ISSN (Print): 2321 -4058, (Online): 2321 -4392

THE INTERNATIONAL JOURNAL OF ADVANCES IN COMPUTER SCIENCE AND CLOUD COMPUTING (IJACSCC)

VOLUME NO. 11

ISSUE NO. 2

MAY - AUGUST 2023

ISSN (Print): 2321 -4058, (Online): 2321 -4392

The International Journal of Advances in Computer Science and Cloud Computing (IJACSCC)

Aim & Scope

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ISSN (Print): 2321 -4058, (Online): 2321 -4392

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International Journal of Advances in Computer Science and Cloud Computing

(Volume No. 11, Issue No. 2, May - August 2023)

Contents

ISSN (Print): 2321 -4058, (Online): 2321 -4392

Development of A Cloud- based and Scalable Virtual Reality Platform with Data Analytics for E-Learning

Kok- Zuea Tang
Engineering Design and Innovation Centre (EDIC), Innovation and Design National University of Singapore Faculty of engineering, block e2a, #04-05, 5 engineering drive 2, Singapore
E-mail: engtkz@nus.edu.sg

ABSTRACT

Virtual reality (VR) is a great tool for more than just gaming. In the e-learning scenario, to provide an immersive experience for learners to understand the topics related to visualizations, for example, mechanical designs, VR can be employed. However, the heavy setup requirement for VR experience is obstructing the accessibility and deployment of VR applications for different users and scenarios. In the case of e-learning for remote users, the setup cost is exceptionally high and the application design that utilizes VR is not scalable. The lack of seamless analytics integration with applications and scalable real-time monitoring for VR is hindering more users to adopt VR to fit their needs and requirements, especially in the e-learning, where cost and effectiveness of equipment for intended purposes are main issues. In consideration of these factors, we provide our application design and system architecture to demonstrate the idea of shifting VR intensive workload from client to server side, showcasing the design and implementation of a fully workable prototype for VR-as-a-Service (VRaaS). Simulation and experimental results are provided to illustrate the strengths and weaknesses of the proposed approach.

Keywords- Virtual reality (VR), VR-as-a-Service (VRaaS), Scalable Virtual Reality Platform, Cloud-Based VR.

I. INTRODUCTION

In modern days, many businesses are moving in the direction of cloud computing. Desktop based application is seen to be gradually replaced by the cloud application thanks to the wise spread of internet. But the reason of moving in the cloud direction is not only just the rise of internet, but also driven by the advantages that cloud computing brings. Cloud computing allows variable workloads, therefore be it hosting on cloud services or private cloud, the cost depends on the usage [1]. Moving from on-premise to cloud infrastructure can be difficult after the client has reliance on the application, so migration should not just be redoing the past activity, but also provide value add to create more opportunity to upgrade the workflow [2]. This be an incentive to move towards cloud in a long-term point of view.

There has been conceptual Cloud-based VR concepts that separate the GPU processing load from the client. One of the common idea is to gather the user motion input into server for VR processing then compress the visual feed by H.264 standard and stream back to client [3]. Another advantage of deploying the application to cloud is that the scenes or tests can be stored on the server, all the resources are managed by the service provider, so client has no worries of managing the package or update [4]. In terms of data storage, cloud computing system allows scalable and reliable data management [5]. The data related processes such as query or filter can be done efficiently by deploying to cloud database [5]. As nowadays the data in the industry has grown so large that it requires big data operations and technologies like Hadoop, it is necessary to push the processes to cloud environment to perform processes [5].

Comparing monolith versus micro-services architecture, monolith application simply means a single executable that depends on shared resources. In general, the architecture is difficult to be scale up due to the intertwine nature and unnatural to distribute without specific framework [6]. For micro-services architecture, the structure is decomposed into small and independent services, this brings the advantage of maintainability and extendibility [6]. Due to the structure has been broken down in smaller pieces, it is flexible enough for the system to keep up the changes and be modified fast enough to catch up the pace [6]. For micro-services which consider content structures in docker container-style, which is the currently industrial lead, computational processes not only can be scaled out across hardware, but performance wise its improved due to the low overhead [7]. Apart from this, by utilizing cluster management system, tasks such as training, simulation and learning can be deployed into containers and distribute to the cluster [8].

Virtual reality system is a common tool in many industry, however most of the systems are worked as an individual and isolated system [9]. The standalone package to run VR applications is usually expensive due to the graphically intensive demand and other essential devices such as headset or controllers [9]. Therefore, by connecting the VR system to the cloud and delegate the processes, the cost of hardware setup can be cut down for everyone to implement it even at home [9].

As mentioned in the cloud computing section, this route has been picked up by other successful venture such as Fra.me that runs desktop grade heavy load application on cloud and stream through H.264 quality back to client's browser [9]. This method can serve one of the requirements, which is to enablecollaborative monitoring, as several users can share the video stream [3].

By moving into cloud, the infrastructure is also ready to support internet-of-things (IoT) integration and analytics. From the IoT Analytics paper, among the 5 layers of an End-to-End IoT Solution, the cloud services are the hub to store and manage the information gathered from devices [10]. It opens a whole additional information source to gather vast amount of raw data for analytics to generate insights [10]. Although security is one of the most vulnerable areas that developer usually failed to address, in the current scope this will not be putting into consideration for the proof-of-concept phase [10].

However, as the IoT devices scale in number, network transmission delay could occur in a many-to- one communication scenario. At the later stage, network protocols designed for IoT application must be tested and deployed. A newly proposed IoT protocol named “Joint Routing and Medium Access Control”, or JRAM, is designed for reducing delays in a many-to-one communication for wireless sensor networks (WSNs) [11].

Apart from the server rendering method, which was the common idea of cloud VR implementation, there is also approach that involve Edge Computing such as rendering on remote edge server or local edge device [1]. Edge Computing perform pre-processing of the information required to be stream back and forth of the network to reduce the load from the server [12]. For streaming Field of Vision (FOV) video with head motion allowed on head-mounted display (HMD), ultralow latency is required to prevent discomfort from the VR scene and it is preferred a latency delay of not more than 22milli seconds [12].

Video streaming technique such as H.264 encoding serves high resolution content to the HMD, but to achieve low latency can be challenging even with multi-user encoding (MUE) [12]. Therefore, to balance between video quality and latency issue, another possible technique namely Frameless Rendering may be able to strike a balance between the both [13]. The technique contrasts the traditional method, which is frame-based algorithms, and works on the principle of “just in time pixel” to minimize latency rate [13]. The core idea of rendering pixel randomly with spatial algorithm and delivers to the HMD immediately may distort the quality of the visual display, but together with hardware acceleration using field-programmable gate array (FPGA), applying image masking and Dataflow Engine (DFE), the visual quality can be improved to be used in VR environment [13].

Lastly, as combined with IoT sensors, data for eye tracking can also be used to improve latency streaming quality. By knowing where the user is looking at, the area where the user is focusing is needed to be rendered in greater details, but the surrounding areas can be rendered in lesser details to reduce the network workload during transmission or edge/server processing [14]. Foveated Rendering take the advantage of human vision systems. The foveal vision has the ability to receive the highest detail from the environment, while peripheral vision lacks the sharpness and details [15]. By utilizing this fact, we designed filters to reduce the quality of the boundaries of the media streamed to reduce the frame information to improve the performance such as latency. The foveated rendering technique is best implemented together with gaze tracking [16], however at the current stage, we only implement this with respect to the head movement tracking. Foveated rendering technique reduces the rendering cost by taking advantages of our human eye structure [15].

II. OVERALL SYSTEM ARCHITECTURE

The key components of the system consist of a cloud VR, data analytics and application design. To enable low processing power PC to consume VR-related contents, various techniques such as server-side processing, network design, peer management system and foveated rendering are applied and experimented to improve the performance. The system architecture can be divided into 2 parts, i.e., the server-side and client-side, as indicated by the top and bottom blue- dotted rounded corners rectangles in Figure 1.

For server-side, we have micro-services, which is used for containerizing backend services into scalable and manageable chucks. Client account database is simply a place to keep the login credentials to access the client application. Next, a cloud-computing platform that is used to run virtual machines (VMs) that deploys our server-side VR application and instance manger server. The application hosting part will be a separate hosting service that runs proxy server, to connect to certain backend services on behalf of client application, and client application server. For the frontend, we designed 2 types of role for client application – manager and user. The manager communicates with the server to initiate VR application and decide the streaming configuration for the user. It has monitoring, and analytics platform built into the application to supervise and collect data related to the end-users' usage.

The proposed web-based approach can be broken down into 3 main categories – cloud-based VR, data analytics and application design. Each of these components work together to provide low-cost and comprehensive VR solution to the client. Cloud- based VR section will discuss about the design and technology utilized to achieve a web-based VR solution that runs the workload on the server-side. While data analytics part shows how the designed tools are built and how they can help the manager client to analyze and visualize the behavioral datacollection from the users. Lastly, the application design in terms of front-end and back-end, which demonstrates how the current prototype is built to serve both the system and the client.

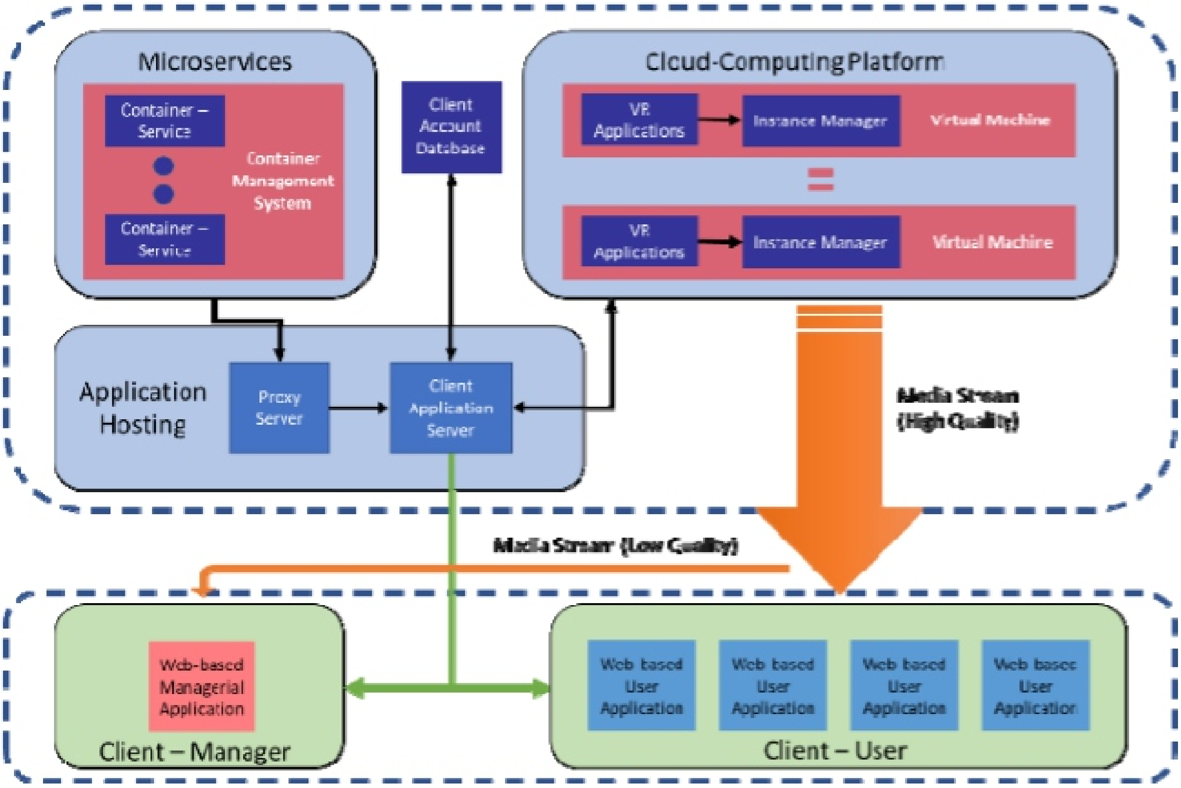


Figure 1. Overview of the proposed system.

A. Cloud-Based VR

The objective of cloud-based VR is to shift the heavy processing workload from client-side to server-side. Previously unavailable content will now be able to run on low processing power computing device through real-time streaming. The media stream will then be converted into a stereoscopic content for the HMD for the user. On top of that, 2 types of client roles are designed, i.e., the manager and the user. The manager utilizes the VR platform to initiate VR applications from the server, then monitor and deploy the applications to the designated users. Through proper network design and techniques, such as foveated rendering, the network workload of this cloud-based VR infrastructure can be reduced and deployed efficiently.

The underlying streaming technology utilizes web real-time communication (WebRTC) and is configured with Selective Forwarding Unit (SFU) with Simulcast topology [5]. The instance manager server on VM, which is hosted on Amazon Web Services (AWS), initiates the VR instance and streams the content through peer-to-peer (P2P) network to designated client [10]. The manager client has the option to utilize foveated rendering to reduce the network workload, as well as selecting the resolution to be streamed to client depending on the context. The user client then utilizes A-Frame, a web framework for VR, to convert the media stream into VR content for HMDs, such as Oculus Rift, to consume.

In addition, there are also other advantages apart from shifting workload to server-side. The latest version of the application can be deployed to all the existing or newly joined users immediately after being updated and maintained. This instant deployment advantage eliminates the need to reinstall or update the on- premise application, while being easily accessible by many.

Server-Client Streaming

The server-client relationship can be separated into 3 parts, i.e., server, network and client. Both the client and the server are connected through peer-to-peer network. The manager type client has the option to trigger start or initialization sequence on the server. This is done through socket signaling using socket.io. Manager application have options to specify the codec, resolution and filter used to stream the VR content to the user type client. On the server side, there is an instance manager server used to manage the deployment of application and streaming. The streaming technology used in this design is WebRTC-based streaming using the RTCMulti Connection package [5].

