values of Y and Z can be incremented and decremented accurately to allow using more mathematical equations in the source file.

The final equation as Char = V/2 + Y + Z.

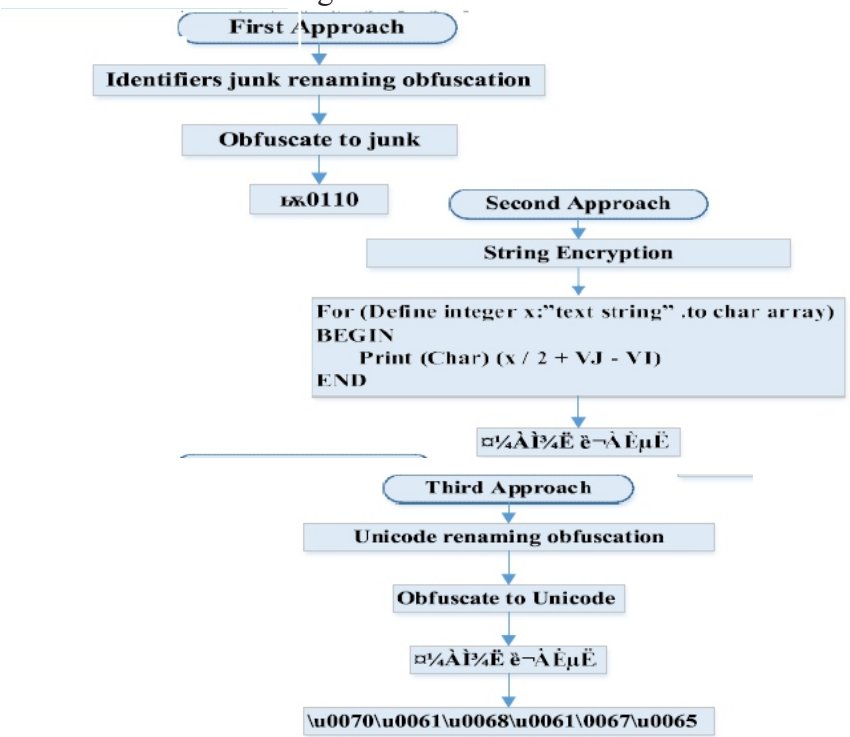
2.2 Identifiers Renaming to Junk Approach

Identifiers will be renamed to junk to hide the meaning of them. The purpose of this conversion is to mislead the reverser while reading the source file. The measurement of this approach was conducted by experiment to validate the effectiveness of the output after obfuscation transformation and to determine the uncovered code after reversing the obfuscated code. The following sections present an explanation in detail about the mechanism of the three approaches.

First section discusses the Unicode renaming obfuscation. Second section discusses string encryption obfuscation. Third section discusses the mathematical equation used to encrypt the strings in the source file. Fourth section discusses the identifiers renaming to junk obfuscation. Fifth section discusses the possibility to merge the three approaches in one source file to create preventative transformation and Displays the results of the merging.

FIGURE 1. Hybrid obfuscation technique.

Fig 1 demonstrates the Hybrid Obfuscation Technique. The proposed technique has changed the form of the code and complicated the look of it. The complication of the codes has created confusion while reading the source file and while reversing the class file.



III. Proposed Approaches

The contribution of this research is to introduce a new hybrid obfuscation technique to overcome the obfuscation of Java programs based on the renaming of the identifiers and string encryption. The proposed technique was based on the hybrid renaming of the identifiers in the source file to create extreme confusion for both the reversing tools the human examining the source file without permission. Independently of the obfuscating renaming strategy used, it was possible to contrast the obfuscation by renaming the identifiers and string encryption in two phases, to start over- come the preventive obfuscation, then to add type information to the identifiers in the source code to contrast layout obfuscation. In the first phase, the renaming of the hybrid obfuscation technique contains two sections. The first section is to rename the identifiers to junk code to hide the meaning and increase complexity and confuse the de-compiler while reversing. The second section is to replace system keywords with UNICODE.

The second phase, the string encryption, where a group of random mathematical equations is inserted into the strings to encrypt them. A framework of transformation was implemented to present the steps of the hybrid obfuscation technique. The proposed hybrid obfuscation technique includes three phases of renaming. In these phases, three renaming approaches were applied in the source file. The proposed hybrid obfuscation technique aims to confuse or mislead the reverser as much as possible while reading the reversed code after obfuscation. The technique should produce the same output as the original code. The following sections discuss the phases of the hybrid obfuscation technique.

3.1 First Approach Unicode Renaming Obfuscation

Unicode is a standard design that uniquely encodes characters written in any language. Unicode uses Hexadecimal to express the character. Unicode is the standard for encoding, representation, and handling of text on computers. There are 136,755 are defined in the Unicode which grant an opportunity to use it widely [25].

package backencrypt	\u0070\u0061\u0063\u006B\u0061\u0067\u0065\u0062\u0061\u0063\u006B\u0065\u006E\u0063\u0072\u0079\u0070\u0074
public class bankencrypt	\u0070\u0075\u0062\u006C\u0069\u0063\u0063\u006C\u0061\u0073\u0073\u0062\u0061\u0063\u006B\u0065\u006E\u0063\u0072\u0079\u0070\u004
public static void main(String[] args)	\u0070\u0075\u0062\u006C\u0069\u0063\u0073\u0074\u0061\u0074\u0069\u0063

TABLE 2. System keywords converted to Unicode

This research has used Unicode to rename the system keywords, the conversion will lead to confusion, where by the reader will not be able to extract the meaning of the code without manually translating it or using a reversing tool

Algorithm 1 Unicode Transformation

BEGIN

Get initial code

Get system keyword codes

Apply UNICODE transformation

END

3.2 Second Approach String Encryption Obfuscation

String encryption is well known in most of the programming languages such as C/C, Java, Python, C#, and PHP. There are several methods to encrypt the strings. This section discusses the string encryption obfuscation technique. Java programming language allows mathematical equations to be used with arrays and loops to encrypt the strings in the source file to create a chaos stream as a method to hide the meaning of it.

Current string encryption such as symmetric Cipher inserts only one mathematical equation to hide the meaning. The encryption of the mathematical equation is however readable by the compiler and confuses the reader. For the proposed hybrid obfuscation technique, mathematical string encryption was used to encrypt the strings in the source file. The mathematical encryption was inserted with character array in for loop in the source file.

The purpose of the mathematical equation is to confuse the reader and complicate the look of the code. Increasing the number of the string encryptions and mathematical equations in the source file will complicate the process of decompiling. after compiling the source code to class file which contains the byte code. The following algorithm displays the transformation to UNICODE. Table 2 displays an example of java system keywords converted to Unicode.

3.3 Mathematical Equation to Encrypt Strings

The equation which was used to encrypt the strings in the source code is associated with beneficial attributes associated with non-beneficial attributes Y indicates the ideal (best) value of the considered attribute among the values of the attribute for different alternatives the fixed and best value for the equation is 2 this value will not be changed. In the case of beneficial attributes (i.e., those of which higher values are desirable for the given application), Y indicates the higher value of the attribute, and the highest value which will be used for the equation.

In the case of non-beneficial attributes, Z indicates the lower value of the attribute. Z indicates the lowest value of the considered attribute among the values of the attribute for different alternatives, the lowest value which will be used is 2. In the case of beneficial attributes, Z indicates the lower value of the attribute. In the case of non-beneficial attributes, Y indicates the higher value of the attribute. Below equation displays the string encryption transformation.

Char = V/2+Y+Z.

The following algorithm displays the steps of string encryption.

Algorithm 2 String Encryption

BEGIN

Get initial code Start String

For (Define integer x:''text string''.to char array) BEGIN

Print (Char) (x / 2vj - vi) END

END

Print new line

END

According to the above algorithm, there is a possibility to use a different mathematical equation for string encryption to transform the characters to different symbols, Fig. 2. demonstrates an example of code after applying string encryption in the source file.

3.4 Third Phase Identifiers Renaming to Junk Obfuscation

The third phase, which was used in the new proposed hybrid obfuscation technique, was renaming identifiers to junk obfuscation. The main purpose of the junk renaming is to create a complicated code that is difficult to understand and difficult to get a meaning out of it.

The renaming junk obfuscation works for confusing the reversing tool that leads to wrong analysis, therefore produce wrong codes. Junk conversion creates an opportunity to create a variety of languages while developing the software for the sake of protection. The class file contains the junk code after compiling the source file.

After using the junk conversion, the converted code will be converted again to junk in the class file which increases the level of protection. The following algorithm is to trans- form identifiers into junk. Fig 4. demonstrates the code after converting to junk.

Algorithm 3 Identifiers Transformation

BEGIN

Get initial code Get identifiers

Transformation Begin Convert characters to junk Transformation END

END

3.5 Applying Hybrid Obfuscation Technique in the Source Code

Java development is based on object orientation whereas the compiler runs the application based on components, unlike structured programs that are developed by C programming language. Therefore, obfuscating the code will not create problem while compiling into machine language or byte code. To use this hybrid obfuscation technique, certain steps must be followed; first step is to use the object junk renaming obfuscation. This conversion must be done first to prevent confusion and errors when the obfuscation process is running. Second step is to use string encryption obfuscation; this technique must be done secondly, for the developer to encrypt all the strings at once. Final step is Unicode renaming obfuscation technique. Carrying out the Hybrid obfuscation technique increases the security level of the code and complicates the reversing process. The string encryption makes the obfuscation technique more effective in terms of securing the code, as it contains so many symbols that help to confuse the de-compiler while parsing and analysis. The following snippet displays the code before and after using obfuscation.

The Hybrid Obfuscation Technique is effective as it con- fuses and the reversing tool while reversing the class file. The reversing tool has translated the junk code to another junk code, and it has translated the encrypted strings to random meaningless numbers. The reversing tool could not perform an analysis of the obfuscated code. Reversing tools have produced errors and illogical code after reversing the obfuscated code. This Hybrid Obfuscation Technique was tested to evaluate the effectiveness and correctness of the code with four reversing tools.

IV. Experiment Procedure

The experiment consists of two phases. First phase is to test the applications that are not using any protection technique to determine the need of java applications for protection. The applications that are used for the experiment are procedural application, image application, object-oriented application, and an obfuscated application [26]. The parameters used for the experiment are:

a. Output correctness
b. Syntax and flow
c. Compiling testing
d. Identifiers names

Second phase of experiment was an attempt to reverse the code after inserting the hybrid obfuscation technique into the source code. The reversing tools used for the experiment are CAVAJ, JAD, DJ, and JD. The parameters for the experiment are

a. Output correctness
b. Syntax
c. Error testing (Reversing code compiling test)
d. Flow test
e. Identifiers names.
f. Decrypt string test
g. During the experiment, we have calculated total lines of code (LOC) of the reversed code before and after obfuscation, total errors of compiled reversed file before after obfuscation. This calculation has numerically determined the strength of the proposed hybrid obfuscation technique. the hypothesis of the experiment is:
h. H1: Hybrid obfuscation techniques do not significantly decrease the ability of the reverser to change the original code.
i. H2: Hybrid obfuscation techniques significantly decrease the ability of the reverser to change the original code.

V. CONCLUSION

Due to the increasing piracy of the software, a novel attempt is made to implement a hybrid obfuscation technique in this research. Typically, after obfuscation, the complexity of the code increases according to logically as well as structurally because of the insertion, removal, or rearrangement of the code. The proposed technique presented has been found to be effective.

The future work is aimed at the development of a frame- work for automation of the presented technique and to pro- vide as a plug-in to support developers to customize the method of obfuscation. The aim has been set to implement the proposed idea for large-scale software protection and improvement.

Implementing a hybrid obfuscation technique is highly recommended and proved successful. Currently, most reveres and companies are very much interested to reverse complicated software applications rather than implementing fresh ones. Implementing the hybrid obfuscation technique will make them struggle to understand the obfuscated code, as it requires a long time to get a meaning out of it.

