

# GLOBAL JOURNAL

OF COMPUTER SCIENCE AND TECHNOLOGY: B

## Cloud & Distributed

Digital Torque Transformation

A Cloud Mobile-based Information

Highlights

Treatment of Diabetic Patients

Improved Hybrid Algorithm Approach

Discovering Thoughts, Inventing Future

VOLUME 19    ISSUE 2    VERSION 1.0



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## Digital Torque Transformation

By Boddam Linga Reddy

*Abstract-* The Equipment Installment Plan (EIP) was a game changer in telecom industry and is an integral part of T-Mobile's Un-carrier strategy. The EIP system is a home-grown system based on Java/J2EE and a combination of client-server and SOA architecture principles. The application runs on Bea Web Logic servers with Oracle DB with multiple batch jobs. As the system grew in size, operational challenges surfaced which includes multiple physical server security updates and maintenance cost. (DTT)" was the answer to address these challenges. The method employed PaaS Pivotal Container Services (PKS). Enterprise PKS uses the latest stable OSS distribution of Kubernetes—with no proprietary extensions. PKS is widely expandable to other applications in T-Mobile ecosystem as PKS can be deployed On-premises as a PaaS.

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## I. INTRODUCTION

Provides wireless voice, messaging, and data services in the United States, Puerto Rico, and the U.S. Virgin Islands under the T-Mobile and Metro by T-Mobile brands. The company operates as the third largest wireless network in the U.S. market with over 65.5 million customers and annual revenues of \$32 billion. Its nationwide network reaches 98 percent of Americans through its EDGE 2G/HSPA 3G/HSPA+ 4G/4G LTE networks, as well as, through roaming agreements.

In 2009, T-Mobile designed, implemented, and launched Device Financing Product. It is known as "Equipment Installment Plan" (EIP) in the telecommunication industry. EIP is the, predecessor of similar products such as Lease, JUMP (Just Upgrade My Phone) and 'Un-Carrier.' Most telecommunication companies now have to use derived EIPs to stay competitive.

The EIP is a T-Mobile home-grown Computer Science Application finance system which currently serves over 45 Million 'Active' Loans and Leases. The EIP built on information technology Java, J2EE, Oracle client-server architecture. The EIP Legacy system feeds large amount of data to over 150+ echo systems in the T-Mobile landscape, which serves Customers, Accounting, Billing, Auditing, Ordering, and the Reporting verticals.

The current challenges involved legacy application [Forbes 2018], EIP system evolved into a very tightly coupled architectural system with numerous interactions and validations. Many functions, though not required for the system itself, are forced to fit-in. As business and market need to be evolved, the system ended up having orchestrations and dependencies on

credit decisions, billing, business rule engine, millions of lines of code, over 250 database tables with more than a quarter billion transactional and historical records.

The monolithic nature of the system is the driver that triggered the need to docker containerize the EIP finance information system using PKS (Pivotal container Service) on-premise cloud [define cloud, cloud computing models]. There are functional and technical disadvantages to the legacy system. Some of them include low scalabilities, as the system is not designed to support elastic infrastructural capacity, low fault tolerance and high turnaround time on speed to market.

Increased business volume caused system response time increased, and performance declined. Infrastructure costs continued to rise because of the need to apply security patches over multiple servers. System Telemetry<sup>(1)</sup> and Logging mechanisms were a challenge.

A client impact-free solution is warranted without any code changes, application configuration changes and database changes.

*Lessons Learned: The finer level details during the engagement of a monolithic system should be given proper care, before its introduction into the landscape, given the fast-changing business and technical needs.*

*Telemetry is an automated communications process by which measurements and other data are collected at remote or inaccessible points and transmitted to receiving systems (Splunk or in-house logging systems) for monitoring.*

### a) The DTT Method

PKS PaaS was elected to overcome existing challenges in the operational front of EIP system.

DTT method is a method to upgrading an application from its existing platform, adhering to clouds' 'Beyond Twelve Factor'<sup>(2)</sup> principles and make it run on cloud, while preserving existing functionality.

Strangler pattern concepts were adopted, and custom java scripts are designed to route the traffic between legacy Web Logic infrastructure and the new cloud PKS infrastructure without interrupting production traffic and clients.

Docker concepts adopted and extended for DTT to build the cloud native application docker container that includes application code, WebLogic application server docker image, and dependent libraries.

Author: e-mail: [lingareddyboddam@gmail.com](mailto:lingareddyboddam@gmail.com)

The existing A10 LTM pool manager (Figure 1) that holds legacy WebLogic instances were left untouched. An additional pool PKS load balancer member was added to connect PKS clustered pods. Custom scripts were designed on A10 LTM router to check the health of the PKS pool member, also known as PKS load balancer to K8 cluster. Custom code extensions were implemented on the exiting EIP application to check application health of routing rules. To achieve complete roll out, A10 software configuration was used to disable each pool member in the WebLogic EIP pool manager and load was gradually transitioned to PKS.

DTT minimized the risk of migration and spread the development effort over time. With the façade safely routing users to the correct application, new functionality

was added to the new system incrementally, while ensuring the legacy application continues to function. Over time, as features are migrated to the new system, the legacy system is eventually "strangled" and safely retired.

The DTT journey took 3 months. Traffic was slowly rolled out in increments bi-weekly and an impact-free transition was achieved.

*Beyond Twelve Factor Principles: Refer to content in link below. <https://content.pivotal.io/blog/beyond-the-twelve-factor-app>*

The high-level visual Figure 1, including the transition to PKS cloud stack, used to achieve 'Digital Torque Transformation' is given below;

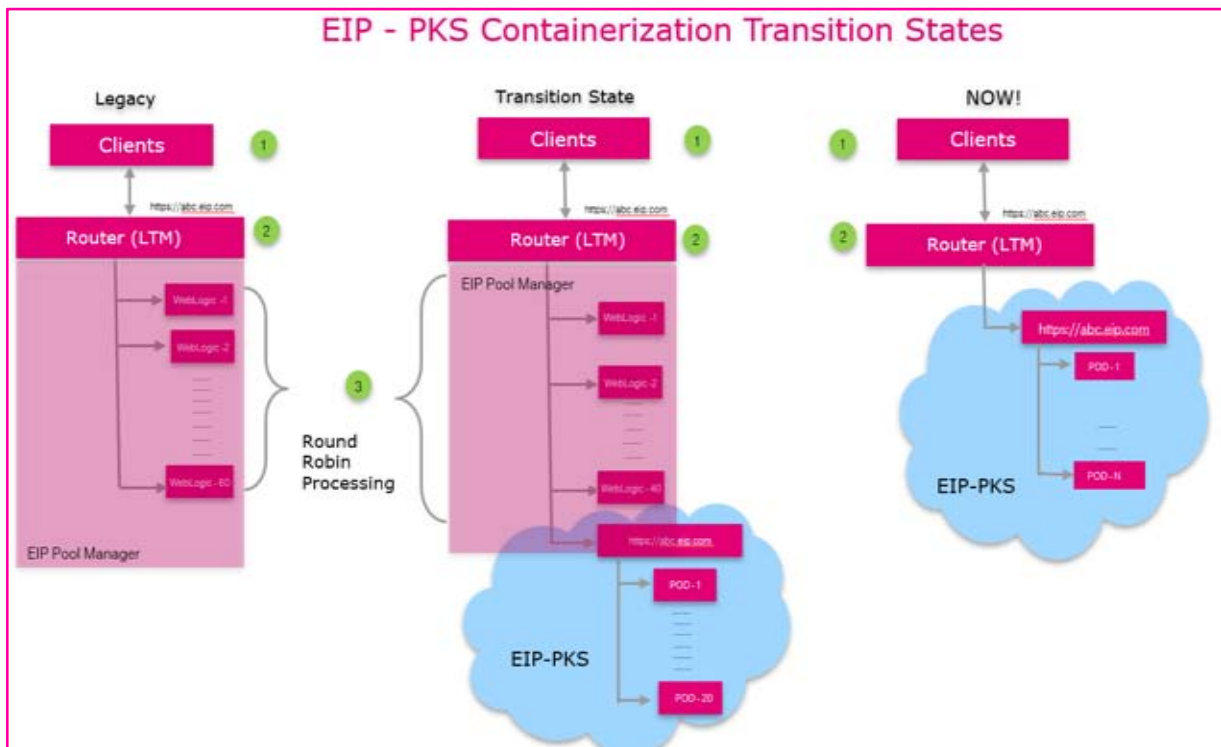


Figure 1: Legacy system infrastructure transition to the new Cloud infrastructure

**Legacy State:** Clients Traffic was always routed from A10 LTM router to WebLogic instances 1 to 60. Load balancing was always round-robin and scattered load across 1-60 instances.

**Transition State:** Client Traffic was routed from LTM to New Pool Member PKS WebLogic container without impacting to the clients with a pilot transaction by throttling logic. Gradually took off legacy WebLogic server from LTM pool.

**Now:** Traffic is transitioned to PKS all the time from LTM. An Ecosystem is enriched with cloud functionalities and advantages.

b) *The Results*

The idea to not impact existing customer-facing applications was attractive. Legacy applications can continue to call the same services and still achieve the business and enterprise goal of moving to anew digitalized service platform.

EIP (online) is now containerized in Production taking 100% traffic enabling us to achieve full benefits of containerization including elastic scale and No patching for security vulnerabilities.

Over 55 security vulnerabilities that required constant patching were reduced to less than 5. Auto-scaling is achieved, and the application is reactive to

elastic/burst scaling with no need for human intervention.

A total of 60 PODS with 30% faster response times and 40% fewer resources and throughput of scaling from 0-60 PODS in less than 5 seconds is a tremendous feat.

NO NEW DEFECTS reported during the transition phase.

*NO Code Change.*

The Figure 2 graph below, denotes # of transactions for "Charge Injection" functionality Before the DTT and After the DTT. The system sustained an increase of almost two and half times load with better processing times. Before the DTT method ~4 millions at the rate of over 3K transactions per minute. After the DTT method over 10 million at over ~7.5K transactions per minute.



Figure 2: # Transaction Volumes per minute increased on old to new

Figure 3 explains the average response time was decreased by 80% from 1,194 milliseconds to 77 milliseconds. The graph below, indicates average response time for Charge injection and finance assets

creation in the new finance system, Before DTT and After DTT. Elasticity of the system was improved and provided better customer experience.

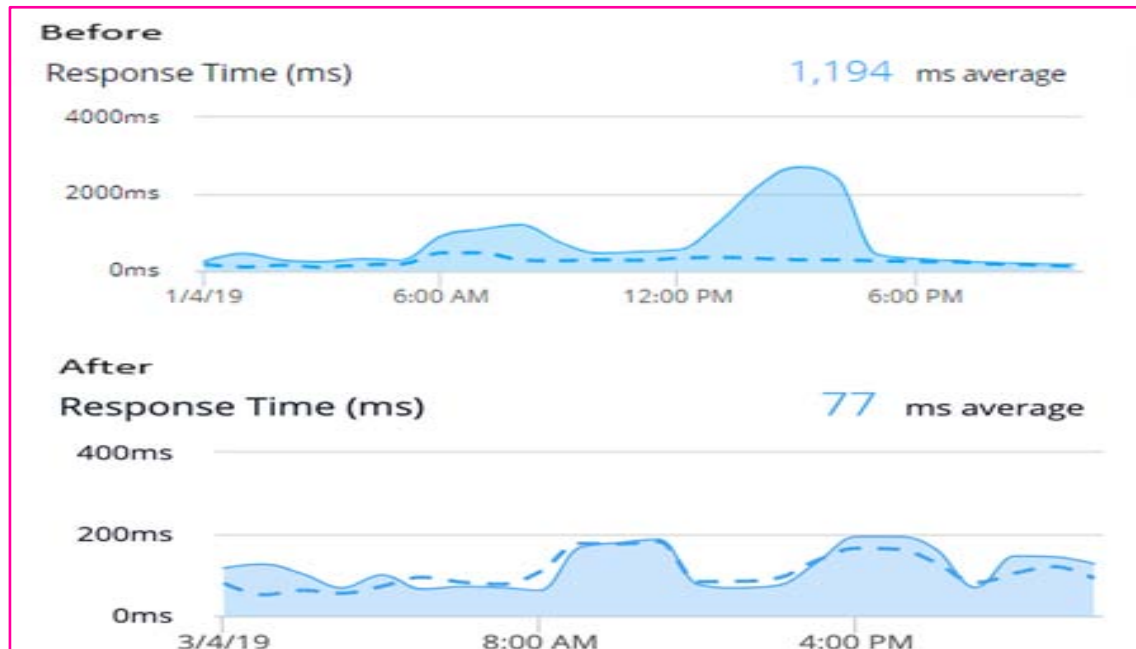


Figure 3: Transaction Response time in milliseconds

## II. DISCUSSION

The customized strangulation pattern to transition legacy system to new system is seamless to the enterprise without interrupting business.

The methodology explains to move away from legacy bare metal hardware in to cloud elastic VMs. Dockerize an application and Heavy weight application server in to containerization and make as light weight and to CI/CD.

Leverages all benefits of kubernetes on PaaS PKS cloud-native container. Kubernetes provides a simple and cost-effective solution for developers seeking to deploy and run their containerized applications on a Kubernetes cluster.

Most of the big enterprises tends to use PaaS as it provides better data security, accelerate product innovation, control, focus resources, get the best monitoring, get the best support and do your project right.

To keep pace with our un-stoppable growth, we needed to raise the stakes for how we manage customer loans, leases and lifecycle information on Equipment Installment Plans (EIP),

We made it! We have completed the journey for taking the monolithic EIP application and replatforming and modernizing it to be a cloud native application. Through this journey, we took a legacy system that was hard to maintain and modernized it into an efficient, cloud native system that is ready to take full advantage of what cloud computing has to offer. Perhaps the best of all, we made it much easier to maintain going forward.

## III. CONCLUSION

The scenario we narrated is not unique. Many companies are lumbered with systems that are not easily wholesale replaced the new platform, yet in many cases, they are critical systems for the company (i.e. the applications companies rely on for profits). In the age of digital transformation, systems must adapt faster than ever before to meet demanding capability and performance needs. A DTT approach of system delivery empowers organizations to meet these challenges while accelerating the pace of innovation, all in a risk averse and sustainable way.

Investing in PKS reduces the time spent keeping systems operational and allows teams to work towards the future—the time and money savings cannot be emphasized enough! For us, watching the technology come to life within six weeks was an amazing thing to see!

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## Hybrid Fuzzy Medical Expert Systems

By Poli Venkata Subba Reddy

*Sri Venkateswara University*

**Abstract-** Expert Systems are intelligent programs of Artificial Intelligence (AI). In many applications, information available to the expert system is incomplete like medical diagnosis. This incomplete information is fuzzy rather than probable. Hybrid fuzzy expert systems (HFMES) combination of different fuzzy expert systems of same type co-ordinate and co-operated. In this paper, Hybrid fuzzy medical expert Systems are studied. Fuzzy inference and fuzzy reasoning are discussed for HFMES Fuzzy knowledge representation is disused for HFMES. Some examples are given for HFMES.

**Keywords:** *medical knowledge representation, fuzzy inference, fuzzy reasoning, fuzzy medical expert systems, hybrid fuzzy medical expert systems.*

**GJCST-B Classification:** 1.5.1



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**Keywords:** medical knowledge representation, fuzzy inference, fuzzy reasoning, fuzzy medical expert systems, hybrid fuzzy medical expert systems.

## I. INTRODUCTION

The Medical diagnosis is inexact, imprecise and uncertain reasoning rather than exact. Various theories are there to deal with inexact, imprecise and uncertain information in Medical diagnosis [1]. Fuzzy logic [15] will deal with the belief where as others are deal with probable (likelihood). The Medical diagnosis is of belief rather than likelihood.

Hybrid fuzzy expert systems combination of different fuzzy expert systems of same type co-ordinate and co-operated. For instance, fuzzy medical expert systems are with symptoms and fuzzy medical expert systems are with medical tests. Hybrid Fuzzy Medical Expert Systems are in cloud environment.

The Medical diagnosis is Hybrid, This system may be viewed as a collection of Medical Expert Systems and these HFMS are to be co-operated and co-ordinate in cloud environment. The medical diagnosis will h deals with independent component in the diagnosis system, each of which reasons based on the Medical Knowledge available and combined for total systems.

## II. FUZZY LOGIC AND FUZZY REASONING

Fuzziness occurs when the body of information is not clearly known. In medical knowledge [1] symptoms and diagnosis are fuzzy rather than likelihood. For example "John has headache (0.9)", "John has chest pain (0.6)" where 0.9 0.6 are fuzzy values. Given some universe of discourse X, a fuzzy subset A of X is defined by its membership function  $\mu_A$  taking values on unit interval [0,1] , i.e.,

$$: X \rightarrow [0,1]$$

Suppose X is finite set. The fuzzy subset A of X may be represented as

$$A = \mu_A(x1)/x1 + \mu_A(x2)/x2 + \mu_A(x3)/x3 + \mu_A(x4)/x4 + \mu_A(x5)/x5$$

Where  $x1, x2, x3, x4, x5$  are individuals and "+" is union.

