AN IOT UTILITY MODULE PLACEMENT METHOD FOR CLOUD-FOG COMMUNITY ENVIRONMENT

Abstract

As of late, the thought of dispensed computing has been stretched out toward the organization edge. Gadgets shut to the employer edge, known as haze hubs, provide figuring capacities with low inertness to neighborhood give up gadgets. In the subsequent haze figuring worldview (moreover called side processing), Utility components can be conveyed to a disseminated foundation, involving each cloud server farms and haze hubs. The preference which foundation hubs ought to have which utility components has an widespread effect on widespread framework boundaries like execution and electricity utilization. A few calculations have been proposed to music down a first-rate function of utilizations on a haze framework. As a rule, the proposed calculations have been assessed tentatively by the separate creators. Without a hypothetical investigation, an intensive and deliberate observational evaluation is of key importance for having the alternative to make sound decisions about the reasonableness of the calculations. Main factor of the research paper is to review the software association calculations for haze registering are assessed in the writing.

**Keywords**: IoT, Cloud-fog, environment, process, Access

Author

Dr. Shaik Jaffer Vali
Department of Computer Science
Rayachoty, Andhra Pradesh, India
Jaffershaik003@gmail.com

I. INTRODUCTION

Distributed computing has been extraordinarily fruitful in giving in fact limitless coping with and stockpiling limit, open from anyplace. Be that as it may, with the quickly development in the volume of devices related with the Web and making use of cloud administrations, new requirements have arisen [1]. A few functions name for steady managing of information from scattered cease gadgets, for which the deferral of sending data to the cloud may be restrictive. Additionally, assuming hordes of quit devices ship their records to the cloud, this may lead to an employer over-burden. The principal notion of these approaches is to give, however included cloud server farms, geologically dispersed gadgets, known as haze hubs. Haze hubs can be both present structures administration gear with spare discern limit, or devices explicitly dispatched for this reason. End devices can offload processing undertakings to adjacent haze hubs, ideally solely 1-2 agency jumps from the stop gadget, so that such offloading causes low idleness [2].

Haze processing (likewise known as part figuring) is due to this fact portrayed via a framework involving cloud server farms, mist hubs, and give up devices. To take benefit of this heterogeneous framework, mist software function calculations should pick for each and every section of an software on which hub of the framework the given phase ought to be put. The scenario of an utility can have significant impact on key fantastic measurements, together with execution, asset utilization, power utilization, and prices [3-5]. Various calculations would possibly target explicit varieties of utilizations (e.g., circulation managing applications) or be conventional.
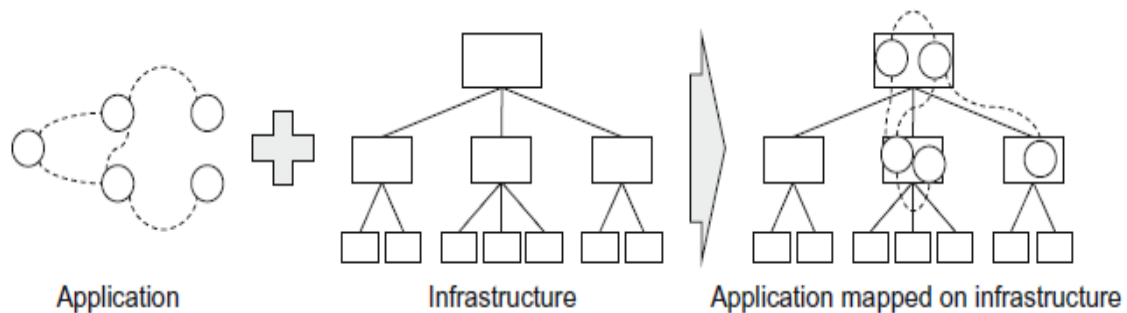
Figure 1: Fogg application placement problem (FAPP)