Web-based Virtual Reality

While the delivery of VR content has been achieved by the server-client streaming or state methods, the content streamed to the client is just a normal media content like any other videos. Another step is required to convert the normal media stream into stereoscopic content for the HMD to consume. This challenge is solved by utilizing a web-based VR technology, WebVR framework – AFrame. After receiving the VR content in real-time, the media is then displayed in the AFrame component a-image within the a-scene. The a-image component is fixed in front of the a-camera component, which is the viewing angle of the user. Through this AFrame framework, it is capable to transform the normal media content into stereoscopic view.

Room-based Management System

For the cloud VR platform to be scalable in terms of client-side and server-side, a room-based management system is developed to support the scalability. A room-based management system is by dividing the socket into different rooms, or session, and each session is managed by the manager type client. For every room that is created, it will have 2 types of sessions – one for manager client; and the other for user client. This room-based management system is not just for the convenience of the server design, but also an intuitive way for the manager client to deploy and manage the various instance.

B. Data Analytics

Analytics is an important part of the platform, as by collecting user's behavior when using the VR application, insights of how user interact with the virtual scene can be extracted. By tracing the movements and interest points, we can analyze how every piece of information in VR world direct users. Heatmap tracing and visualization are useful tools when we want to have an interactive way to analyze user's behavior. Apart from these, the ability to perform full-text query and scale the backend system are crucial as well. The built-in data analytics platform, while hosting on AWS, utilizes Elastic Search (ES), Kibana and Vega to perform query and data visualization. The client application is built on a Node.js server and hosted on a Heroku service together with a proxy which serves as a middleman to connect to AWS on behalf of the client. Furthermore, a micro-services architecture is integrated into the current infrastructure using Kubernetes to manage Docker containers.

Search Engine and Visualization

The search engine and data base we used for storing user's movement data and records are ES, which is part of the ELK stack – (E)lasticSearch, (L)ogStash and (K)ibana. In the current stage of deployment, only ES and Kibana are used as logging is not the current priority for this paper. ES is a database with a powerful query engine included. It has an effective performance regarding full-text query, details of the full-text query test. The database can be divided into 3 types of nodes when being deployed to the distributed infrastructure. Each of them has their own authority and roles to ensure the load balancing and redundancy requirement are met. The master node can be used to store data, perform load balancing and manage cluster. The client node only serves as load balancing. The data node stores data and can receive query or perform routing if needed. In the current setup, there are 2 of each types of nodes in the cluster. Due to the limitation of the development hardware, each node will be allocated a maximum of 512MB of memory.

Scatter Plot with Boundaries and Interest Points Indication

One of the visualization made for this stage is displaying the scatter plot in two dimensions, i.e., horizontal axis X and vertical axis Y rotation. This allows us to know the specific coordinates that the user has glanced through. At current stage, the X and Y rotation can only collect the head rotation, in future after incorporating gaze tracking, the scatter plot design can be used to map the user's gaze path too. The scatter plot has 2 additional functions – boundary and interest point tracking. We can set specific boundaries in terms of X and Y directions, when the user has crossed the boundaries, the scatter plot will indicate distinct color and size in visualizing the points. The next function is that we can also classify the duration of staring at certain point be interest point. So, when user has stared at certain point for more than the specified duration, it will indicate a larger size and color in the scatter plot. This visualization is developed using Kibana-Vega and Figure 2 shows the scatter plot.

C. Application Design

For this section, we divide the various components into frontend and backend sub-section. The frontend sub-section will focus mainly about the components that are relevant to user interaction or experience, such as responsive design or several types of client application. On the other hand, backend sub-section will be discussing about components such as security, application and VM hosting, distributing system and data collection.

Frontend: Client Roles – Manager and User

The client application has 2 types of role – manager, which is the application to send initialization signal to server to prepare VR application for streaming and access data analytics tools to analyze the data report; user, which is the application for end-user with HMD and is dedicated to solely consuming the VR content.

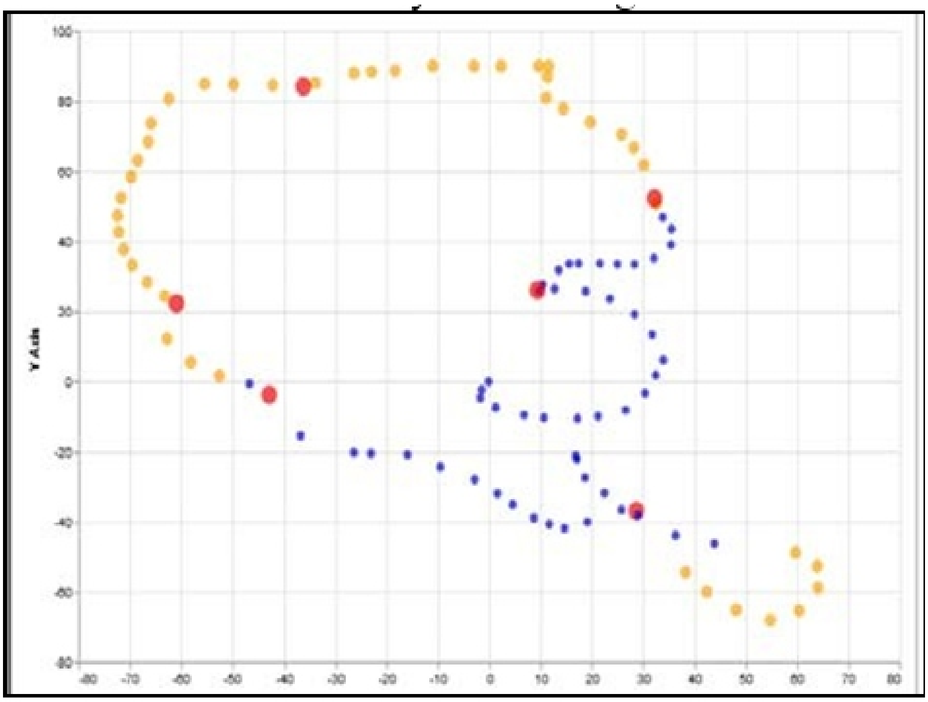


Figure 2. Scatter plot with interest point and boundary detection.

Frontend: View Engine

View engine – Embedded JavaScript (EJS), is used for templating for certain application pages. It adds an extra layer of complexity, but also provide useful additional function as well. By using EJS, we have the capability to pull JavaScript from the server to dynamically create page element, inject data and separate common HTML components for reusability.

Frontend: User Interface Framework and Responsive Design

For the client to have a pleasant user experience in utilizing the platform, Bootstrap v4 user interface (UI) framework is added to enhance the user experience. In addition, a web application is also designed with responsive in mind. When the browser shrinks in size, the UI will update itself to accommodate the browser window constraints. This may allow the application to be deployed on mobile devices with different aspect ratios.

III. INITIAL TEST RESULTS

This section discusses about the scalability and workload on both server and client using the proposed cloud-based VR architecture. We run two application instances concurrently on the same server and benchmark the resources usage. The client-side resources usage is also monitored to determine the processing workload required for decoding the media feed. Figure 5 and 6 are the screenshots of the 2 applications that we used to test the scalability. The first application running on server is a Unity application that has lower graphic processing requirement as compared to the second application used. The second application that will be running for this test is the Corridor Lighting Example made by Unity Team. The latter Unity application has higher graphical processing requirement due to the rendering and effect on the scene. It is having high detailed lightings and reflections in the surroundings. The state before streaming and after streaming are collected as well. Throughout the test, the RAM usage does not have any significant changes. Therefore, it has been omitted out from the benchmark table. The resolution user client streaming is in Full HD (1080p of 1920x1080), while for manager client it is fixed at NTSC widescreen (240p of 426x240). Both applications are Unity based and the latter application has excessively high rendering workload. The tables below are the benchmark for various stages in the streaming process. Three test scenarios are simulated. More details of each test scenario are described below. Metrics involved are CPU usage, GPU usage, Wi-Fi data rate for all the entities. We would analyze the effects of the different scenarios based on the metrics to understand whether this cloud-based architecture is amenable for scaling- up:

- Test 1: This test consists of 1 server and 1 manager client with 2 applications deployed (Table 1).
- Test 2: This test consists of 1 server and 2 user clients with 2 applications deployed (Table 2).
- Test 3: This test consists of 1 server, 1 user clients and 1 manager client with 1 application deployed (Table 3).

The metrics shown in Tables 1 to 3 are mean values averaged over the execution time period. From Test 1 (Table 1), it can be seen that the server and manager client CPU usage remains low throughout the experiment. However, because of the high graphics requirements of App 2, server GPU rises up high. The cloud-based WebVR ensures the client load remains manageable. This trend is repeated in Tests 2 and 3. The main point to note is that the user clients do not need high-end GPU processing power.

	None	App 1 Initialized	App 1 Streamed	App 2 Initialized	App 2
Server	CPU Usage: ~6% GPU Usage: 0% Wi-Fi Sending Rate: 0	CPU Usage: 18% GPU Usage: 8% Wi-Fi Sending Rate: 0	CPU Usage: 34% GPU Usage: 23% Wi-Fi Sending Rate: 304Kbps	CPU Usage: 52% GPU Usage: 95% Wi-Fi Sending Rate: 376Kbps	CPU Usage: 55% GPU Usage: 98% Wi-Fi Sending Rate: 1.1Mbps
Client – Manager (Test machine 1)	CPU Usage: ~6% GPU Usage: ~1% Wi-Fi Receiving Rate: 0	NA	CPU Usage: 18% GPU Usage: ~4% Wi-Fi Receiving Rate: 400Kbps	NA	CPU Usage: 33% GPU Usage: ~5% Wi-Fi Receiving Rate: ~800Kbps

Table I: Data Streaming from Server to 1 Manager Client using 2 Different Applications (App 1: Single Unity App-Low Graphics Requirement) (App 2: Unity Corridor Lighting Example-High Graphics Requirement).

	None	App 1 Initialized	App 1 Streamed	App 2 Initialized	App 2 Streamed
Server	CPU Usage: 5% GPU Usage: 1% Wi-Fi Sending Rate: 24Kbps	CPU Usage: 20% GPU Usage: 9% Wi-Fi Sending Rate: 0	CPU Usage: 43% GPU Usage: 36% Wi-Fi Sending Rate: 304Kbps	CPU Usage: 42% GPU Usage: 98% Wi-Fi Sending Rate: 360Kbps	CPU Usage: 82% GPU Usage: 99% Wi-Fi Sending Rate: 5.1Mbps
Client – User 1 (Test machine 1)	CPU Usage: 30% GPU Usage: 43% Wi-Fi Receiving Rate: 0	NA	CPU Usage: 79% GPU Usage: 77% Wi-Fi Receiving Rate: 352Kbps	NA	NA
Client – User 2 (Test machine 2)	CPU Usage: 17% GPU Usage: 67% Wi-Fi Receiving Rate: 0	NA	NA	NA	CPU Usage: 52% GPU Usage: 99% Wi-Fi Receiving Rate: 2.8Mbps

Table II: Data Streaming from Server to 2 User Clients using 2 Different Applications (App 1: Single Unity App-Low Graphics Requirement) (App 2: Unity Corridor Lighting Example-High Graphics Requirement).

	None	Application Initialized	Stream to Manager	Stream to User
Server	CPU Usage: 9% GPU Usage: 5% Wi-Fi Sending Rate: 0	CPU Usage: 25% GPU Usage: 98% Wi-Fi Sending Rate: 0	CPU Usage: 36% GPU Usage: 98% Wi-Fi Sending Rate: 552Kbps	CPU Usage: 49% GPU Usage: 98% Wi-Fi Sending Rate: 5.9Mbps
Client – Manager (test machine 1)	CPU Usage: 13% GPU Usage: 4% Wi-Fi Receiving Rate: 0	NA	CPU Usage: 17% GPU Usage: 4% Wi-Fi Receiving Rate: 560Kbps	NA
Client – User (test machine 1)	CPU Usage: 17% GPU Usage: 68% Wi-Fi Receiving Rate: 0	NA	NA	CPU Usage: 50% GPU Usage: 99% Wi-Fi Receiving Rate: 6.0Mbps

Table III: Data Streaming from Server to 1 Manager Client and 1 user Client using 1 Applications (App 2: Unity Corridor Lighting Example-High Graphics Requirement).

REFERENCES

[1] Kondo, D., Javadi, B., Malecot, P., Cappello, F. and Anderson, D. 2009. Cost-benefit analysis of Cloud Computing versus desktop grids. In Proceedings of 2009 IEEE International Symposium on Parallel & Distributed Processing (Rome, Italy, 23-29 May 2009). IPDPS '09, IEEE, New York, NY, 1-12.

[2] Pahl, C., Xiong, H. and Walshe, R. 2013. A comparison of on-premise to cloud migration approaches. In Proceedings of Second European Conference on Service-Oriented and Cloud Computing (Málaga, Spain, 11-13 September). ESOCC 2013, Springer, Berlin, Heidelberg, 212-226.

[3] L. Sun, T. Fukuda and B. Resch, "A synchronous distributed cloud-based virtual reality meeting system for architectural and urban design", Frontiers of Architectural Research, vol. 3, no. 4, pp. 348-357, 2014.

[4] M. Zampoglou, A. Malamos, K. Kapetanakis, K. Kontakis, E. Sardis, G. Vafiadis, V. Moulos and A. Doulamis, "iPromotion: A Cloud-Based Platform for Virtual Reality Internet Advertising", Big Data and Internet of Things: A Roadmap for Smart Environments, pp. 447-470, 2014.

[5] He, Y. Wu, Y. Dong, Y. Zhang and W. Zhou, "Dynamic multidimensional index for large-scale cloud data", Journal of Cloud Computing: Advances, Systems and Applications (2016) 5:10, 2017.

[6] N. Alshuqayran, N. Ali and R. Evans, "A Systematic Mapping Study in Microservice Architecture", 2016 IEEE 9th International Conference on Service-Oriented Computing and Applications (SOCA), 2016.