The fuzzy subset "headache" may be represented as

$$\text{Headache} = 0.4/x1 + 0.6/x2 + 0.8/x3 + 0.7/x4 + 0.5/x5$$

$$\text{Fever (in F)} = \{0.4/98.5, 0.5/99, 0.6/101, 0.7/103\}$$

The fuzzy set type 2 is given by

$$\text{Headache} = \{0.4/\text{mild}, 0.6/\text{moderate}, 0.9/\text{severe}\}$$

John has "mild headache" with fuzziness 0.4 etc., Similarly

$$\text{Rash} = \{0.4/\text{mild}, 0.6/\text{moderate}, 0.8/\text{serious}\}$$

The propositions may contain quantifiers like "very", "more or less", etc. these propositions can be reduced to simple propositions by using power operators. The square operator is used for "very", "most", (concentration), etc. the square root operator is used for "more or less"(diffusion), etc.

For instance,

$$\begin{aligned} \text{Very headache} &= \text{headache}^2 \\ &= 0.16/x1 + 0.36/x2 + 0.64/x3 + 0.49/x4 + 0.25/x5 \end{aligned}$$

The fuzziness in medical knowledge may be divided into two kinds, one is fuzzy number set and the other is discrete fuzzy set. The fuzzy number set contains usually integers or real numbers. The discrete fuzzy set contains usually linguistic variables.

For example, fuzzy number set in medical knowledge is given by

$$\text{Malaria-test \{in cycles\}} = \{0.0/1, 0.3/2 + 0.5/3 + 0.55/4 + 0.6/5 + 0.8/6\}$$

$$\text{Dengue-test (in lines)} = \{0.1/1 + 0.3/2 + 0.4/3 + 0.6/4 + 0.65/5 + 0.7/6\}$$

Where 110, 120, 125, 130 are diastolic pressure and 70,80,100,120 are systolic pressure

$$\text{Conjunctivitis} = \{0.3/\text{serious}, 0.7/\text{purulent}, 0.8/\text{chronic purulent}\}$$

Author: Sri Venkateswara University, e-mail: vsrpoli@hotmail.com



Suppose A, B, C is Fuzzy sets, and the operations on Fuzzy sets are given below

- $AVB = \max(\mu_A(x), \mu_B(x))$  Disjunction
- $A \wedge B = \min(\mu_A(x), \mu_B(x))$  Conjunction
- $A' = 1 - \mu_A(x)$  Negation
- $A \rightarrow B = \min\{1, (1 - \mu_A(x) + \mu_B(x))\}$  Implication
- $A \circ B = \min_x \{\mu_A(x), \mu_B(x)\} / x$  Composition

The fuzzy conditional proposition is of the form "if <precedent> then <consequent-part>"

Zadeh [12] fuzzy conditional inference is given by if x is A then x is B

$A \rightarrow B = A \times B = \min\{1, 1 - \mu_A(x), \mu_B(x)\}$  Implication  
 If x is  $A_1$  and x is  $A_2$  and, ..., and x is  $A_n$  then x is  $B = \min\{1, 1 - (A_1, A_2, \dots, A_n) + B\}$

Mamdani [5] fuzzy conditional inference is given by if x is A then x is B

$A \rightarrow B = A \times B = \min\{\mu_A(x), \mu_B(x)\}$  Implication  
 If x is  $A_1$  and x is  $A_2$  and, ..., and x is  $A_n$  then x is  $B = \min\{A_1, A_2, \dots, A_n, B\}$   
 In medical diagnosis, the consequent part is derived from precedent part [6].  
 If x is  $A_1$  and x is  $A_2$  and, ..., and x is  $A_n$  then x is  $B = \min\{A_1, A_2, \dots, A_n\}$

The Fuzzy propositions may contain quantifiers like "Very", "More or Less" etc. These Fuzzy quantifiers may be eliminated as

- $\mu_{\text{Very}}(x) = \mu_A(x)^2$  Concentration
- $\mu_{\text{More or Less}}(x) = \mu_A(x)^{1/2}$  Diffusion

Fuzzy reasoning is drawing conclusions from Fuzzy propositions using fuzzy inference rules [5]. Some of the Fuzzy inference rules are given below

R1: x is A  
 x and y are B  


---

 y is  $A \wedge B$

R2: x is A  
 x or y is B  


---

 y is  $A \vee B$

R3: x and y are A  
 y and z are B  


---

 x and z are  $A \wedge B$

R4: x or y are A  
 y or z is B  


---

 x or z are  $A \vee B$

R5: x is A  
 if x is A then y is B  


---

 y is  $A \rightarrow B$

### III. FUZZY MEDICAL EXPERT SYSTEMS(FMES)

Expert Systems have been a rapidly developing field. A recent trend in Expert Systems is the development of Fuzzy Expert Systems for solving particular problems ranging from Medicine, Scientific, Engineering and Socioeconomic areas [1, 7, 8, and 11]. The object of the expert systems is to capture the knowledge of an expert in particular problem domain, represent it in a modular, expandable structure, and transform it to their users in the same problem domain. Many times knowledge available to the expert system falls under uncertain, imprecise, vague, incomplete, inconsistent and inexact. Zadeh [15] introduced fuzzy logic to deal such information which is based on belief rather than probable.

An Expert System is called Fuzzy Expert System if it reasons about fuzzy information. The components of fuzzy expert system are shown in fig.1. It is necessary to understand the components of fuzzy Expert system. The Fuzzy Expert System contains Fuzzy knowledge base (Fuzzy rule based), Inference engine, Working memory, Explanation subsystem, Natural language interference and knowledge question. We mainly concentrate on fuzzy knowledge bases because the others are vastly developed [11, 12, and 25].



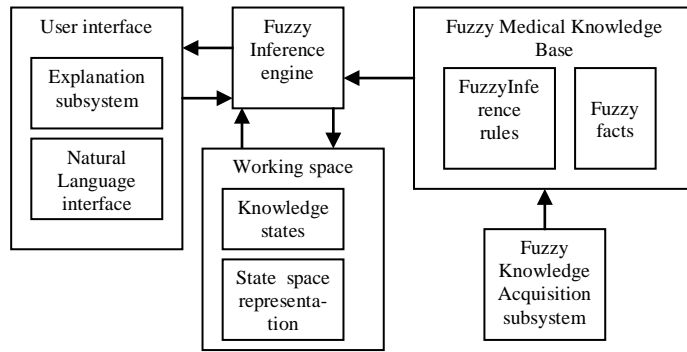


Fig. 1: Fuzzy expert System

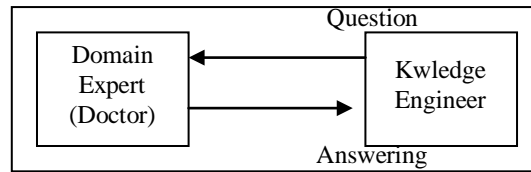


Fig. 2: Question Answering Sub-System

*Domain expert*

The knowledge and experience have been used to specific area of interest to store it in the fuzzy expert system.

a) *Knowledge Engineering*

The knowledge engineering is the problem solving strategy consists of problem solution such as control architecture(search strategies), Fuzzy knowledge representation and problem solution strategy, which determine, what knowledge to apply.

b) *Inference engine*

It is responsible for interpreting the contents of the Fuzzy knowledge base in order to reach a goal or conclusion. The inference engine can be divided into three parts.

c) *Context Block*

This part contains the current state of the problem and solution.

d) *Inference ( Reasoning) Mechanism*

These parts search the appropriate set of knowledge and data with the help of context block in order to reach a goal or conclusion.

e) *Explanation Facility*

The facility helps the user to understand the line of reasoning.

f) *Knowledge acquisition facility*

New knowledge is generated with the assistance of this facility.

g) *Work Space*

It is storage structure of problem description and the levels of problem states (knowledge sources). The Fuzzy rule based knowledge to be stored can be schematically represented in a net form.

IV. G. USER INTERFACE

The module of the Fuzzy expert system permits the user to benefit from the system.

EMYCIN] is Medical expert system shell in which medical diagnosis shall be defined [7,8]. The fuzzy information shall also be possible to define in EMYCIN.

$$CF [h,e]=MB [h,e] - MD [h,e]$$

Where MB [h,e] and MD [h,e] are the probabilities of Belief and Disbelief. used in MYCIN

*Fuzziness is considered instead of probabilities.*

The fuzzy certainty factor (FCF) for proposition "x is A" is defined as

$$FCF [x,A]=\mu_A^{FCF}(x) = MB [x,A] - MD [x,A].$$

$\mu_A^{FCF}(x) \rightarrow [0, 1]$  is single membership function.

$$\mu_A^{FCF}(x) = \mu_A^{Belief}(x) - \mu_A^{Disbelief}(x)$$

for instance,

$$\mu_{cough}^{FCF}(x) = \mu_{cough A}^{Belief}(x) - \mu_{cough}^{Disbelief}(x)$$

The conjunction and disjunction, negation and implication are given below.

$$FCF[x, A \vee B] = \max \{FCF[x, A], FCF[x, B]\}$$

$$FCF[x, A \wedge B] = \min \{FCF[x, A], FCF[x, B]\}$$

$$FCF[x, A'] = 1 - FCF[x, A]$$

$$FCF[x, A \rightarrow B] = \{FCF[x, A]\}$$

$$FCF[x, A_1, A_2, \dots, A_n \rightarrow B] = \min \{ FCF[x, A_1], FCF[x, A_2] + FCF[x, B], FCF[x, A_n] \}$$

The fuzzy medical expert systems are is problem solving systems using Fuzzy medical reasoning with Fuzzy medical facts and rules. These Fuzzy facts and rules are modulated to represent the Medical Knowledge available to the system. The Fuzzy Medical Expert System is independent component which performs Fuzzy reasoning in HFMES.

Consider the following fuzzy facts and fuzzy rules.

Rule 1: if fever (0.8,0.1)  
and rash(0.95,01)  
and body ache(0.9,0.3)  
and chills(0.9, 0.25)

Then the patient has chickenpox

Rule 2:if cough(0.85,0.1)  
and swollen glance(0.9,0.2)  
Then the patient has diagnosis mumps

Rule 3: if there is cough (0.95,0.2)  
and sneezing(0.8,0.15)  
and runny nose(0.8,9.15)

Then the patient has diagnosis  
whooping\_cough(0.7)

The fuzzy medical rule are given by using FCF

Rule 1: if fever (0.7)  
and rash(0.65)  
and body ache(0.6)  
and chills(0.75)

Then the patient has chickenpox (0.65)

Rule 2:if cough(0.75)  
and swollen glance(0.7)  
Then the patient has diagnosis mumps (0.65)

Rule 3: if there is cough (0.75)  
and sneezing(0.65)  
and runny nose(0.7)

Then the patient has diagnosis whooping\_cough (0.7)

For rule-1, fuzzy expert system is given fever rash, body\_ache and chills the system will reason diagnose chickenpox with fuzziness of 0.9.

#### IV. FUZZY MEDICAL KNOWLEDGE REPRESENTATION

The knowledge representation is essential module of all Fuzzy expert systems for learning [15]. It is a formal representation of the fuzzy information provided by domain expert (Doctor) as encoded by the knowledge engineer.

Information provided by the domain expert may be certain and uncertain, imprecise, vague, incomplete, inconsistent and inexact in Medical diagnosis. v

Fuzzy Medical knowledge representation deal with the structure used to represent the knowledge provided by the Domain expert. Fuzzy medical expert systems used standard techniques for representing Fuzzy medical knowledge including fuzzy facts and Fuzzy rules.

For instance,

“Patient has Cold” is represented as  
[Cold] Symptom (Patient, Cold)

The Fuzzy position “Patient has Headache” may be modulated as  
[Headache] Symptom (Patient, Headache)

Patient has Cold or cough  
may be represented as

[Cold V coughs] (Symptom (Rma, Cold) V Symptom (Rma, cough))

Some of the Fuzzy Reasoning rules are

$$R1: \frac{[A]R(x) \quad [B](R(x) \text{ or } R(y))}{[A \wedge B]R(y)}$$

$$R2: \frac{[A]R(x) \quad [B](R(x) \text{ or } R(y))}{[A \vee B] R(y)}$$

$$R3: \frac{[A](R(x) \text{ and } R(y)) \quad [B](R(y) \text{ and } R(z))}{[A \wedge B](R(x) \text{ and } R(z))}$$

$$R4: \frac{[A](R(x) \text{ or } R(y)) \quad [B](R(y) \text{ or } R(z))}{[A \vee B](R(x) \text{ or } R(z))}$$

R5: : [A]R(x)  
 if [A]R(x) then [B]R(y)  
 -----  
 [[Ao (A→B)]R(y)]

Patient has more or less Sugar  
 If Patient has Sugar Then Patient is diabetes  
 F1: [more or less Sugar] Symptom (Patient, sugar)  
 F2: If [Sugar] Symptom (Patient, Sugar) Then [Diabetes]  
 Symptom (Patient, Diabetes)  
 From F1 and F2 infer  
 : [more or less Sugar] o [Sugar → Diabetes]  
 FKR is useful for learning fuzzy propositions.

V. HYBRID FUZZY MEDICAL EXPERT SYSTEMS

HFMES is collection of expert system and is combined the solutions of the different type of expert

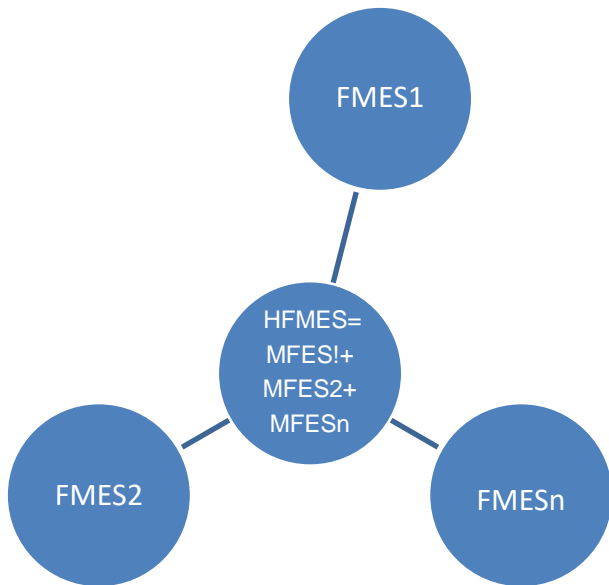


Fig. 4: HFMES

FMES 1 contains  
 Patient has Malaria  
 Patient has Dengue  
 If Malaria-test and Dengue-test then Viral fever  
 F1: [Malaria] lab test (Patient, Malaria)

systems in the cloud environment in which the Fuzzy Medical Expert Systems are to be co-ordinate and co-operated HFMES performs reasoning with the Fuzzy Medical Expert Systems. In the First, the Fuzzy Medical Expert System and Fuzzy modulations are defined for the Fuzzy information. In the Second, if the local Fuzzy Medical Expert System has no sufficient information, it connects to other Fuzzy Medical Expert System for required information. Third, the HFMES is to co-operate and co-ordinate to get the final solution.

FMES is the individual problem solving expert system. It will give individual solution. The HFMES system is shown in Fig.3.

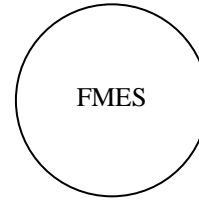


Fig. 3: FMES

Hybrid Fuzzy Medical Expert Systems. is collection of different types of Medical Expert Systems, individual solution will be found and combined for total solution. The HFMES system is shown in Fig.4.

F2: [Dengue] lab test (Patient, Dengue)  
 If [Malaria] lab test (Patient, Malaria) [Dengue] lab test (Patient, Dengue) then [viral-fever] Symptom (Patient, fever)

FMES 2 contains  
 Patient has Cold  
 Patient has Body-ache  
 Patient has Headache  
 Patient has Chills

If Patient has Cold and Patient has Body-ache and Patient has Headache and Patient has Chills then viral fever

[cold] Symptom (Patient, Cold)  
 [body-ache] Symptom (Patient, Body-ache)  
 [headache] Symptom (Patient, Headache)  
 [chills] Symptom (Patient, Chill)  
 Then [very-fever] Symptom (patient, very-fever)  
 If [cold] Symptom (Patient, Cold) ^  
 [body-ache] Symptom (Patient, Body-ache) ^  
 [headache] Symptom (Patient, Headache) ^  
 [chills] Symptom (Patient, Chill)

The two hybrid systems FMES1 and FMES2 may are stored in two different clouds or single cloud. The hybrid systems are combined to give diagnosis FMES1 and FMES 2 = min{FMES1, FMES2}

For example  
 Suppose, the fuzziness is given as  
 Patient has Malaria (0.65)  
 Patient has Dengue (0.7)

The FMSE2 is give by  
 0.65  
 Suppose, the fuzziness is given as  
 Patient has Cold (7.75)  
 Patient has Body-ache (0.7)



Patient has Headache (0.8)  
Patient has Chills (0.85)

The FMSE2 is give by  
0.7

The hybrid expert system by combining is given by  
HFMES=FMES1  $\wedge$  FMES2= 0.65

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# A Cloud Mobile-based Information Retrieval and Optimal Route Service Delivery System for Aiding the Treatment of Diabetic Patients in Nigeria

By Akingbesote Alaba. O.