Tracking down the fantastic scenario for a given software (or set of utilizations) and a given basis is troublesome. A few small print of this trouble have been shown to be NP-hard. The pertinence, effectivity, and productiveness of proposed calculations is in most cases confirmed with a check assessment. To permit all round mounted assertions about the exhibition of the calculations, the exploratory evaluation ought to follow an orderly strategy.The calculation must be assessed on a unique association of important benchmark difficulty examples, with good and moving boundary values, additionally contrasting towards different slicing facet calculations, and the effects ought to be measurably dissected [6]. Tragically, in a few cases, the trial evaluation experiences basic issues, for example, making use of simply ridiculously little trouble occurrences or contrasting the proposed calculation simply with inconsequential contenders. In such cases, the assessment results do not find how tremendous the given calculation genuinely is. This vigorously hinders further logical

development on haze utility scenario calculations. The research paper main aims giving a file of the performs with the huge logical writing regarding the evaluation of mist utility role calculations. To this end, we overview round one hundred papers proposing haze software role calculations, also, look at how they investigate these calculations. We order the evaluation in the papers as per forty models, like the pre-owned evaluation climate, the number of utilized trouble examples, the gauge calculations for correlation, and the pre-owned assessment measurements. We check out the discoveries, distinguishing high-quality and horrible practices, and furthermore talking about the development over the lengthy haul (i.e., contrasting greater up to date with extra mounted papers). Past overviews on mist utility role [7-9] core round trouble variations also, calculations, simply momentarily referencing how calculations had been assessed. Nonetheless, as the discipline is developing, the sturdy evaluation of proposed calculations is gradually significant. As a long way as each person is concerned, our paper is the predominant thorough overview of the assessment of haze utility function calculations.

Gedeon et al. [10] represent the haze utility function trouble as given below: Given is the depiction of a basis I and an utility A. I carries records about the hubs (cloud server farms, haze hubs, give up gadgets), consisting of their limit (central processor, Slam and so on), and about the connections between hubs, with records such as inertness and switch pace of every connection. The factor of the FAPP is to music down a planning (situation) of utilization components on foundation hubs. A set R of stipulations must satisfied, incorporate asset requirements of the components (as some distance as pc chip, Slam and so on), and conceivably of the connectors (e.g., regarding facts switch capacity). There can likewise be one-of-a-kind prerequisites, There can be quite a number conditions of the given functions on the given framework that regard all prerequisites. From these positions, the fine one ought to be picked, involving a given set O of targets. Goals would possibly incorporate, for model, limiting utility response time or in prevalent strength utilization [11].

One difficulty incidence of the FAPP includes of monitoring down an reply for a given info (i.e., utility and basis depiction), which fulfills the conditions and ideally improvements the given targets. There are a vast vary of renditions of the FAPP, contingent upon the precise varieties of prerequisites and aims considered, as properly as on extra presumptions about the framework and the applications. Coming up subsequent are a few fashions for the separation between a range of FAPP variations:

- A few creators control the underlying scenario of new applications, even though others address the restreamlining of presently placed functions decided to respond to changes.
- The variants of the issue, stop devices cannot have parts, whilst in different editions this is conceivable.

There are moreover different streamlining problems in haze processing that are related with the FAPP. For instance, a few creators explored the offloading of express calculations from an quit machine to a haze hub, or the conveyance of burden amongst mist hubs. Such issues are special in relation to the FAPP, considering the fact that they do not encompass deciding on the arrangement of utilization parts. three Approach To warranty a respectable inclusion of the massive writing, we performed out a unique writing search [12]. Figure two suggests an define with cycle. To warranty greater inclusion, we utilized similarly

questions on Google Researcher with associated terms, which include "haze software association issue" and "application function in mist registering".

Next to catchphrase search, we moreover utilized snowball search, the place papers refering to or refered to by means of the typically discovered extensive papers are broke down too. Along these lines, likewise papers that utilization distinctive wording (edge alternatively than mist, administration as a substitute than software and so forth.) can be found. Specifically, we in this way determined the assessment [11], from which the proceeded snowball search brought about a few similarly associated papers. The significance of every observed paper was once surveyed physically.