[7] Hale, L. Li, C. Richardson and G. Wells, "Containers for portable, productive and performant scientific computing", Computing in Science & Engineering, pp. 1-1, 2017.

[8] P. Sun, Y. Wen, N. Ta and S. Yan, "Towards Distributed Machine Learning in Shared Clusters: A Dynamically-Partitioned Approach", 2017 IEEE International Conference on Smart Computing (SMARTCOMP), 2017.

[9] T. Inamura, S. Unenaka, S. Shibuya, Y. Ohki, Y. Oouchida and S. Izumi, "Development of VR platform for cloud-based neurorehabilitation and its application to research on sense of agency and ownership", Advanced Robotics, vol. 31, no. 1-2, pp. 97-106, 2016.

[10] "GUIDE TO IOT SOLUTION DEVELOPMENT", 2017. [Online]. Available: https://iot-analytics.com/wp /wp- content/uploads/2016/09/White-paper-Guide-to-IoT- Solution-Development-September-2016-vf.pdf. [Accessed: 20- Sep- 2017].

[11] R. Singh, B. Rai and S. Bose, "A Joint Routing and MAC Protocol for Transmission Delay Reduction in Many-to-One Communication Paradigm for Wireless Sensor Networks", IEEE Internet of Things Journal, vol. 4, no. 4, pp. 1031-1045, 2017.

[12] X. Hou, Y. Lu and S. Dey, "Wireless VR/AR with Edge/Cloud Computing", 2017 26th International Conference on Computer Communication and Networks (ICCCN), 2017.

[13] S. Friston, A. Steed, S. Tilbury and G. Gaydadjiev, "Construction and Evaluation of an Ultra Low Latency Frameless Renderer for VR", IEEE Transactions on Visualization and Computer Graphics, vol. 22, no. 4, pp. 1377-1386, 2016.

[14] K. Chan, K. Ichikawa, Y. Watashiba and H. Iida, "Cloud- Based VR Gaming: Our Vision on Improving the Accessibility of VR Gaming", 2017 International Symposium on Ubiquitous Virtual Reality (ISUVR), 2017.

[15] A. Patney, J. Kim, M. Salvi, A. Kaplanyan, C. Wyman, N. Benty, A. Lefohn and D. Luebke, "Perceptually-based foveated virtual reality", ACM SIGGRAPH 2016 Emerging Technologies on - SIGGRAPH '16, 2016.

[16] Y. Feng, G. Cheung, W. Tan, P. Le Callet and Y. Ji, "Low- Cost Eye Gaze Prediction System for Interactive Networked Video Streaming", IEEE Transactions on Multimedia, vol. 15, no. 8, pp. 1865-1879, 2013.

Efficient Deep Learning Hyperparameter Tuning on the Cloud (Intelligent Distributed Hyper-Parameter Tuning with Bayesian Optimization using Cloud Infrastructure)

[1] Mercy Prasanna Ranjit, [2] Gopinath Ganapathy
[1]Advanced Analytics and AI, Microsoft India Corporation Private Limited Bangalore, India
[2]Department of Computer Science, Bharathidasan University, Trichy, India
E-mail: [1]mercy.prasanna.peter@gmail.com, [2]gganapathy@gmail.com

A B S T R A C T

The paper discusses how we can leverage cloud infrastructure for efficient training and hyperparameter tuning of deep neural networks on the cloud. With the introduction of Horovod framework distributed training of deep learning models has been made trivial on the cloud thereby reducing the time taken to run a single iteration, but the hyperparameter tuning exercise on high dimensional hyperparameter spaces remains a challenge. The paper experiments Bayesian Sequential Gaussian Process Optimization of hyperparameters on the cloud at different levels of concurrency for the warmup runs. Two different distributed hyper-parameter tuning approaches were experimented on the cloud – Training on multiple nodes with higher warm-up concurrency Vs Distributed Training on multiple nodes with Horovod and reduced number of warm-up runs. The results indicate that greater number of warm-up runs results in better exploration of the search space. The hyper parameter choices of every run were optimized using Bayesian optimization technique to take advantage of the learnings from previous runs. The hyper parameter tuning and distributed training with Horovod was performed using Azure Machine Learning Service for Video Activity Recognition problem using LRCN network with transfer learning from Resnet50 backbone.

Keywords - Distributed Training, Horovod, Hyperparameter Tuning, Deep Learning, Bayesian Optimization, Automated Machine Learning, Neural Architecture Search

I. INTRODUCTION

Deep Learning training and hyper parameter tuning requires exploring a vast space of neural network architectures and hyper parameter values for arriving at the ones which works the best for your problem. This has become imperative with the introduction of automated machine learning where multiple machine learning pipeline configurations and neural architectures are evaluated in parallel to arrive at an optimal model. This is usually a time consuming and computationally expensive exercise especially compounded when you are working with image data and neural networks where there are variety of network architectures and parameters to explore like the number of layers and nodes, number of filters, filter size, stride size, optimizer, learning rate, decay factor etc.

With the introduction of Horovod framework, it was made easier to adapt the code for distributed training and hence faster training of deep neural networks. Cloud together with container services provides the ability to spin compute dynamically in the cloud, scale as required and deploy deep learning jobs with dependencies packaged as container images, track run metrics and outputs and dispose compute once the job is completed. These capabilities have opened up avenues for quicker experimentation in the cloud. The distributed runs when coupled with Bayesian optimization or Reinforcement learning enables making intelligent choices based on past runs for faster convergence towards hyper-parameter values and network choices that works the best. This paper makes use of Bayesian Optimization to explore the hyperparameter space at different levels of warm-up concurrency.

Approach 1 described in Fig. 1 consists of distributing the hyper-parameter tuning across multiple nodes with each node running one hyperparameter combination. The training of the network is not distributed in this approach. More runs will be performed in this approach simultaneously with each run taking longer to complete. With four nodes in the machine learning compute cluster, each node runs with different hyperparameter choices simultaneously. This method will have four warmup runs and only the fifth run can run Bayesian optimization for the first time. The execution time of every run varies and hence usually no runs complete at the same time and all runs benefit from the Bayesian optimization except the warmup runs.

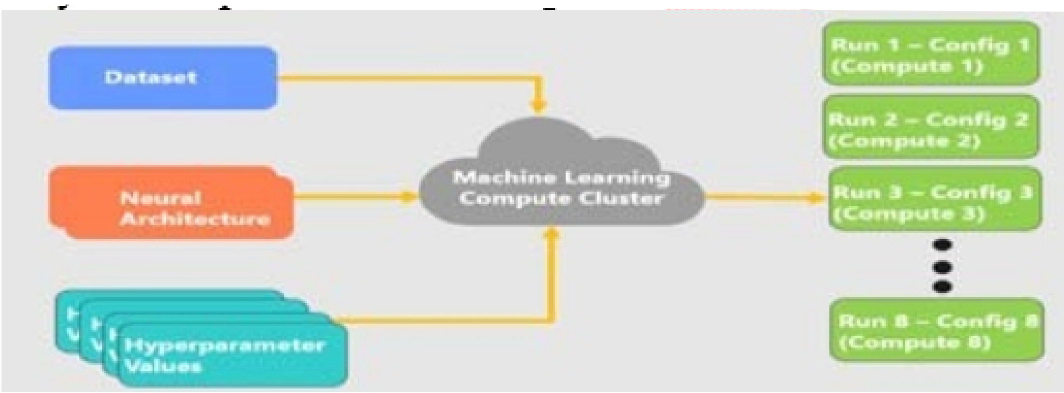


Fig 1: Distributed hyper-parameter tuning with Bayesian Optimization.

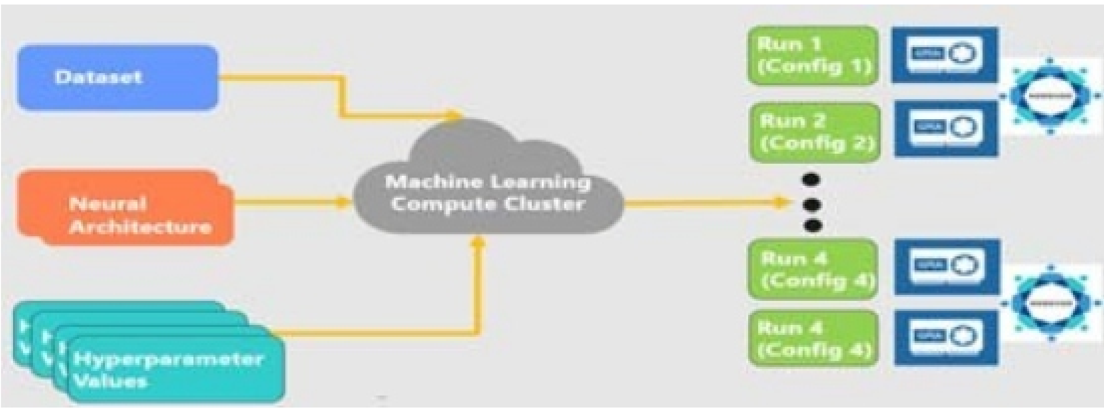


Fig 2: Distributed training with horovod and hyper-parametter tuning with Bayesian Optimization.

The second approach in Fig. 2 is distributing the training with horovod framework where each run is distributed across nodes. The number of runs running concurrently is reduced as the training is distributed. With the machine learning compute cluster of 4 nodes and horovod distribution of training across 2 nodes, each submission will only have 2 runs each running one hyperparameter combination. This method will have only two warmup runs and only the third run can run Bayesian optimization for the first time. Since horovod is used for training each run in a distributed way, training time for each run is reduced.

The experiments sought to measure how different number of warm-up runs can impact the search space exploration and convergence of hyperparameters when using Bayesian optimization. We did not alter the number of nodes when the experiments were in progress and Bayesian optimization was used to suggest only one hyperparameter combination at a time when a run is completed and the node is available to pick up a new combination.

II. RELATED WORK

[1] Discusses Bayesian optimization as a method of finding the maximum of expensive cost functions. The paper discusses the optimization process employing Bayesian technique of setting a prior over the objective function and combining it with evidence to get a posterior function that permits a utility-based selection of the next observation to make on the objective function.

The paper also discusses the exploration (sampling from areas of high uncertainty) and exploitation (sampling areas likely to offer improvement over the current best observation) trade-off as one of the challenges where too much exploration, and many iterations can go by without improvement and too much exploitation leads to local maximization which is not desired.

[2] Discusses the intelligent choice of samples for Bayesian optimization of objective function by using a Gaussian process upper confidence bound rule (GP- UCB) This objective function based on this rule prefers both points x where f is uncertain (large $\sigma t-1(\bullet)$) and such where we expect to achieve high rewards (large $\mu t-1(\bullet)$), it implicitly negotiates the exploration–exploitation tradeoff.

[3] Discusses the representation of hyper parameter optimization objective function as multidimensional Gaussian distributions. The paper also discusses an acquisition function that encodes the measure of usefulness of trying a hyperparameter combination. The probability of improvement acquisition function is that we pick the next point based on the maximum probability of improvement (MPI) as Expected Improvement (EI) function with respect to the current maximum.

The paper discusses an approach to parallelize the Exploration–Exploitation Tradeoff by using GP-BUCB, a principled algorithm for choosing batches, based on the GP-UCB algorithm for sequential GP optimization. the cumulative regret of the parallel algorithm only increases by a constant factor independent of the batch size providing a rigorous theoretical support for exploiting parallelism in Bayesian global optimization.

[4] Discusses Google Vizier, a Google-internal service for performing black-box optimization in the cloud that has become the de facto parameter tuning engine at Google. Google Vizier is used to optimize many of their machine learning models and other systems, and also provides core capabilities to Google's Cloud Machine Learning HyperTune subsystem. It discusses the features such as transfer learning and automated early stopping that the service provides in addition to the underlying infrastructure and Gaussian Process Bandit Optimization algorithm.

[5] Discusses the use of Bayesian optimization based acquisition function that indicates which machine learning pipeline to try next in the context of automated machine learning where the system automatically tries out different machine learning pipelines that maximizes or minimizes the objective function. The paper describes the use of Non-linear matrix factorization with Gaussian processes for modeling the performance of different machine learning pipelines on different datasets. The paper discusses an approach that optimizes the entire pipeline of preprocessing, algorithm selection and hyper parameter tuning and not just hyperparameter tuning in isolation.

[6] Discusses the distributed deep learning framework Horovod, an open source library that improves on both obstructions to scaling: it employs efficient inter-GPU communication via ring reduction and requires only a few lines of modification to user code, enabling faster, easier distributed training in TensorFlow. Horovod is also available via the Keras abstraction which we used in our experiment.

III. EXPERIMENTAL SETTINGS

The Input dataset for the experiment was sampled from the Kinetics 400 dataset from Google DeepMind which was part of the ActivityNet Large- Scale Activity Recognition Challenge. The experiment was performed for three sport activities – Archery, Bungee Jumping and Bowling with 997, 907 and 930 records, respectively. The experiment extracted 360p images at 1 fps (frames per sec). The shape of the input dataset for the LRCN network was (None, 10, 299, 299, 3) where None referred to the no. of input images, 10 refers to the time units corresponding to the ten second video clips and (299,299,3) refers to the height, width and no of channels in the input image frames.

The LRCN network used Resnet50 for feature extraction and stacked LSTM for action sequence classification. The experiment was carried out in Azure cloud on a 4 node NC6 cluster each powered by NVIDIA Tesla K80 GPU. A separate experiment was performed to identify the best optimizer as SGD with Nesterov acceleration. Figure 3 shows the activity classification approach.