The proposed technique was evaluated empirically with the experiment. Four reversing tools were used for the experiment to determine the ability to discover the code and analyze it. An interview was conducted with programming experts from the industry. Results from the experiment and interview supported the research's hypothesis and objectives. According to the experiments, the proposed technique has shown promising results, where the objectives of the research are met, where a chaos stream was created during reversing, junk code was generated from the reversing tool, and an extra layer of garbage created from the reversing tool as a result of the inability to read the obfuscated code.

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SMQA: Similarity Nodes Query Algorithm Based on Large Dynamic Evolution of Graph

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ABSTRACT

In the evolution of dynamic graph topology, in order to quantify the change of the change of the relation between the nodes within a certain time, a concept, namely ubiquitous similarity node, was defined, and the level of ubiquitous similarity with the current node was measured by the frequent degree of interaction with the current node and the uniformity of distribution, and a similarity node query processing algorithm for large dynamic graph based on the snapshots was proposed. The concrete content includes the snapshot expression of the dynamic evolution of graph, namely evolution dynamic graph; the semantic representation and its formal representation of the nodes` ubiquitous similarity in the dynamic evolution of graph, which was characterized by the frequent degree of interaction and uniformity coefficient of distribution; the matrix representation and processing method of the semantic of the nodes` ubiquitous similarity; the query algorithm for ubiquitous similarity nodes. The experimental results on the synthetic dataset and the real dataset show that the proposed algorithm can deal with the nodes` ubiquitous similarity query on the large dynamic graph can be implemented in the practical applications.

Keywords: Large Scale Graph, Dynamic Graph, Time Snapshot, Data Query

INTRODUCTION

Graph, as a data structure, does better in expression capacity of universality than linear table and tree do. With the application of Graph structure in those describe the complex association between the large scale entities, such as social network analysis, biology information, computer network and Web knowledge discovery, the scale of graph appears explosive increase, the realistic connotations that graph represented become more diversified and more complicate, thus, plenty of researchers chose graph to model various complicated network system. For instance, the literature [5] abstracts the cooperative relationship among authors in DBLP into a graph structure, the nodes in the figure represent the author, and the edges between the nodes represent the partnership between the authors. The large-scale graphs that describe real-world applications change over time, that is, the dynamic evolution of a graph (called an evolving or dynamic graph).Evolving graph scan be divided into two types according to their changes: one is the change of topological relations in the graph; the other is the content of the data objects represented by vertices and edges in the graph, or the changes of evaluation mode of a particular object in the graph.

In recent years, more and more researches have focused on the similarity query. The similarity query is to find a set of graphs or nodes similar to a query graph or node in a given graph. Usually, in the practical application of graph similarity query, the conceptual application problem is transformed into a suitable graph, which can represent the problem, and the similarity calculation of the graph is done by different methods. The existing researches focus on similar sub graph queries, and focus on static large-scale graphs or dynamic cumulative graphs for sub graph similarity query.

In practical application, people often pay attention to the change and maintain of the connection between nodes in a certain time domain during the evolution of evolving graph topology. For example, which nodes are in contact with the current node, that is, the connection of the node to the current node in the entire time domain may not always exist, but at most moments the association exists, and how to measure the strength of the connection, and so on.

Because people pay attention to the connection between the other nodes and the current node in the process of evolution, it can be understood as a kind of concomitant situation in some sense. So, this node is called the similar node of the current node. Whether the current nodes are connected frequently, whether the links are evenly distributed over the whole time domain, and so on. In practical applications, such as the cooperation between the DBLP authors, people will query for a period of time with this author or cooperation between the author, query the length of time between collaborators and how close the cooperation is and so on.

In this paper, we study the query problem of similar nodes on large scale evolving graphs, and propose a query processing method based on snapshot. The article including: snapshot representation of evolving graphs, the semantic and formal representation of the similarity of the evolving graph nodes during the evolution of the graph, the matrix representation and processing of the similarity of the evolving graphs nodes, and the similarity query processing algorithm.

II. RELATED WORK

The similar query of the graph has always been the hotspot in the data processing, many scholars have done a lot of research on this issue, and most of the existing research results are based on similar sub-graphs for query processing. A similar subgraph query is a subgraph that is similar to a given query topology, and these subgraphs are similar to the structure of the query graph, except that there are differences in the number of edges or nodes.

Early studies are mostly similar to sub graphic queries on static graphs, including precision matching similar subgraph queries and approximate matching similar subgraph queries. About accuracy matching, the literature proposed a sub-graph query feature index model [1], which uses the tree as an index term, and then based on the tree code for subgraph query is NP complete Problem [2], the query time complexity is high. Here a method is proposed to include the idea of searching, which means that the two graphs aresimilar in that the query graph and some similar graphs in the database contain exactly the same structure. Moreover, its biggest problem is that its similarity degree is relatively high, the result set is smaller, in practical application can only meet the requirements of precise semantics, but not applicable to the requirements of ubiquitous semantics.

For approximate matching, it is usually to set up the similarity measure of graphs, such as based on Similarity measure of maximal common subgraph, Similarity measurement of edit distance, and then the similarity calculation of the graph is carried out using different methods to find the nodes satisfying the metric and Side, resulting in a similar match with the query results [3]. The researchers put forward some methods of graph approximate matching from different points of view, based on the similarity of the approximate graph matching method, such as C-tree [4], TALE [5], and SAGA [6] etc. These methods pre-process the graph data by pre-setting the thresholds, leaving only the nodes and edges that satisfy the threshold range, taking into account only the characteristics of the individual nodes. In addition, the similarity calculation in the structure, such as LeRP (Length-R Path) [7] algorithm and SF

(Similarity Flooding) [8] algorithm. LeRP is the square of the isomorphism of the approximate subgraph, the method is based on calculating the path and the number of loops of length r associated with a node to obtain the largest approximate isomorphic subgraph of the two graphs. SF is a general graph with the algorithm, applied to the pattern matching, the use of similarity of the node spread, through the fixed-point iterations to get the mapping of the nodes. These two methods have a higher degree of matching than the previous class. The above research results are based on the static structure model. However, due to the dynamic characteristics of the graph, the above research results cannot describe the similarity of nodes or subgraphs in the whole evolution of the graph, and cannot effectively deal with the evolving graph structure.

In addition, similar queries based on evolving graphs in the existing literature are focused on attention similar subgraph structure, this similar query is from the perspective of the dynamic accumulation of the figure, that is, from the evolving graph in a period accumulated changes in the situation, find the desired query results. At present, there are some results on subgraph similarity of evolving graphs. An algorithm for mining sub graphic evolution pattern mining on an evolutiongraph is proposed [9]. Using the overlapping sub-structure of the optimal similar piece set of the connected subgraphs, the dynamic programming algorithm is used to find the evolution pattern of the connected subgraph Set, this method uses the overlapping sub-structure, cannot accurately characterize the evolving graph with time and the time complexity of the intermediate process is high. A method of using frequent subgraphs as query index keywords is introduced [10]. The frequent subgraph is organized into a tree-like index structure from small to large, decomposing the query into a number of sub-graphs, and use these sub-graphs in the index of information to filter. The use of indexes on rapidly changing evolving graphs results in a large amount of query processing overhead, in practical application is not convenient. The above similar subgraph query is engraved from different angles. In this paper, the subgraph query on large-scale evolving graphs is focused on the semantic representation and query validity of the cumulative change trend in the query, and the semantic study in the process of dynamic evolution is less. The similarity between the evolutionary processes of nodes is obtained directly during the process of structural change. In practical applications, this paper found that people are often concerned about large-scale evolving graph, in the process of evolution of the topology. The relationship between the nodes in the graphs is kept within a certain time domain, and how strong the relationship is. It pays more attention to the description and description of the change of the similarity of the nodes in the process of the evolution of the evolving graph instead of instantaneous results of state cumulative change.

In this paper, we combined with the existing static diagram, cumulative evolving graph similarity subgraph query related research results, considering the relationship between the nodes of evolving graph evolution process, studied the nodes in the similar semantic of the large-scale evolving graph and dynamic semantic similarity definition of similarity query processing method of effective nodes [11].

III. UBIQUITOUS SIMILARITY NODES AND THEIR QUERY

While evolving graph topology evolution, the relationship between the nodes with time dynamic changes. Time domain, some nodes and the current node or keep in touch, the frequency of contact between nodes is different, each time the duration of the different nodes that the similarity of different degrees. This chapter presents a similarity semantics and its query method to describe and calculate the node similarity in the evolution process. This semantics indicates that nodes with frequent contact with the current node in the whole time domain and high degree of similarity with nodes distributed over the whole time domain.

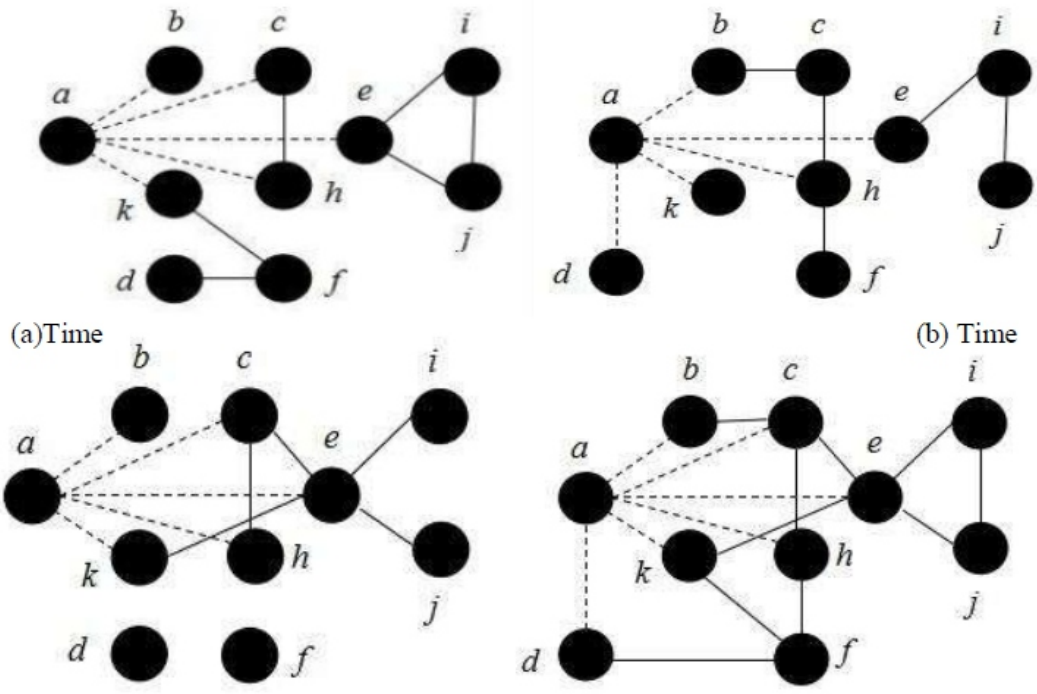
A. Node Aggregation

Definition 1 Interaction Diagram. G: (V, E) is an interactive graph, V is the node, representing each entity; E is the edge between the nodes, representing the interaction between entities.

Definition 2 Evolution Evolving Graph (Evolution Graph). The evolving graph of the interaction graph G in the time domain is shown as a snapshot of the n time, formalized as Graph G shows the interaction between all nodes and nodes during the time period from time to time. With the dynamic evolution of the graph, new nodes and edges are constantly appearing in the graph, and the original nodes and edges disappear from the graph. Over time, the dynamic behavior of the graph can be described as a group of non-overlapping snapshots. Evolutionary evolving graphs emphasize the process of dynamic evolution rather than the result. In order to describe this conveniently, this paper will be the traditional meaning of the evolving graph called cumulative evolving graph. Cumulative evolving graphs focus on the result of dynamic evolution rather than the process.

In Fig. 1, (a) to (c) show the snapshot at time ~, respectively. The snapshots on the time domain shows the evolution of the interaction graph G over time, that is, the evolution of the evolving graph, as shown in Figure 1 (a), (b) and (c). Different time snapshots are mutually exclusive, and they do not contain any common information that only shows the interaction between entities and entities that are included at time. The snapshot of the snapshot on the time domain shows the evolution of the interaction graph G over time.