1. **The accompanying sorts of requirements have been utilized:**

- General residences (7 rules) seize the measurement of the carried-out tests, the local weather utilized for the assessment, and the gauge calculations utilized for correlation.
- Appraisal residences (2 rules) join with how the aftereffects of the trials were handled.
- Framework homes (15 rules) join with the basis that was once utilized (much of the time mimicked) for the examinations in the given paper. This incorporates data about the dimension of the foundation, like the volume of haze hubs. We moreover took a gander at the place the take a look at records utilized in the examinations (like the restriction of hubs or the information switch capability of connections) got here from, to be aware of how life like the utilized boundary values are [13].
- Likewise, to basis properties, software residences (16 measures) join with the measurement and sketch of the functions utilized in the analyses, as nicely as the beginning of the traits for section and connector boundaries. Subsequent to arranging the papers, we investigated the consequences to distinguish frequent examples also, patterns, which are depicted in the following segments. four Outcomes To understand patterns, we should take a gander at the every year improvement of the extent of papers with given qualities [14]. Notwithstanding, the quantities in person years are plenty of the time little, so that patterns would possibly be misplaced in the commotion, and no surely large assertions can be made.

Figure 2: Fog computing model

For instance, Fig.2 indicates the recurrence with which a variety of varieties of assessment conditions have been utilized every year. With such a low number of papers, irregular events (e.g., a gathering processe simply dispensed in the subsequent year) can typically contort the outcomes. Besides, the translation of the plan is convoluted by means of the trade of the all-out variety of papers every year. For model, it very nicely may additionally be presumed that "anonymous take a look at systems" suddenly grew to become disliked from 2019 to 2020, on the other hand the equal is by using all debts legitimate for specific types of conditions. In the accompanying, we existing the essential penalties of our examination as per the models of Fig. three Further subtleties, incorporating graphs with the each year improvement of the numbers (both outright and comparative with the all-out variety of papers in the given year) are accessible on the web.

2. **Assisment Climate:** The recurrence with which a variety of types of evaluation conditions were utilized. From the ninety-nine researched papers, fifty-two utilized a cutting-edge mist processing take a look at device ("named take a look at systems"), 35 utilized an distinct reenactment local weather ("anonymous test systems"), and 19 utilized a testbed, i.e., a restrained scale agency for take a look at purposes with proper tools and programming. No paper published a proper sending, i.e., a creation scale sending in a real setting, with real gear and programming. It indicates in greater element through the range of papers the exceptional named check systems were utilized. Various check structures have been utilized, but simply iFogSim used to be utilized by means of a few special creators [15]. (For instance, Fog Torch used to be utilized in 6 papers, then again all of them had been composed via a comparable examination bunch.)

3. **Pattren Calculations:** It suggests the recurrence of a number types of calculations utilized as a benchmark to which proposed calculations had been thinking about. 10 papers utilized no sample calculation for examination. One paper did not current an personal calculation, but regarded at existing calculations with one another. We remoted the pre-owned popular calculations into 5 classifications: "Trifling calculations", "Nontrivial calculations", "Calculations from writing", "Own calculations" (i.e., versions of the creators' very own calculation) and "Calculations in genuine items".

For each span, the determine suggests how regularly the extent of utilized issue examples falls into the given stretch. In the match that a paper reviews a range of tests, we added the volume of trouble instances of the analyses. Most of papers [10-14] utilized someplace in the vary of 1 and 20 trouble cases. The volume of trouble instances was in the span simply 19 and more than one times, separately. Figure eight suggests a histogram of the volume of runs per problem case, i.e., the number of instances an investigation was once rehashed on a comparable difficulty occasion. Here, we partitioned the association of fantastic numbers into the stretches. For each and every stretch, the parent suggests how often the volume of runs per issue occurrence falls into the given span. On the off hazard that a paper published a number of investigations, we take the best quantity of runs per trouble event in any examination. In generally 50% of the papers, simply a single run for every trouble event was performed. 10 papers carried out 2-10, 19 papers carried out 11-15, and 6 performed in extra of a hundred runs for every problem case. From the 6 papers with in excess of a hundred runs per difficulty occurrence, 5 performed considerably a higher quantity of than one thousand runs for each and every difficulty

case. It ought to be observed that 14 papers did not needless to say exhibit the volume of runs per issue example, so we had been unable to allocate them to any span.