*Adekunle Ajasin University*

**Abstract-** Diabetes is considered as one of the most incurable diseases in the world. Studies have shown that at least fourteen million, four hundred and six thousand Nigerians are currently living with the incurable disease. Several researchers have proposed the use of mobile technology to aid diabetes treatment, but challenges such as time taken for physicians to attend to patients due to unavailable Information and problems associated with location of hospitals are recurrent. This research approached these challenges by developing a cloud mobile-based Information retrieval and optimal route service delivery system for aiding the treatment of diabetic patients in Nigeria. This was achieved using Java API to run on Android OS. Each user registers and fills necessary information on this application once.

**Keywords:** *cloud, mobile, diabetes, solution, type1. type 2.*

**GJCST-B Classification:** *C.2.4*



ACLOUDMOBILEBASEDINFORMATIONRETRIEVALANDOPTIMALROUTESEVICEDELIVERYSYSTEMFORAIDINGTHETREATMENTOFDIABETICPATIENTSINNIGERIA

*Strictly as per the compliance and regulations of:*



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# A Cloud Mobile-based Information Retrieval and Optimal Route Service Delivery System for Aiding the Treatment of Diabetic Patients in Nigeria

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**Abstract-** Diabetes is considered as one of the most incurable diseases in the world. Studies have shown that at least fourteen million, four hundred and six thousand Nigerians are currently living with the incurable disease. Several researchers have proposed the use of mobile technology to aid diabetes treatment, but challenges such as time taken for physicians to attend to patients due to unavailable Information and problems associated with location of hospitals are recurrent. This research approached these challenges by developing a cloud mobile-based Information retrieval and optimal route service delivery system for aiding the treatment of diabetic patients in Nigeria. This was achieved using Java API to run on Android OS. Each user registers and fills necessary information on this application once. This information is uploaded directly to Alibaba cloud, which serves as the repository. The prototype demonstration of this work was carried out with thirty patients, a total of eighteen physicians across six hospitals designated as A,B,C,D,E and F Cities. Three physicians in each designated hospital attended to 5 patients, and the time taken to attend to each patient using our developed model was recorded and compared with existed method. We adopted the Djisktra algorithm to suggest the shortest distance to a hospital within a patient's vicinity, in case the patient requires emergency treatment. The algorithm made use of six hospitals; A,B,C,D,E and F having 2,4,1,7,3,2,1 and 5 kms as the distances from one location to another on the graph. The developed model recorded an average of 17.802, 17.866, 17.868, 18.268, 17.200, and 19.336 Minutes across the six hospitals, the existing system was also demonstrated using same conditions and an overall average time of 39.66 Minutes was recorded. Based on the six hospitals used in the experiment and with the use of relaxation approach of the Dijkstra algorithm, the result obtained from Source A (Patient) to destination F (Shortest Distance to the patient's location) was 9km. The developed mechanism has proved to achieve success in tackling issues of late response to patients by physician and getting closest hospital with right physician.

**Keywords:** cloud, mobile, diabetes, solution, type1. type 2.

## I. INTRODUCTION

Diabetes is considered as one of the most incurable diseases in the world, and once a patient gets infected, it remains forever [1]. Early

research on diabetes mellitus such as in [2], defined the disease as a genetically determined disorder of metabolism which in its fully developed clinical expression, is characterized by fasting hyperglycemia, atherosclerotic vascular disease, and neuropathy. Studies in [3] showed that in 180 million Nigerians, the estimated occurrence of diabetes is 1% in rural areas, and ranges from 5% to 7% in urban areas. That is; at least fourteen million, four hundred and six thousand (14,406,000) Nigerians are currently living with the incurable disease. The continuous and organized management of the diabetes is the only way to avoid the impact of such incurable disease. Earlier methods of treatment of diabetes was based on paper and pen work. The pictorial evaluation of patients' healthcare was not possible [4]. The past record of patient record is only on the desk of the medical expert who treated the patient. With the introduction of computer in early sixties, most doctors use the desktop to store data or information. This has some shortcomings; one of these is the concept of information sharebility within and outside the medical doctor's domain. Various research works have tried to solve this problem through the use of technology over the physical one on one treatments, see for example [5] and [6].

In [7], the use of web based was introduced. Also, the idea of using mobile health technology for solving diabetes issues was introduced in [8] and [9]. These works serve as the foundation on which other mobile health improvement was built. While these ideas have achieved great success in solving diabetes related issues. However, accessibility of diabetic information by doctors from other domains where such patient is visiting probably for the first time is a challenge. There have been over 180,000 recorded deaths of diabetic patients in Africa where Nigeria tops the list. One basic cause was because they were unable to connect their doctors from remote areas therefore making it difficult to receive treatment as soon as possible due to elongated time taken to attend to patients [10]. For example, if a patient is travelling from Lagos to Kano, and on getting to Abuja the blood sugar increases, He needs to visit any closest diabetic centre within Abuja domain. Getting

*Author:* Adekunle Ajasin University.  
*e-mail:* Akingbesotealaba@aaau.edu.ng

to the hospital the patient information is not there but in Federal Medical Lagos Island where he lives. Therefore, the doctor will need to start all over to get accurate Information that will lead to proper prediction. This may take time and sometime the patient may be unconscious and much information may not be gathered. The second issue is that of getting the optimal route to the closest hospital from the patient position. If a wrong route is taken it may lead to delay and this may lead to death. Therefore, two challenges of timely information availability and optimal route selection problems are the issues this research aim at tackling in the context on Nigeria Mobile health system. To achieve this, the research proposes a cloud mobile-based Information retrieval and optimal route service delivery system for aiding the treatment of diabetic patients in Nigeria. This system will aid the minimization of the time taken by physicians to treat diabetic patients and recommend the shortest route to the available hospital.

The rest of this paper is organized as follows: Section II introduces the literature review. Section III demonstrates the design and the implementation of the system. In section IV the results are discussed and ended with the conclusion in Section V.

## II. LITERATURE REVIEW

Cloud computing is an information technology service model that allows computing services to be provided on-demand to customers over a network in a self-service fashion and independent of devices and location. These services include Software, Infrastructure and a Platform [11]. The main idea of cloud computing is to have rapid and uninterrupted access to various services. With cloud technology, cloud service providers and consumers can interact without necessarily coming into contact [12]. Recently, several services are being deployed in cloud; examples of such services include cloud market, toys, and more importantly health services. The need to deploy health services on the cloud is numerous. The work of [13] highlighted few of the benefits of deploying health services in cloud. Furthermore, in [14], the author emphasized on the effects of deploying severe and chronic health related issues in cloud. Example of such severe health issues is Diabetes mellitus. This is a genetically determined disorder of metabolism which in its fully developed clinical expression is characterized by fasting hyperglycemia, atherosclerotic and micro-angiopathic vascular disease, and neuropathy [2]. However, in [15], the authors defined Diabetes mellitus (DM) as a glucose metabolism disease characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both. Diabetes happens because the body can't use glucose correctly either the pancreas not producing enough insulin or the cells of the body not reacting rightly to the insulin produced.

This disease has three main types; type I, type II and Gestational diabetes [16]. With the evolution of technology, management of diabetes has become easy and uncomplicated. A home blood glucose test was a major leap ahead for diabetics, after the patient tests his blood glucose levels, the management system records and stores the test results and other detailed data like, date and time of tests, the type and dosage of insulin, type of exercise, diet [16]. DM poses a great threat to human health as well as a huge socioeconomic burden for governments. According to the updated data from the international diabetes federation (IDF), the estimated global prevalence of DM reached 8.8% in 2015 and 12% of global health expenditure was due to DM in the same year [1].

Advancement in ICT provides a variety of options for developing hardware and software deployment platforms for new test and sensor technologies. However, many of these products have not been optimized for usability or evaluated for their effectiveness in motivating or changing users' self-management behaviors [17]. For example, The work of [18] and [19] developed new ideas in the area of mobile technology for diabetes management, However, there are few published studies addressing which specific elements of mobile diabetes applications offers the greatest potential to benefit users effectively. Many mobile decision support software apps for smartphones are now available for diabetes and are intended to assist patients to make decisions in real time without having to contact their HCP. For example in Rao *et al.*, (2010), The author reported that they had visited the Apple iTunes store on October 9, 2009, and selected the 12 diabetes apps with the highest ratings. They found that these apps contained 22 types of data management features. The work of [20] identified and reviewed 71 commercial mobile diabetes applications available at the Apple applications store as well as 16 mobile diabetes applications from the medical literature. They found that these applications has incorporated inputted data from up to six monitoring tasks and provided up to seven support tasks. Future mobile decision support applications are expected to also incorporate information guided by global positioning systems, such as where to find nearby healthy restaurant foods. Patients with diabetes can use the information presented by apps to help guide their choices of medication doses, foods, or exercises.

Though ICT has contributed to the positive growth of health care delivery systems in major hospitals in Nigeria, however, most healthcare providers believe that improvement in telecommunication within the hospitals will also improve the quality of healthcare. For example, up to 68% of post-surgical patients have been effectively followed up using their GSM phone contacts [21]. This observation beams a ray of hope as it appears that with increasing availability of mobile



phones and extension of connectivity to the rural areas, the problem of patient follow-up which has been the bane of longitudinal study design in Nigeria may be over soon. The use of telephone to schedule clinic appointments is also emerging, particularly more prominently in University College Hospital, Ibadan (UCH).

In [22], the authors emphasized that People saddled with chronic diseases need recommendations or facts regarding disease management. These include dosage adjustment of medication and other general information that highlights correction of life styles, changes in diet and physical exercise. The ubiquity of mobile phones and its current integration in health care has made it a worthy tool to this effect. The need to evolve from regular GSM call monitoring of sick patients led to e-Health. By definition, e-Health, or digital health, is the use of emerging communication and information technologies, especially the internet, to improve health management [23]. M-Health is a sub segment of e-Health, and it is the use of mobile computing and communication technologies (eg, mobile phones, wearable sensors) for health services and information [24]. Mobile health technology uses techniques and advanced concepts from an array of disciplines, for example, computer science, electrical and biomedical engineering, medicine and health-related sciences [25].

Recently, mobile phone has become the main sources of information for users. In fact, a huge number of applications were developed in different mobile operating systems to respond to the user's requirements [16]. Several applications have been created to manage diabetes. In [25], the authors designed a Framework for a Mobile-Based Alert System for patient Adherence in Nigeria. The system works by sending mobile medical alerts through SMS to patients, prompting them to take their drugs. However, the real life system wasn't implemented. The authors in [13] developed a Mobile Based Patient Compliance System for Chronic illness care in Nigeria. The phone based Patient Compliance System (MPCS) works by reducing the time-consuming and error-prone processes of existing self-regulation practice to facilitate self-reporting, non-compliance detection, and compliance reminder among patients in Nigeria. The work in [26] carried out a study on the effects of Mobile Phone Short Message Service on Antiretroviral Treatment adherence in Kenya. The study showed that several researchers have applied wireless technology in ensuring patient adherence to antiretroviral treatments. In [22], the authors designed and implemented a Voice-based Mobile Prescription Application (VBMOPA) to improve health care services. The application can be accessed anyplace anytime, anywhere through a mobile phone by dialing an appropriate number, this connects users to an e-prescription application that is resident on a web server. This system could lead to costs and life savings

in healthcare centres across the world especially in developing countries where treatment processes are usually cumbersome and paper based. In [27], a system that sends Diabetes Educative materials via Mobile Text Messaging SMS messages to educate parents with Type 1 diabetic children was developed. In Norway, SMS messages were sent to educate parents with Type 1 diabetic children. Wedjat which is a mobile medication reminder and monitoring system was developed in [28]. It is a smart phone application designed to help remind its users to take the correct medication on time and record the in-take schedules for later review by healthcare professionals. Also, In [29], developed a mobile based medicine in-take reminder and monitor system. Research in [30] developed a Wireless Technology for social change was developed. It works by collecting patient information using mobile phones during home based care visits for HIV/AIDS patients. Also, BGluMon (Blood Glucose Monitor) a mobile application that permits the patient to see clearly his/her blood glucose level on daily basis was developed in [31].

The contributions of all these authors is well appreciated; however the shortcomings observed allow the research to contribute. One observation is that most of these works focus on treatment of diabetes without considering the previous Information of patients. However, experience based on past history of patient is the best method to be used or study by medical experts before prescribing any drugs, Sometime there is the need to change patient's drug and this can only be done based on the past history. The second is that of deterring the optimal route based on the current patient's position. Getting the optimal route was never explained by any of these authors. Two things that differentiated this work from others are:

- a) Provisioning of Cloud based Information Retrieval system of every registered diabetic patient to be available anywhere across Nigeria through Alibaba cloud.
- b) Provisioning of optimal route for diabetic patient from its current location to the available hospital where this treatment will take place. This is achieved through the use of Dijkstra Algorithm.

These to the best of the researcher's knowledge is yet to appear in the literature

### III. INFORMATION RETRIEVAL AND OPTIMAL ROUTE SYSTEM (IRORS) DESIGN

The Information Retrieval and Optimal route system is design are in two phases. The first phase is in the Information gathering which has to do with the registration of diabetic Information of patients in any of the 36 states of the Federal and State hospitals across the country in Nigeria. The registration allows patients



with a unique key with biometric proof which serves as the primary key for proper identification and also guide against double registration. This was achieved using Java API to run on Android OS. As soon as the registration is done, the Information is recorded in Alibaba cloud as shown in Fig. 1. Whenever a diabetic's patient has a rise in glucose level such patient can visit any of the available hospital closer to where he or she is positioned. All that the doctor will need is to retrieve the current Information of the patient from the Alibaba cloud for usage. Once the Doctor has finished attending to the patient, then the patient Information is updated and return to the cloud for future use across the states. Apart

from this, other Information were gathered and put in the cloud for patients to and can be retrieved anytime. These includes the:

- Method of diagnosing a patient with Diabetes Miletus
- Information of symptoms associated with Diabetes Miletus
- Information pertaining to the treatment and management of Diabetes Miletus Patient.
- Feeding Plan and type of food a Diabetes Miletus Patient should eat so as to manage his/her health.

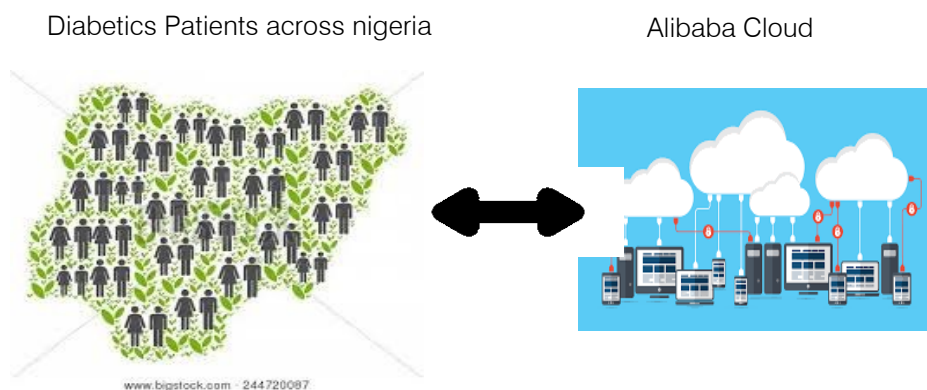


Figure 1: Cloud based Information Retrieval System

On the issue of the optimal route selection, The use of relaxation approach of the Dijkstra algorithm given by  $d[v]=d[u]+c[v]$  was used to get the shortest paths and distance. The full algorithm is in Table 1. The Dijkstra Algorithm used six cities within Abuja as a prototype demonstration. These are A,B,C,,D,E and F

having 2,4,1,7.3.1,2 and 5kms respectively as the distances from one location to another on the graph. This undirected graph is depicted in Figure 2 as a means of recommending the nearest hospital to patient in transit.