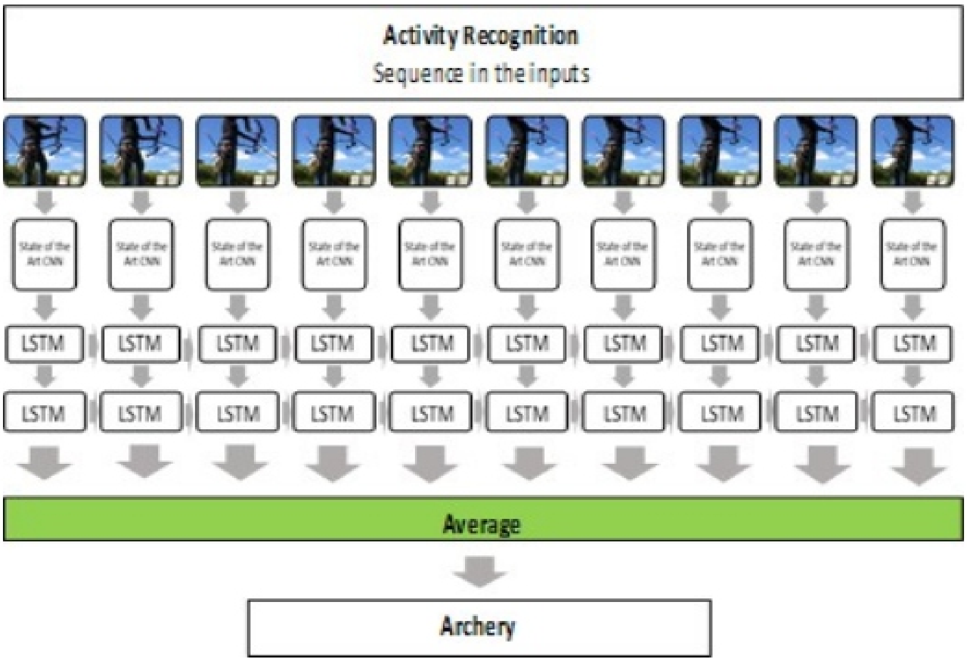


Fig 3: LRCN using two-layer LSTM stack and Resnet50 backbone.

The experiments used the configuration mentioned in table I for the hyper-parameter tuning convergence for different approaches.

Problem	Activity Recognition in Videos
Training Iterations	15
Backbone CNN	Resnet50
Network Type	LRCN
Optimizer	SGD
Nesterov Acceleration	TRUE
LR Decay	No
Hyper-tuning parameters	Learning Rate, Momentum and Batch Size.

Table 1: Experiment Configuration

The hyperparameter tuning was done for three different hyperparameters - learning rate, batch size and momentum values for SGD. Total of thirty-one runs were submitted for both the experiments. The first experiment ran four runs in parallel. The execution times of these runs varied which meant none of these runs had the same completion time. The runs chose hyperparameter values from the sampling space using Bayesian optimization of hyperparameters that optimized the selection of hyperparameters that maximized the validation accuracy using the history of previous runs. The first four runs can be considered as warm-up runs as it did not have any history to use. As the completion times of runs were sequential, the no of history runs available for Bayesian optimization also increased linearly.

The second experiment used horovod distributed training framework for distributed training across nodes. Each run was distributed across two nodes. Hence two runs were performed in parallel with each run distributed across two nodes. At any time only two runs were performed in parallel. Thirty-one runs were performed in total. The first two runs did not have any history and hence can be considered as the warm-up runs. The training time of each run was lower as it distributed the training across two nodes, but the no of concurrent runs was less. The training time of each run was different and hence no runs completed at the same time which implied that the number of runs used for the Bayesian optimization also increased linearly. The difference from Approach 1 is that the number of warm-up runs was just 50% of what Approach 1 had.

The experiments aimed to see how Bayesian tuning with different no of warm-up runs performed towards the search for the best hyper parameters. The no of nodes for training in both the experiments were same. Different levels of concurrency for the warm-up runs was achieved using horovod. Table II below shows the experiment settings for distributed hyper parameter tuning for neural networks in the cloud.

	Experiment 1	**Experiment 2**
Horovod enabled	No	Yes.
No of runs	31	31
No of Parallel Runs	4	2
No of Warm-up runs Bayesian Optimization Runs	4	2
No of history runs for Bayesian optimization at run n.	N	N

Table II: Distibuted Hyper Parameter Tuning Experiment Settings

IV. RESULTS

A. Distribution of Validation Accuracy

The hyperparameter values that was chosen based on Bayesian optimization and their corresponding validation accuracies were measured across all the runs in both the experiments.

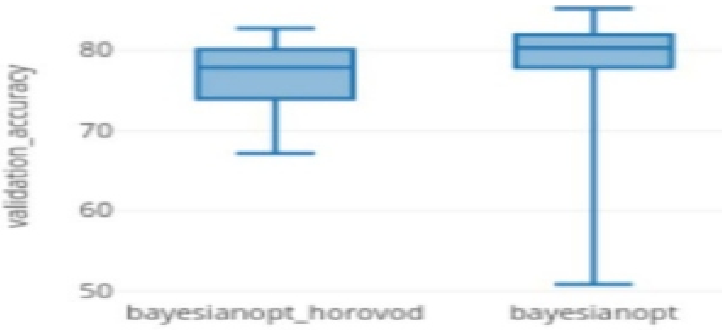


Fig 4: Validation Accuracy Distribution with Distributed Hyperparameter Tuning Approaches

Fig.4 shows the validation accuracy distributions obtained with both the approaches. Approach 1 which had more warm-up runs for Bayesian optimization yielded runs with higher validation accuracy.

Table III shows the inter quantile range values of validation accuracies observed using both the approaches.

Validation Accuracy	Experiment 1	Experiment 2
Max	85.25	82.79
Median	80.33	77.87
First Quartile	77.87	73.96
Third Quartile	81.97	80.13

Table III: Validation Accuracy Distribution

B. Distribution of Hyper-parameter values.

The hyper-parameter values for both the experiments were sampled between 0.001 and 0.05 for learning rate, 0.6 and 0.9 for SGD momentum and 16,14 and 32 for batch-size.

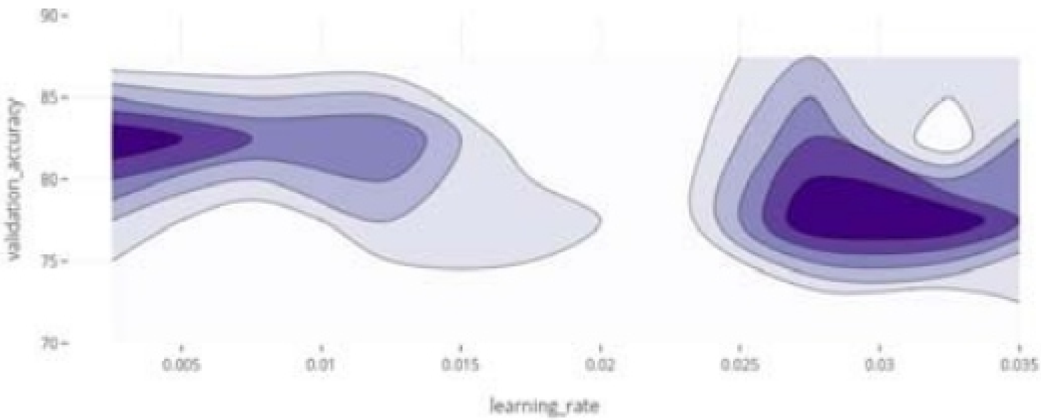


Fig 5: Frequency 2D contour histogram of Learning Rate Vs Validation Accuracy for Bayesian Hyperparameter Tuning

Fig.5 shows higher validation accuracy values were corresponding to learning rates sampled between 0.02 and 0.03 and 0.001 for Experiment 1 which was distributed hyperparameter tuning with Bayesian optimization and four concurrent runs. This is also the high frequency sampling region which is indicated from the darker color shades.

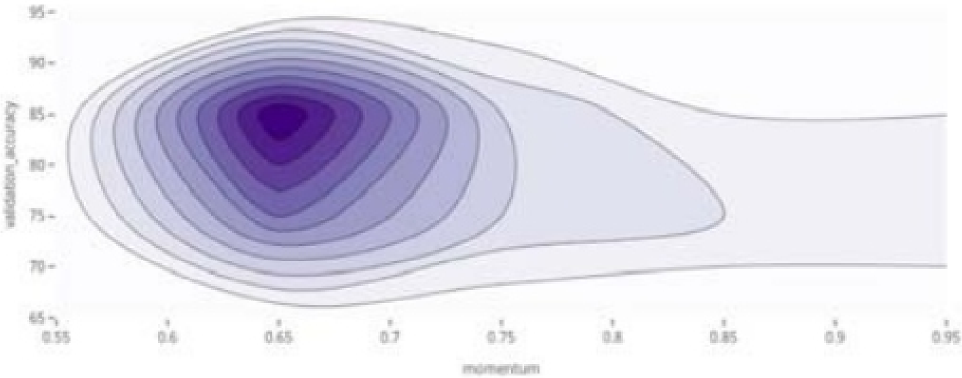


Fig 6: Frequency 2D contour histogram of Momentum Vs Validation Accuracy for Bayesian Hyperparameter Tuning

Fig.6 shows higher validation accuracy values were corresponding to SGD momentum values frequently sampled around 0.6 for Experiment 1. There were also momentum values greater than 0.7 which led to higher accuracy but the frequency of them being less.

Momentum	Validation Accuracy	Learning Rate
0.610612	85.25	0.028512
0.6	85.25	0.035443
0.6	85.25	0.03439
0.607167	83.61	0.035
0.6	82.79	0.001
0.715265	81.97	0.005194
0.6	81.97	0.029682
0.767591	81.15	0.009031
0.613719	81.15	0.027869
0.778186	80.33	0.043299
0.977457	80.33	0.0119
0.618248	80.33	0.002759

Table IV: High Frequency Sampling Regions Experiment I

Table IV shows samples of well performing momentum and Learning Rate samples for Experiment 1.

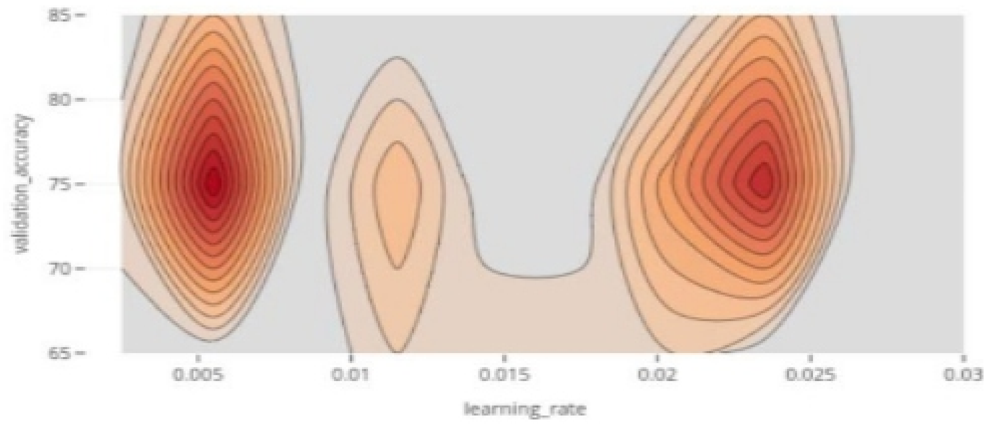


Fig 7: Frequency 2D contour histogram of Learning Rate Vs Validation Accuracy for Bayesian Hyperparameter Tuning with Horovod

Fig.7 shows higher validation accuracy values were corresponding to learning rates sampled around 0.005 and 0.02 for Experiment II which was distributed hyperparameter tuning with Bayesian optimization and two concurrent runs using horovod. This is also the high frequency sampling region which is indicated from the darker color shades.

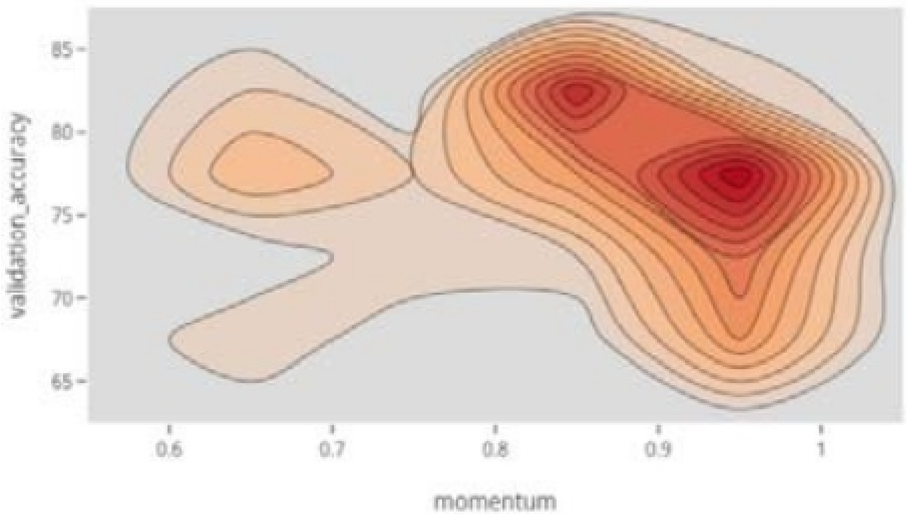


Fig 8: Frequency 2D contour histogram of Momentum Vs Validation Accuracy for Bayesian Hyperparameter Tuning with Horovod

Fig.8 shows higher validation accuracy values were corresponding to SGD momentum values frequently sampled around 0.8 and 0.9 for Experiment 2. There were also momentum values less than 0.7 which led to higher accuracy but the frequency of them being less.

Momentum	Validation Accuracy	Learning Rate
0.883153	82.79	0.0005
0.877294	82.79	0.0005
0.863048	82.79	0.0005
0.619106	81.97	0.023239939
0.800283	81.15	0.022215887
0.897316	81.15	0.0005
0.909958	80.33	0.005180786
0.89335	80.33	0.004044698

Table V: High Frequency Sampling Regions Experiment II

Table V shows samples of well performing momentum and Learning Rate samples for Experiment 2.