II. EVALUATION PROPERTIES

1. **Assisment Measurments:** Figure 9 indicates which measurements had been utilized and how often to quantify the nature of haze application association calculations. As must be visible, inertness was once the most largely utilized metric. A greater itemized examination suggests that the expression "idleness" used to be utilized with various implications (in accordance with previous discoveries [10]). Specifically, fifty-two papers introduced the start to end dormancy of an software (or the entire for a bunch of uses), comprising of the best possibility for each calculation and facts move. 19 papers estimated not-start to finish inactivity, i.e., both simply organisation dormancy or simply calculation time. Of the fifty-two papers that idea about begin to end inertness, four moreover concept about community idleness and calculation time independently, so in the cease 23 papers viewed not-start to end dormancy. Adjacent to inertness, moreover asset use, community utilization, and QoS infringement were frequently utilized as evaluation measurements. Financial prices and strength utilization had the most noteworthy increment over the lengthy haul. Just 12 papers think about the extent of relocations as a metric. The papers utilized features of the subsequent scenario as evaluation measurements. Just 38 of the ninety-nine papers viewed the execution season of the association calculation. From these 38, 30 moreover notion about adaptability of the calculation develops with increasing trouble size.

2. **Mesarable Evaluation:** Generally, 50% of the examined papers (49 out of 99) utilized some type of factual appraisal of the aftereffects of their analyses. Through a lengthy shot the most well-regarded factual comparison approach (utilized in 33 papers) is figuring the everyday of the results from several runs. Likewise, a few one-of-a-kind strategies have been utilized, notwithstanding the truth that by using a minority of papers, to supply greater insights regarding the circulation of the outcomes. Boxplots furthermore, sure bet spans had been utilized through 9 papers each, with an of course increasing pattern. A CDF (total circulation capability) used to be utilized by way of 6 papers. Factual speculation testing was once utilized with the aid of simply 1 paper (it was once a Wilcoxon marked rank test).

   The percentage of such papers diminished basically from extra professional to more present-day papers. Beginning of utilization boundary values Figure 12 indicates how often the boundary upsides of the purposes (like parts' pc processor requirements and connectors' facts transmission prerequisites) are self-picked minus any extra clarification ("Self-picked: Not determined"), arbitrarily created based on self-picked stretches ("Self-picked: Produced"), taken from a true framework ("Reality") or from the writing ("Writing"). forty-nine papers utilized self-picked values without any defense. 18 papers created boundary esteems arbitrarily, in mild of self-picked spans. In the extra up to date papers, involving the writing as the hotspot for software boundaries fantastically expanded, while the extent of papers making use of self-picked and now not similarly indicated values diminished [16]. A few papers concerned quite a number hotspots for utility boundaries; in this way, the quantity of the number of papers from all training surpasses the all-out wide variety of papers.

3. **Number of Parts:** Figure thirteen suggests a histogram of the volume of components utilized in the tests. On the off risk that a paper utilized a range of purposes with more than a few portions of parts, we picked the restriction of these numbers. The volume of components is amongst 1 and 10 for 27 papers, someplace in the vary of eleven and a hundred for 35 papers, or greater one hundred for 29 papers. In 7 papers, the volume of components was once no longer first-class from the paper. In this segment, we take a look at the results to apprehend awesome and horrible practices and patterns. We core round two indispensable components of the legitimacy of observational examinations: inward legitimacy and outside legitimacy [14]. Inner legitimacy implies that the exams allow sound and significant ends to be drawn for the instances protected through the tests. Outer legitimacy implies that the ends can be summed up to unique situations that were not tried unequivocally.