Figure 1 (d) depicts the cumulative changes from the time to the time, that is, the cumulative evolving graph. It shows that the evolution of time with the cumulative accumulation cannot be intuitively reflected with the specific changes over time, it is difficult to support the evolution of time granularity over time with the query processing operations.



(a) - (c) Time (d) The cumulative evolving graph of time
Figure 1 Evolving graph and the cumulative evolving graph

Figure 1 is an interaction diagram, where the entity node represents the author, representing the interaction between the entities that the interaction between the author.

Definition 3 the Aggregation of Node v. The node in the community where the node is directly interacted with the node v interacting with the node at the time t_i is expressed as, then the aggregation of the nodes v in the time domain T, that is, the aggregation of the nodes, can be expressed as .

The community here refers to the set of nodes with connectivity in the i-th evolution snapshot of the evolution graph. In Figure 2, each dotted circle represents a community, and is a collection of all communities in the cooperative network of the BDLP authors at the time .

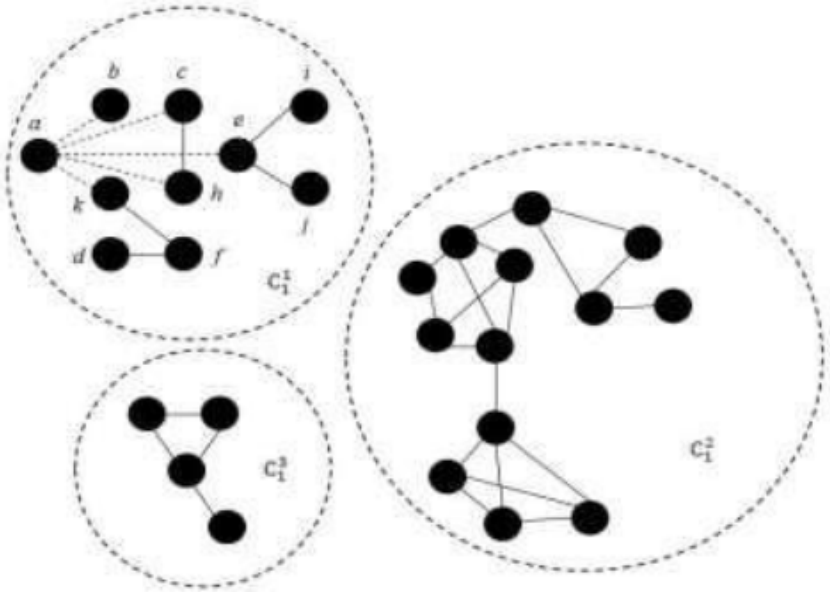


Figure 2: the snapshot of cooperative relationship between the DBLP authors at time t_1

Figure 3 shows the aggregation of the author a in the time domain in the cooperative graph of the DBLP author, and the aggregation of the node a at time is extracted from the community with node a in Fig 2.

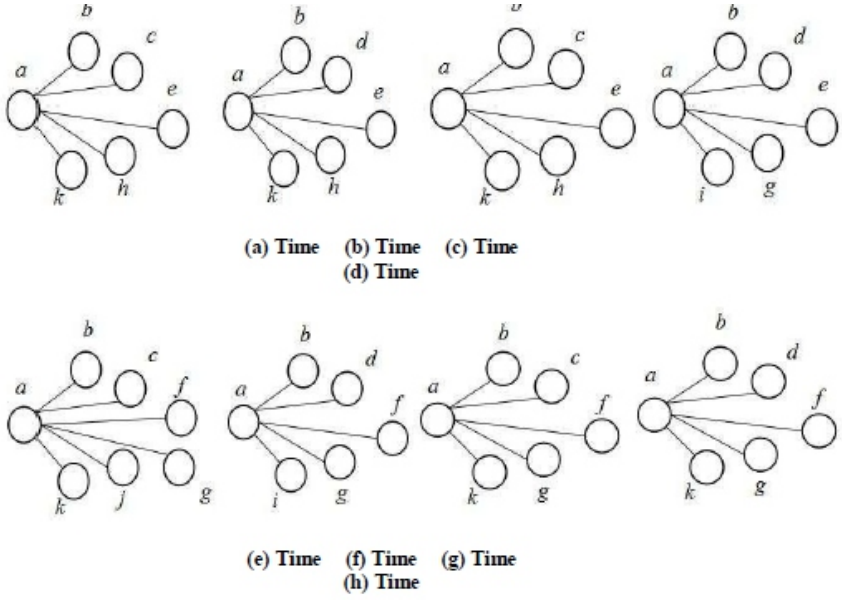


Figure 3: the aggregation of node a in the cooperative relationship between the DBLP authors

B. Ubiquitous Similarity Nodes

Ubiquitous similarity Nodes describes a kind of similar semantics of evolutionary evolving graphs in the evolutionary process, which pay more attention to the process of evolving evolution rather than the result.

1) Ubiquitous Similarity Nodes

Definition 4 Ubiquitous similarity node. On the time domain, the node w is concerned with most of the time (considering the number of times the node w appears in the n dynamic snapshots and the time interval on the entire time domain) Then the node w is the ubiquitous similarity node of node v.

The concern here is that there is a connected edge between node w and node v.

For example, in the evolution of the relationship between DBLP authors, the author c cooperates with author a frequently (see Figure 3), and this cooperation is more evenly distributed throughout the time domain, which could name author c is the ubiquitous similarity node to author a.

This kind of similarity can be given different meaning with the application field, such as in the social network, the user's attention can be expressed among the users have a common topic and so on.

2) Description of Node's Similarity

In order to quantify the node w in the time domain T most of the time are concerned about the degree of node v, in this paper, we give a node similarity function, which depicts the cumulative sum of the proportion of nodes w in the node of all nodes v over time. The concern node of node v is the node that the aggregation of node v directly interacted with node v.

The cumulative sum represents the degree of ubiquitous similarity between node w and node v. The more the number of occurrences of the node w in the snapshot of the evolution evolving graph, the bigger the cumulative sum and the higher the degree of similarity between the nodes w and v; When the two nodes and appear the same number of times in the snapshot of the evolution evolving graph, it is necessary to consider both the snapshot distribution containing the node and the snapshot distribution containing the node. If the snapshot containing the node is distributed evener than that of the node over the time domain, the accumulative sum of node is greater than that of, and the similarity between node and node v is greater.

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C. Matrix Representation and Operation of Ubiquitous Similarity Node

Using the calculation method of Eq. (1), we can get a series of nodes sorted in the whole time domain with the current ubiquitous similarity node, but this method needs to repeat the scanning of the aggregation of nodes at all times in the whole time domain. This aggregation is stored using adjacency lists, each of which takes up storage space as v + 2e, and the storage space required for node aggregation at n time is large. Thus, as for the aggregation of nodes in n moments, this section gives its corresponding matrix representation and calculation method.

This article uses the 01 sequence to represent the aggregation of nodes. If the node w exists in the aggregation of node v at time, then the corresponding value in the sequence is set to 1, otherwise it is set to 0.For example, in Fig.3, the sequence at time is 11111 and at time is 10111, and so on, the sequence at is 1000111010.

Whereas the abscissa represents the evolution of a node wj in the aggregation of node v in n times, that is, which the abscissa of the matrix can be formally expressed as, the ordinate represents the aggregation state of the node v at time, that is, node, the aggregation of the node v at time ti in the matrix can be formally expressed.

IV. THE QUERY ALGORITHM FOR UBIQUITOUS SIMILARITY NODES

In the large-scale evolving graphs that describe the complex relationships between entities, the ubiquitous similarity node query algorithm can query nodes that are similar to the current nodes during the whole time domain evolution and can be distinguished by similarity.

A. Algorithm

In this paper, the generalized query processing method is as follows. Firstly, we find the community of the node v where the node is located from the time domain T evolution evolving graph G, and then find the aggregation of the node v from the community at time to get the aggregation of the node v from the time domain T, then transform it into a representation of the two-dimensional matrix. Next, we use the node similarity function of ubiquitous similarity node, which represented as sim (v, w), to calculate the similarity of the focused node wj and node v. Finally, sorting the similarity value from high to low, which was function calculation result of the focused nodes. The value larger, indicating that the node is more similar to the node,and the specific algorithm is shown in Algorithm 1, which is based on the algorithm.

Algorithm 1 Query Algorithm of Ubiquitous Similarity Node.

Input: interaction graph G = (V, E), time domain T, query point v;

Output: the SIM collection.

1) convert graph G = (V,E) into T temporal snapshots
2) FOR i=1 to n DO
3) cluster EG // divide the interaction diagram into communities.
4) = { | 1 ti T} // get the aggregation of node v
5) get array // the aggregation of node v is stored in the matrix A
6) get array // AND matrix A to get matrix B
7) END FOR // end for
8) FOR j = 1 to m DO
9) get |LCC| in B // get |LCC| from matrix B
10) save in the SIM set // store the results.
11) END FOR
12) Sort in the SIM set // sort the ubiquitous similarity nodes
13) END // end of algorithm

B. Examples

Considering the eight successive graphs of the aggregation of node a in Fig. 3, we can get the degree of similarity between node a and nodes b, c, d, e, f, g, h, I, j, k according to the similarity function of equation.

According to the size of the calculated values, the similar sequences of these nodes and node a are b, k, g, d, f, e, c, h, i, j, which the degree of similarity decreases, and the similarity between node b and node is

highest, because node b appears the most, and the time interval is 0. In this time domain, the node d appears four times, the time interval is 1, that is to say that the node d containing the is evenly distributed in the eight graphs; the node e also appears four times, the time interval within the time interval is 0, the time interval occurring in time period is 4, that is to say that the distribution of containing node e is not uniform throughout the time domain. So the degree of similarity between node d and node a is stronger than that of node e and node a.

From the example that the dynamic diagram of the evolution of partnership relationship among DBLP Authors, we can see that the similarity degree of nodes is a kind of common semantics between the common nodes of the evolution of the graph. This semantics focuses on the cooperation of other authors and the author, whether this cooperation is more evenly distributed throughout the evolution of the entire evolving graph of the time domain. The more frequent the cooperation, the more evenly distributed, the more similar to the research interests of author a.The semantic description of the similarity with respect to the frequency of interest and the time interval of attention is given above, the ubiquitous similarity nodes. In addition, people are also concerned with the current node to keep in touch with the node, that is, these nodes in the time domain for a period of time with the current node relationship is stable, concerned about the different duration of the node that the degree of similarity, which can be called nodes directly similar, because of its processing and the node is similar to the ubiquitous node, so do not repeat them.

V. EXPERIMENTAL RESULTS AND ANALYSIS

Experimental operating environment: clocked at 3.40GHz CPU, 1GB of memory, 1TB hard drive. Operating system is Linux, development tools are VC6.0, programming language C++.

A. Experimental Configuration

In this paper, the real-time data set DBLP and synthetic data set Web Graph (as shown in Table 1) on the snapshot- based similar node query processing algorithms to evaluate the test algorithm running time and storage space occupancy rate, and by setting the size of the graph to test the robustness and efficiency of the algorithm.

Data Set	the Number of Nodes	the Number of Edges
DBLP	684,911	7,764,604
WebGraph	10,000,000	213,000,000

Table 1 Data Set DBLP and Data Set Web Graph

DBLP integrated database system in accordance with the chronological order listed in the field of computer science researchers, which can be downloaded from www.informatik.uni-trier.de/~ley/de/. The graph has more than 680,000 different authors and more than 7 million cooperation between them.

Web Graph is a collection of web pages, which can be downloaded from webgraph.dsi.unimi.it. The nodes in the graph represent the web page and the edges between the nodes represents the links to web pages. This paper extracts a subgraph using it, which consists of 10 million web nodes and 21.3 million links.