C. Covergence of Hyper-parameter values.

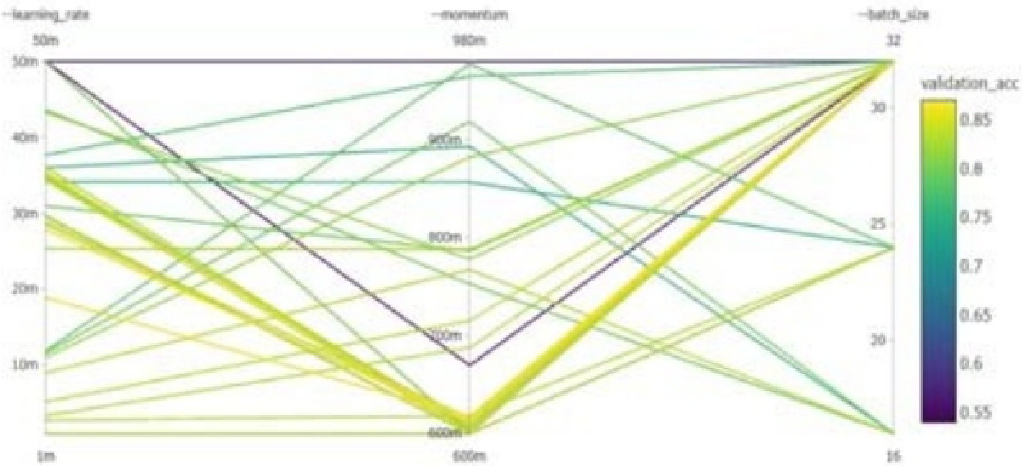


Fig 9: Parallel Coordinates Chart for Experiment I

Fig.9 is a parallel co-ordinates chart that color codes the best performing hyperparameter values for batch size, SGD momentum and learning rate for Experiment 1 which was distributed hyperparameter tuning with Bayesian optimization and four concurrent runs. The batch size converged to size 32, momentum converged to values around 0.6 and learning rate to values between 0.2 and 0.3.

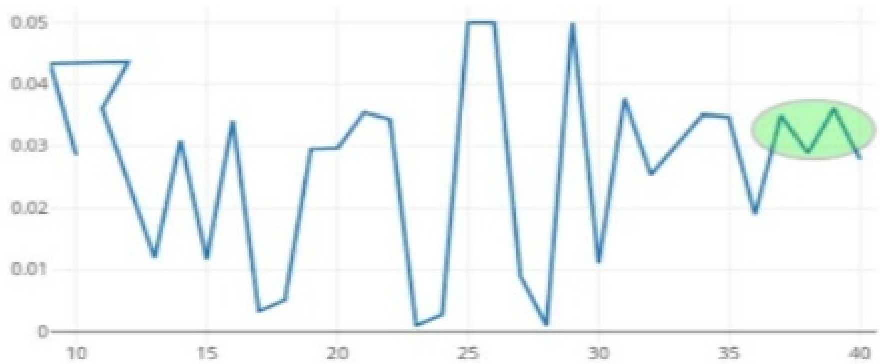


Fig 10: Convergence of Learning Rate for Bayesian Tuning

Fig. 10 shows as the runs progressed the learning rates started to converge to values between 0.02 and 0.03. The sampled regions around lower learning rates like 0.001 were not explored further by Bayesian tuning and hence not taken to convergence.

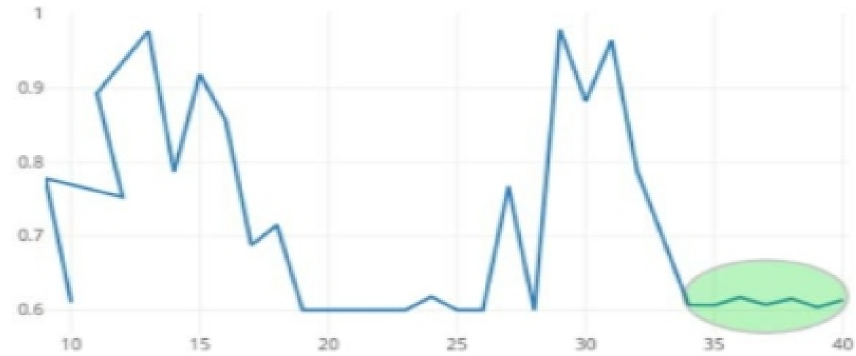


Fig 11: Convergence of Momentum for Bayesian Tuning

Fig. 11 shows as the runs progressed the momentum started to converge to values around 0.6. The sampled regions around higher momentum greater than 0.8 were not explored further as the Bayesian optimization tuning considered it not better and hence not taken to convergence.

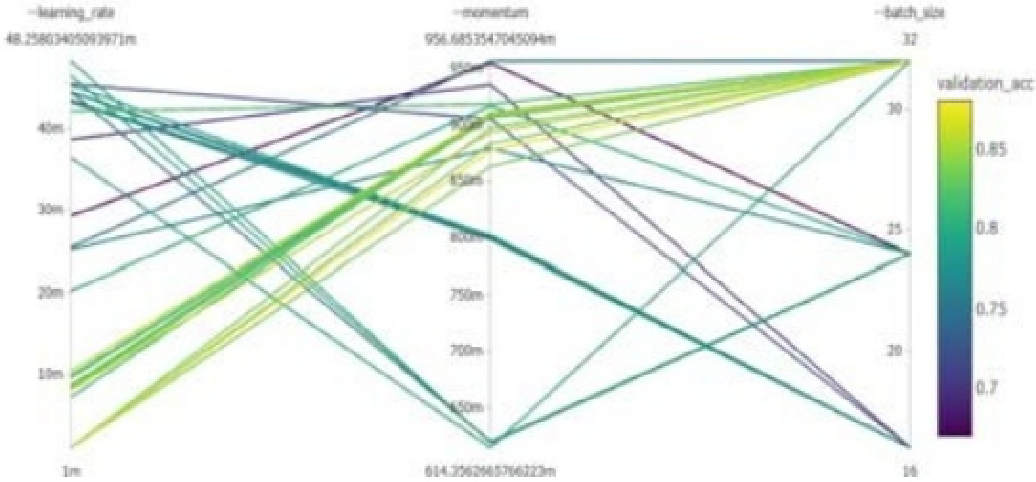


Fig 12: Parallel Coordinates Chart for Experiment II

Fig.12 is a parallel co-ordinates chart that color codes the best performing hyperparameter values for batch size, SGD momentum and learning rate for Experiment 2 which was distributed hyperparameter tuning with Bayesian optimization and Horovod with two concurrent runs. The batch size converged to size 32, momentum converged to values between 0.8 and 0.9 and learning rate to lower values like 0.0005.

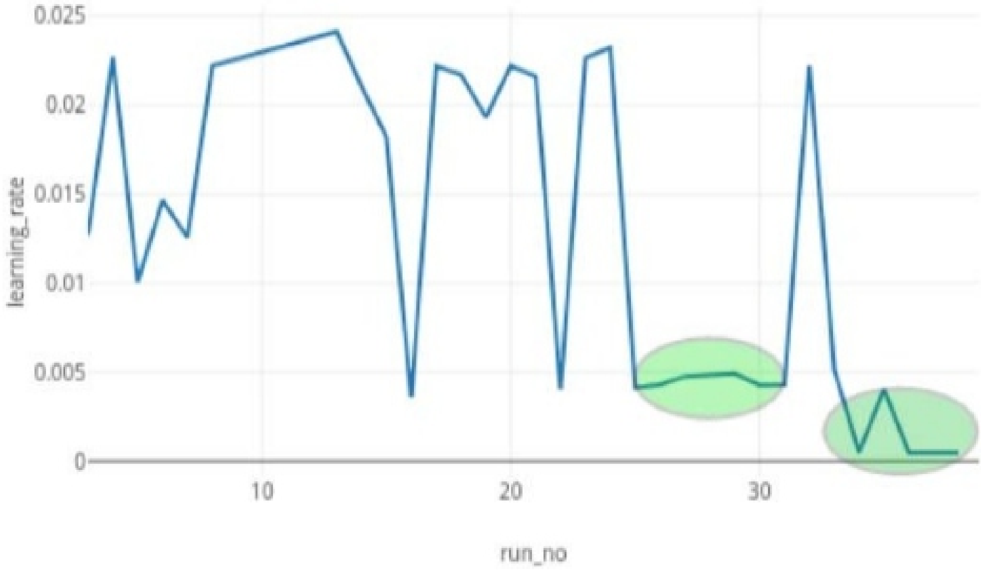


Fig 13: Convergence of Learning Rate for Bayesian Tuning with Horovod

Fig. 13 shows as the runs progressed the learning rates started to converge to lower values around 0.0005 The sampled regions around higher learning rates like 0.02 were not explored further by Bayesian tuning and hence not taken to convergence.

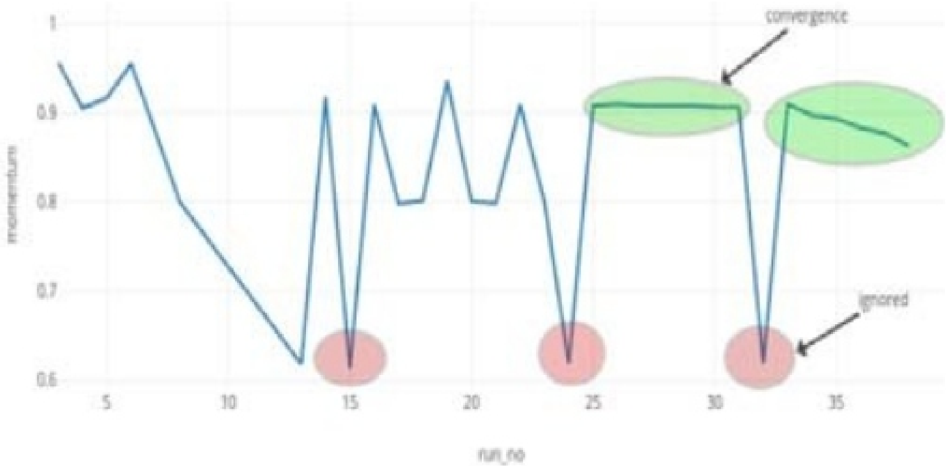


Fig 14: Convergence of Momentum for Bayesian Tuning with Horovod

Fig. 14 shows as the runs progressed the momentum started to converge to values between 0.8 and 0.9 The sampled regions around lower momentum values like 0.8 were not explored further as the Bayesian optimization tuning considered it not better and hence not taken to convergence.

From the results of both the experiments we saw different convergence regions, Experiment 1 with four concurrent runs and Bayesian Optimization converged to higher learning rates and lower momentum values whereas Experiment 2 with two concurrent runs and distributed training with Horovod and Bayesian optimization converged to higher momentum and lower learning rates. Both the convergence regions performed reasonably well as we saw from the convergence table values in Table IV and Table V.

D. Unexplored Hyperparameter Regions

Some regions of hyperparameters were left unexplored with Bayesian optimization tuning with both the approaches. This attributed to the limited number of runs, vast combinations to explore across the three hyperparameters – learning rate, momentum and batch size and also the exploitation – exploration tradeoff setting for the Bayesian Optimization tuning.

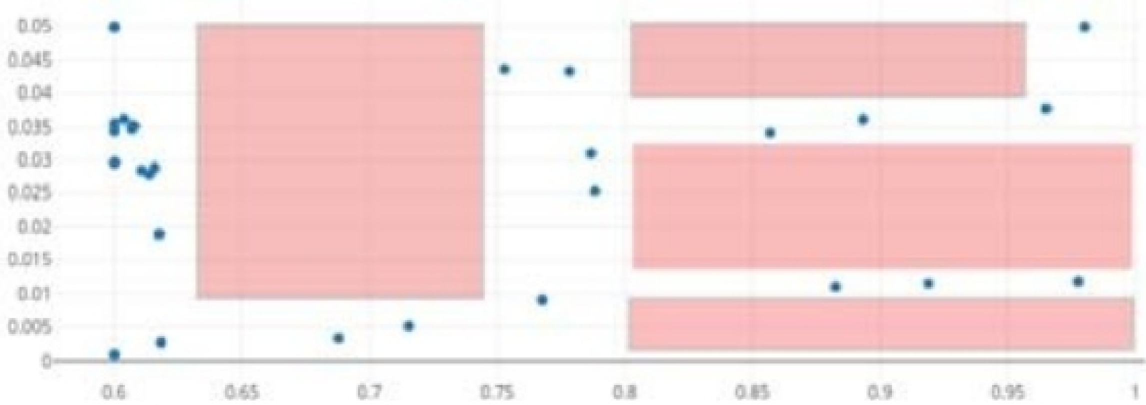


Fig 15: Unxplored regions of Learning Rate and Momentum for Baysian Tuning –ExperimentI

Fig. 15 shows the unexplored regions Experiment 1 which was distributed hyperparameter tuning with Bayesian optimization and four concurrent runs. The explored regions seem to be fairly distributed with still scope for lot of improvement.

Fig 16: Unxplored regions of Learning Rate and Momentum for Baysian Tuning with Horovod– Experiment II

Fig. 16 shows the unexplored regions Experiment 2 which was distributed hyperparameter tuning with Bayesian optimization, horovod for distributed training and two concurrent runs. The explored regions do not seem to be fairly distributed with still scope for lot of improvement.

Though both the approaches have scope for improvement, experiment 1 which was initiated with more warm-up runs due to higher concurrency seemed to have reasonable coverage in the hyper- parameter space across the three hyperparameters. Experiment 2 where we used only two concurrent runs for

Bayesian tuning though it yielded convergence of hyperparameters with reasonable accuracy did not have good coverage across the hyperparameter space for learning rate and momentum. This can be more acute when we are exploring higher dimension spaces of hyperparameters.

V. CONCLUSION

The experiments indicated that Bayesian Optimization can be very helpful to explore higher dimensional hyperparameter spaces especially when initiated with more warm-up runs to guide the exploration-exploitation process.