4. **Inside legitimacy of observational assesments:** Checking on the penalties of the previous region uncovers a few risks to the inner legitimacy of observational examinations on haze software association calculations.

5. **Benchmark Caluclations:** Many papers make use of inconsequential calculations or debilitated variations of their very own calculations as examination gauge, or no correlation with extraordinary calculations by any stretch of the imagination. Such a trial configuration does not allow to survey whether or not the proposed calculation propels the satisfactory in class. Notwithstanding, Faction. likewise uncovered a promising pattern: the volume of papers using gauge calculations from the writing is expanding.

   The humans team requirements to assist this pattern. Recently proposed calculations ought to be contrasted with modern high-performing calculations to exhibit that they work on the state of the workmanship. This likewise suggests that calculation executions ought to be made freely accessible with the aim that exceptional scientists can contain them for correlation. As referenced in Group. Calculations from [15] have been regularly utilized as correlation standard. This does not mean, in any case, that these calculations ought to be moreover utilized for examination later on. These calculations have been allotted in 2017. From that factor forward, various calculations have been displayed to beat them. Hence, they do not address the high-quality in type anymore. Number of runs and measurable appraisal For randomized calculations, an ample variety of runs ought to be carried out on each issue event to restriction the affect of possibility. In any event, for deterministic calculations, randomization and enjoying out a range of runs may provide greater experiences into the calculation's presentation. The share of papers with simply a solitary run per difficulty prevalence is diminishing, which is admirable.

   The humans team requirements to assist this pattern. Recently proposed calculations ought to be contrasted with modern high-performing calculations to exhibit that they work on the state of the workmanship. This likewise suggests that calculation executions ought to be made freely accessible with the aim that exceptional scientists can contain them for correlation. As referenced in Group. Calculations from [15] have been regularly utilized as correlation standard. This does not mean, in any case, that these calculations ought to be moreover utilized for examination later on. These calculations

have been allotted in 2017. From that factor forward, various calculations have been displayed to beat them. Hence, they do not address the high-quality in type anymore. Number of runs and measurable appraisal For randomized calculations, an ample variety of runs ought to be carried out on each issue event to restriction the affect of possibility. In any event, for deterministic calculations, randomization and enjoying out a range of runs may provide greater experiences into the calculation's presentation. The share of papers with simply a solitary run per difficulty prevalence is diminishing, which is admirable.

III. REPRODUCIBILITY

We considered all via Faction. 4, a few papers could not be sorted in some of the researched aspects, on the grounds that the giant facts was once now not best from those papers. Creators ought to painting their trial association in such element and lucidity that others can replicate the analyses. This assists with limiting the chance of blunders, what's more, on the off threat that mistakes are made, they are less difficult to become aware of (e.g., by way of analysts) and can be amended.

1. **Assessment Condictions:** A introduction scale certifiable sending would be the exceptional evaluation climate. Nonetheless, it shows, all papers make use of a replica or testbed all matters being equal. This is justifiable, seeing that the utilization of a introduction scale genuine employer motives gigantic costs. Additionally, reproductions experience the advantage of easy trial and error with a variety of settings. Not utilisinga advent scale proper enterprise isn't always absolutely a issue, assuming the pre-owned local weather acts in essentially the equal manner to actual advent conditions. It is essential to approve that the pre-owned local weather acts tons the equal way to proper introduction conditions. Tragically, this seldom occurs. Utilizing a non-reasonable assessment climate can intensely debase the adaptability of the consequences to beneficial settings.