In order to describe the evolution of the evolving graph, each experiment using 20 snapshot graph. For the DBLP dataset, a snapshot represents the research collaboration between authors within a year, this

paper selected 20 snapshots from 2013 to 2020 as the algorithm required for the real evolution of evolving graph. As for WebGraph data set, a snapshot represents the link status between web pages in a month, this paper simulates the change of web page link status for 20 consecutive months as the synthetic evolving graph.

There are two parts in the experiment. The first part is to test the relationship between the number of nodes participating in the ubiquitous similarity node query and the running time of the algorithm in the evolving graph of the two data sets. 5 sets of experiments were performed on each data set. The number of nodes involved in the processing is increased at a rate of 10 times each time. Each of which is compared with the original query node is similar to the method and the matrix is used to query the node similar to the method. Each group of experiments was compared between the two were the original methods to query similar nodes and the methods to query that by using the matrix representation. The second part is to test the evolving graph of two data sets respectively, and compare the relationship between the number of node that participating the query of the ubiquitous similarity node and the storage space required by query. 5 sets of experiments were performed on each data set. The scale of nodes involved in the processing is increased at a rate of 5 times each time. Every experiment compares the original methods to Each group of experiments was compared between the two were the original methods to query the similar nodes and the methods to query that by using the matrix representation.

B. Experimental Results and Analysis

Experiment 1 examines the relationship between the number of nodes participating in the query and the query speed of similar nodes. Figure 4 lists the processing time for both methods on the DBLP dataset and the WebGraph dataset. In the experiment, the nodes of the initial DBLP dataset changed from 60 to 6000, and the nodes of the initial WebGraph dataset changed from 10 to 10000, and their running time increased with the increase of nodes. The experimental results show that the run time of the ubiquitous similarity node query algorithm is shorter than that of the two-dimensional matrix, which indicates that the representation of the matrix can shorten the query time and improve the query efficiency effectively.

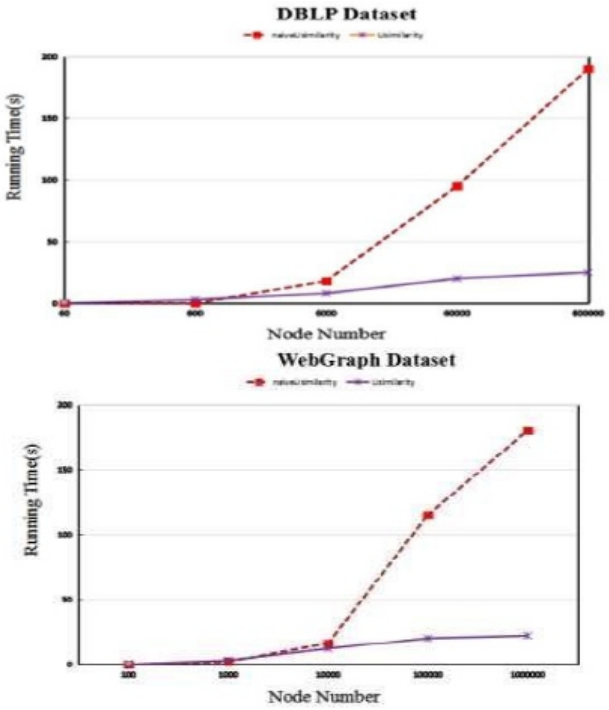

Figure 4: Running Time

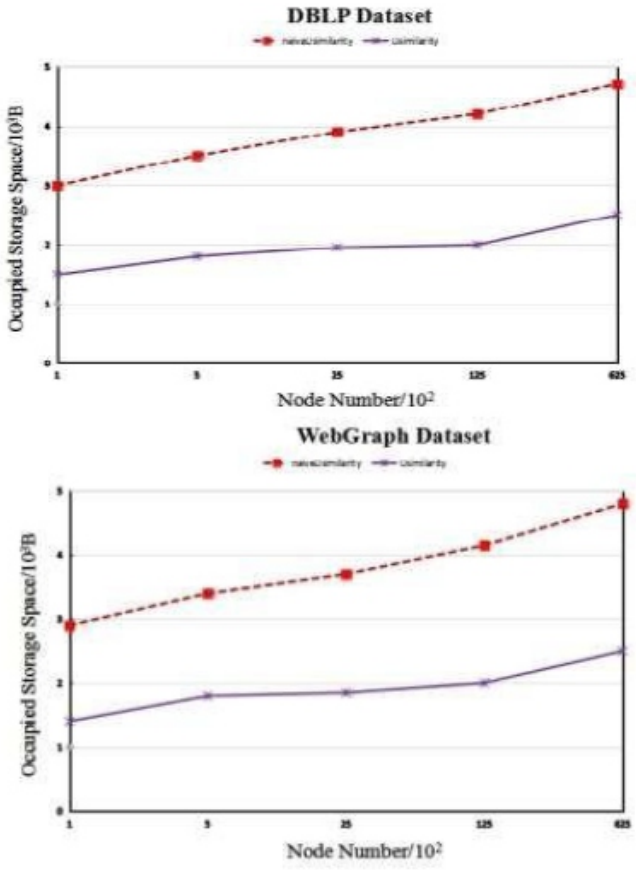

Figure 5: Occupied Storage Space

Experiment 2 examines the relationship between the size of the nodes participating in the query and the required storage space. The results are shown in Figure 5. In the five experiments, the size of the nodes participating in the query processing on the two data sets was expanded from 10 to 62500, and the storage space was increasing as the number of nodes participating in the query increased.

The experimental results show that the storage space of the ubiquitous similarity node query algorithm using matrix is much smaller than that of the simple algorith According to the above two kinds of test results, it's found that the processing method to query snapshot-based large-scale evolving graph similar node is feasible. The computational complexity of this method is small and the time complexity is O (n^2). Compared with the simple query algorithm about ubiquitous similarity node, the node query processing algorithm, which based on matrix, about ubiquitous similarity node is short, the storage space is small, and it has good processing performance.

V. CONCLUSION

In this paper, we focus on the similarity problem of nodes in the dynamic evolution of large-scale evolving graphs, and propose a similar query method for large-scale evolving graphs based on snapshots. From the perspective of the evolution of evolving graphs, it depicts the dynamics of the graphs, depicts the semantics of the ubiquitous similarity nodes that are widespread in the evolutionary process, and gives the corresponding functions of similarity of the ubiquitous similarity node, and representation and computational methods of matrix and query algorithm to the ubiquitous similarity node. Experimental results on synthetic data sets and real data sets show that the computational complexity of the algorithm is low and the time complexity is low and the efficiency is high. The query

results are of practical significance in real application. The snapshot in the evolving graph depicts the process of dynamic evolution, but its storage also has a large space overhead. In the next step, we will further study the incremental storage technology in the evolutionary evolving graphs and the optimization query method of node ubiquitous similar semantics on incremental snapshot storage.

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Application and Development of Chinese Traditional Auspicious Patterns in Modern Design

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ABSTRACT

Chinese traditional auspicious patterns are integrated into modern design works through different forms of expression, which shows the unique aesthetic thought and design style of the Chinese nation. Not only the development and innovation of traditional Chinese design, but also the integration of profound cultural heritage and modern design. With the development of modern digital technology, increasingly number of traditional patterns are integrated with modern graphic design. This paper analyzes the application and development of traditional auspicious pattern in modern graphic design, so as to study how to carry forward and inherit it better in modern design.

Keywords : ***Traditional,Auspicious patterns, Modern Graphic design,Application development***

APPLICATION AND DEVELOPMENT OF CHINESE TRADITIONAL AUSPICIOUS PATTERNS IN MODERN DESIGN

In modern design, more and more design elements are widely used. In recent years, With the popularity of traditional pattern-based creative products , Chinese traditional culture has once again received widespread attention. The application and development of pattern is the embodiment of visual communication, and decorative pattern has strong adaptability, so it has been widely used. [1]By searching "auspicious patterns" in WANGFANG data, 123 core journal articles on auspicious patterns were retrieved, including clothing, decoration, product packaging, interior design and pattern design in modern design. The author further expresses in the content of such articles that the rich connotation of auspicious patterns and the use of auspicious patterns in modern design are the inheritance of culture. It advocates restoring traditional culture and combining western modern design concepts to create modern design works with both Chinese traditional charm and contemporary sense based on national traditional culture. [2]

1. HISTORICAL DEVELOPMENT OF AUSPICIOUS PATTERNS

1.1 Generation of auspicious patterns

Stemming from Chinese culture, which, formed along a long history of five thousand years, embodies the collective wisdom of numerous craftsmen and the people, Chinese auspicious patterns are the reflections of historical eras, as well as life styles in ancient times. In the course of time, cultural development has been gradually flourishing along with life improvement, therefore, people's yearnings for good lives are not just limited to praying activities. While words are used to express thoughts directly, patterns, on the other hand, are able todepict life in an abstract way. As a kind of aesthetic production, pattern is a gradually developed ideology and concept. It is also a cultural change, reflecting the

relationship between man and nature. [3]It is fair to say that auspicious patterns represent not only Chinese people's longings toward good lives, but also Chinese unique achievements in art and aesthetics. Likewise, the application of these ancient patterns is a conveyance of good wishes, and at the same time, the creation of art works. In On Auspicious Culture, Mr. Zhang Daoyi classifies auspicious culture in three ways: folk life, auspicious content and moral means. [4-5] In general, traditional auspicious patterns refer to decorative patterns with certain propitious meaning. They are applied, individually or in group, to express feelings and wishes in figurative, metaphorical, or homophonous ways. Patterns, implying "fortune, prosperity, longevity and happiness", are most common in China. Auspice is materialized in these patterns with different tokens symbolizing various concepts in life. , the Chinese word of auspice, is originated from the Chapter of Ren Shi Jian, literally the Realm of Human Interactions, of Chuang Tzu. Chuangtzu states that if one can clear his mind, he is able to understand the essence of Tao, and, in this way, auspice will be endless.[6-7] In early times, auspicious patterns, deriving from earthenware of primitive communes, reflected mainly material production and human reproduction. In addition, original totems were also the predecessors of traditional auspicious patterns. As human being made constant progress, their desires for good life went beyond abundant lives and numerous descendants. As a result, many auspicious patterns were created to convey the feelings and wishes in all aspects of ancient people lives.[8-10]

Fig. 1&2 Patterns on earthenware

Fig. 3 Symbolizing auspicious patterns

1.2 The Implication of Auspicious Patterns

Patterns are the carriers of the spirit of the ancient people, condensing the spirit of the whole nation. Auspicious culture is also a direct current in the long history of the Chinese nation. [11]Symbolization and homophony are most common in traditional auspicious patterns. A unique feature of mandarin is one

pronunciation usually corresponding to a couple of homophonic words. With this extremely favorable prerequisite, homophony becomes the most distinguished character of Chinese patterns in terms of propitious wishes conveyance. In another word, auspicious implications can be derived from homophonic objects. For instance, an upside-down bat represents "fortune has arrived", for "bat" in Chinese is homophonic to "fortune or good luck", and "upside-down" is homophonic to "arrival".[12] Another case is the vase, which is homophonic to "safe and sound". Countless homophonies in this kind can be found in China with numerous applications in the aspects of decoration, clothing and pottery. These profound applications not only convey the longings of ancient people toward beautiful things and happy lives, but also lay the foundation for traditional design. Folk craftsmen employed auspicious patterns into handicrafts. Craftsmen and designers in later generations have learned a great deal from these little handicrafts and they became valuable reference for the integration of traditional and modern design.

Not only does our nation have patterns and totems that express the people's good wishes, but any country with a long history has its own unique patterns. It also has a unique way to inherit traditional culture. As one of the treasures of the world, the British Museum has also designed many creative products that draw on traditional elements and patterns. Once launched, it has been popular with consumers all over the world. Just like the cultural and creative products of the Palace Museum, the British Museum's and more museums are introducing cultural and creative products of various traditional patterns, which undoubtedly proves the importance of traditional patterns to cultural communication and the positive impact they bring.