With availability of horovod for distributed training, each iteration can be completed faster with more compute thereby accelerating time towards convergence. The number of machine learning computes were not altered during this exercise, future work can explore varying computes in the cloud with more compute deployed during the warm-up phase and decreasing compute as the optimization marches towards convergence. This can significantly improve costs taking advantage of the convergence of the Bayesian optimization process.

REFERENCES

[1] Eric Brochu, Vlad M. Cora, Nando de Freitas (2010) A Tutorial on Bayesian Optimization of Expensive Cost Functions, with Application to Active User Modeling and Hierarchical Reinforcement Learning. arXiv:1012.2599v1

[2] Niranjan Srinivas., Andreas Krause, Sham M. Kakade, Matthias Seeger (2010) Gaussian Process Optimization in the Bandit Setting: No Regret and Experimental Design. arXiv:0912.3995v4

[3] Thomas Desautels, Andreas Krause, Joel Burdick (2012) Parallelizing Exploration–Exploitation Tradeoffs with Gaussian Process Bandit Optimization. In Proceedings of the 29th International Conference on Machine Learning, Edinburgh, Scotland, UK

[4] Daniel Golovin, Benjamin Solnik, Subhodeep Moitra, Greg Kochanski, John Karro, D. Sculley (2017) Google Vizier: A Service for Black-Box Optimization. In Proceedings of the 23rd Knowledge Discovery and Data Mining Conference, Halifax, NS, Canada

[5] Nicolo Fusi., Rishit Sheth , Melih Huseyn Elibol (2018) Probabilistic Matrix Factorization for Automated Machine Learning. arXiv:1705.05355v2

[6] Sergeev, A., Del Balso, M. (2018) Horovod: fast and easy distributed deep learning in TensorFlow. arXiv:1802.05799v3.

Multi- Label Classification of Toxic Comments using Fast- Text and CNN

[1]Suresh Mestry, [2]Vishal Bisht, [3]Roshan Chauhan, [4]Kaushik Tiwari, [5]Hargun Singh
[1]Assistant Professor, Computer Engineering, RGIT, Mumbai, India
[2,3,4,5]Student, Computer Engineering, RGIT, Mumbai, India
E-mail: [1]suresh.mestry@mctrgit.ac.in, [2]vishalkbisht@gmail.com, [3]singhrosen@gmail.com
[4]kaushikt97gmail.com, [5]hargunsingh3896@gmail.com

A B S T R A C T

Social networking and online conversation platforms provide us the power and ease to share our views as well as ideas. However, we are facing situations where, most of the people have taken these platforms as take for granted where they see it as an opportunity to harass and target others leading to cyber-attack and cyber- bullying, nightmare experiences and suicidal attempts in extreme cases. Manually identifying and classifying such comments is a very long, tiresome and unreliable process. In order to solve this challenge, we are aiming to develop a deep learning system which will identify such negative content over online discussion sections and successively classify them into proper labels. Our proposed model aims to apply the text-based convolution Neural Network (CNN) with word embedding, using Fast Text Method to analyze the comments. Fast-Text has shown more efficient results than Word2Vec and GLOVE model. Our model will aim to improve detecting different types of toxicity to improve the social media experience. The dataset used for building the model is Wikipedia's talk page edits.

Keywords - CNN - Convolution Neural Network, RNN - Recurrent Neural Networks, TFIDF - Text Frequency Inverse Document Frequency, SVM - Support Vector Machines, GLOVE-Global Vector for Word Representation.

I. INTRODUCTION

In today's world, conversation over the online social forums is one of the most common and easy way of communicating and expressing one's thoughts. These platforms allow you to discuss various things and share opinions over a particular topic. But maintaining decency and a good level of conduct or behavior over these platforms could be difficult. A lot of abusive content, harassment, jeering, cyber- bullying related activities has become very common on such places which leads to harmful effects on person's mental and psychological health. This can sometimes lead to detrimental and life-longing effects on one's life. Such type of situations can conclude for many people to stop expressing their opinions and not to seek and receive help from others. The companies which owns such online discussion platforms has been working on different solutions such as comment classification techniques, user blocking mechanisms and comment filtering systems. In the comment classification approach, the goal is to classify the comments or sentences based on their toxicity level into various categories. By categorizing these comments, the action team can take appropriate actions to curb the occurrence and growth of negative influences created with such activities on social platforms. Such a multi-label classification model will make the purpose of social conversation on social media more effective and positive. By automating this comment classification approach, the companies can save their time and manual efforts in moderating these platforms.

The data that we have used for our model is Kaggle's Toxic Comment Classification Dataset regarding Wikipedia's talk page edits. Using CNN, the aim is to develop a multi-headed model which classifies the comments based on its toxicity level into 6 different categories. They are: toxic, severe-toxic, obscene, threat, insult and identity-hate.

II. OBJECTIVES

- Creating a word embedding mechanism that can help to identify the slang or negative terms in the comment.
- Identify the class to which the slang term belongs based on toxicity level and assign corresponding weights.
- Perform an efficient pre-processing unit to make data suitable for analysis
- Create a CNN model to perform classification process by training the model with training data to fit and test to model to evaluate the accuracy rate.
- Improving the model by back propagation mechanism and managing the trade-off between over-fitting and under-fitting.

III. RELATED WORK

[1] They discovered that CNN performs toxic classification very well as compared to RNN due to high locality (features surrounding them) and specific labels. CNN with word embedding prove to be computationally efficient faster than LSTM but CNN with character-level embedding gives more accurate results as compared to RNN with LSTM cell and CNN with word-embedding.

[2] Paper published on 2011, discovered the aggressive and cyber-bullying related data found in YouTube and decomposed then for better classification. The data surveyed upon were mainly taken from controversial discussions.

[3] Experimented to predict the polarity of Twitter's tweets using LSTMs model and performed comparable results with recent algorithms.

[4] Discovered that CNN with word embeddings establishes a better approach for text classification as compared to SVM, Naive Bayes (NB), k-nearest neighbor and Linear Discriminant Analysis. CNN suits to be perfect for text classification and categorization based on labels provided in the training dataset.

[5] Researchers experimented word-level binary and multi-label classification on LSTM and CNN models and received that CNN models with character-level classification yielded the best performance.

IV. PROPOSED SYSTEM

We propose to use system comprising of Fast-Text word embedding technique and CNN for multi label classification task of toxic comments. In this system, input as comments will be fed from social sites which will be analyzed and send to word embedding phase. In this, sentences are broken into words and embedded into vectors which can be processed by CNN. After evaluation by trained CNN model, a resultant labels or categories of toxicity will be predicted and can be visualized.

V. METHODOLOGY

Machine or deep learning algorithms cannot process strings (plain text) as input. These algorithms are unable to process such string as raw input. Word embedding technique provides a solution for this issues by transforming the string text into a numerical format or vector format which can be used by model and also this format can be used to find semantic relationships between the associated words by calculating the difference between those two respective vectors, referred as embedding space.

Word2Vec focuses to find context behind the words by learning important relationships between them with the help of the neural network architecture which helps in deducing similarity between the neighbouring words. Word2Vec involves the encoding, in which it converts the text to a vector format using an encoding scheme like one-hot encoding and then embedding for dense vectors with similarity.

GLOVE does the task similarly as Word2Vec. The glove is a new log bilinear regression model. Glove counts all character and overall statistics are captured relating to how often it occurs.

Rather, than learning a vector representation for a word (like in Word2Vec), Fast-text learns from a representation for each character n-gram. Each word is delineated as a bag of character n-grams, so the overall word embedding is a sum of these character n-grams.

Fast Text is different from the above 2-word embedding techniques. While Word2Vec and GLOVE treat each word as the smallest unit to train on, Fast Text uses n-gram characters as the smallest unit. For example, the word vector 'apple' could be broken down into separate word vectors units as ['ap', 'app', 'ple', 'le']. So, the word embedding vector for "apple" is the sum of all these n-grams. Benefits of fast text are that it generates better word embeddings for rare words, or even words not seen during training because the n-gram character vectors are shared with other words. This is one thing that Word2Vec and GLOVE cannot bring home the bacon. That means that even for antecedently unseen words (e.g., due to typing mistakes), the model can make an educated guess towards its meaning.

$$-\frac{1}{2}\sum_{n=0}^{\infty} y_n \log\left(f(BAx_n)\right)$$

Fast-text can millions of example text data within minutes over a multi-core CPU and perform prediction on raw unseen text among more than 300,000 categories in less than 5 minutes.

Convolution Neural Network (CNN) is forward-feed neural network which contains three layers, convolution layers, pooling layers, and fully- connected dense layers. CNN is mostly used for the image classification task. Here, instead of an image, the input to CNN is sentences or documents represented as a matrix. In this, every row in matrix is a word or it can also be character where each row is a vector quantity that represents a word. These vectors are lower dimensional representation of words or what we call, word embedding like word2vec or GLOVE, but they could also be one-hot vectors that index the word into a vocabulary.

For a 10word sentence employing a 100-dimensional embedding, we might have a 10×100 matrix as our input.

In a vision, our filters slide over local patches of an image, but in NLP we typically use filters that slide over full rows of the matrix (words).Thus, the "width" of our filters is typically an equivalent because the breadth of the input matrix. The height, or region size, may vary, however windows over 2–5 words at a time is typical. For multi-label classification task, in CNN, we will use the soft-max layer as the output layer since it assigns the probability of belonging to a particular label in probabilities, in the range of 0 to 1.

$$\sigma(z)_j = \frac{e^{z_j}}{\sum_{k=1}^{N} e^{z_k}}$$

The first layer of the CNN embeds words into low- dimensional vectors. The next layer performs convolutions over the embedded word vectors mistreatment multiple filter sizes. For E.g., sliding over three, 4 or 5 words at a time. Next, we will be going to max-pooling. The results are put into a long feature vector which the fed into for dropout regularization, and classify the result using a soft-max layer. For each word we have a look-up table for word embeddings.

These m-dimensional embeddings square measure initialized at random and updated whereas coaching. These word representations square measure then averaged into a text -representation. After embedding, embedded tokens are fed into convolution and pooling layer and with some dropout, objective can be achieved. Figure 1 represents the work flow of classification task.

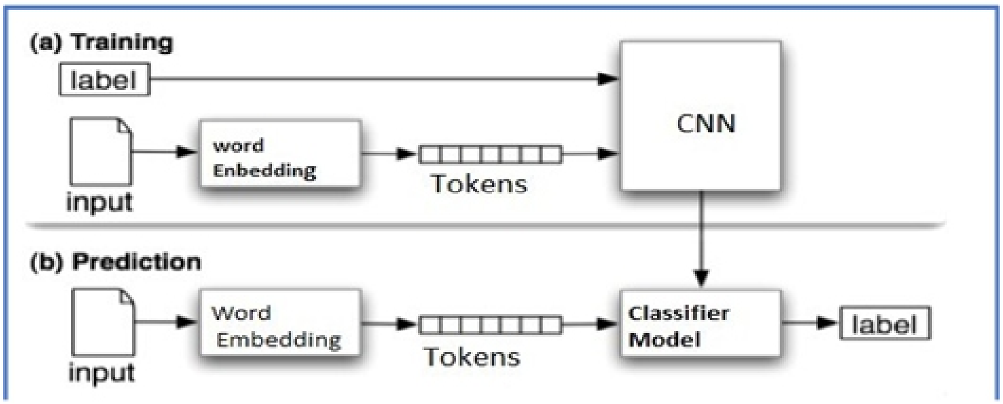


Figure 1. Workflow for model implementation

VI. ARCHITECTURE

The architectural design for our proposed model, representing software architecture is shown in Figure 2 and work-flow model is shown in the Figure 1.

1. Comments from Social Platforms: Gathering our comment data from the desired sources.

2. Data Study and Analysis: Work is to analyse the content, nature of data gathered and try to visualize the data present in terms of number of words and labels provided in the training set. Figure 3 and 4 shows the visualisation performed in our project with the Wikipedia dataset. We can derive that the number of comments having less than 200 words is very high in our dataset. Also, we can make a point from the figure 4 that most of the comments belongs to categories of toxic, obscene and insult.

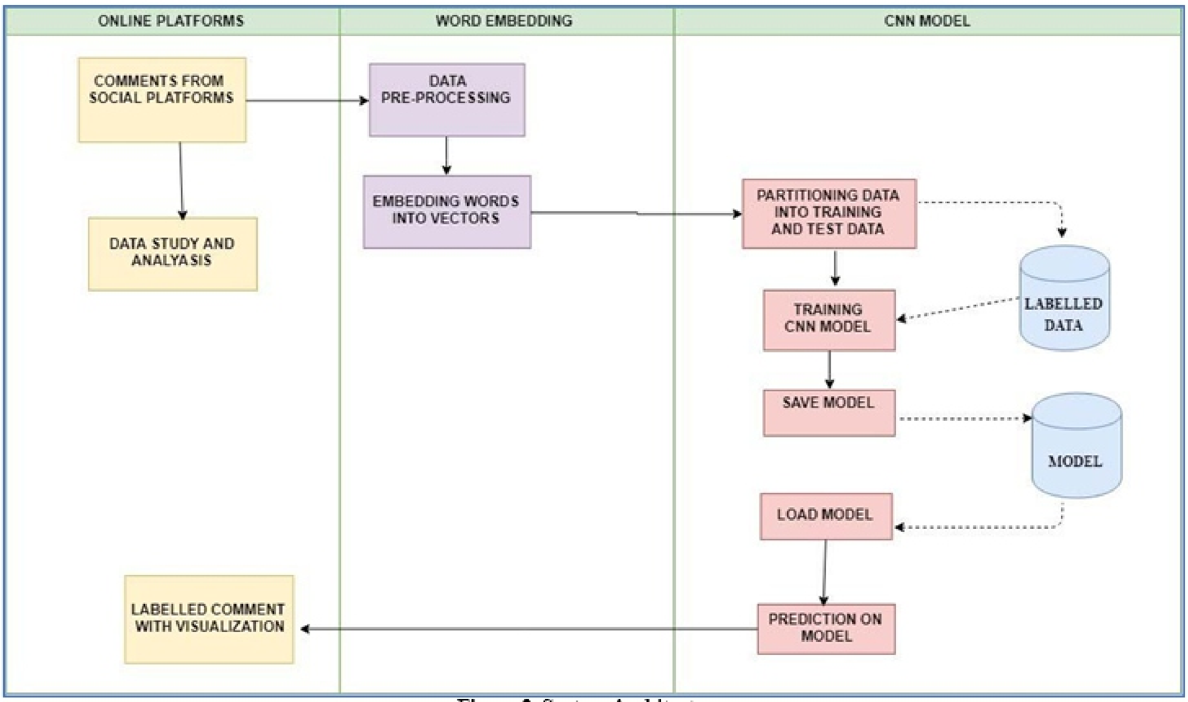


Figure 2. System Architecture

3. Data Pre-processing: To prepare data for model, we here remove all punctuation characters, conversion into lowercase letters, removing stop- words and appending the numeric digits to it.