   The human beings crew ought to chip away at the advent and cautious approval of assessment conditions for haze software association calculations, and later on reliably make use of those conditions [18]. The exploratory evaluation of calculations is continuously confined to a confined association of problem occurrences, and we can not relaxation certain whether or not the results can be summed up to other issue examples. By the by, creators ought to goal using a delegate set of issue occasions, to domesticate hypothesis alternatively a great deal as should moderately be expected. This requires a great range of difficulty cases, be that as it may, as group showed, most papers in fact utilize now not many. The share of papers utilizing all matters viewed 20 trouble instances is diminishing, while the percentage of papers using extra than forty is expanding, on the other hand the sample is slow. The following inquiry is the way smart the pre-owned problem examples are. In every of the 4 instances we noticed that as most papers make use of self-picked designs and boundary values with subsequent to no legitimization, which brings up the difficulty of how smart these designs and values are.

   Then again, the basis geography is seldom taken from authentic frameworks, and additionally reusing geographies from the writing is intriguing. The 1/3 inquiry with appreciate to trouble events is the manner by using which full-size they are. As groups it

shows, most of papers make use of beneath one hundred parts, underneath a hundred haze hubs, and beneath one hundred stop gadgets. While these difficulty prevalence sizes ought to well address constrained scope mist organizations, they do not show up to be ample to take a look at how the calculations scale to giant haze arrangements. A few creators persuade haze processing by citing research awaiting billions of stop gadgets, on the other hand no paper without a doubt performs writing.

The reuse of framework and software important points from the writing is expanding, which is a advantageous pattern. In any case, it likewise things which previous papers are utilized as sources. The most important factor ought to be to reuse check records that is sensible. A few creators utilizing the iFogSim check gadget reuse take a look at data from [19]. In the measurable assessment, the normal, but in addition the fluctuation used to be idea of Martin et al. likewise examined what quantity of time their calculations require for on such huge problem occurrences.

Great practice: utilization of big scope check frameworks and extensive take a look at applications. It carried out a pastime in iFogSim. The boundary values for the basis had been taken from current tools (for instance, the tools setup of a Samsung phone phone) and specific get entry to community innovations, such as LTE and WiFi. The software shape and the boundary upsides of the utility have been taken from the writing. A sum of eight trouble instances have been inspected. 50 runs have been carried out per problem case and in a while the regular was once determined. The brought calculation was once contrasted with the calculation from [93]. The execution time predicted through the calculations to discover a viable association was once likewise examined. Great practice: utilization of boundary values from real frameworks.

2. **Rundown of Suggestions:** We at present sum up our tips for the exploratory evaluation of haze software association calculations:

- Utilize an evaluation local weather that has been displayed to deliver consequences in mediocre blunder limits contrasted and the special introduction framework.
- Utilize an ample wide variety of a range of trouble cases. The problem examples utilized for the evaluation ought to be illustrative of the varieties of trouble occurrences that should emerge in the specific introduction framework. This will usually anticipate in any event about many difficulty cases.
- Decide the format and boundary values for the basis and the purposes from good sources (from actual frameworks or the writing).
- Guarantee that the measurement of the check problem activities is in a comparative attain as the size of the goal frameworks. Use reducing part calculations as examination standard.
- Play out an sufficient variety of runs per problem incidence to restriction the impacts of possibility. The critical wide variety of runs can be assessed making use of measurable techniques from the precise sure bet stage and accuracy [13]. As a guideline, if playing out the investigations on a number of events prompts surely a variety of conveyances, then, at that point, the extent of runs isn't always sufficient.
- Utilize sturdy measurable techniques, comparable to hypothesis testing, to consider the outcomes. To domesticate the good-sized evaluation of new mist utility

association calculations, the neighborhood vicinity ought to tackle a few well-known difficulties: Creation and specific exploratory approval of becoming evaluation stipulations (test systems, testbeds).