Fig.4&5British Museum Creative Products

II：WHY DO WE USE TRADITIONAL AUSPICIOUS PATTERNS

2.1 Economic Development and Social Stability

Just like the variety of traditional auspicious patterns, a great many of folk sayings have been created in China, for instance, "antique prevails in the prosperous ages, while gold in the chaotic ages". Only in peaceful times, when lives are prosperous and people are contently settled, can antique collection become a novel amusement out of common daily goods. Then why is gold popular in chaotic ages? Gold has been one of the circulating currencies in China since ancient times. When a country is in chaos and its people are hardly possible to live on, what people want is naturally in great difference to that in prosperous times. They have no time or money to pursue any kind of amusement and the most basic living needs are critical, so money undoubtedly becomes the most needed. In recent years, the revival of traditional culture has reached a new peak, which is also in line with this saying.

With the rapid social development, how do Chinese understand traditional culture? Is tradition good or bad? After several-hundred-year cutting off from the outside world, tradition is equal to backwardness in the mind of Chinese people. The once advanced culture was overcome by the backward one, naturally leading to backwardness of the country and setback of its social system, so the country was inevitably bullied by other advanced ones. It explains why tradition means backwardness and traditional culture is regarded as pedantic in China for a very long time. However, having experienced tremendous society evolvement and great economy development, the Chinese come to realize that every coin has two sides. We should also "take its essence and discard its dregs" in regard to traditional culture, which is a profound embodiment, not only of enriched literature and various schools of thoughts, but also of every single aspect of life. Economy development has brought about cultural prosperity and society evolvement has prompted the inheritance and development of excellent traditional culture. When people are living a well-off life, they get higher demand on the prosperity of culture. The integration of modern and traditional excellent culture is a way to develop traditional culture and, at the same time, to infuse new blood into modern culture.[13]Consequently, a great number of works with a combination of tradition and modernity are created, from which people are able to comprehend connotation and significance of traditional culture in another angle.

Chinese culture is an internalized one, which means all its developments have derived from people's heart and all its thoughts have focused on inner spiritual search, i.e. what people really want. In ancient times, what people really wanted was nothing more than a peaceful nation and a prosperous life. For most people, these were ambitious goals and they would long for a happy, healthy and safe life only. The original design stemmed from such a state of mind and people applied this inner yearning into daily ware. Such an application not only carried a connotation, but also made a daily ware enchanting. In this way, good wishes are handed down from generation to generation. Cultural inheritance is equal to cultural integration in a historical perspective. No country can stay the same over time and cutting off from the outside world is doomed to be inappropriate in contemporary world. Only with exchange and integration of different peoples, can our culture become rich and colorful.

As is known to all, a culture can be further developed only by conforming to the times, and science advances are due to promote cultural development. In a small-scale peasant economy, the greatest happiness is to have enough food and clothing. The pray for a favorable climate is actually the longing for a good harvest, resulting into an improvement of life. However, in a prosperous society, enough food and clothing is no longer the only requirement of people. They have made more explorations on how to improve life quality. During the Westernization Movement, national capitalism began to develop because of market competition and "aesthetics".Consequently, the concept of "art and design" is put forward. The pursuit of beauty is natural in human being. [14]As life is getting better, people would put more weight on pursuing and developing their personal hobbies. Hence, various features and rich humanistic connotations. By integrating the peculiar spirit of Chinese nation into design works, the development of traditional patterns has reached a new peak.This paper analyses how to innovate traditional auspicious patterns in modern graphic design and the impact of traditional patterns in modern design, and emphasizes the importance of traditional culture to the Chinese nation.

2.2 Action on Cultural Inheritance

In order to discover and inherit the traditional pattern of the Palace Museum, the China Forbidden City Society and the King soft Office Corporation, the China Forbidden City Society and King soft Office Corporation jointly organized an event to "find the beauty of the "Chinese pattern". The "Chinese

pattern"refers to the texture pattern under the background of Chinese culture. The texture pattern covers the main symbolic elements in Chinese culture, including the profound Chinese culture attached to the material carrier of calligraphy, painting, utensils, architecture, fabrics, etc. On the symbolic elements of Chinese culture, the Palace Museum has a unique treasure trove of resources. The 1.06 million square meters of ancient wooden buildings and more than 1.86 million pieces (sets) span the cultural relics of various eras, carrying the cultural heritage of Chinese culture for thousands of years, with high historical value, cultural value and artistic value. The beauty of " Chinese pattern " is to analyze the aesthetic code of Chinese culture by discovering the various symbols contained in the architecture and cultural relics of the Palace Museum. This activity elaborates on the cultural connotation of the "Chinese pattern" represented by the Forbidden City from the professional fields of books, clothing, architecture and other fields. From the point of view of digitalization and landing application of traditional culture, this activity puts forward an innovative idea of inheriting the value of traditional Chinese culture with the help of Internet science and technology.

The Forbidden City is the "Internet Celebrity" that spreads traditional culture in recent years. Many innovations have made people re-recognize the beauty of traditional culture and patterns. King Soft Office Corporation is also a leader in office software on the Internet, so this kind of activity is undoubtedly a hope to find a new way for the spread of traditional patterns. The event will collect the design works through the competition and digitize the traditional patterns in order to give the figurative patterns a new form and be known to the world by digital means. More and more international activities combined with traditional patterns reflect the enthusiasm of the people of the world for traditional Chinese patterns. The reason why the pattern can produce such a great influence is also the inheritance and love of the Chinese for culture. It is the common aspiration of the people of the world to promote what they love and protect, so the power of such activities is strong, opening up new directions for design and further promoting traditional culture.

Fig. 6 Find the beauty of the "Chinese pattern"

III. MODERN DEVELOPMENT AND APPLICATION OF AUSPICIOUS PATTERNS

3.1 Development of Modern Design in China

Along the constant development of modern design, digital technology enables increasing applications of traditional patterns in the field. It is not only an inheritance and development of traditional culture, but also an injection of modern graphic design concepts into Chinese culture. During the integration of traditional and modern design, the originality of ancient design is understood in a more comprehensive way, so, by applying traditional shapes and implications into modern design, it is possible to create works fusing Chinese cultural connotation, the characteristics of the times, and personal uniqueness. Every Chinese has his or her own opinion on Chinese traditional culture. The best way to in herit and

develop these auspicious patterns is to explore how to maximize the application of traditional auspicious patterns in modern design and how to integrate traditional and modern culture. Integrating traditional patterns into modern graphic design inspires modern graphic design.[15]From ancient times to the present, auspicious patterns represent people's longing toward good lives and "auspicious" culture always take a high status in Chinese five-thousand-year history. Thanks to this spirit, the full development and application of auspicious patterns in modern design is achieved. Graphic design has a belated start in China. Chinese modern graphic design was influenced by western counterpart at the beginning. Having been constrained to a certain extent, it is not better to integrate its own culture and blindly pursue and imitate Western design. After following the footsteps of western peers and along with the rapid development of the Internet, exchange between Chinese and western culture increased dramatically.[16]Many designers begin to carry on in-depth study into Chinese traditional culture and try to transform traditional patterns into new ones to apply in graphic design, aiming to reveal the connotation of Chinese traditional culture in a modern way. Graphic design is a kind of visual communication in which people obtain all information via their visual sense. In another word, one can use his or her eyes to take all intended information of graphic design works. The emergence of digital media technology upgrade visual communication from simple graphic forms to digital images. However, what we have inherited in traditional culture are unable to convey easily via visual means. If we imitate the trend of thoughts and means of expression in the western modernism blindly, we will lose our inheritance in Chinese traditional culture. Therefore, we should research how to combine auspicious patterns of traditional culture into modern graphic design, that is, how to carry our traditional culture forward in modern designing. No matter traditional or modern elements, they can fuse mutually in art design and mutual learning in this kind can surely bring about constant innovation and development. While national culture can provide endless wisdom to modern design, modern design can help traditional culture to create new values. Thus, traditional culture plays an irreplaceable role in the developing modern design. In recent years, the development of traditional culture has reached a new peak. Not only our traditional ideology and culture are carried forward, but also various patterns on cultural relics, and these relics as well, are developed in a modern way. They are applied to all kinds of modern art works.

3.2 Generation of Modern Design of auspicious clouds

Modern graphic design includes the design of trademark, poster, graphic advertisement, logo, etc. Traditional auspicious patterns can facilitate graphic design with abundant applicable elements and expressive effects, for example, auspicious cloud patterns, the most frequently used patterns. The clouds symbolize the weather, therefore, conveying prays for a good climate, as well as favorable natural phenomena, of ancient people. In addition, the awe to the heaven is also one of the important reasons for the creation of auspicious cloud patterns.[17-18]Although they are never the prime element no matter in which kind of design, it is certainly a major deficiency if lack of auspicious cloud patterns in ancient design. Only a combination of all propitious patterns can convey good wishes in a more effective way.

With the change of dynasties, the shape of auspicious moire is constantly changing. The improvement of living standards also has obvious changes in the use of patterns. The ancient people's vision of auspicious beauty is also reflected in modern people. For five thousand years, the body of the descendants of Yan and Huang Dynasty has flowed with the same blood, and their love and inheritance of traditional culture are run in the same groove. Early human design activities started with various totems and patterns. All nations in the world have their own way of looking forward to a happy life.

Patterns are one of the most direct forms of expression in the case of language impassability. Their emergence has played a great role in promoting international exchanges and is an important bridge for cultural communication. Therefore, in modern design for the use of patterns is indispensable.

Fig. 7Auspicious cloud patterns

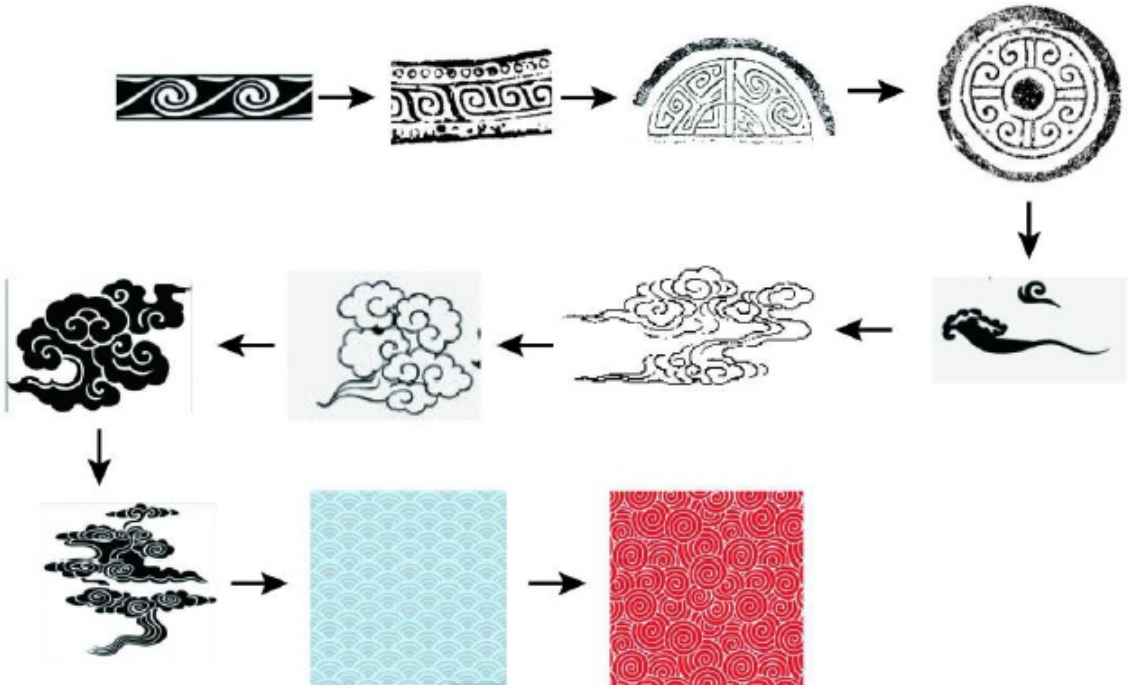

Fig. 8Evolution of Auspicious cloud patterns

Fig. 9 Cultural and creative tapes of the Taipei Palace Museum

Fig.10&11Cultural and creative tapes of the Forbidden City

3.3 Brilliant traditional pattern design products

Chart 1

Cultural connotation is vital in poster design, so ancient traditional patterns, just like the nourishments of plant roots, can deliver cultural flavors ceaselessly, and become valuable reference in this field. In these posters, the applications of traditional patterns can be regarded as re-absorption and inheritance of traditional culture, and, on the other hand, have endowed traditional culture with the characteristics of the new times. In the collision of modern and tradition, the impact of Chinese culture on its people become more explicit. It is no doubt that the application of traditional auspicious patterns is to infuse traditional culture, like new blood, into modern design. [19]