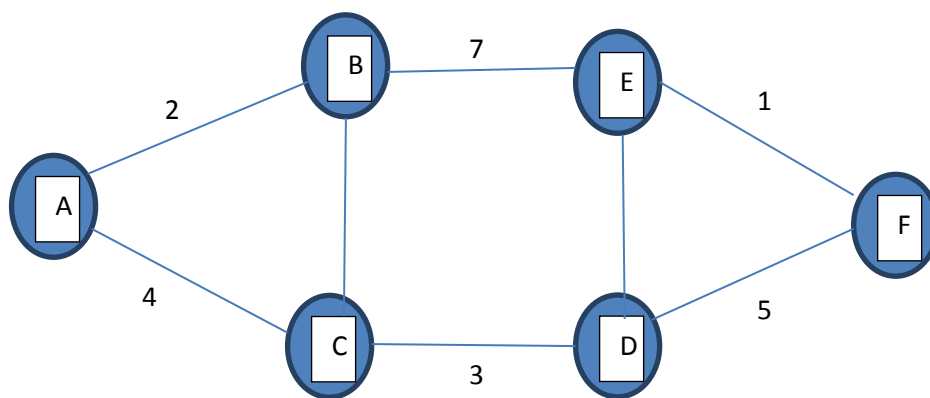


Figure 2: Shortest Path for Patient

Table 1: The Dijkstra Algorithm

<pre> <b>function</b> Dijkstra (Graph, source):   create vertex set Q   <b>for each</b> vertex v in Graph:     dist [v] ← INFINITY     prev [v] ← UNDEFINED     dist [source] ← 0   <b>while</b> Q is not empty:     u ← vertex in Q with min dist [u]   remove u from Q   <b>for each</b> neighbor v of u:     alt ← dist [u] +cost (u, v)     <b>if</b> alt &lt; dist[v]:       dist[v] ← alt       prev[v] ← u   <b>return</b> dist [], prev []         </pre>	<pre> // Initialization // Unknown distance from source to v // Previous node in optimal path from source // Distance from source to source  // Source node will be selected first  // Where v is still in Q  // A shorter path to v has been found         </pre>
---	--

#### IV. RESULTS AND DISCUSSION

Figure 3 shows part of the registration interface phase of diabetic patients during early registration. The results obtained from our experiment are in two phases. The first is into retrieval of Information of patient while the second is into getting the shortest distance and path from source that is, patient's position to destination (shortest hospital route). Table 2 to Table 8 and Figure 3 to Figure 4 attended to the first phase and Table 9

attended to the second phase. The full discussion is given under the discussion section.

#### V. DISCUSSION

The mobile application has a lot of interfaces to aid diabetic patients in their treatment. One of these is the Registration page which is shown in Figure 3. This allows patients to fill their information and register as a new user, all the information is uploaded to the Alibaba cloud.

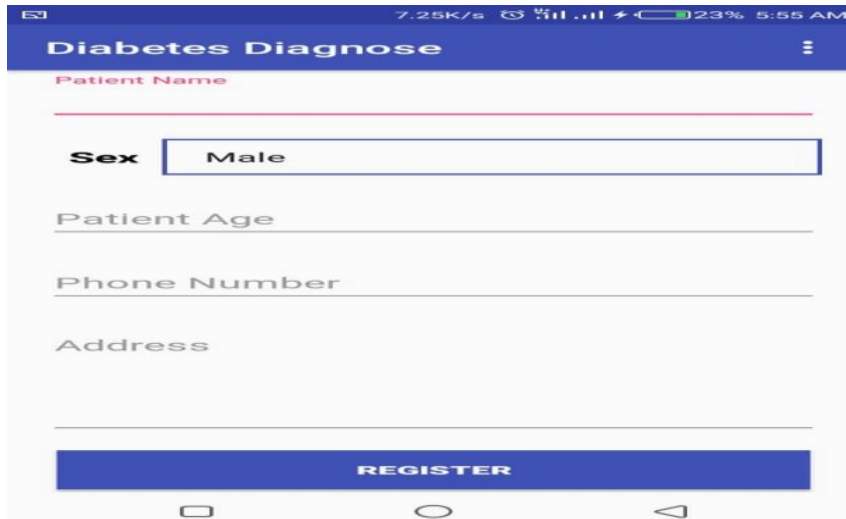


Figure 3: Registration Interface

The developed model was tested with thirty (30) patients with the use of six (6) hospitals designated by A,B,C,D,E and F and eighteen (18) physicians. Five (5) patients were assigned to hospital A, and Physicians A1 – A3 attended to the patients. Physician A1 spent twenty (20) minutes, Physician A2 spent fifteen (15) minutes, and Physician A3 spent eighteen (18) minutes on Patient 1. This is shown in Table 3. The average time spent on the patients was calculated and recorded. This is repeated for Patients 2 – 5.

The entire process was repeated in the other hospitals B, C, D, E and F, and the average time taken to attend to patients in each hospital is calculated and recorded. This is shown in Table 2 to Table 7.

Table 2: Hospital A's READINGS

Patient	Physician A_1	Physician A_2	Physician A_3	Average
1	20	15	18	17.67
2	15	17	22	18.00
3	17	19	23	19.67
4	16	17	17	16.67
5	15	17	19	17.00

Average = 16.60      Average = 17.00      Average = 19.8

Table 3: Hospital B's READINGS

Patient	Physician B_1	Physician B_2	Physician B_3	Average
1	24	12	15	17.00
2	22	17	21	20.00
3	18	24	18	20.00
4	17	18	19	18.00
5	14	13	16	14.33

Average = 19.00      Average = 16.80      Average = 17.80

Table 4: Hospital C's READINGS

PATIENT	PHYSICIAN C 1	PHYSICIAN C 2	PHYSICIAN C 3	AVERAGE
1	19	15	23	19.00
2	17	17	22	18.67
3	19	15	25	19.67
4	18	17	16	17.00
5	16	15	14	15.00

Average = 17.80      Average = 15.80      Average = 20.00

Table 5: Hospital D's Readings

Patient	Physician D_1	Physician D_2	Physician D_3	Average
1	20	15	18	17.67
2	15	17	22	18.00
3	17	19	23	19.67
4	15	19	25	19.67
5	17	16	16	16.33

Average = 16.80      Average = 17.20      Average = 20.80

Table 6: Hospital E's Readings

Patient	Physician E_1	Physician E_2	Physician E_3	Average
1	20	15	18	17.67
2	15	17	22	18.00
3	17	19	20	18.67
4	13	15	18	15.33
5	15	17	17	16.33

Average = 16.00      Average = 16.60      Average = 19.00

Table 7: Hospital F Readings

PATIENT	PHYSICIAN F_1	PHYSICIAN F_2	PHYSICIAN F_3	AVERAGE
1	20	15	18	17.67
2	15	17	22	18.00
3	17	19	23	19.67
4	16	22	24	20.67
5	18	23	21	20.67

Average = 17.2      Average = 19.20      Average = 21.60

The overall reading of the developed model is shown in Figure 3. It shows the average response time recorded in the six (6) hospitals. The existing method was also tested with five (5) patients and three (3) physicians, and the time taken by physicians to attend to the patients is recorded, and the average was

calculated. This is shown in Table 8. The comparison of the average time taken by physician in each hospital to attend to their patients using cloud based system was 18.05 minutes as depicted in Figure. This was compared to the current existing system that recorded 39.66 minutes as shown in Table 8 and Figure 4.

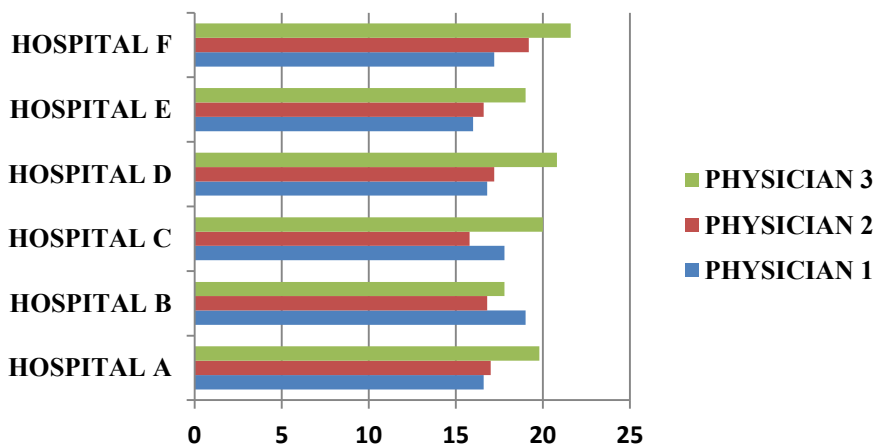


Figure 3: Overall Reading of Cloud Based Model

Table 8: Time taken (Mins.) by Physicians to attends to patients using existing system

Patient	Physician 1	Physician 2	Physician 3	Average
Patient 1	35	39	41	38.33
Patient 2	32	36	37	35.00
Patient 3	40	42	43	41.67
Patient 4	41	45	41	42.33
Patient 5	42	43	38	41.00

Average = 39.66 Minutes

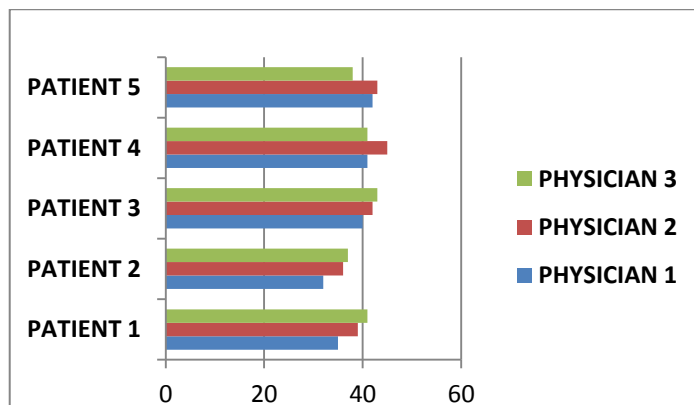


Figure 4: Readings of Existing Model

On the issue of the shortest distance and paths, the source of patient was chosen from location A and the best hospital for the treatment is location F via different paths as depicted in Figure 2 in section three earlier. The result is shown in Table 9, where the initial location was A= 0 and all other locations become ∞. Now the direct paths to A are B and C with C(u,v) to be 2 and 4 respectively. But 2 is less than ∞ and less than 4. Therefore the new d(v) = 2 and is selected. Once it has been selected the next direct paths to B is C and E with C(u,v) to be 1 and 7 respectively. This gives 3 as

the minimum distance as against the former 4 in location C and 9 in E. The minimum out of 4 in C and 9 is selected. The new minimum (d(v) = 4). Once a location has been selected it will not be selected again. This process continues until it reaches F. Based on the Dijkstra Algorithm of Table 1 the minimum distance obtained was 9kms. The shortest path to location F is indicated by the arrow in Table 3.9. This is given as F (9) →(8)→(6)→(3)→(2)→(0) in reserve order. This becomes A→B→C→E→D→F.

Table 9: Shortest Path of Hospitals (A,B,C,D,E and F)

	A	B	C	D	E	F
A	0 ←	∞	∞	∞	∞	∞
B		2 ←	4	∞	∞	∞
C			3 ←	9	∞	∞
E				9	6 ←	∞
D				8 ←		11
F						9 ←

## VI. CONCLUSION

Diabetes is one of the killer diseases in the world. Although this cannot be cured but it can be managed as revealed by scholars. The management of this disease is a function of early retrieval of patient Information when the sugar level rises. This is because

late retrieval of Patients' Information by Doctors may lead to death of such patient. It is also a function of getting the good hospital that will handle the involved patient. In addition, getting the shortest distance from the source (Patient location) to the available hospital is also an important issue to be addressed. This work has

addressed these challenges by designing a cloud mobile-based Information retrieval and optimal route service delivery system for aiding the treatment of diabetic patients in Nigeria. This system will aid the minimization of the time taken by physicians to treat diabetic patients and recommend the shortest route to the available hospital. This was achieved using Java API to run on Android OS. Each user registers and fills necessary information on this application once. This information is uploaded directly to Alibaba cloud, which serves as the repository. The prototype demonstration was carried out with thirty patients with a total of eighteen physicians across six hospitals. Three physicians in each designated hospital attended to 5 patients, and the time taken to attend to each patient using our developed model was recorded and compared with existing method. The Dijkstra algorithm was adopted as the solution to achieve the optimal path problem. The reason for the adoption of this algorithm is based on the fact that it is a one source shortest path algorithm. The algorithm made use of six hospitals; A,B,C,D,E and F having 2,4,1,7,3,2,1 and 5 kms as the distances from one location to another on the graph.

The prototype demonstration recorded an average of 17.802, 17.866, 17.868, 18.268, 17.200, and 19.336 Minutes across the six hospitals, the existing system was also demonstrated using same conditions, and an overall average time of 39.66 Minutes was recorded. Based on the six hospitals within Abuja metropolitan city used in the experiment, and with the use of relaxation approach of the Dijkstra algorithm. The result obtained from Source A (Patient) to destination F (Shortest Distance to the patient's location) was 9km.

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## Survey on Load Balancing in Cloud Computing

By R.Gowri Prakash R. Shankar & S. Duraisamy

*Bharathiar University*

**Abstract-** Cloud computing is a biggest technology. It is different cloud services are SaaS, PaaS, IaaS. Cloud users are able to access software and applications from whenever they need while it is being host by an outside party in cloud. Cloud services are bought on a pay-as-user-go or subscription basis. The cloud users getting into increased day by day. In this paper mainly focused on Load balancing within the cloud computing surroundings has a crucial impact on the performance. Smart load balancing makes cloud computing additional economical and improves user satisfaction. Load balancing may be a pc networking technique to distribute work load across multiple computer or a multiple cluster, networks, links, central processing unit, diskdrive and alternative resources. Aload balancing technique transfer or migrates a task for over loaded machine to below loaded machine while not effecting current user running tasks.

**Keywords:** cloud computing, load balancing, virtual machine, cloudsims.

**GJCST-B Classification:** C.2.4



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# Survey on Load Balancing in Cloud Computing

R.Gowri Prakash<sup>α</sup> R. Shankar<sup>ο</sup> & S. Duraisamy<sup>ρ</sup>

**Abstract-** Cloud computing is a biggest technology. It is different cloud services are SaaS, PaaS, aaS. loud users are able to access software and applications from whenever they need while it is being host by an outside party in cloud. Cloud services are bought on a pay-as-user-go or subscription basis. The cloud users getting into increased day by day. In this paper mainly focused on Load balancing within the cloud computing surroundings has a crucial impact on the performance. Smart load balancing makes cloud computing additional economical and improves user satisfaction. Load balancing may be a pc networking technique to distribute work load across multiple computer or a multiple cluster, networks, links, central processing unit, diskdrive and alternative resources. Aload balancing technique transfer or migrates a task for over loaded machine to below loaded machine while not effecting current user running tasks. In this survey presenting review of various comparisons of algorithm and performance improvement parameters and load balancing methods for cloud computing.

**Keywords:** cloud computing, load balancing, virtual machine, cloudsim.

## 1. INTRODUCTION

Cloud Computing enables cloud customers to enjoy the on-demand high quality applications and services from a centralized pool of configurable computing resources. This new computing model can relieve the difficult of storage management, allow universal data access with independent geographical locations, and avoid capital expenditure on hardware, software, and personnel maintenances, etc. As cloud computing becomes mature, lots of sensitive data is considered to be centralized into the cloud servers, e.g. Personal health records, secret enterprise data, government documents, etc. Cloud Computing has attracted the enormous companies like Google, Microsoft, and Amazon and regarded as a great influence in today's data Technology industry. Business owners are attracted to cloud computing concept because of several features .Cloud computing refers to applications and services that run on a distributed network using virtualized resources and accessed by common internet protocols and networking standards. It is distinguished by the notion that resources square measure virtual and limitless which details of the physical systems on that

**Author α:** Ph. D Research Scholar, Dept. of Computer Science, Chikkanna Government Arts College, Tirupur, Bharathiar University, Coimbatore, Tamilnadu, India. e-mail: prakashcs003@gmail.com

**Author ορ:** Assistant Professors, Dept. of Computer Science, Chikkanna Government Arts College, Tirupur, Bharathiar University, Coimbatore, Tamilnadu, India. e-mails: shankarcgac@gmail.com, sdsamy.s@gmail.com

code runs square measure abstracted from the user. cloud computing using deployment models tells you where the cloud is located and for what purpose. Public, private, community, and hybrid clouds square measure readying models. Service models describe the sort of service that the service supplier is providing. The best-known service models are Software as a Service, Platform as a Service, and Infrastructure as a Service—the SPI model. The service models build on one another and define what a vendor must manage and client's responsibility is.

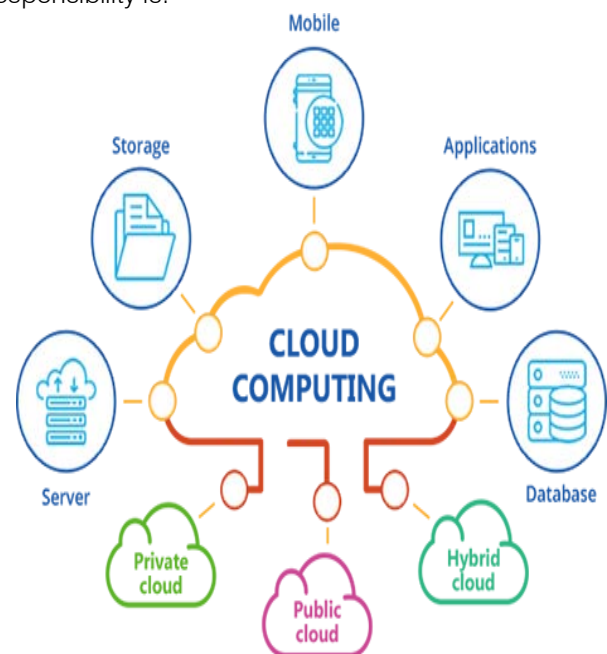


Fig. 1: Cloud computing deployment models

### a) Public cloud

A public cloud is one based on the standard cloud computing model, in which a service provider makes resources, such as virtual machines (VMs), applications or storage, available to the general public over the internet. Public cloud services may be free or offered on a pay-per-usage model [1].