IV. CONCLUTION

Meaning of wellknown versions of the FAPP that allow the instant examination of various calculations tackling a comparable difficulty variation. Making a storehouse of brazenly on hand and immediately cloth haze application arrangement calculation executions. Meaning of preferred benchmark trouble examples or mills for such problem occurrences. We have delivered the penalties of a writing find out about on mist software situation calculations. Our emphasis was once on how currently proposed calculations are assessed. We researched ninety nine papers and categorised them in view of a scientific classification of forty classes, from which we delivered right here the most charming outcomes. The penalties of our investigation exhibit that the legitimacy of the discoveries from existing experimental assessments is often compromised. Normal inadequacies of such assessments incorporate the absence of correlation with reducing part calculations, absence of measurable appraisal, ridiculous evaluation conditions, too few or too little problem cases, and inappropriate check information. Albeit a component of these viewpoints show up to work on over the lengthy run, there is nevertheless a lot of to do to moreover work on the legitimacy of such assessments. We introduced a few proposals on the nice way to remain away from the identified entanglements.

Future work ought to zero in on making sound basis for the specific evaluation of haze software function calculations. This contains the advent and approval of sensible evaluation prerequisites (like take a look at systems), laying out popular variations of the haze software function trouble alongside (generators of) comparing benchmark problem cases, and making a storehouse of interoperable calculation executions.

REFERENCES

[1] Muhammad Rizwan Anawar, Shangguang Wang, Muhammad Azam Zia, Ahmer Khan Jadoon, Umair Akram, Salman Raza, "Fog Computing: An Overview of Big IoT Data Analytics", Wireless Communications and Mobile Computing, vol. 2018, Article ID 7157192, 22 pages, 2018.

[2] Atlam, H.F.; Walters, R.J.; Wills, G.B. Fog Computing and the Internet of Things: A Review. Big Data Cogn. Comput. **2018**, 2, 10.

[3] H. K. Apat, B. sahoo, P. Maiti and P. Patel, "Review on QoS Aware Resource Management in Fog Computing Environment," 2020 IEEE International Symposium on Sustainable Energy, Signal Processing and Cyber Security (iSSSC), 2020, pp. 1-6,

[4] Mseddi, W. Jaafar, H. Elbiaze and W. Ajib, "Joint Container Placement and Task Provisioning in Dynamic Fog Computing," in IEEE Internet of Things Journal, vol. 6, no. 6, pp. 10028-10040, Dec. 2019,

[5] Z. Rezazadeh, M. Rezaei and M. Nickray, "LAMP: A Hybrid Fog-Cloud Latency-Aware Module Placement Algorithm for IoT Applications," 2019 5th Conference on Knowledge Based Engineering and Innovation (KBEI), 2019, pp. 845-850, T. Hiessl, V. Karagiannis, C. Hochreiner, S. Schulte and M. Nardelli, "Optimal Placement of Stream Processing Operators in the Fog," 2019 IEEE 3rd International Conference on Fog and Edge Computing (ICFEC), 2019, pp. 1-10, doi: 10.1109/CFEC.2019.8733147.

[6] P. Maiti, J. Shukla, B. Sahoo and A. K. Turuk, "Efficient Data Collection for IoT Services in Edge Computing Environment," 2017 International Conference on Information Technology (ICIT), 2017, pp. 101-106

[7] H. Ben-Ammar and Y. Ghamri-Doudane, "An ICN-based Approach for Service Caching in Edge/Fog Environments," GLOBECOM 2020 - 2020 IEEE Global Communications Conference, 2020, pp. 1-6.

[8]   V. Yadav, B. V. Natesha and R. M. R. Guddeti, "GA-PSO: Service Allocation in Fog Computing Environment Using Hybrid Bio-Inspired Algorithm," TENCON 2019 - 2019 IEEE Region 10 Conference (TENCON), 2019, pp. 1280-1285, doi: 10.1109/TENCON.2019.8929234.

[9]   T. S. Nikoui, A. Balador, A. M. Rahmani and Z. Bakhshi, "Cost-Aware Task Scheduling in Fog-Cloud Environment," 2020 CSI/CPSSI International Symposium on Real-Time and Embedded Systems and Technologies (RTEST), 2020, pp. 1-8

[10] J. Gedeon, M. Stein, L. Wang and M. Muehlhaeuser, "On Scalable In-Network Operator Placement for Edge Computing," 2018 27th International Conference on Computer Communication and Networks (ICCCN), 2018, pp. 1-9.