As people are giving increasingly weight on traditional culture, auspicious patterns, or their new transformed versions, are used in more and more modern design works. When it comes to "traditional innovation", it has to be mentioned that the Taipei Palace Museum, the ancestor of Cultural Creative Products, which is full of cultural and creative topics and economic benefits in the development of collection derivatives. In 1983, Qin Xiaoyi, then president, put forward the creative idea of "innovating

from tradition, combining art with life". For more than 30 years, the Palace Museum of Taipei has created a unique creative industry. In 2013, the paper tape "I Know" was introduced as a popular copy of Emperor Kangxi handwriting, which is an important symbol of the development of Taipei Palace Museum from "traditional collection imitation" to "modern literary creation".

which "the Forbidden City Taobao Shop" is the most outstanding examples by our side. Cultural and creative products in this shop have integrated, by new techniques, with traditional auspicious patterns and shapes of cultural relics in the Forbidden City. For instance, these patterns are fully applied in the design of adhesive tapes, making them sensational best-selling products in the Internet. So, it is fair to state that the relationship between traditional auspicious patterns and modern design is complementary. In other words, modern design can inherit and carry traditional patterns forward, while traditional auspicious patterns can deliver cultural connotation and applicable elements for modern design. Through the application of culture transfer model in creative product design, it can effectively help designers understand the essence of creative product design and improve the quality and efficiency of creative product design.[20]

Whether Taipei Palace Museum or Beijing Palace Museum, their creative products are undoubtedly designed to enable more and more people to understand our traditional culture. These two art treasures belong to our country, which are well known by the public in another form, and integrate the precious treasures that we think are far away from us into our life.It also enables people to know more about museum treasures through creative products, and further narrows the distance between us and museums. The production of creative products is also in line with the development of the times and people's pursuit of novelty. It is not only a cultural practice, but also a historical heritage.[21]

3.4 Olympics and auspiciousclouds

The earliest and most noticeable pattern design should be the propitious cloud torch and Torch Relay Symbol of the 2008 Beijing Olympic Games.Its appearance makes the application of Chinese elements in modern design vivid. In this international Olympic grand meeting, we express our beautiful vision and expectations in a unique way of the Chinese nation, so that tourists and athletes from all over the world can have a glimpse of the style of traditional patterns. Through the relay of the torch, the culture of China for five thousand years has been brought to all parts of the world, and has been recognized by the world. With the "auspicious clouds" of the classical culture, the meeting with modern civilization adds a wonderful stroke to the Olympic spirit. [22]The relationship between traditional auspicious patterns and modern design complements each other. Modern design inherits and develops traditional patterns. Traditional auspicious patterns provide cultural connotation and design materials for modern design. Therefore, the progress of science and technology in the era of change can not be separated from traditional culture.

Why should we combine the traditional pattern with the modern Olympic Games? That is, the Chinese people's high acceptance of traditional culture, but also the enthusiasm of inheritance. We hope that the world can see our culture and understand our national connotation. It is also because of the high national acceptance and promotion spirit that more and more designers begin to use traditional patterns to integrate modern design and innovation. More and more good design will be produced, which will enhance the awareness and better publicity of national culture. [23]

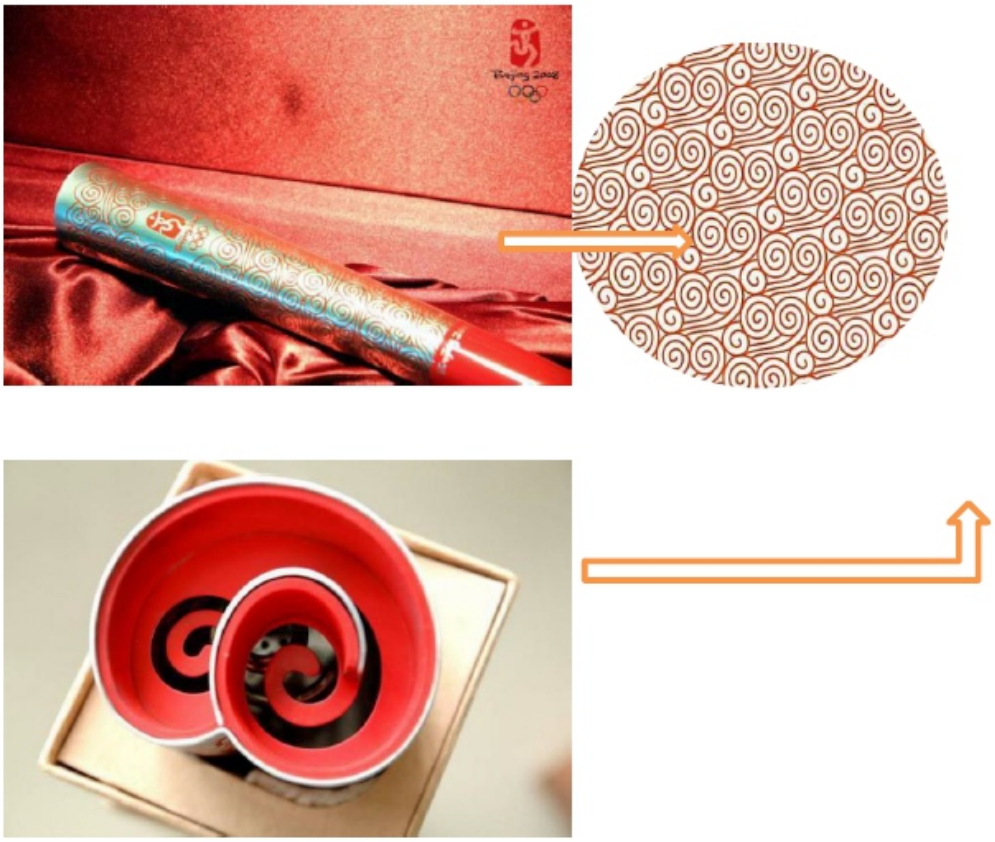

Fig.12Propitious Cloud torch of the 2008 Beijing Olympic Games

Fig. 13 Torch Relay Symbol of 2008 Beijing Olympic Games

3.5 International Repercussions

Chinese Traditional auspicious patterns not only appear in Chinese modern design works, but also become common in western counterparts. In the 17th century, a great many western designers began to advocate decoration styles with oriental elements. They collected patterns from Chinese pottery and

furniture so as to learn oriental design styles and look for unique design inspiration. The oriental styles were transformed and applied in their own design.[24。 25]According to them, these traditional patterns represented the long-history Chinese culture and they were aware of the propitious implications in the Chinese auspicious culture. Nowadays, more and more Chinese elements are applied in Western design, showing a great influence of Chinese traditional design patterns and culture on the West. The emergence of so many cross-border design works also marks the growing recognition of Chinese traditional patterns in the world.

Similarly, culture blend helps more people understand the implication and significance of these Chinese Traditional patterns. In the process of mutual learning between Chinese and western design, the prevalence of "Chinese Style" in the West is also one of the important ways to carry forward traditional culture. Wewant to innovate and develop traditional auspicious patterns, but at the same time, we should employ a global perspective, for we must not cut us off from the outside worlds. With the integration of tradition and modernity, we can develop a modern graphic design, which is in line with today's international context, and contains national connotation as well. [26]With the globalization of the economy, culture is also developing towards globalization. New trends of thought are constantly emerging with the exchange of cultures. The space of design is also expanding, which makes the national design cooperate with the world language to form a new art form.[27]

Fig.14&15Rococo style with Chinese elements

Fig.16&17German designers apply traditional Chinese window design to tea packaging

Fig.18 Starbucks cooperation with VIVIENNE TAM

IV. CONCLUSION

Chinese traditional culture is formed in the course of a five-thousand-year history and has integrated the yearnings of countless ancient Chinese for better lives, and its auspicious part has survived till today due to the unique features of the Chinese nation. Traditional culture is an unlimited resource for modern design and also a solid foundation of modern graphic design. Its application in modern design is an in-depth cultural exploitation, too. Auspicious patterns symbolize the beginning of ancient design and become symbols of Chinese nation with modern significance. Although Chinese traditional culture has been continuously developed and inherited in modern design, great challenges remain. During the innovation of auspicious pattern design, great attention should be paid to traditional culture, rather than to a single end of design only. It is the cultural connotation of these patterns that is the most worthwhile to be inherited and carried forward.

The fusion of traditional pattern and modern design is the blend of the old and the new, and also the "modernization" of traditional pattern. The reason why we can have such a high acceptance is that the traditional pattern is a part of the Chinese nation, which has strong national characteristics. The high enthusiasm makes the traditional pattern widely used in modern design, even in foreign design. These are not only the inheritance of traditional culture, but also the positive impact on future design. The collision of old and new cultures is undoubtedly important for design. With the continuous progress of science and technology, more and more traditional cultures will appear in people's lives through digital means. The integration of design is another way of continuing culture. As a kind of national wealth, traditional culture not only endows modern design with new connotations, but also improves the economic benefits of all kinds of creative products through many novel means. This proves the improvement of living standards. People's spiritual needs are also growing. Therefore, the inheritance of Chinese culture with great connotation is of stages, and the change of people's thinking is also an important factor in the progress of the times. Not only is Chinese traditional culture worthy of promotion and inheritance in modern design, but also the excellent cultures of all countries in the world should be promoted in the development of the times. The auspicious pattern is widely used in design as a graphic, which is not only easy to understand but also can close people's psychological distance, and is more easily accepted by consumers, thereby promoting the prosperity of business.

This article only extracts a part of the patterns of many traditional auspicious patterns for analysis and explanation, and the conclusions reached have certain limitations. Due to the variety of traditional Chinese patterns, it will be a difficult undertaking to merge existing and proven patterns with modern design. The author hopes that with the development of science and technology and the advancement of modern technology, more and more researchers can participate in the study of combining traditional culture and modern design, so as to better carry out cultural communication and communication

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Design A Model to Analyze Open Sources Node JS IOT Frame Works

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ABSTRACT

Internet of Things (IoT) technologies has evolved rapidly during the most recent decade, and numerous architecture types have been proposed for distributed and interconnected frameworks. However, most frameworks are implemented following divided approaches for specific application domains, introducing difficulties in providing unified solutions. Node.js is quick and reliable for substantial files and hefty network load applications because of its event driven, non-blocking, and asynchronous approaches, where developers can also maintain a complete projects in single pages (SPA) and can use for IoT. Node.Js is a server-side platform mainly utilized for constant application as a result of it event-driven architecture and non-blocking I/O. Node.js is found to be 10 times quicker in I/O operations. The outcomes show that the IoT entryway dependent on an open source ecosystem had a steady and reliable framework performance with a certain information size and concurrency scale. These conditions satisfy the application requirements of the IoT in most sensing environments.