### b) Private cloud

The private cloud infrastructure is operated for the exclusive use of and organization. The cloud may be managed by that organization or a third party. Private clouds maybe either on- or off-premises.[1]

### c) Hybrid cloud

A hybrid cloud combines multiple clouds (private, community of public) where those clouds retain their unique identities, but are bound together as a unit. A hybrid cloud may offer standardized or proprietary

access to data and applications, as well as application portability[3].

d) *Community cloud*

A community cloud in computing is a collaborative effort in which infrastructure is shared between several organizations from a specific community with common concerns (security, compliance, jurisdiction, etc.), whether managed internally or by a third-party and hosted internally or externally [2].

## II. SERVICES OF CLOUD COMPUTING

As a cloud computing has developed different vendors offer cloud that have different services associated with them.

*Software as a Service (SaaS)*: this is the top most layer of the cloud computing stack directly consumed by end user .i.e SaaS.

- ❖ Next generation SaaS promises every things as a services over the internet.

- ❖ Cloud computing started with similar premises.
- ❖ A computing paradigm where there exists a fixable set of computing resources across the internet.[3]

*Platform as a Service (PaaS)*: This provides a service to the user for the layer of package platform. It provides a storage device for the mixed applications and expenditure. User will have associate degree freedom to create their individual applications that gives communications for the user. It presents predefined parts of united OS and also the application server, e.g. LAMP platforms.

*Infrastructure as a Service (IaaS)*: This provides a service to the user for the essential storage and processor infrastructure as a service over the network. For this service user have to be compelled to pay charges, once they use this service over network. During this process the cloud computing give a service over the web, hardware and package in datacenters as a service. The datacenter of hardware and package is termed as Cloud [3].

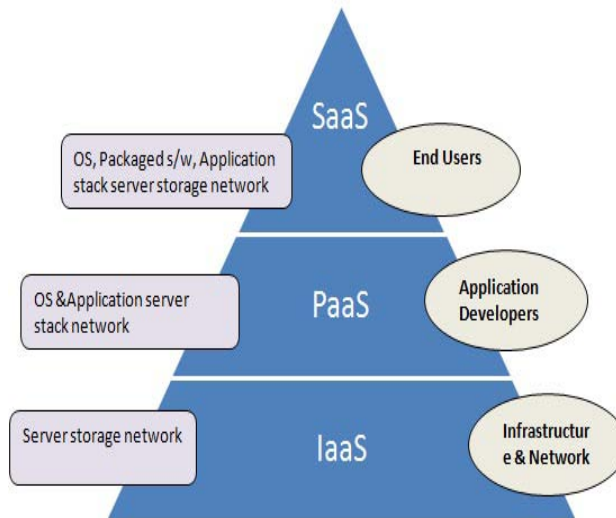


Fig. 2: Services in cloud computing

## III. BENEFITS OF CLOUD COMPUTING

The ultimate aim of cloud computing benefits are [4]:-

*Flexibility*: There is high rate flexibility.

*Speed & Scales*: traditional methods to buy and configure hardware and software are time consuming

*Easier management of data and information*: Since all data are located on centralized location, data are more or organized making it easy to managed.

*Device diversity*: we can access our application and anywhere in the world on any system.

*Increased storage capacity*: increased storage capacity is another benefits cloud computing. as it can store more data as compare to a personal computer.

*Easy to learn and understand*: since people are quite used to cloud application like Gmail, Google docs so anything related to same is most likely to be understood by user.

*Automatic updating*: Its saves companies time and effort to update multiple servers.

*Risk*: Cloud computing services means taking services from remote servers.

*Security*: security and privacy are the biggest concerns about cloud computing.

*Migration Issue:* migration problem is also a big concern about cloud computing.

#### IV. NEED FOR LOAD BALANCING

The fundamental point of load adjusting is to appropriate the traffic among the hub similarly in the group to improve things execution of system.

The point of load adjusting is as per the following:

1. To improve the surety of administrations to the purchaser.
2. To improve the client fulfillment.
3. To expand use of asset.
4. To diminish the execution time and holding up time of undertaking originating from various area [8].
5. To make administration execution better.
6. Keep up bunch steadiness.
7. Assemble a framework that can endure the shortcomings.
8. Accommodate future adjustment.

Load balancing is a technique used to distribute workloads uniformly across servers or other compute resources to optimize network efficiency, reliability and capacity. Load balancing is performed by an appliance - either physical or virtual -- that identifies in real time which server in a pool can best meet a given client request, while ensuring heavy network traffic doesn't unduly overwhelm a single server.

In addition to maximizing network capacity and performance, load balancing provides failover. If one server fails, a load balancer immediately redirects its workloads to a backup server, thus mitigating the impact on end users.

Load balancing is usually categorized as supporting either Layer 4 or Layer 7. Layer 4 load balancers distribute traffic based on transport data, such as IP addresses and Transmission Control Protocol (TCP) port numbers. Layer 7 load-balancing devices make routing decisions based on application-level characteristics that include HTTP header information and the actual contents of the message, such as URLs and cookies. Layer 7 load balancers are more common, but Layer 4 load balancers remain popular, particularly in edge deployments.

#### Goals of Load Balancing

- ✓ Archive optimal resource utilization
- ✓ Maximize throughput
- ✓ Minimize response time
- ✓ Avoid overload
- ✓ Avoid crashing

One of the most normally used applications of load balancing is to be produced one web services from multiple server, generally refer to as server farm. Normally load balanced system widespread website, massive web relay chat network, high band with transfer Protocol sites, Network News Transfer Protocol (NNTP) servers, name System (DNS) servers, and databases[2].

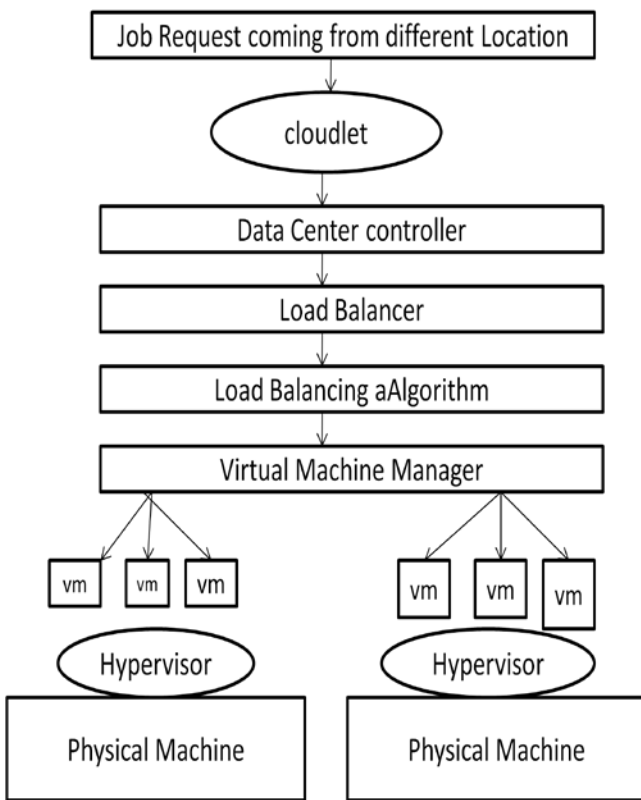


Fig. 3: Structure of cloud computing environment [15]

#### V. LOAD BALANCING IN CLOUD COMPUTING

Load balancing improve the distribution of workload across multiple computing resource for a cluster, network links, control processing unit, disk drive.

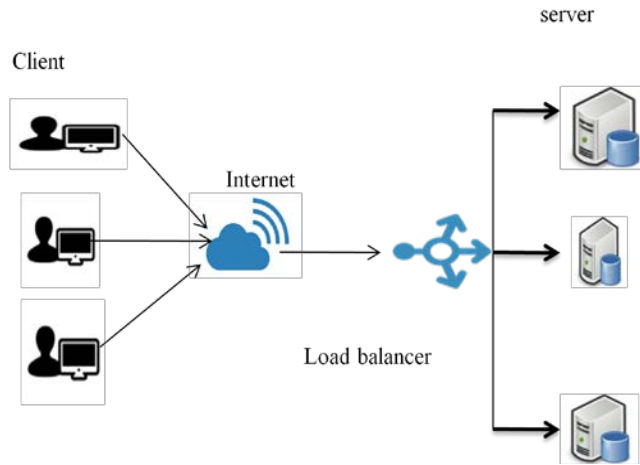


Fig. 4: Client using load balancing in server

Typically a load balancer sits between the client and server accepting incoming network and application traffic and distributing it across multiple backend servers using different algorithms. By leveling application requests across multiple servers, a load balancer reduces individual server load and prevents any one of the application servers from changing into one purpose of failure, therefore rising overall application accessibility and responsiveness. Load balancing algorithms can be categorized mainly into two groups as discussed in the following section.

#### a) Static Algorithms

Static algorithms divide the traffic equally between servers. By this approach, the traffic on the servers will be distributed evenly, and consequently, it will make the situation more imperfect. This algorithm, which divides the traffic equally, is announced as the round robin algorithm. However, there were lots of problems associated with this algorithm. Therefore, weighted round robin was developed to improve the critical issues of round robin. In the weighted round robin algorithm, each server is assigned a weight, and according to the highest weight, they receive more connections. In a situation where all the weights become equal, servers will receive balanced traffic [5].

#### b) Dynamic Algorithms

Dynamic algorithms designate proper weights on servers dynamically by searching the whole network. The lightest server is loaded to balance the traffic. However, selecting an appropriate server needs real-time communication with the networks, which leads to extra traffic added to the system. Dynamic algorithms predicate on queries that are made frequently on servers. However, sometimes prevailing traffic prevents these queries from being answered, and correspondingly, more added overhead can be distinguished on the network [5].

## VI. LOAD BALANCING ALGORITHM IN CLOUD COMPUTING

There are various load balancing algorithms used in cloud computing. In this study, several different algorithms have been studied. The following are:

**Round Robin:** Round Robin is the simplest algorithm that uses the time slicing mechanism. It is one of the static load balancing algorithms. The round robin algorithm is a job allocation method. Here, time is divided into several sectors, and each node is given a specific time quantum interval and quantum node operation [6]. In scheduling, a time quantum plays a very important role, because if the time slice is very large, then the round robin scheduling algorithm is the same as the FCFS planning [6].

The disadvantages of the method is that although the algorithm is very simple, it determines the quantum size, it generates an additional load scheduler. It has higher context switches that increase the turn-around time, and low throughput.

**First Come First Serve:** First come, first served (FCFS) is a working framework procedure planning calculation and a system direction-finding the board instrument that naturally executes lined demands and procedures by the request of their entry. With first come, first served, what starts things out is taken care of first; the following solicitation in line will be executed once the one preceding it is finished. FCFS for parallel handling and is going for the Asset with the littlest holding up line time and is chosen for the approaching job. The Cloud Sim toolbox underpins First Come First Serve (FCFS) planning procedure for interior planning of occupations. Assignment of application-explicit VMs to Hosts in a Cloud-based server farm is the obligation of the virtual machine provisioned part. The default approach

actualized by the VM provisioned is a direct approach that apportions a VM to the Host in First-Come-First-Serve (FCFS) premise. The Inconveniences of FCFS is that it is non preemptive..Its turnaround and reaction is very low[7].

*Opportunistic Load balancing algorithm:* it is also one of the static load balancing algorithm. do not consider the present workload in virtual machine. Usually keeps each and every node busy. In this algorithm in with unexecuted task is quickly and in random order to the current node. Each one task is assigned to the node randomly. Disadvantages of the method is that although the algorithm provides a load balancing schedule bus dose not produce in good result. The task in a slow manner. were the current execution time of the node is not calculated [8].

*Generalized Priority Algorithm:* Client characterize the need as per the client request you need to characterize the parameter of cloudlet like size, memory, data transfer scheduling policy and so on. In the proposed technique, the task are first organized by their size to such a that one having most highest size has highest position.

The key factor for prioritizing task is their size and for Vmis their MIPS. This task performing better than foe FCFS and Round Robin algorithm. The virtual machine is prioritized according to their MIPS values such that one having highest MIPS has highest rank [7].

*Weighted Round Robin Algorithm:* weighted round robin Algorithm consider the resource capabilities of the VMs and assigns higher number of task to the higher capacity VMs based on the weight age given to each of the VMs. But it failed to consider the length of the task to select the appropriate [9].

*Weighted Active Monitoring Load Balancer (AMLB):* The active monitoring load balancer maintain information about every VMs and number of requests currently allocated to which virtual machine. When a allocate new VM arrives it identifies the least loaded VM. If there are more then one, the first identified is selected. Active VM Load balancer return the VM id to the data center controller. The data controller sends the request to virtual machine identified id. Data center controller notifies the new allocation and cloudlet is sent to it. The proposed algorithm to implemented in cloud computing using cloudsim toolkit. In java language. these VMs of different processing tasks and request assigned virtual machine to optimized performance parameters such as response time and data processing time giving an load balancing algorithm in cloud environment[10].

*Global scheduling algorithm:* VM resource scheduling in cloud computing environment in this main advantages

of genetic algorithm. this method according to the historical data and current state compute in the advanced influence it will on the whole system need deploying are arranged physical node and choose solution in which on the system after arrangement . in this way is best load balancing and reduces or avoids dynamic migration hence resolve the problem of load balancing and high migration cost caused by traditional scheduling algorithm. therefore a monitoring and analyzing mechanism is needed to better solve the problem of load balancing. This is also a further research subject [11].

*Min-Min Load balancing algorithm:* Min-Min is a static load adjusting calculation, where the parameters related to the activity are perceived ahead of time. Min\_Min algorithm, the execution and completion time of the unassigned waiting in queue are identified by the cloud manager. The jobs with minimum execution in time are being assigned first to the processors, so that the task is completed in time. But the tasks with maximum execution need to wait for a specific period of time. As such, all the all the tasks in the processor must be updated and the tasks in the queue must be removed. The task with minimum time execution performs better than the maximum time execution. The main disadvantage of this algorithm is that it leads to starvation. The terminology related to static load balancing for Min-Min is [6].

- Excepted Time of Compute (ETC) - The running time excepted for tasks in every one of the hubs are put away in ETC,
- Minimum Execution Time Algorithm (MET) – It secures the best position processor-pair, were current load isn't considered, and
- Minimum Completion Time Algorithm (MCT) – It allots the tasks dependent on the base fruition time.

*Max-Min Load Balancing Algorithm:* Max-Min is same as the Min-Min algorithm, where the maximum time jobs are selected. Only once the minimum time jobs are completed. When the minimum jobs are completed, the tasks that are in the queue are assigned to the processor. Execution time of all tasks is being updated to the processor. Since it is a static algorithm, the time of every task is calculated in advance and performed in a correct manner. An improved version of max-min algorithm was projected in [12].

*Honeybee Foraging Load Balancing Algorithm:* It is one of the dynamic load balancing algorithms, where they are designed based on the behavior of honey bees. Honey bees have been classified into two types. They are: finders and reapers. The finder honeybee helps in finding the honey source. Once honey source is found, they do the waggle dance to indicate the quality and

quantity of available honey. After that, the reapers gather the honey from the sources. Then, again they go for the waggle dance to specify the honey that is left. In load balancing, the servers are combined together as virtual servers, where each and every virtual server has a process queue. It needs to maintain a separate queue for each and every node. Depending on the priority, the task is taken into concern, by removing the task that is waiting in the overloaded machine. The tasks removed are loaded into lightly loaded machine. Those tasks are known as scout bee for the next step [8]. The behavior of honey bee in load balancing technique has stimulated to reduce the response time of virtual machine, which also reduces the waiting time. The main disadvantage of this algorithm is, it does not show any improvement in throughput [8].

**Biased Random Sampling Load Balancing Algorithm:** Biased Random Sampling is a dynamic load balancing algorithm. Here, random sampling method is being used to achieve the load balancing across all the nodes. In this algorithm, all the servers are treated as nodes. This method is represented in the form of virtual graph, constructed with the connectivity which represents the load on each node. Each node is taken as vertex in a directed graph. When a request is received from the client to the load balancer, the load balancer assigns the job to the node that has a minimum of one in-degree. Once a job is assigned to the node, the server starts executing the job, indicating the reduction in availability of free resources. After the completion of the job, the node gets incremented by one in-degree, indicating the increase in available resources. The addition and deletion of such processes are completed by the process of random sampling technique. Threshold value is used as a parameter that considers each and every process by representing the maximum walk length. The traversal is from one node to another node until finding a designation is known as a walk. After receiving the request from the load balancer, it compares the current node to the randomly selected node with the threshold value. If the threshold value is equal or greater than the current walk length, the node executes its job, or else it moves to another neighbor node that is randomly selected. The performance decreases as the number of servers increases [13].

**Ant Colony Optimization Based Load Balancing Algorithm:** This algorithm is designed to seek out the optimal path among the food and colony of ant, based on its actions. The main aim of this approach is to distribute the work load among the nodes in an efficient manner. The regional load balancing node is preferred as head node in Cloud Computing Service Provider. As the request is being sent, the ant starts its first movement from the head node. The ants collect the information from the cloud node and assign the tasks to the

particular node. Once the task is assigned to the head node, the ant moves in a forward direction with the overloaded node to the next node checking whether the node is overloaded or not. During the movement, if it finds any loaded node again it moves in a forward direction, else it finds the overloaded node, it moves in backward direction and replaces were the node found before. Once the job gets successful it is updated, then the result is reported based on the individual result of the ant. After receiving the individual result they are combined together to build the complete report. The solution set is updated automatically, when the ant updates the result for every movement. To prevent backward movement, the ant commits suicide when it reaches the target node [14].