[11] Anand Singh Rajawat Sumit Jain KanishkBarhanpurkar,(2021) Fusion protocol for improving coverage and connectivity WSNs, IET Wireless Sensor Systems.

[12] Rajawat A.S., Upadhyay P., Upadhyay A. (2021) Novel Deep Learning Model for Uncertainty Prediction in Mobile Computing. In: Arai K., Kapoor S., Bhatia R. (eds) Intelligent Systems and Applications. IntelliSys 2020. Advances in Intelligent Systems and Computing, vol 1250. Springer, Cham

[13] Hedhli, A., Mezni, H. A Survey of Service Placement in Cloud Environments. J Grid Computing **19,** 23 (2021).

[14] Skarlat, O., Nardelli, M., Schulte, S. et al. Optimized IoT service placement in the fog. SOCA 11, 427–443 (2017).

[15] Rajawat A.S., Barhanpurkar K., Shaw R.N., Ghosh A. (2021) Risk Detection in Wireless Body Sensor Networks for Health Monitoring Using Hybrid Deep Learning. In: Mekhilef S., Favorskaya M., Pandey R.K., Shaw R.N. (eds) Innovations in Electrical and Electronic Engineering. Lecture Notes in Electrical Engineering, vol 756. Springer, Singapore.

[16] Martin, J.P., Kandasamy, A. & Chandrasekaran, K. Mobility aware autonomic approach for the migration of application modules in fog computing environment. J Ambient Intell Human Comput 11, 5259–5278 (2020).

[17] Dadashi Gavaber, M., Rajabzadeh, A. MFP: an approach to delay and energy-efficient module placement in IoT applications based on multi-fog. J Ambient Intell Human Comput 12, 7965–7981 (2021).

[18] Subbaraj, S., Thiyagarajan, R. &Rengaraj, M. A smart fog computing based real-time secure resource allocation and scheduling strategy using multi-objective crow search algorithm. J Ambient Intell Human Comput (2021).

[19] Ramzanpoor, Y., Hosseini Shirvani, M. &Golsorkhtabaramiri, M. Multi-objective fault-tolerant optimization algorithm for deployment of IoT applications on fog computing infrastructure. Complex Intell. Syst. (2021).

[20] HarshitGupta,AmirVahidDastjerdi,SoumyaKGhosh,andRajkumarBuyya.2017.iFogSim:Atoolkitformodelin gandsimulationofresourcemanagementtechniquesintheInternetofThings,EdgeandFogcomputingenvironment s. Software:PracticeandExperience47,9(2017),1275–1296.

[21] Mahmud R., Ramamohanarao K., Buyya R. Application Management in Fog Computing Environments: A Taxonomy, Review and Future Directions. ACM Comput. Surv. 2021;53:1–43. doi: 10.1145/3403955.

[22] Saurez E., Hong K., Lillethun D., Ramachandran U., Ottenwälder B. Incremental Deployment and Migration of Geo-Distributed Situation Awareness Applications in the Fog; Proceedings of the 10th ACM International Conference on Distributed and Event-Based Systems; Irvine, CA, USA. 13 June 2016; Irvine, CA, USA: ACM; 2016. pp. 258–269.

[23] Tocze K., Nadjm-Tehrani S. Proceedings of the 2019 IEEE 3rd International Conference on Fog and Edge Computing (ICFEC) IEEE; Larnaca, Cyprus: 2019. ORCH: Distributed Orchestration Framework Using Mobile Edge Devices; pp. 1–10.

[24] Castellano G., Esposito F., Risso F. A Service-Defined Approach for Orchestration of Heterogeneous Applications in Cloud/Edge Platforms. IEEE Trans. Netw. Serv. Manag. 2019;16:1404–1418. doi: 10.1109/TNSM.2019.2941639.

[25] Salaht F.A., Desprez F., Lebre A. An Overview of Service Placement Problem in Fog and Edge Computing. ACM Comput. Surv. 2021;53:1–35. doi: 10.1145/3391196.