KEYWORDS: Internet of Things (IoT), Node.js, Server-side Platforms, Database Server, JavaScript

INTRODUCTION

Internet of Things (IoT) is another revolution of the Internet. It makes Objects themselves recognizable, obtain intelligence, communicate information about themselves and they can get to information that has been collected by other things. The Internet of Things allows people and things to be connected Anytime, Anyplace, with anything and anyone, ideally using any way/network and any service as shown in Figure 1.1.This implies addressing components, for example, Convergence, Content, Collections, Computing, Communication, and Connectivity. The Internet of Things provides interaction among the genuine/physical and the digital/virtual worlds. The physical entities have digital counterparts and virtual representation and things become context mindful and they can detect, communicate, interact, trade information, information and knowledge. Through the utilization of intelligent decision making algorithms in software applications, appropriate rapid responses can be given to physical entity dependent on the most recent information collected about physical entities and consideration of examples in the historical information, either for a similar entity or for similar entities. These clears new dimension of IoT concept in the domains, for example, inventory network the board, transportation and logistics, aerospace, and automotive, brilliant environments (homes, buildings, infrastructure), energy, guard, agriculture, retail and that's just the beginning. Internet of things as the name recommends, is the connectivity of ordinary devices with one another. With the progression in technology, numerous devices are using sensors, actuators, implanted computing and cloud computing.

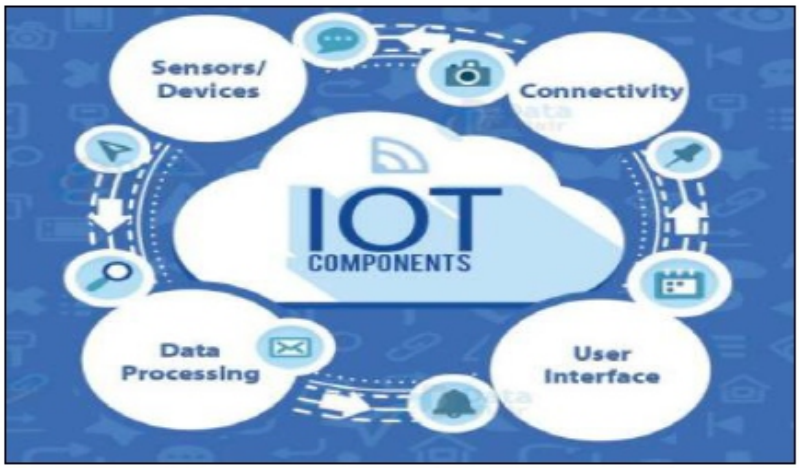

Figure 1 Internet of Things (IoT)

This has empowered communication between devices. To lay it out plainly, the Internet of Things empowers devices (things) to interact and co-ordinate with one another in this manner reducing human intervention in basic regular undertakings. To improve understanding of IoT considers the scenario of a savvy home. When the alert rings it imparts a sign to the coffee creator and the toaster, which automatically begin doing their jobs without any human intervention. Consequently, saving time and making our regular assignments simple, this kind of device communication is the Internet of Things. The IoT empowers physical objects to see, hear, think and perform jobs by having them "talk" together, to share information and to co-ordinate decisions. A network of heterogeneous devices/applications has its own arrangement of difficulties. Moreover, as the communication among these devices just as with related services, is required to happen anytime, anyplace, it is oftentimes done in a wireless, autonomic and specially appointed way. In addition the services become substantially more fluid, decentralized and complex. Consequently, the security barriers in the Internet of Things become a lot thinner. The IoT architecture, like the Internet, will grow in an evolutionary fashion from a variety of discrete contributions, instead of from a terrific arrangement. Security is a major concern while dealing with the Internet of Things. A majority of IoT empowered devices are not make sure about and can be gotten to by a third gathering easily. Hence there is a serious need to standardize it to guarantee that the privacy of the client is not invaded. Investigation into the IoT field is still in its beginning phase, and a standard definition of IoT is not yet available. IoT can be viewed from three perspectives. Internet of things common definition is defining as: Internet of things (IoT) is a network of physical objects. The internet is not only a network of computers, however it has evolved into a network of device of all sort and sizes , vehicles, advanced cells, home appliances, toys, cameras, medical instruments and industrial frameworks, animals, people, buildings, all connected ,all communicating and sharing information dependent on stipulated protocols in order to achieve savvy reorganizations, positioning, tracing, safe and control and even personal continuous online monitoring , online update, process control and administration.

Internet of things is an internet of three things:

(1). People to people,

(2) People to machine /things,

(3) Things/machine to things/machine, interacting through internet. Internet of Things Vision: Internet of Things (IoT) is a concept and a paradigm that considers pervasive presence in the environment of a variety of things/objects that through wireless and wired connections and

unique addressing plans can interact with one another and cooperate with other things/objects to make new applications/services and arrive at common goals. In this context the innovative work difficulties to make a savvy world are enormous. A world where the genuine, digital and the virtual are converging to establish keen environments that make energy, transport, cities and numerous other zones more intelligent.

Internet of Things is allude to the overall idea of things, especially ordinary objects, that are coherent, recognizable, locatable, addressable through information sensing device or potentially controllable via the Internet, irrespective of the communication implies (regardless of whether via RFID, wireless LAN, wide territory networks, or other methods). Regular objects include not only the electronic devices we encounter or the products of higher technological development, for example, vehicles and equipment yet things that we do not ordinarily think of as electronic by any stretch of the imagination -, for example, food, clothing, chair, animal, tree, water and so forth Internet of Things is another revolution of the Internet. Objects make themselves recognizable and they obtain intelligence by making or enabling context related decisions on account of the way that they can communicate information about themselves. They can get to information that has been totalled by other things, or they can be components of complex services. This transformation is concomitant with the development of cloud computing capabilities and the transition of the Internet towards IPv6 with an almost unlimited addressing capacity. The goal of the Internet of Things is to empower things to be connected anytime, wherever, with anything and anyone ideally using any way/network and any service.

BUILDING BLOCKS OF IOT

How about we expect all electronic devices that are as of now available are connected to one another through the internet to form a certain framework. What's more, these little frameworks re-join each other to form bigger frameworks. That is IoT for you (IoT framework). Here are the IoT building blocks:
End Devices

These are the most essential devices or key things in IoT. These are the active sensing devices or actuators working in collecting the important significant information and perform the ground level processing. For instance: RFID at piece of clothing stores, temperature sensors at home and cameras at the highways.

Gateways

It is the local processing node/device. It connects the end devices to the network or an internet (cloud). It should not only exchange the pertinent information collected from the sensors or actuators yet additionally process them to some degree and forward the particular information to the cloud. It also provides the intelligence by sending back the information received from the cloud.

Connectivity

Since IoT is a network-based framework; the 'connectivity' assumes a vital role. The various service providers have given multiple solutions for the connectivity of the end devices to the doors and afterward to the cloud. Also, it is a double/duplex framework. Thus, it works in the to and fro communication framework among applications and equipment. Subsequently, the connectivity can work both in wireless or wired mechanism. For instance: Bluetooth, Wi-Fi, RFID, GSM and so on.

LITERATURE REVIEW

Li Da Xu et al (2014),Internet of Things (IoT) has provided a promising opportunity to build powerful industrial frameworks and applications by leveraging the growing ubiquity of radio-frequency identification (RFID), and wireless, mobile, and sensor devices. A wide scope of industrial IoT applications have been developed and deployed lately. In an effort to comprehend the development of IoT in industries, this paper reviews the ebb and flow examination of IoT, key enabling technologies, major IoT applications in industries, and identifies research patterns and difficulties. A main contribution of this review paper is that it summarizes the present status of-the-craftsmanship IoT in industries systematically.

YangQun Li et al (2013),The Internet of Things (IoT) is increasingly important for daily life. However, the development of IoT applications still faces numerous problems, for example, heterogeneity, complex administration, and other difficulties. In this paper, first, the open source technologies of IoT are overviewed. We compare these technologies from the point of view of different degrees of technical requirements, for example, device the executives, information the board, communication, intelligent information processing, security and privacy protection; we also look at requirements of application development and deployment. Second, IoT integrated development platform architecture for IoT applications dependent on open source ecosystem is proposed and assessed in an industrial setting. We applied P2P technology to distributed resource the board and block chain-based savvy contract mechanics for resource billing the executives. The outcomes show that the IoT passage dependent on an open source ecosystem had a steady and reliable framework performance with a certain information size and concurrency scale. These conditions satisfy the application requirements of the IoT in most sensing environments.

EXPERIMENTAL METHODS

This paper aims to implement a framework for application developers which include software groups like Node.js and Mongo DB and make APIs to connect their application with their database easily without worrying of the server-side coding. Also this APIs can be utilized to make drivers for various platforms like Android, .Net, IOS and so on There should be a more convenient and simple path for an application developer to connect their applications and website with a database server. This backend server should be with the end goal that it could deal with multiuser demand and should be of high concurrency. Also it should mull over the privacy and security of information. Node.js is as of now another and trending technology in JavaScript. It is a platform built on Chrome's JavaScript runtime for easily building quick, adaptable network applications. Using Node's core functionality and integrating it with one of the quickest and adaptable database i.e. Mongo DB, we intent to implement a framework for a backend server for our database which can help easily connect our frontend with the Mongo DB. This framework will have the following bit of leeway over the above mentioned ways:

1. It will make a developer liberated from writing the server side script and subsequently making him concentrate only on the frontend to the application.
2. This framework utilizes Node.js with is than traditional scripting language like PHP, Ruby on Rails and so on
3. All the layers on this framework utilize only one language throughout the stack i.e. JavaScript, subsequently making it very much fit and in a state of harmony.
4. As the database server is deployed on the developers framework, he has full control over the privacy and security of it.

Node.js can be utilized with numerous databases, for example, MySQL, Mongo DB, yet because of various favourable circumstances of Mongo DB over other databases, we are using Mongo dB in our project. Mongo DB is an increasingly popular document-based, high-performance NoSQL database. In Mongo DB, information is stored as a document as a bunch of key worth pairs. It can define multiple databases in Mongo DB where every database can have numerous collections, and those collections are simply a bunch of documents that consist of information stored as a key-esteem pair. The information structure that defines a Mongo DB document is called BSON (Binary JSON). BSON is binary representation of JSON and furthermore supports information types, for example, Date, which is not supported in plain JSON format. Mongo DB internally converts JSON to BSON and vice versa for performance benefits, although the client can save, inquiry and retrieve as JSON. Mongo DB offers excellent performance for situations containing high write loads, yet where information integrity isn't a pressing concern; a good model are the comments sections of enormous, occupied websites like Craigslist or The New York Times incidentally, these aren't theoretical coincidentally: both of these utilization Mongo DB. Our main aim is to implement a single framework integrating node.js and its modules, for example, mongojs, express.js the deployment of Mongo dB as a remote database is considered after evaluation of its performance. This paper aims to implement framework using peaceful API's over conventional API's, for example, SOAP or CORBA. REST is an architectural style that utilizes simple HTTP calls for inter-machine communication instead of more complex options like CORBA, COM+, RPC, or even SOAP. Using REST implies your calls will be message-put together and reliant with respect to the HTTP standard to describe these messages. Using the HTTP protocol implies REST is a simple solicitation/response mechanism. Each solicitation restores an ensuing response.