*Throttled Load balancing Algorithm (TLB)*

This algorithm load balancer maintains tables of virtual machine indexes as available are running state (buys). The client server first to make request the data center to find a suitable virtual machine perform the recommended tasks. The data center request a load balancer to distribute virtual machine load balancer scans the index table from available virtual machine index table is scan completed. VMs is found the data center passes request to virtual machine identified in a identifier.

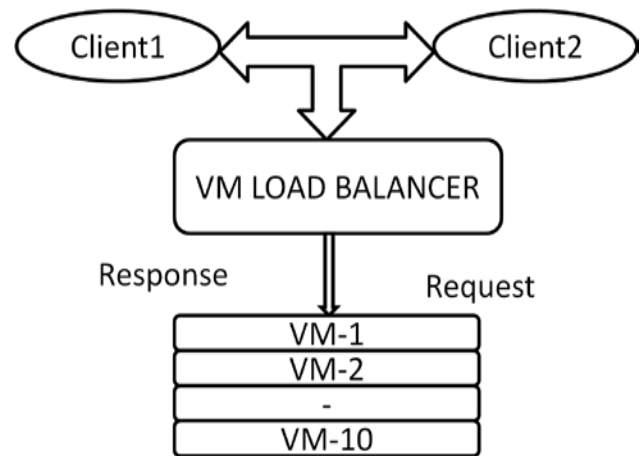


Fig. 5: Throttled Algorithm

Data center confirms the load balancing of the new distribution and data center appropriately revises the index table. When processing a client request, if the corresponding virtual machines not found load balancer returns -1 to the data center. The data center request is processed by the data center [14].

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**Active Clustering load balancing Algorithm:** Active Clustering is an improved method of random sampling. The concept of clustering is used in this algorithm. The main principle of this algorithm is grouping similar nodes together, and working based on those grouped nodes. Grouping of nodes helps the resources to increase the throughput efficiently. In this algorithm, a method called match-maker is introduced [7]. While an execution starts, the first node selects the neighbor node. The neighbor node is taken as match make node, which connects the neighbor node that is same as initial node. At last the match maker node gets disconnected. And this process is done iteratively to balance the load equally. The system performance is improved highly, by increasing the throughput. There is an efficient utilization of resources when there is an increase in throughput.

**Block-based load-balancing algorithm:** Entity Resolution with multiple keys in Map Reduce. Actually, the authors extended the Block Split algorithm presented in Kolb et al. (2011) by considering more than one blocking key. In their algorithm, the load distribution in the Reduce phase is more precise because an entity pair may exist in a block only when the number of common blocking keys between the pair exceeds a certain threshold (i.e., kc). Since an entity may have more than one kc key, it needs to generate all the combinations of kc keys for potential key comparisons. The proposed algorithm features in the combination based blocking and load-balanced matching. Experiments using the well-known Cite Seer X digital library showed that the proposed algorithm was both scalable and efficient.

**Genetic Algorithm:** A genetic algorithm for scheduling and load balancing for static parallel heterogeneous system. Their techniques consider five main factors: Encoding generation of initial populations, fitness function, selection operator and crossover operator.

Each task is considered as a gene. A generation of an initial random population for entry into the first generation was done by the genetic algorithm. Random generator functions of chromosomes are employed. Individual are selected according to their fitness value. Once fitness values have been evaluated for all chromosomes, good chromosomes is selected through rotating roulette wheel strategy. Crossover operator randomly selects two parent chromosomes (chromosomes with higher values have more chance to be selected) and randomly chooses their crossover points, and mates them to produce two child (offspring) chromosomes. However, their approach was able to reduce response time and execution time when compared with LPT, SPT and FIFO algorithms.

Table1: This table find the load balancing techniques

References	System State	Technique	Concept
Babu and Krishna(2013)	Dynamic	Honey bee behavior–inspired load balancing	Use of foraging behavior of bees
Arab and Sharifi (2014)	Dynamic	Resource discovery and load-balancing combination	Increase scalability by Communication between the resource and load
(Wang et al. 2015)	Dynamic	Workload balancing and Resource management framework for Swift Storage	Live VM Migration
Chien et al. (2016)	Dynamic	Using estimation method of job finish time	Load balancing VMs using end of service time
Bala and Chana (2016)	Dynamic	Predictive load-balancing approach using machine learning	Identifying overloaded and under loaded machine using machine learning
Ghoneem and Kulkarni (2017)	Dynamic	Modified active VM load-balancing technique	Use of reservation table for uniform allocation of requests.



Summary of Task-Based Load-Balancing Techniques			
Ramezani et al. (2014)	Dynamic	Task-based system load-balancing method using particle swarm optimization	Live VM migration
Wu et al. (2016)	Dynamic	Genetic-ant colony hybrid algorithm for task scheduling	Combine features of genetic and ant colony optimization technique Genetic search for available resources and ant colony selects optimal solution for execution
Shen et al. (2016)	Dynamic	Considering network topology and transmission time in scheduling	Implementing task scheduling on Map Reduce to minimize data transmission time
Elmougy et al. (2017)	Dynamic	A hybrid task scheduling algorithm based on shortest job and round robin with dynamic task quantum	Storing short and long tasks in separate ready queues and executing separately to minimize starvation

Table 2: An overview of application oriented load balancing

Wei et al.(2015)	Dynamic	Designing a mobile cloud model with efficient application processing	Efficient exploiting of idle computing, storage and sensing capability of mobile device
2013 Deye et al. (2013)	Dynamic	Limiting the number of requests through load balancer at a given time	Making load balancing more Dynamic. Mitigating the effects of interference of sharing resources
2013 Wei et al. (2013)	Dynamic	Verifying the definitions of mobile cloud computing Providing a Bio-inspired application scheduling algorithm	Reducing response latency Maximizing the profit Improving utilization.
2012 Sarood et al. (2012)	Dynamic	Using a message driven adaptive runtime system	Load balancing for tightly coupled parallel application

From table1 and table2 the various nature various load balancing techniques and the timeline are mentioned in a clear manner. This is very helpful to the researchers.

### VII. CONCLUSION

The performance of the various load balancing algorithms are studied this paper. Load balancing is an important technique for improving distributed system performance by considering the group of hosts in the system to share their workloads. This results in a better utilization of hosts resources, a high system throughput and quick response time of user requests. In load sharing, the incoming client requests are evenly distributed among the participating hosts. Load balancing is a basic errand in cloud computing condition to accomplish greatest usages of assets. In this various proposed algorithm are numerous performance to study parameters in cpu cost, memory cost, configuration time and distance cost.

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## An Era of Cloud ERP: Significant Differentiation with Premise ERP

By Yash Savla & Prof. Prathamesh P.Churi

*Abstract-* This paper is the outcome of research in ERP solutions. It talks about how changing in technology is affecting the overall growth of IT industry specifically ERP solution providers. It also gives insight on how different types of organizations are adapting to the change in technology for their betterment. The insights are based on the thorough analysis of the past and current situation in the ERP market. It tries to differentiate cloud and on-premise ERP solution on various parameters. This document also gives the answer to the future of this market segment.

*Index-terms:* cloud ERP, premise ERP.

*GJCST-B Classification:* C.2.m



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# An Era of Cloud ERP: Significant Differentiation with Premise ERP

Yash Savla <sup>α</sup> & Prof. Prathamesh P.Churi <sup>σ</sup>

**Abstract-** This paper is the outcome of research in ERP solutions. It talks about how changing in technology is affecting the overall growth of IT industry specifically ERP solution providers. It also gives insight on how different types of organizations are adapting to the change in technology for their betterment. The insights are based on the thorough analysis of the past and current situation in the ERP market. It tries to differentiate cloud and on-premise ERP solution on various parameters. This document also gives the answer to the future of this market segment.

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## I. INTRODUCTION

The birth of Cloud Computing opened up many doors for businesses to cut their cost in investing for computing resources. Cloud industry has grown remarkably since then worldwide Public IT Cloud Service Revenue in 2018 is predicted to be \$127B [1]. So the question is whether this transformation of moving ERP from the Organization's premise to the Cloud sustain or not.

## II. THE CURRENT SCENARIO

There is a race among companies to move to cloud and why not, it has been providing great results. Now as there is increase in potential customers, the Cloud ERP providers are also increasing. This situation is similar to current E-commerce industry wherein with the increase of internet users there has been an increase in terms of the number of players in the market. We are moving to perfect competition kind of a market. In 2015 the investment in On-premise ERP declined over 30%. This speaks volumes of what the current scenario is and where the future is heading. Customer satisfaction becoming the main goal of most of the companies there is a need to make the process of production to delivery more and more quick. Current

On-premise solutions are not helping this cause. Thus companies are reaching out to specialized ERP providers. Finance, Accounting, Sales, Production are major areas where companies are looking for cloud ERP's[2].

## III. SME'S PERSPECTIVE

Small and medium sized enterprises (SME's) are gaining most out of Cloud ERP. First and foremost they don't have enough capital to invest in On-premise ERP because they themselves are not sure about their existence. They are more focused on their core business processes. In the beginning cloud providers believed their market was large enterprises (LE's) but most of the LE's had enough money and support staff to maintain On Premise ERP they never looked for other solutions. Moreover LE's were not ready to have their data on the third party's premises. This led to realization of ERP providers to focus on SME's. Considering Indian market, with Startup India program lots of SME's have developed. This will just cause an increase in demand for cloud ERP solutions. Almost 60% of Indian SME's have already implemented Cloud ERP and market is only growing. Thus Cloud ERP is expected to grow in SME's segment [3].

## IV. LONG TERM VIEW

Microsoft scaled up its R&D in cloud and spent 90% of R&D budget on cloud research in the year 2011. Microsoft has always been a company which has an eye on the future and keeps on innovating. This trend kept on following and they became 4th largest company to spend on cloud. Google and Amazon followed the footsteps of Microsoft and they also came up in the rankings in terms of spending on R&D in the field of cloud. Following is a table which shows the ranking of these top cloud provider companies [4].

Table 1: Ranking in Terms of Spending on R & D in Cloud

Year	Microsoft	Google	Amazon
2013	5	12	22
2014	4	9	14
2015	4	6	7

Author <sup>α</sup>: Prin L. N Welingkar of Management Development and Research, Bengaluru, India. e-mail: yash.savla.we@gmail.com

Author <sup>σ</sup>: Computer Engineering, SVKM's NMIMS Mukesh Patel School of Technology Management and Engineering, Mumbai, India. e-mail: Prathamesh.churi@nmims.edu

Now this spending is for a reason, they see a huge opportunity in terms of business. This rise in the market of cloud services is also observed by other major companies and they are also trying to catch the same train which

Microsoft did. This situation will prove to be a sea of opportunity for other player wanting to enter the cloud market [5].

## V. DECLINE OF ON-PREMISE ERP

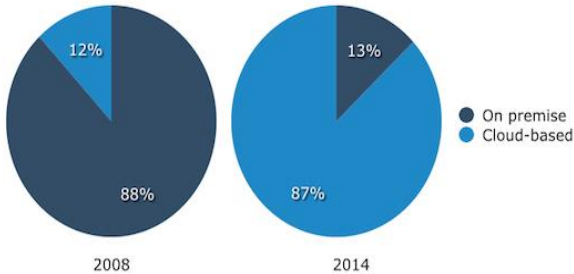


Figure 1: Decline of On-Premise ERP

According to Softwareadvice.com there has been a considerable change in deployment preference of various ERP solutions. Organizations are willing to deploy cloud based ERP solutions. There has been a great decline in demand for on-premise ERP solutions. This change has occurred within the gap of four years. This trend will sustain for coming years. This decline is mainly because organizations preferring cloud solutions over on-premise solutions. There is also lack of innovation in the field of on-premise solutions

## VI. THE CONCERN

History says no change in IT has been smooth every new technology or concept has its own ups and downs. So what is the concern with cloud ERP? Well the concern with cloud ERP is the Security. As stated earlier LE's were concerned about their data going to the third party, because of this reason cloud ERP was not successful in that segment of the industry. SME's a small scale industries they are not much worried about their data but what if any one of it becomes a big company? Will it trust the cloud ERP vendor? These questions will be answered in the coming future. But there is a huge speculation that security concerns may hamper the growth of Cloud ERP providers.

## VII. THE FUTURE

As the cloud ERP market takes its steps towards Perfect competition market, the only beneficiary from this kind of situation will be the customers. The law of demand and price in perfect competition says that as the demand curve would be elastic. Customers would have many options to choose from and the ERP

providers would fight for the market share. Now the fight for the market share would be based on price of the ERP solution unless some provider comes up with a ERP solution which has some unique feature. Now this will only disrupt the market and small players in the market would merge or get acquired by the big players in the ERP industry. The same story will repeat as in the case of current E-commerce industry where small players are being acquired by companies like flipkart and amazon. The LE's will not be affected by this change caused in ERP industry because they will keep using their On-premise ERP.

## VIII. CONCLUSION

SME's are the major contributors to cloud ERP and will continue to be the same. The only difference is now they have less choice while in future they will dictate terms and they will be the price makers. The growth of cloud ERP will depend on how Start-ups and other SME's grow further. The economic situation of the world will also play an important role. With Cloud ERP provider there is a need to innovate and attract customers towards them to increase the market share. On premise ERP will not become extinct LE's will be their biggest market.

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# Improved Hybrid Algorithm Approach based Load Balancing Technique in Cloud Computing

By Srinivasa Rao Gundu & T. Anuradha

*Dravidian University Kuppam*

**Abstract-** The routine life of modern citizens is completely dominated by the computer aided services. The computer aided services depends on information and communication technologies. The success behind this cloud computing are data centers with virtualization technology equipped with fastest internet and the wide acceptance of the users due to its affordable price to the common people. Effective services can be provided to the end user only when proper scheduling of tasks are done in peak hours when heterogeneous collection of requests are coming to the data center. The load is balanced in such situations, to attain equilibrium position in load. It is a difficult task to balance the load. Load can be balanced using either by software or hardware.

**Keywords:** *cloud computing, cpu, latency, performance, software, networking, load, load balancing.*

**GJCST-B Classification:** *C.2.4*



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# Improved Hybrid Algorithm Approach based Load Balancing Technique in Cloud Computing

Srinivasa Rao Gundu <sup>α</sup> & T. Anuradha <sup>σ</sup>

**Abstract-** The routine life of modern citizens is completely dominated by the computer aided services. The computer aided services depends on information and communication technologies. The success behind this cloud computing are data centers with virtualization technology equipped with fastest internet and the wide acceptance of the users due to its affordable price to the common people. Effective services can be provided to the end user only when proper scheduling of tasks are done in peak hours when heterogeneous collection of requests are coming to the data center. The load is balanced in such situations, to attain equilibrium position in load. It is a difficult task to balance the load. Load can be balanced using either by software or hardware. In software approach algorithm based load balancing makes us to achieve the better results. Hybrid approach in algorithm is a combination of more than one algorithm. RTEA Hybrid algorithm has shown better results in the considered parameters of makespan, waiting time, and burst time.

**Keywords:** cloud computing, cpu, latency, performance, software, networking, load, load balancing.

## I. INTRODUCTION

The cloud computing is a specialized environment with a huge collection of computer systems which are connected to internet with either public or private networks. This cloud computing environment provides facility to the end user on demand. This technology has reduced the price to acquire the different softwares, operating systems, and tools which were only available to the larger companies upon huge investments. These services are available on demand [1] and the services are metered and the user needs to pay only for the services are used. It is one or other way to customized usage of information technologies. Cloud computing is a collection of heterogeneous services under a single umbrella of cloud service provider. Therefore in many cases we do not need to install or acquire new devices to have some specialized services by the cloud computing service providers such as, Google provides its several type of services to the end users such as Gmail, Google docs, Google maps etc. Microsoft Company is also providing the services such as Microsoft Office 365 and Microsoft azure to the end users. Sales force, Amazon is also providing the services to its consumers with the user needed services.

**Author α:** Ph. D. Research Scholar, Department of Computer Science, Dravidian University Kuppam, A.P. (India).  
e-mail: srinivasarao.gundu@gmail.com

**Author σ:** Professor, Department of Computer Science, Dravidian University Kuppam, A.P. (India). e-mail: rajamaata@yahoo.co.in

The cloud computing services are provided on demand and as per the user requirements. This process does not need to be done by somebody manually perhaps automatically which is called as software automation process. This type of dynamic provisioning provides not only increased service capacity but also provides reliability, security and privacy. The cloud services can be had using any one of the devices using such as personal computers, mobiles etc using any type of network access.

## II. COMPUTING AT DATA CENTRE LEVEL

The data centre and cloud architectures [4] are keeping on advancing, to address the requirements of expansive scale multi server farms in clouds. These requirements are revolved around seven measurements called (i) scalability, (ii) storage, (iv) bandwidth, (v) speed in network services, (vi) efficiency in memory utilization, (vii) agility in service creation, (viii) cost productivity.