4. Embedding word into vectors: The processed comments are converted into vector format, in numerical representation using Fast-Text.

5. Partitioning into training and test set: Splitting the data into training and test data with a 70:30 ratio respectively.

6. Training on CNN: First layer performs convolutions over the embedded word vectors using multiple filter sizes, then pooling layers and the dense layers, model will be saved.

7. Save model: Saving model checkpoints for future predictions. This also helps while tuning or adjusting the parameters of the model for accuracy improvement

8. Load model: Load model for predictions on the new unseen data, that is, unseen comments.

9. Visualizing with labels: Visualising or showing tagged or label comments on the platform end. Efficient visualizing the results with a well storytelling of the data or insights can help organizations to take proper measures for their platforms and reduce the chances of such activities to happen, thereby creating a positive impact on the digital world.

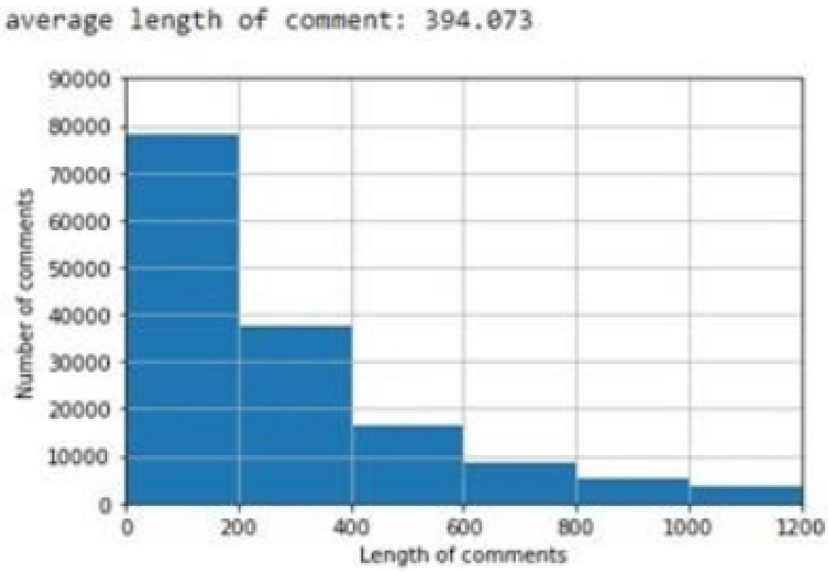


Figure 3. Number of Comments vs. Length of comments

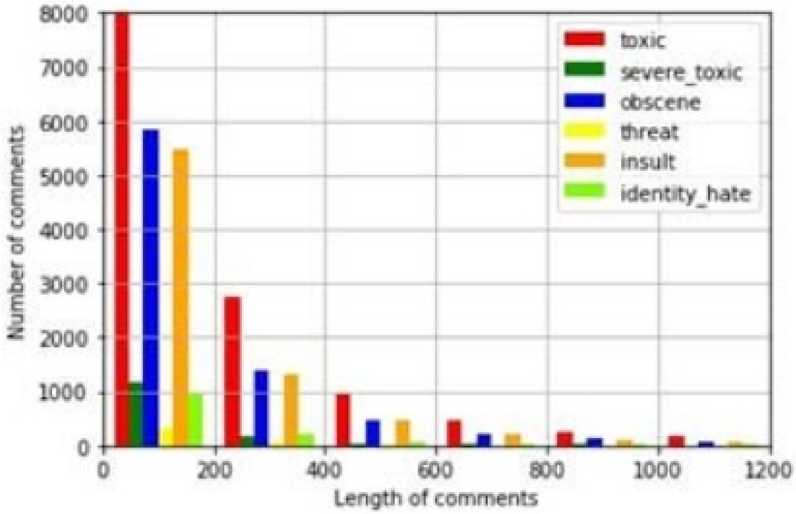


Figure 4: Number of Comments vs. Length of comments with multiple labels

VII. CONCLUSION

This project focuses on comments sharing applications like Wikipedia, YouTube, Twitter, Facebook etc. where online conversations and discussions take place on a regular basis. This comment contains words and expressions which ranges from positive impact to negative and toxic attacks. Our project focuses on to categorize such toxic sentences and identify such practices online so as to reduce its impact and monitor such acts. This will help the companies as well as government to achieve anti-bullying goals. The project does not cover to take actions over the comments classified, instead its main goal to classify the comment into proper category which explains it accurate nature and intent.

REFERENCES

[1] Thedora Chu, Max Wang, Kylie Jue. "Comment Abuse Classification with Deep Leraning." Stanford University.

[2] Karthik Diankar, Roi Riechart, Henry Lieberman. "Modeling the Detection of Textual Cyberbullying." Massachusetts Institute of Technology, Cambridge MA 02139 USA.

[3] Xin Wang, Yuanchao Li, Chengjie Sun, Baoxum Wang and Xialong Wang. "Polarities of Tweets by Composing Word Embeddings with Long ShortTerm Memory." 7th InternationalJoint Conference of Natural Language Processing. July-2005.

[4] S. V. Georgakopoulus, A. G. Vrahatis, S. K. Tasoulis, V. P. Plagianakos. "Convolutional Neural Networks for Toxic Comment Classification." arXiv:1802.099574v1 [cs.CL], 27 Feb 2018.

[5] Manav Kohli, Emily Kuehler and John Palowitch. "Paying attention to toxic comments." Stanford University.

[6] E. Wulcyzn, N.Thain and L.Dixon. "Ex-Machina-Personal attacks seen at scale." 2017 International World Wide Web Conference Committee (IW3C2), ACM 978-1-44501-4913- - 10/17/04

[7] Kevin Khieu, Neha Narwal. "Detecting and Classifying Toxic Comments." Stanford University- CSS224N.

[8] C. Nobata, J.Tetreault,A. Thomas, Y. Mehdad and Y.Chang. "Abusive language detection in online user content."

ISSN (Print): 2321 -4058, (Online): 2321 -4392

Client- Side Web Development Learning Environment with Utilization of Real Time Collaboration Tools (WEBLECT) using WEBRTC for Blended Learning

[1] John R. Del Rosario, [2] Benilda Eleonor V. Comendador
[1,2]Polytechnic University of the Philippines
E-mail: [1]john.delrosario@live.com.ph, [2]bennycomendador@yahoo.com

ABSTRACT

The learning process is aided by employing collaboration-based information possibly improving its retention through the already proven effectiveness of blended learning models. Going with the interaction and experience based blended learning, actual application of a problem-solving scenario makes a person try to accomplish the task based on how it was achieved in the past before trying anything else. With enough experience of tackling a problem a learner should be able to tap previous knowledge to accomplish an endeavor. Allowing a more meaningful approach to learning enables learners to retain as much information as possible. In this study a survey was conducted to gain understanding on web development learner's ideas on learning better through collaboration. The proponent used different studies as a reference for enhancing learners' experiences in web development learning which was eventually developed in to a learning management system with real-time collaboration tools. Web RTC was used in providing the real-time functionalities within the system that allowed learners to communicate in real-time thereby enhancing their experience and allowing them to share and collaborate ideas.

Keywords - Blended Learning, Experiential Learning, Web Development, Web, WebRTC

I. INTRODUCTION

Interactive teaching is becoming a feasible way of allowing learners to understand more about subject matters in a way that enables them to better grasp concepts through visualization. In general, the way in which individual concepts and theories are initially learned seems to play an important role in the degree to which this information is used later on. [1] Even in a classroom setting particularly computer classes where activities are subject to so much disorganization, reaching out to every student is a challenge. Enabling real time communication heightens interactions and increases the possibility of learners actually retaining information in events that need learners to acquire the knowledge in the form of condition-action pairs mediated by appropriate goal- oriented hierarchies. [1]. Allowing learners to interact through activities that challenge them should allow better retention of information as they are given more point-of-reference moments wherein they required a particular piece of information. Therefore any tool allowing such interaction heightens the experience of education and retention.

Blended learning is a formal education program in which a student learns at least in part through online delivery of content and instruction with some element of student control over time, place, path, and/or pace and at least in part at a supervised brick-and-mortar location away from home. By combining traditional classroom model and application of technological tools in learning, students are exposed to an improved learning experience. [2] By using the aforementioned technology on a learning tool gives possibilities of learners cooperating in activity scenarios where in previous practices are confined. Having these learners subjected to exchange of information technically exposes them to greater amount of experience thus possibility having them learn more. Not only through these exchanges but also will they learn through the exposure to different environments that would require them to collaborate to others in order to gain the information, thus allowing them to mark a piece of event in their memory that this particular event required them to acquire a piece of information relevant to their objective which makes this kind of learning admirable for blended learning. Since the mid-1980s, organizations around the world have depended on video conferencing to help them conduct business in a cost-effective, efficient, and more productive manner. Real world deployments have traditionally focused on the conference room as the implementation, the business meeting as the application, and reduced travel expenses as the benefit.[3]

It is no question that implementing real time communications can benefit any entity in a number of ways depending on the use case, though it can be challenging to do the implementation of such technology. Despite criticisms to the web being dead [4] HTML and JavaScript are also emerging as a popular development platformfor stand-alone applications, especially for smart phones and tablets. [5][6]JavaScript eventually became a key component in enabling continued evolution of the world wide weband through the introduction of Ajax made it a more interactive and dynamic environment. [7]Following this trend came WebRTC which utilizes the web as a media for real time communications. WebRTC is being shipped as an API within the Web browser through JavaScript. All the platforms supported by the said technology is based upon thenative APIs that are implemented based on the WebRTC specifications. [8] Having a common codebase for the technology would mean that development of applications using it would mean less overhead as there will be little to no differences in the usages of the APIs hence the more likely for it to be plausible for implementations of innovations especially in the field of education wherein the need for accessibility is an important factor. Being open source also has its merits because compared to all other implementations having the technological solution that costs nothing and is free for all to modify and use benefits all parties – both user and the technology. [9]

II. PROPOSED SYSTEM

Related Studies

Previous blended learning environment implementations lacked on the collaboration aspect as stated by most of the studies. The main reason for not being able to provide for the needs in this aspect was the lack of technology to fully support what the community wants which is to be able to replicate the brick and mortar type of learning as much as possible within a blended learning setup. Furthermore, the technology before also did not come simple, cheap or effective enough to be able to integrate it with the concepts of learning already known. These studies provided the proponent a venue for improving the conditions of learning in this aspect as well to demonstrate the available technology toolset as of the time of writing of the study. Due to these reasons, the desire to create a learning environment with collaboration tools deriving from an open-source publicly available technology was met and thus the author developed WEBLECT.

Introduction to blended learning

Today's education are based on a variety of learning models that are always adjusted to align with the strategic objects. Both the effectiveness of the learning model and the susceptibility of the students to get more information are taken into consideration in choosing what model to apply and what are to adjust in it in order to make the most out of the learning application. Some researchers coined traditional schooling as a factory model wherein the students are expected to be an output of the ideals of the school which is basically the opposite of what our education should be which is to deal with the deficiencies of the students in order to progress them to what they ought to be.

It has been described as a defunct methodology because what the school should be bringing to students are the levels of content that the students are capable of, not the other way around. In doing so the learning process encourages the students to pursue their own interest because they are not burdened by keeping up with the demands of the learning process and instead enable them to be at their own pace and measure their own learning. [10][11]

With the generation of computerization and information age almost all its applications that are found feasible are made and eventually made its way into the realm of learning. Taking blended learning's meaning literally wherein it being defined as a composition of different approaches, models and styles of learning computerized media, it has been made to cater to the learners' needs. [12] Through the course of time it has been made that this learning model coincide with the traditional brick-and-mortar way of teaching and learning as the subject matters that require the usage of certain kinds of technology eventually required the mixture of both. With this need came the transition and dilemma whether the combination of both elements is actually good enough to sustain the previous ways of learning and be good enough to take its effectiveness one step further.[13]

Blended learning problems in the communication domain

Blended learning has always been a challenge to implement effectively. For most of the part the communications aspect of blended learning has always been the most critical in that the focus of the communications must be learner-centric.

Previous efforts to smoothen communications was not that effective for the learners felt that the tools in use, that is online content, discussion boards and emails, were lacking interaction and too out of focus.