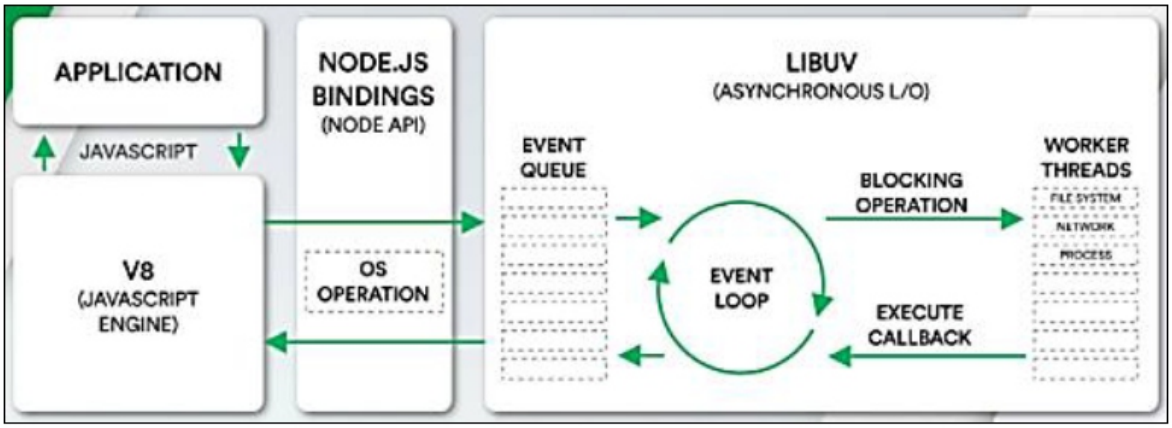

Figure 2 Node.JS System

Node.js is a software platform that allows you to make your own webserver and build web applications on top of it. Node.js is not itself a webserver, nor is it a language. It contains a built-in HTTP server library, meaning that you don't have to run a different web server program, for example, Apache or IIS. This ultimately gives you more prominent control over how your web server works, however does increase the complexity of getting it going particularly in a live environment. With PHP for instance, you can easily find a shared server webhost running Apache, send some files up over FTP and all being great your site is running. This works on the grounds that the webhost has just configured Apache for you and others to utilize. With Node.js this is not the situation, as you configure the Node.js server when you make the application. Express is utilized to oversee client sessions, with optional support from Mongo DB. Client authentication will typically utilize Node.js, Express, Mongo DB and Mongoose, yet there are various third-party modules that you can plug into your application so that you don't need to do the entirety of the difficult work. A server on local port can be empowered using following code:

Var express = require ('express'); app.listen (3000); //parameter is port number console.log ("Server running on port 3000"); //This will start the server on the port no. 300 of local host.

Express edited compositions this difficulty away by setting up a web server to listen to incoming solicitations and return applicable responses. On top of this it also defines a directory structure. One of these folders is arrangement to serve static files in a non-blocking way the exact opposite thing you need is for your application to need to wait when somebody else demands a CSS file, you could configure this yourself directly in Node.js, yet express does it for you. An asynchronous programming model of events and call backs is appropriate for a server which needs to wait for a lot of things, for example, incoming solicitations and inter-process communications with other services (like Mongo DB).

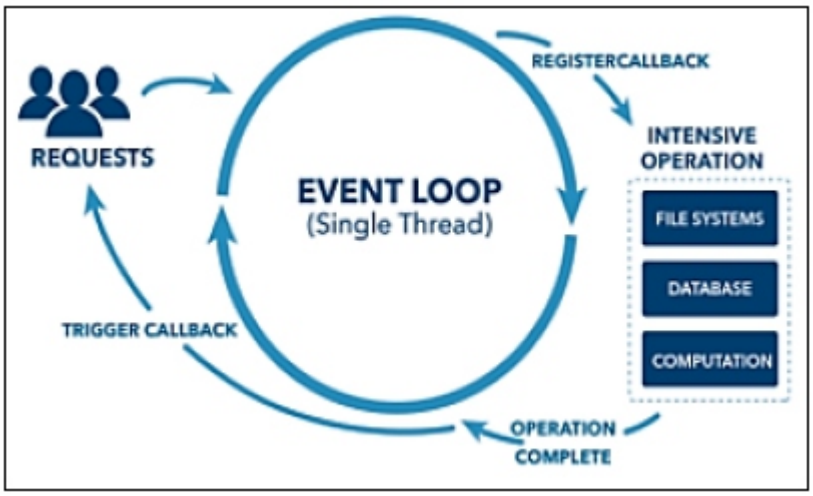

Figure 3 Node.JS – Non Blocking I\O

Mongo DB is a low-overhead database where all entities are freestyle BSON "binary JSON" documents. This allows you to work with heterogeneous information and makes it simple to deal with a wide variety of information formats. Since BSON is compatible with JSON, building a REST API is simple the server code can pass solicitations to the database driver without a lot of intermediate processing. Node and Mongo DB are inherently adaptable and synchronize easily across multiple machines in a distributed model; this combination is a good choice for applications that don't have an equally distributed load. This asynchronous nature on node coupled couple with its compatibility with Mongo DB makes it vital for our server as it's a continuous functioning framework. We further need to write all possible operation that is supposed to be in a database server. All CRUD (make, Read, Update, Delete) to and from db. We build an API for all CRUD operation using get back to functionality of Node.js. The APIs when triggered lead to executing its operation in the database and ending with the resulting get back to function.

The below example of an Insert API:

```
app.post ('/register', function (req, res)
{
console.log ("Request for Insertion received with this data");
console.log (req.body);
db.users.insert (req.body, function (err, docs)
{
console.log ("Data after insert: ");
```

```
console.log (docs);
res.json (docs);
});
});
```

These APIs work on various HTTP protocols. In the above code for instance we get a HTTP demand from a client with JSON information to be inserted. The code executes it by using the mongo dB driver functionality lastly responds with a HTTP response variable. This APIs is then used to build driver for Android Platform.

Advantages of Node.js over others

Node.js is built from ground for the purpose of handling asynchronous I/O as it is built of JavaScript and JavaScript is built as event loop. Like the on click event for a button in client side JavaScript is and event loop. While other environments do have this component, they have it with using third gathering libraries or are not built from ground for a similar purpose like the Node.js and consequently they are often slow, or slacks and does not belongs as a standard element to them. Some of the models are Event Machine built for Ruby, Twisted licensed under open source MIT License, it is introduced for Python and is available since Python 2 onwards, and network framework library for Apache named as Apache MINA which is also called "Networking Socket Library" and is another illustration of providing event-driven and asynchronous limited to APIs only. Similarly Apache AsyncWeb is built using Apache MINA and Perl's Any Event. Similarly an edge of Node.js over others will be that it will be fit for handling multiple solicitations while it will act like a client towards the third party services by executing only a single string. Other dialects in such manner will block the processing until the remote server responds first for their initial solicitation accordingly they will require multiple threading for executions. Comparatively in Node, all what you will utilize is asynchronous as it will become quite hard if you are to write non-asynchronous code in it. Also Node.js will never force to cradle information outputting while the others like Event Machine, forces buffering in numerous cases to cushion the information.

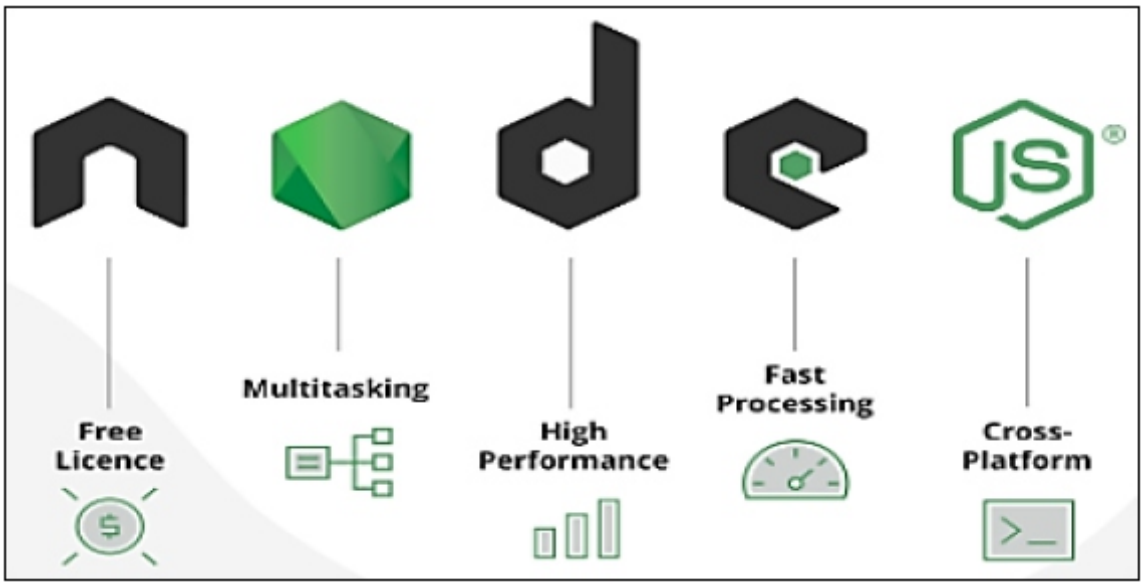

Figure 4 Advantages of Node.JS

Being server side JavaScript, another admirable edge of Node.js over others is that a developer will be required to only have knowledge and experience of a single language i.e. JavaScript, no issue if he is

developing client side scripts or scripts for server side. The developer is not required to trade his brain cycles from for one language at client side and afterward for another dialect at server side. Consequently JavaScript start to finish as depicted in the Figure 2. Here the database of JavaScript also store date like a JavaScript Object. Adding to this, it is also worth considering that Node.js is new and hence have benefit of taking precautions against the mistakes which other dialects had come across in the past, for example, the mistake of in reverse compatibility. Figures shows that about 47% of web surfers need a website to be loaded within 2 seconds and a 3 second defer drops the customer satisfaction by 16%. Here the Node.js leads as the interpreter of Node.js is more modest and quick compared to other dialects like PHP. Here the server side applications are for all time kept ON unlike other dialects where each initiation of the application will follow cycles consuming strides of for instance loading configurations, followed database connectivity, acquire required information lastly render the increase language. Node.js on other hand lessens these means by keeping an application forever ON.

Application of Node.js

Node.js was compared with PHP/Nginx for Performance and Scalability, where Node.js showed high performance and scalability compared to PHP/Nginx. The two analysts developed web application on Dijkstra Algorithm and simulated load of concurrent client demands using some load generators. University of Notre Dame in had a project report issued where the author performed tests among Node.js and Ruby's Event Machine and Apache's threading model, which estimated demand time over the quantity of cores. Node.js had again beaten the other two especially when the quantity of cores was increased. Node.js based DPWS – Devices Profile for Web Services (named as Node. DPWS) was assessed for performance and compared with alternative DPWS tools. The scientist concluded that Node.js based DPWS was anything but difficult to use just as light weight. Node. DPWS had beaten even the most striking substitute of it in the field of IoT (Internet of Things). Node.js also assumes important role in GIS field and a paper published in Journal of Korea Spatial Information Society utilized Node.js in Web GIS. They implemented Node map and concluded in their examination that Internet GIS have its future bright in combination to the Node.js. Another analysis learn at has shown that Node.js can be utilized to have complex continuous applications and that these application can be served for millions of client connections. There is a web service named MAGI which is utilized in infrastructures of graphic processing unit (GPU) for the purpose of quick information analysis of Micro RNA-seq. While MAGI depend on Node.js, it did tended to the limitation of other similar tools to not being ready to deal with enormous files, and a burdensome error prone advances. Also MAGI helped uncovered the deferral in downstream analysis as the others are time consuming and solved the issue of others of not being ready to provide statistical tests. Node.js is adopted by developers and analysts for IOT for the reasons that JavaScript quick and is familiar among the huge number of web developers as they use it with HTML5 for programming front end User Interfaces, and important point is that JavaScript is best for installed devices as its temperament is to support asynchronous and event-driven functions. Also the programming model adopted by Node.js is an extraordinary fit for implanted devices just as servers and the domain specialists have just adopted Node.js for the purpose of IOT. Microsoft has also adopted Node.js for IOT development in its developer resources.

CONCLUSION

The Internet of things is the future for the coming many years which helps in developing the Smart World where everything is connected to one network. As security is consistently a big problem across each framework however in IoT it is the most important zone in which we need to work to make sure about information or information which is on one connected network. One of the major components in

securing an IoT infrastructure is around device identity and mechanisms to authenticate. So to overcome on these securities of IoT devices strong encryption and authentication plans depend on cryptographic need to design and new security protocols are required. This paper presents the framework using node.js to build highly adaptable and high-speed backend database server for web developers just as application developers. It also demonstrates the utilization of NoSQL database, for example, Mongo dB in proposed project work over other traditional database, for example, MySQL. In this paper, we explained the security issues in each layer and its estimates which assist us with understanding and to improve security in IoT architecture. More intelligent security frameworks that include oversaw danger detection, anomaly detection, and predictive analysis need to evolve. All the above discussed issues will be exploration opportunities in IoT security.

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