## III. REVIEW OF RELATED LITERATURE

1. T. Kokila vani has proposed Load Balanced Min Min scheduling set of rules [5] which produces higher effects than minmin scheduling set of rules. It reduced the make span and attained improvement.
2. Jens Buysse et al. described a new method to minimize [6] the power intake. This routing and scheduling algorithm selects unused nodes and turns off those nodes. In step one, it chooses the special nodes and which are marked as the destination nodes. In the second step, it decides the unicast route to a particular destination to supply. The results illustrated the power consumption reducing by 50% lesser in comparison with other standard scheduling and routing algorithms.
3. Wanneng Shu et al. Proposed a new type of power effective algorithm in which the resources [7] are allocated in a cloud computing environment. The CloudSim device kit is used to study the performance of the set of rules. Time, cost and energy intake are used as the parameters in this set of rules. The response time and make span has drastically reduced.
4. M. Hemamalini, M. V. Srinath, et al carried out their stud on a heuristic set of rules for data placement. In this study, the heuristic method focuses [8] on



the node scheduling which is used to reduce the energy consumption in the cloud. This study has accommodated the maximum data on the minimum quantity of nodes. It has used the greedy approach for this process. The algorithm is implemented with the use of Cloud Sim.

5. Ms. Nitika, Ms. Shaveta, Mr. Gaurav Raj carried their research on Equally Spread Current Execution Algorithm. In this study, the set of rules are used to handle the system with priorities and it has distributed the burden randomly [9]. This distribution is done with the help of a parameter scale. This process transfers the load to the lightly loaded digital gadget or handles that venture and takes much less time. It is observed by the researchers that it provides the maximize throughput. This set of rules makes use of the spread spectrum method to balance the weight of the task considering into more than one virtual machines.
6. Bhuvnesh Pathania et al. proved the performance of his proposed approach which has reduced the electricity consumption. In this approach virtual machines are loaded with variable load [10]. This load is balanced in the grid clusters which are enough to manipulate the required Quality grade.
7. Jianfeng Zhao and Hongze Qiu et al. provided their research related information with the help of a replication approach to achieve many unique possibilities, such as lowering the system running time and power consumption. The algorithm has [11] employed genetic protocol and used ant colony optimization technique.
8. Javid Taheri et al. has worked on match making scheduling segment and offered algorithms to lessen the make span for executing all jobs and their transfer time [12]. It used two distinct set of rules for scheduling the activity to mirror the information fields to the linked nodes.
9. Fabrizio Ferrandi et al. has offered a new method on ant colony optimization technique. This technique efficiently solves the problems which encounter in multiple scheduling [13]. It reduces the overall execution time. It gives mapping of undertaking and gives a message.
10. A. P. Nirmala, Dr. S. Veni, et al. Proposed a new hybrid scheduling mechanism and a step rescheduling approach. In this mechanism, suitable resources are decided based on the availability [14]. All scheduling activities are done with the help of dynamically allocated resources.
11. Poonam Singh, Maitreyee Dutta, and Naveen Aggarwal et al. has made a proposal of new algorithm for optimizing the make span and the reliability of workflow scheduling in cloud systems. This technique uses the nearby search or shortest path for designing [15] a new type of and quicker

heuristic method. This method tried to solve the hassle of mapping independent scheduling to a virtual machine.

#### IV. SCHEDULING

Generally, scheduling [16] is a term used for a set of rules that will govern the order by the execution of a particular process. Here the process is a word used for an executable programming part. A process execution will undergo in the computer system such as a CPU (central processing unit) burst followed by an IO (input output) burst again a CPU (central processing unit) burst followed by an IO (input output) burst and so on. 'Burst' is an action with as fast as possible highest speed and continued action. Scheduling is an important property of an operating system. Scheduling process can be looked as 'Service request scheduling' and 'Resource response scheduling'. Generally, service request scheduling occurs due to (i) When the user submits his or her request to the service provider (ii) Service provider executes the request (iii) Processing the request in the service request architecture (iv) Dynamic virtual machine generation and dispatch at the provider site. A computer system needs scheduling before use; CPU (central processing unit) is one of the most critical parts in the computer. Multiprogramming is one of the basic and important scheduling techniques. Generally CPU (central processing unit) scheduling is done in such a way as to keep it busy as much as possible. There are two issues (i). Jobs must be smaller so that they could receive large fraction of number of processors they requested. (ii). Execution efficiency of smaller jobs may be low.

#### V. VIRTUALIZATION

In cloud computing, virtualization [17] is a key idea. Virtualization improves the effectiveness of computing resources utilization and additionally the dynamic resource provisioning capacities in a cloud. The virtual machine, whose associated necessities cannot be domestically fulfilled, are selected for migration. This set of rules searches the maximum loaded virtual machines and allocate the load in an effective manner. Virtualization provides the applications to migrate from one server to another. This migration is possible dynamically, which means there is no need to make the server down, and the workload can be easily managed.

#### VI. LOAD BALANCING

The main objective of load balancing [18] in a computing environment is to guarantee that no single system is overloaded with tasks, while the other physical node is left idle. The key criteria for a good load balancer are to maintain a balanced state of workload among the actively participating computational nodes.

Apart from the central task of load balancing, scheduled jobs, it also focuses on maximizing the throughput, minimizing the response time and better resource utilization. A cloud load balancer should have the characteristics in such a way that the cloud service providers will not be overloaded with the set of requests.

## VII. INTERNAL WORKING MECHANISM OF HYBRID ALGORITHMS

The algorithm is a step by step method with a set of rules that can provide solutions within a finite number of steps. A hybrid algorithm [19] is a combination of two or more algorithms. Before a user sends a 'request' to the load balancer, it resolves the load balancer's domain name using a domain name server (DNS). Domain name server returns one or more internet protocol addresses (IP address) to the client machine. With network load balancers, load balancing creates a network interface for each available virtual machines list which is either busy or idle. Each load balancer node in this virtual machine list uses this network interface to get a static internet protocol address (static IP Address). It can be optionally associated one internet protocol address with each network interface when it creates the load balancer. As traffic to the application changes over time, load balancing scales the load balancer and updates the DNS entry. Here one important aspect is that domain name server entry specifies the TTL (Time to live) as sixty seconds. TTL makes the internet protocol address can be re mapped quickly in response to change the traffic. The client machine determines which internet protocol address need to use for sending the requests to the load balancer. Load balancer node requests the server. Load balancer node selects a virtual machine which can handle the request. Now the load balancer node sends the request to the target using its private internet protocol address (Private IP Address). When a load balancer accepts incoming traffic from the client and routes the requests to its virtual machine pool. The load balancer also checks whether the virtual machine is either idle or busy and ensures that it routes the traffic only to the virtual machines which are capable to handle. If it is being used equally spread current execution algorithm, for example, it is cross zone load balancing. In this load balancing, the nodes of the load balancer would distribute the requests regardless of the availability of virtual machines and distributes the traffic evenly across all the virtual machines in the pool of virtual machines. With the application of load balancer, the load balancer node receives the request and evaluates the priority order to determine which rule to apply and then selects a virtual machine from the pool of virtual machines for the rule action using the routing algorithm. Routing is performed independently for each one of the virtual machines in the virtual machine pool,

even though when the virtual machine is assigned to the pool of virtual machines. With network load balancers the load balancer node receives the connection to select the virtual machine from the virtual machine pool for the default rule using a flow hash algorithm. Based on the protocol, source internet protocol address (Source IP Address), source port, destination internet protocol address (Destination IP Address), destination port and transmission control protocol sequence number, select the virtual machine. The transmission control protocol (TCP) connections from a client have different source ports and sequence numbers and can be routed to a different virtual machine. Each individual transmission control protocol connection is routed to a single virtual machine.

## VIII. LOAD BALANCING PARAMETERS FOCUSED

1. *Make Span*: is also called as job completion time. It should be less than response time. Job completion time = Response time - Waiting time which are measured in nano seconds
2. *Waiting time*: is the time difference between turnaround time and burst time. Waiting time = Turnaround time - Burst time which are measured in nano seconds
3. *Burst time*: is the Time required by a process for CPU execution Burst time = Turn Around Time - Waiting time which are measured in nano seconds

## IX. IMPLEMENTATIONAL DETAILS

Technologies used in this tool are (i). Java programming language, (ii) Java Swing, (iii) Cloud sim (iv) Simjava, (v) Operating system are Windows Xpor Windows7, (vi) IDE: Eclipse, (vii) JDK 1.8 and above. It is aimed to investigate and simulate the large scale internet applications in the cloud environment. Most of the internet applications depend upon many parameters and most of the time the values for those parameters need to be assumed. Therefore it is important to change those parameters and repeat the simulations.

*Round Robin Algorithm*: Round robin is the easiest algorithm used for the logic division of time and nodes. In this algorithm, the overall time is partitioned into the number of segments, and each node in the system is allocated a with a particular time segment or time period.

*Inputs*: Virtual machine image size 10000 (Image size is operating system, application, data to be installed on multiple virtual machines- Usually it is tested for security, reliability and has the best tested configuration), Virtual machine memory - 1024 Mb, Virtual machine bandwidth -1000, Virtual machine operating system- Linux, Virtual machine manager - Xen, RAM – 204800 Mb, Storage

space – 100TB, Bandwidth - 10,0000 ,VM scheduling policy - Time shared policy 4 1000 MIPS., Data Centre Configuration ,Data Centre Architecture – X86, Data Centre Operating System – Linux, Data Centre virtual machine manager – Xen, Number of machines in the data centre – 20, Memory per machine in data centre – 2048 Mb, Storage per machine in data centre–100000 Mb, Available band width per machine in data centre – 10000, Number of processors per machine in data centre – 4, Processor speed in data centre –100 MIPS, Virtual machine policy in data centre – Time shared policy, User grouping factor in data centre –1000, Request grouping factor in data centre–100, Executable instruction length in data centre– 250.

*Results obtained on round robin algorithm:* The results obtained in round robin algorithm as given below in table 1. Here the Average response time in nano seconds of time.

**Table 1:** Result obtained on round robin algorithm

	RR
Makespan	300.37
Waiting time	0.04
Burst time	0.25

*Demerits of round robin algorithm:* (i) Clients have to wait in the waiting queue un till and un less the suitable virtual machine is available (ii) The additional load on the scheduler to decide the size of quantum.

**a) Throttled algorithm and its features**

(i). It is a static algorithm or static scheduling algorithm, (ii). It is a virtual machine based algorithm, (iii).Throttled virtual machine load balancer keeps a list of virtual machines and their status whether they are busy or idling when the user cloudlet request comes assigns to a proper virtual machine and lets the work to be done.

*Inputs:* In case of inputs, same virtual machine configuration and data centre configurations need to give in order to get proper evaluation of throttled algorithm.

**b) Results obtained on Throttled algorithm**

Throttled algorithm results are as given below in Table 2. The values stated here are taken on average and measured in nano seconds.

**Table 2:** Result obtained on Throttled Algorithm

	Throttled
Makespan	300.38
Waiting time	0.03
Burst time	0.25

*Demerits of throttled algorithm:* It works properly only if all virtual machines in data centre have the same hardware configuration. Therefore there is a need to improvement. Hybrid approach can be used to improve

this algorithm. Modifications in the algorithm would bring flexibility.

*Combination of round robin and throttled algorithm:* As since cloud computing needs heterogeneous nature of virtual machines, throttled algorithm does not support. Round robin algorithm can be combined with throttled algorithm in a hybrid approach.

*Inputs:* In case of inputs, same virtual machine configuration and data centre configurations need to give in order to get proper evaluation of RTH algorithm.

*Results obtained from the execution of RTH algorithm:* RTH algorithm results are as given below in Table 3. The values stated here are taken on average and measured in nano seconds.

**Table 3:** Result obtained from the execution of RTH algorithm

	RTH
Makespan	300.34
Waiting time	0.02
Burst time	0.24

*RTH algorithm comparison with round robin and throttled algorithm:* RTH algorithm comparison with round robin and Throttled algorithms results are as given below in Table 4. The values stated here are taken on average and measured in nano seconds.

**Table 4:** RTH algorithm in comparison with Round Robin and Throttled Algorithms

	RR	Throttled	RTH
Makespan	300.37	300.38	300.34
Waiting time	0.04	0.03	0.02
Burst time	0.25	0.25	0.24

*Advantages of RTH Algorithm:* A slight improvement is observed in makespan waiting time and burst time.

*Problem statement:* It is observed that it requires all virtual machines configuration to be the same then only it is showing better performance. In other words, updating the index table is getting delayed in providing the response to the arrived requests.

*ESCE algorithm:* It is based on the spread spectrum method. In this method, the load balancer monitors the scheduled jobs. Equally Spread Current Execution load balancer puts all the tasks in the job pool and assigns them to the virtual machine. As the load balancer monitors the Scheduled Jobs, balancer keeps track of job's which are in the queue frequently.

*Inputs:* In case of inputs, same virtual machine configuration and data centre configurations need to give in order to get proper evaluation of equally spread current execution algorithm.

*ESCE algorithm simulation result:* Equally spread current execution algorithm simulation result table would look like as given below in Table 5.

**Table 5:** Equally Spread Current Execution (ESCE) Algorithm Simulation Result

	ESCE
Makespan	300.38
Waiting time	0.03
Burst time	0.26

*Problem with ESCE algorithm:* There is a computational overhead to scan the Queue again and again RTH, ESCE algorithm comparison table is given below in Table 6. The values stated here are taken on average and measured in nano seconds.

**Table 6:** RTH Algorithm and Equally Spread Current Execution(ESCE) Algorithm Comparison

RR	Throttled	RTH	ESCE
Makespan	300.37	300.38	300.34
Waiting time	0.04	0.03	0.02
Burst time	0.25	0.25	0.24

*Combination of RTH and ESCE algorithms:* To improve RTH algorithm, Equally spread current execution algorithm can be combined with hybridization concept.

*Results obtained from the execution of RETH*

*Algorithm:* RTH algorithm results are as given below in Table 7. The values stated here are taken on average and measured in nano seconds.

**Table 7:** Result obtained from the execution of RTH algorithm

	RTH
Makespan	300.34
Waiting time	0.02
Burst time	0.24

*RTH Algorithm in comparison with earlier Algorithms:* RTH Algorithm in comparison with earlier algorithm table are look like as given below in Table 7. The values stated here are taken on average and measured in nano seconds.

**Table 7:** RTH Algorithm in comparison with Earlier Algorithms

RR	Throttled	RTH	ESCE	RTH
Makespan	300.37	300.38	300.34	295.35
Waiting time	0.04	0.03	0.02	0.02
Burst time	0.25	0.25	0.24	0.24

*Advantages of new RTH Algorithm:* A slight improvement is observed in makespan waiting time and burst time.

*Disadvantages of new RTH Algorithm:* It is observed that updating the index table is getting overhead.

*Search for a new algorithm for the betterment in RTH Algorithm:* The main drawback of RTH Algorithm is updating in the table is getting overhead. There is a need to improve in this algorithm.

*Artificial bee colony optimization Algorithm:* Karaboga, proposed a foraging behaviour of honey bee swarm in 2005. Artificial Bee Colony Optimization technique was inspired by the above mentioned behaviour of the bee swarm. Artificial Bee Colony Optimization Algorithm is a novel metaheuristic approach which was developed in 2005. It is a dynamic algorithm. Best Suited for cloud Environment. Best suited for Parallel Processing. There will be three types of Bees (a) Scout Bees: Arbitrarily searches for Honey (b) Onlooker Bees: Determines the food source by calculating the fitness (c) Employed Bees: Gather the information about the food resource and exchange the information gathered with onlooker bees.

*Artificial Bee Colony Optimization Algorithm Simulation Result:* ABCO Algorithm simulation results is given below in Table 8.

**Table 8:** Load balancing in Artificial Bee Colony Optimization (ABCO) Algorithm

	ABCO
Makespan	300.34
Waiting time	0.02
Burst time	0.24

*Problem statement:* It is observed that this algorithm is slow to obtain an accurate solution and it requires new fitness tasks on the new algorithm parameters to improve performance. Therefore there is a need for improvement.

*Need for the improvement:* As since the artificial bee colony optimization algorithm requires improvements. As per the existing real time scenario there is a need for the algorithm with the following characteristics (i) The algorithm needs to work efficiently in the distributed environment (ii) The algorithm needs to be a virtual machine friendly, (iii) The algorithm should make the virtual machine to work efficiently under the heavy loads and (iv) The algorithm should assure that it is capable to provide services in the peak demand hours sufficiently.

*Combination of RTH and ABCO Algorithms:* The ABCO is a novel and a heuristic algorithm. This algorithm is motivated by honey bee intelligent foraging behaviour. It is used for a searching process to solve the real time parameters optimization problems. The Disadvantages of this algorithm is, it is slow in getting the better result. Many numbers of objective function evaluations are required. There is a possibility of losing relevant information when the function is being optimized. To

improve RTEH algorithm, ABCO algorithm can be combined using the hybrid approach. This algorithm can be called as RTEAH algorithm.

*RTEAH Algorithm Simulation Result:* RTEAH Algorithm simulation results are as given below in Table 9.

**Table 9:** Load balancing in RTEAH Algorithm

	RTEAH
Makespan	292.46
Waiting time	0.01
Burst time	0.23

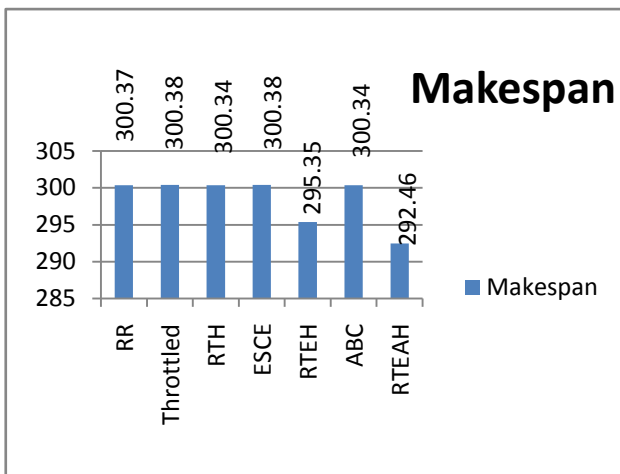
RTEAH Algorithm in comparison with other Algorithms

RTEAH Algorithm can be compared with other previous algorithms as given below in Table.10

**Table 10:** RTEAH Algorithm in comparison with other algorithms

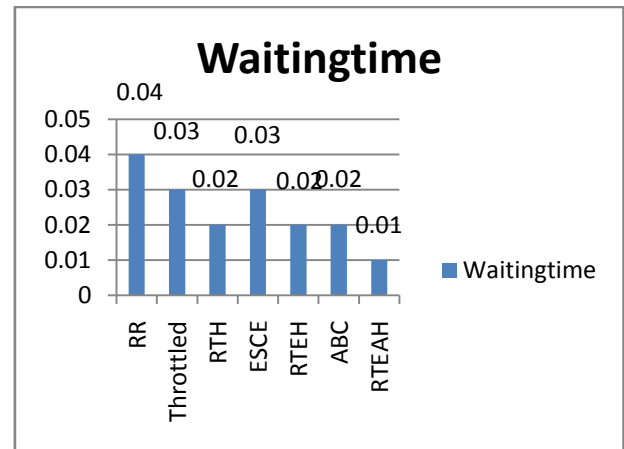
	RR	Throttled	RTH	ESCE	RTEH	RTEAH
Makespan	300.37	300.38	300.34	300.38	295.35	292.46
Waiting time	0.04	0.03	0.02	0.03	0.02	0.01
Burst time	0.25	0.25	0.24	0.26	0.24	0.23

Comparison of RR, Throttled, RTH, ESCE, RTEH and RTEAH algorithms for the makespan in the form of a graph1.



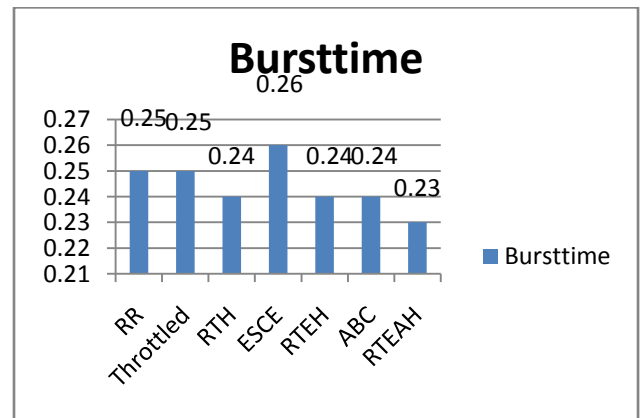
**Graph 1:** Comparison of different algorithms for makespan

Comparison of RR, Throttled, RTH, ESCE, RTEH and RTEAH algorithms for waiting time in the form of a graph2.



**Graph 2:** Comparison of different algorithms for waiting time.

Comparison of RR, Throttled, RTH, ESCE, RTEH and RTEAH algorithms for Burst time in the form of a graph3.



**Graph 3:** Comparison of different algorithms for Burst time.

*c) Advantages of RTEAH algorithm*

The New RTEAH Algorithm has shown betterment in case the Cloud Computing Load Balancing Parameters in terms of Makespan, Waiting time and Burst time. Therefore RTEAH is considerable.

*d) Limitations and Scope of Research*

- i. The research is focused on load balancing in hybrid algorithmic approach in cloud computing environment.
- ii. Efforts are done to make betterment of the performance of scheduling in the cloud environment.
- iii. Research study is focused on load balancing in hybrid algorithmic approach in cloud computing environment.

*Conclusion and Future work:* The new RTEAH algorithm has shown betterment in case of some of the considered cloud computing load balancing parameters such as Makespan, Waiting time and Burst time, keeping in view of Data centers and virtual machines, number of requests allotted, number of requests successes, number of request failed, during the peak hours and in non peak hours as since the requests are coming in random way RTEAH algorithm has shown the considerable performance. Proposed approaches in algorithms can be used in cloud IaaS. Some parameters did not considered in the present research such as given below (i). Network Bandwidth (ii). Memory Utilization ratio (iii). CPU Utilization ratio (iv). Disk space usage (v). CPU Processing Speed (vi). Latency is the time taken to return a data packet to the sender. (vii). Fault Tolerance.

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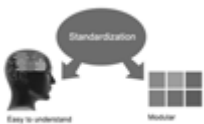
We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.





The FARSS can go through standards of OARS. You can also play vital role if you have any suggestions so that proper amendment can take place to improve the same for the benefit of entire research community.

As FARSS, you will be given a renowned, secure and free professional email address with 100 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders, Auto-Responders, Email Delivery Route tracing, etc.



The FARSS will be eligible for a free application of standardization of their researches. Standardization of research will be subject to acceptability within stipulated norms as the next step after publishing in a journal. We shall depute a team of specialized research professionals who will render their services for elevating your researches to next higher level, which is worldwide open standardization.

The FARSS member can apply for grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A. Once you are designated as FARSS, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria. After certification of all your credentials by OARS, they will be published on your Fellow Profile link on website <https://associationofresearch.org> which will be helpful to upgrade the dignity.



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The FARSS is eligible to earn from sales proceeds of his/her researches/reference/review Books or literature, while publishing with Global Journals. The FARSS can decide whether he/she would like to publish his/her research in a closed manner. In this case, whenever readers purchase that individual research paper for reading, maximum 60% of its profit earned as royalty by Global Journals, will be credited to his/her bank account. The entire entitled amount will be credited to his/her bank account exceeding limit of minimum fixed balance. There is no minimum time limit for collection. The FARSS member can decide its price and we can help in making the right decision.

The FARSS member is eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get remuneration of 15% of author fees, taken from the author of a respective paper. After reviewing 5 or more papers you can request to transfer the amount to your bank account.



## MEMBER OF ASSOCIATION OF RESEARCH SOCIETY IN SCIENCE (MARSS)

The ' MARSS ' title is accorded to a selected professional after the approval of the Editor-in-Chief / Editorial Board Members/Dean.

The “MARSS” is a dignified ornament which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., MARSS or William Walldroff, M.S., MARSS.



MARSS accrediting is an honor. It authenticates your research activities. After becoming MARSS, you can add 'MARSS' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, Visiting Card and Name Plate etc.

*The following benefits can be availed by you only for next three years from the date of certification.*



MARSS designated members are entitled to avail a 25% discount while publishing their research papers (of a single author) in Global Journals Inc., if the same is accepted by our Editorial Board and Peer Reviewers. If you are a main author or co-author of a group of authors, you will get discount of 10%.

As MARSS, you will be given a renowned, secure and free professional email address with 30 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders, Auto-Responders, Email Delivery Route tracing, etc.





We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The MARSC member can apply for approval, grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A.



Once you are designated as MARSC, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria.

It is mandatory to read all terms and conditions carefully.



## AUXILIARY MEMBERSHIPS

### Institutional Fellow of Open Association of Research Society (USA)-OARS (USA)

Global Journals Incorporation (USA) is accredited by Open Association of Research Society, U.S.A (OARS) and in turn, affiliates research institutions as “Institutional Fellow of Open Association of Research Society” (IFOARS).



The “FARSC” is a dignified title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

The IFOARS institution is entitled to form a Board comprised of one Chairperson and three to five board members preferably from different streams. The Board will be recognized as “Institutional Board of Open Association of Research Society”-(IBOARS).

*The Institute will be entitled to following benefits:*



The IBOARS can initially review research papers of their institute and recommend them to publish with respective journal of Global Journals. It can also review the papers of other institutions after obtaining our consent. The second review will be done by peer reviewer of Global Journals Incorporation (USA) The Board is at liberty to appoint a peer reviewer with the approval of chairperson after consulting us.

The author fees of such paper may be waived off up to 40%.

The Global Journals Incorporation (USA) at its discretion can also refer double blind peer reviewed paper at their end to the board for the verification and to get recommendation for final stage of acceptance of publication.



The IBOARS can organize symposium/seminar/conference in their country on behalf of Global Journals Incorporation (USA)-OARS (USA). The terms and conditions can be discussed separately.

The Board can also play vital role by exploring and giving valuable suggestions regarding the Standards of “Open Association of Research Society, U.S.A (OARS)” so that proper amendment can take place for the benefit of entire research community. We shall provide details of particular standard only on receipt of request from the Board.



Journals Research  
inducing researches

The board members can also join us as Individual Fellow with 40% discount on total fees applicable to Individual Fellow. They will be entitled to avail all the benefits as declared. Please visit Individual Fellow-sub menu of GlobalJournals.org to have more relevant details.



We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.



After nomination of your institution as “Institutional Fellow” and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.

The board can also take up the additional allied activities for betterment after our consultation.

### **The following entitlements are applicable to individual Fellows:**

Open Association of Research Society, U.S.A (OARS) By-laws states that an individual Fellow may use the designations as applicable, or the corresponding initials. The Credentials of individual Fellow and Associate designations signify that the individual has gained knowledge of the fundamental concepts. One is magnanimous and proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice.



Open Association of Research Society (US)/ Global Journals Incorporation (USA), as described in Corporate Statements, are educational, research publishing and professional membership organizations. Achieving our individual Fellow or Associate status is based mainly on meeting stated educational research requirements.

Disbursement of 40% Royalty earned through Global Journals : Researcher = 50%, Peer Reviewer = 37.50%, Institution = 12.50% E.g. Out of 40%, the 20% benefit should be passed on to researcher, 15 % benefit towards remuneration should be given to a reviewer and remaining 5% is to be retained by the institution.



We shall provide print version of 12 issues of any three journals [as per your requirement] out of our 38 journals worth \$ 2376 USD.

### **Other:**

**The individual Fellow and Associate designations accredited by Open Association of Research Society (US) credentials signify guarantees following achievements:**

- The professional accredited with Fellow honor, is entitled to various benefits viz. name, fame, honor, regular flow of income, secured bright future, social status etc.



- In addition to above, if one is single author, then entitled to 40% discount on publishing research paper and can get 10% discount if one is co-author or main author among group of authors.
- The Fellow can organize symposium/seminar/conference on behalf of Global Journals Incorporation (USA) and he/she can also attend the same organized by other institutes on behalf of Global Journals.
- The Fellow can become member of Editorial Board Member after completing 3yrs.
- The Fellow can earn 60% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.
- Fellow can also join as paid peer reviewer and earn 15% remuneration of author charges and can also get an opportunity to join as member of the Editorial Board of Global Journals Incorporation (USA)
- • This individual has learned the basic methods of applying those concepts and techniques to common challenging situations. This individual has further demonstrated an in-depth understanding of the application of suitable techniques to a particular area of research practice.

**Note :**

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- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.
- In case of “Difference of Opinion [if any]” among the Board members, our decision will be final and binding to everyone.

”



# PREFERRED AUTHOR GUIDELINES

**We accept the manuscript submissions in any standard (generic) format.**

We typeset manuscripts using advanced typesetting tools like Adobe In Design, CorelDraw, TeXnicCenter, and TeXStudio. We usually recommend authors submit their research using any standard format they are comfortable with, and let Global Journals do the rest.

Alternatively, you can download our basic template from <https://globaljournals.org/Template.zip>

Authors should submit their complete paper/article, including text illustrations, graphics, conclusions, artwork, and tables. Authors who are not able to submit manuscript using the form above can email the manuscript department at [submit@globaljournals.org](mailto:submit@globaljournals.org) or get in touch with [chiefeditor@globaljournals.org](mailto:chiefeditor@globaljournals.org) if they wish to send the abstract before submission.

## BEFORE AND DURING SUBMISSION

Authors must ensure the information provided during the submission of a paper is authentic. Please go through the following checklist before submitting:

1. Authors must go through the complete author guideline and understand and *agree to Global Journals' ethics and code of conduct*, along with author responsibilities.
2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s) names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
5. Authors should submit paper in a ZIP archive if any supplementary files are required along with the paper.
6. Proper permissions must be acquired for the use of any copyrighted material.
7. Manuscript submitted *must not have been submitted or published elsewhere* and all authors must be aware of the submission.

## Declaration of Conflicts of Interest

It is required for authors to declare all financial, institutional, and personal relationships with other individuals and organizations that could influence (bias) their research.

## POLICY ON PLAGIARISM

Plagiarism is not acceptable in Global Journals submissions at all.

Plagiarized content will not be considered for publication. We reserve the right to inform authors' institutions about plagiarism detected either before or after publication. If plagiarism is identified, we will follow COPE guidelines:

Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

- Words (language)
- Ideas
- Findings
- Writings
- Diagrams
- Graphs
- Illustrations
- Lectures





- Printed material
- Graphic representations
- Computer programs
- Electronic material
- Any other original work

## AUTHORSHIP POLICIES

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1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

### Changes in Authorship

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

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### Appealing Decisions

Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

### Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

### Declaration of funding sources

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

## PREPARING YOUR MANUSCRIPT

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.



### ***Manuscript Style Instruction (Optional)***

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

### ***Structure and Format of Manuscript***

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

- a) A title which should be relevant to the theme of the paper.
- b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
- c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
- d) An introduction, giving fundamental background objectives.
- e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
- f) Results which should be presented concisely by well-designed tables and figures.
- g) Suitable statistical data should also be given.
- h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

- i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
- j) There should be brief acknowledgments.
- k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.



## FORMAT STRUCTURE

***It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.***

All manuscripts submitted to Global Journals should include:

### **Title**

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

### **Author details**

The full postal address of any related author(s) must be specified.

### **Abstract**

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

### **Keywords**

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in a research paper?" Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

### **Numerical Methods**

Numerical methods used should be transparent and, where appropriate, supported by references.

### **Abbreviations**

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

### **Formulas and equations**

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

### **Tables, Figures, and Figure Legends**

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.



## Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

## PREPARATION OF ELECTRONIC FIGURES FOR PUBLICATION

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

## TIPS FOR WRITING A GOOD QUALITY COMPUTER SCIENCE RESEARCH PAPER

Techniques for writing a good quality computer science research paper:

**1. Choosing the topic:** In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

**2. Think like evaluators:** If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

**3. Ask your guides:** If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

**4. Use of computer is recommended:** As you are doing research in the field of computer science then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

**5. Use the internet for help:** An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.



**6. Bookmarks are useful:** When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

**7. Revise what you wrote:** When you write anything, always read it, summarize it, and then finalize it.

**8. Make every effort:** Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

**9. Produce good diagrams of your own:** Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

**10. Use proper verb tense:** Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

**11. Pick a good study spot:** Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

**12. Know what you know:** Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

**13. Use good grammar:** Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

**14. Arrangement of information:** Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

**15. Never start at the last minute:** Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

**16. Multitasking in research is not good:** Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

**17. Never copy others' work:** Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

**18. Go to seminars:** Attend seminars if the topic is relevant to your research area. Utilize all your resources.

**19. Refresh your mind after intervals:** Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.



**20. Think technically:** Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

**21. Adding unnecessary information:** Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

**22. Report concluded results:** Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

**23. Upon conclusion:** Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium through which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

## INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

### **Key points to remember:**

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

### **Final points:**

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

*The introduction:* This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

### **The discussion section:**

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

### **General style:**

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

**To make a paper clear:** Adhere to recommended page limits.



### *Mistakes to avoid:*

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

### **Title page:**

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

**Abstract:** This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

*Reason for writing the article—theory, overall issue, purpose.*

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

### **Approach:**

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

### **Introduction:**

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.



*The following approach can create a valuable beginning:*

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

#### **Approach:**

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

#### **Procedures (methods and materials):**

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

#### **Materials:**

*Materials may be reported in part of a section or else they may be recognized along with your measures.*

#### **Methods:**

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

#### **Approach:**

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

#### **What to keep away from:**

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.





**Results:**

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

**Content:**

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

**What to stay away from:**

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

**Approach:**

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

**Figures and tables:**

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

**Discussion:**

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."



Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

**Approach:**

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

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<i>Introduction</i>	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
<i>Methods and Procedures</i>	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
<i>Result</i>	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
<i>Discussion</i>	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
<i>References</i>	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring



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