[14] As technology became more capable interactions between students and student-teachers became more of the focus as well as these were still elements of normal classroom settings that are proved to contribute to other student's learning. [15] This concept then paved the way to interactions-as-transaction paradigm [16] wherein the factors outlined in some researchers through interactivity correlates to the overall learning experience of students and should be taken into consideration when designing a course outline for blended learning. And with that employment of communication aides for learning became a norm that technology caught up with it and enabled more opportunities to enhance the learning experience for both teachers and students alike. With technology courses being a challenge to teach as it forces a classroom to combine traditional face to face learning, technology application either becomes a leverage or a distraction as stated current blended learning environments have difficulties in bridging the gap between learners and materials interaction. [17][18][19]

Evolution of enabling technology that can support blended learning

Through the utilization of capable blended learning methodologies and technology, educators are able to identify the extent of the students' competences andare the one to adapt what they will serve to the learners in order to maximize their learning capability without the cost of the students' welfare and confidence.[20] Technology surmounts geographical limitations of traditional communication and at this point in time is being pushed even further by enabling it at real time. The application in education made it possible to support remote learning without physical interaction but through blended learning interestingly this technique is also being applied and is demanding even more collaborative functionalities in order to simulate local classroom environments. [12][20] But technology almost always does not come free and is a product of extensive research and development. With regard to blended and ubiquitous learning the first concepts of using computer technologies in teaching came with the idea that any electronic instrument could aid in teaching then with computers came e- learning. [21] By then most of the implementations of communication agents was mostly through asynchronous methodologies wherein users will only tap the agent on the time that is mostly convenient for them. [22] Some examples of asynchronous implementations are through message boards, blogs, and messaging systems [20][23] and improved reference materials called wikis which are now in extensive use and the one at most recent which is social media. [24]

On the other hand is synchronous learning which is the most similar of all ubiquitous learning implementations to traditional classroom learning methodology wherein the interactions are done in real time. [25] The feeling of having communications in real time heightens the feeling of having a real conversation and interaction [26] which has been seen to be directly correlated with learning satisfaction and retention. [27]

Differences of technology that can be utilized in blended learning

Given the differences between the technologies now and back in the past it can be seen that it has improved much that the openness of technology makes the capability knock almost at our doorsteps. Both synchrony and asynchrony in communications is not a problem anymore as the technology tackling it evolves every single day.

Computer networking being implemented in both wired and wireless formats through Ethernet paved the way to it become the medium for other technologies for communication. [28] With the medium in place implementations then came starting with the hypertext transfer protocol or commonly known as HTTP which aimed and eventually became the standard information exchange for the World Wide Web. [29] The exchange of information became more demanding as the usage of the World Wide Web grew from basic content exchange demand to requests of applications being in place in the web ranging from simple to complex which required a more interactive version of served content. [7]XMLHttpRequest or now commonly known as AJAX answered the need for the level of dynamic- ness as it allowed the once static content served from initial HTTP requests to be appended or manipulated using retrieved additional content from server.[30] Though it alleviated the need for a dynamic functionality it was not a perfect solution because this was still implemented through HTTP wherein a content was only served whenever it was requested by a client which is not really a 2 way communication that fulfilled the purpose of the new dynamic-ness which became the demand.

The need for a real time communication through the World Wide Web was fulfilled by the emergence of the protocol called Web Sockets. The need for the protocol came from the limitations of XML Http

Request. With Web Sockets the communication between machines became bidirectional removing the need for client-server to wait for a resource request and now only requires a negotiation to initiate the direct communications. This eliminated the workaround used to make this possible in the previous technologies and making implementation more seamless. [31]

Demands seems to move along with the advancement of technology as requirements for more complex and challenging web applications are envisioned. Moving further from client-server model the industry demanded a model wherein machines could communicate directly with each other eliminating the need for a server to mediate with communications. Doing so could eliminate the costs of maintaining an additional server and would really scale well as only the peers themselves would talk in between the communications. Superseding the Web Sockets in this particular area is the WebRTC which enables bidirectional peer to peer communication that allows sharing of media and data more efficiently than its predecessors. With the data stream going through less machines the chances of data being lost decreases therefore increases reliability and the communications' latency decreases therefore improving overall performance. [32] What sets WebRTC apart from other technologies is that it is an open source project which means that there will be no costs in gaining hold of its usage as opposed to other technologies. WebRTC is also build as a specification and what this means is that the functionality which is now build in directly into browsers and some mobile devices will soon reach other kinds of devices as well. The other notable implementation also provide real time communications but with caveats is the notable Real-Time Messaging Protocol or also known as RTMP which is a proprietary protocol that enables performant transmission media for data and multimedia but can only be used on Adobe Flash [33], which is also notable mentioning that is being avoided in favor of HTML5 which is also open source and is built-in within browsers. [34]

System Architecture

The system is developed through a multi-tier architecture design that consists of the application, database and communications server. Figure 3 describes the overall system architecture of WEBLECT. The application server is responsible for serving the application to the connecting clients over HTTPS. WebRTC only allows connection through a secure protocol for security reasons so HTTPS is the only viable option. It is responsible for authenticating the users and facilitating data transfer. The application server is served through Microsoft's IIS Server. The communications server is responsible for the signaling processes of WEBRTC which is required to establish the peer-to-peer connection sessions, which allows the clients to communicate directly to each other. The server implements the Socket.IO software through the NodeJS platform. Once sessions are established, the clients can exchange data directly, that is without server facilitation and network traffic intervention, to each other and in real time.

(WebRTC 1.0: Real-time Communication Between Browsers, 2016) The database server contains the application repository which hosts the data for the tool which includes user,

course, activities and assessment records. The database server is implemented through Microsoft's SQL server. The tool in which the study is focused on should aid in the learning of web development through the features that is integrated in it. The activities dashboard provides the pending and upcoming activities for students as well as the pending assessments for instructors for a course. The course and activities management features allow the instructors to create and manage the content of the respective items while allowing the students to view and download the inputted contents in it. The user and roles management allow administrators to manage the accounts within the system and assign roles for each. The assessment management allows administrator accounts to assess activities submitted by students. The Web IDE provides the area for students to code web elements including HTML, JavaScript and CSS and allows them to show the output in the same page. This page is part of the students' activity workflow. The Web IDE also provides the collaboration tools that transmit and receive data in real-time where the modules are described in Error! Reference source not found..

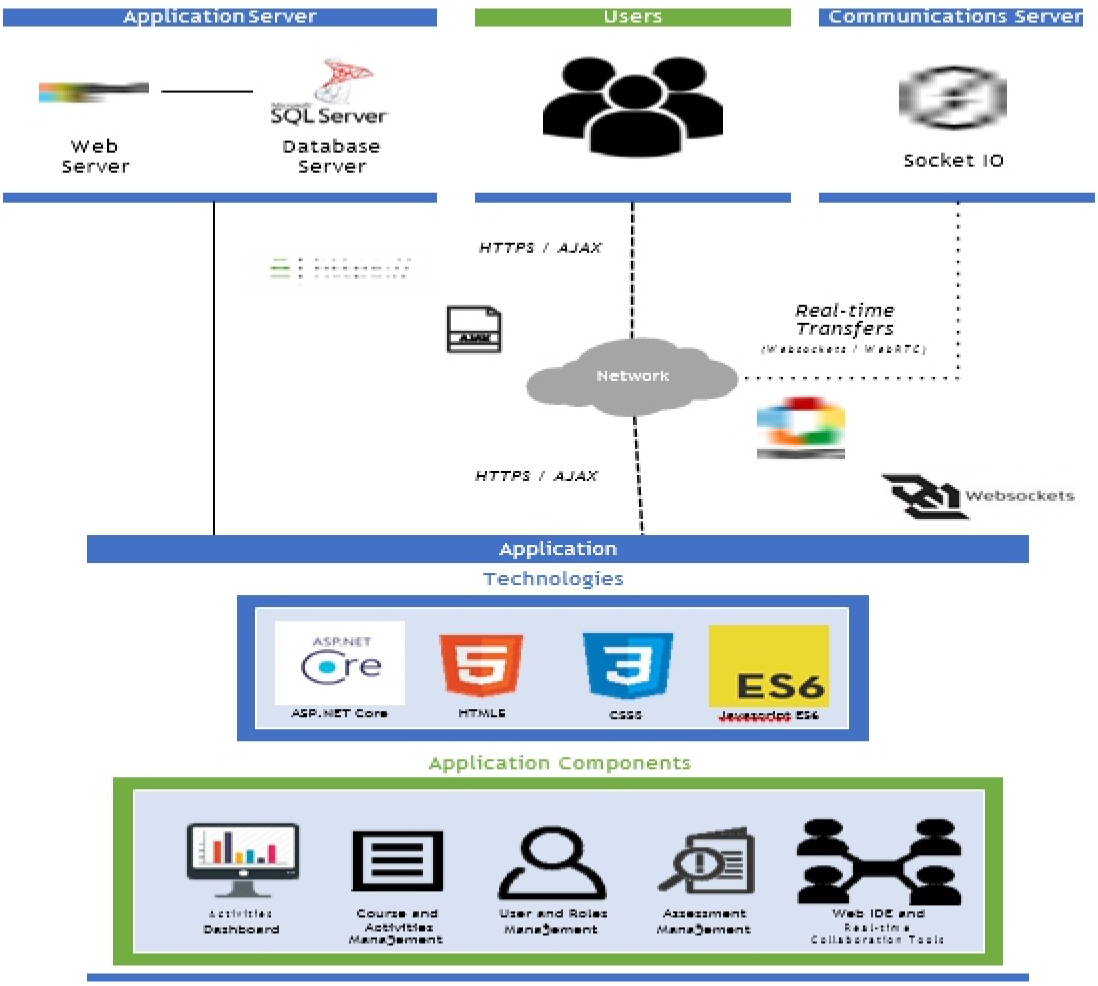


Figure 1. WEBLECT High Level Architecture

The application components can be used by the user logging in first within the system. The system administrator would need to setup the users that will have normal and administrative access to the system. The admin should then set the courses which provide the high-level element for the student interaction. Next that will be set up is the lessons and the activities within it. When everything has been set up can the collaboration of the users take place in the activity modules where the users are connected to each other through the collaboration modules. After the activity has been submitted can the corresponding administrators view and rate their students' activity sessions. When all the activities of the student for the particular lesson are assessed then can it be assessed; the same with the overall course assessment. The assessed elements can then be viewed by the students when it is presented in their dashboard or when they access the corresponding page.

The application components are used in a manner flow as described in Figure 2.

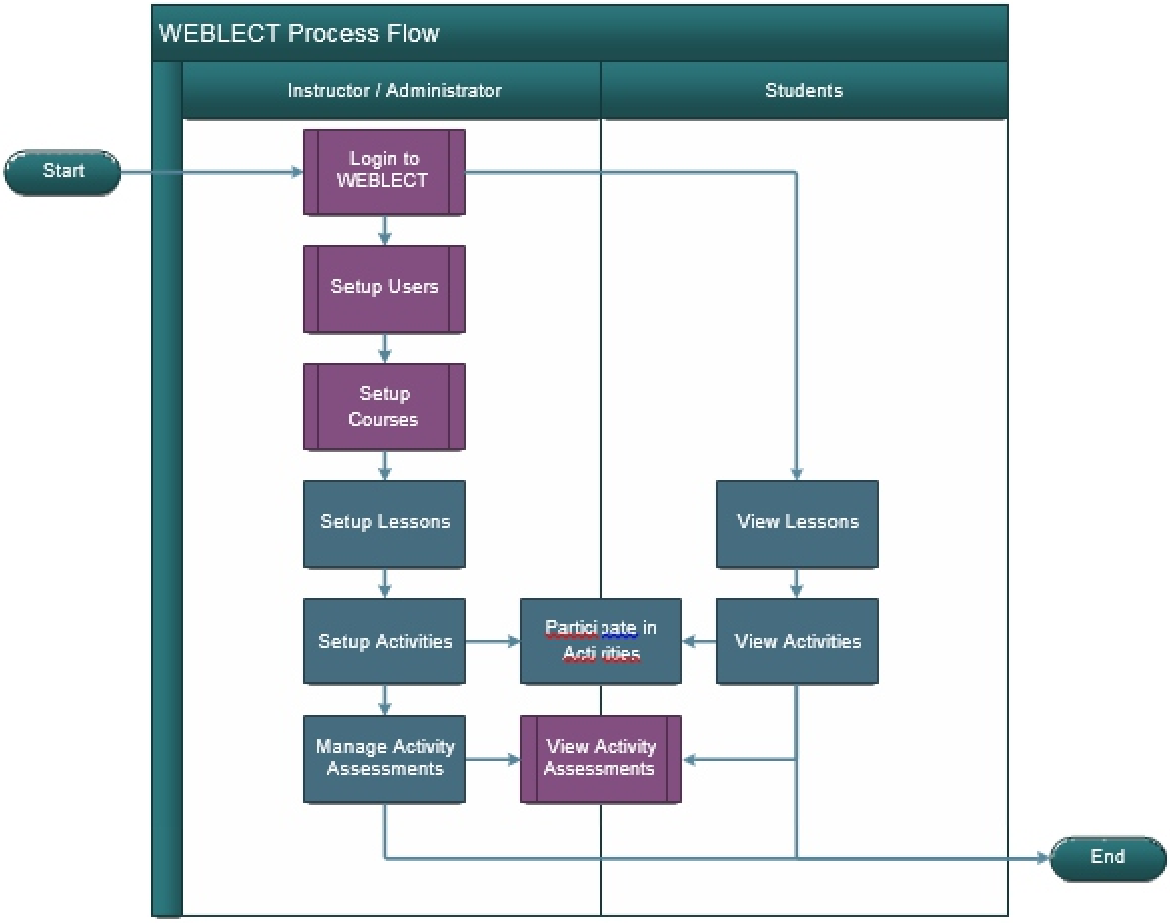


Figure 2. WEBLECT Process Flow Diagram

The real-time communication modules are included through the application inside the application server through the real-time functionalities of Socket.IO and WebRTC. These technologies were chosen because of many reasons mainly with these technologies being free and open-source, secure, and easy to develop and deploy. There is not many, if any, licensing issues and interoperability is great with other existing technologies.

WebRTC also reduces load in operating costs as connections are made by the clients itself and does not rely on servers once connected so concurrency and reliability is high.

As with many existing learning management systems being expandable they suffer from performance issues as extending the base system requires more resources for its servers to perform well; In contrast with the tool developed the modules integrated with it does not piggy back on the actual used servers.

The real-time communications modules are initiated by user in the application through the browser. This initialization in turn requires the communications server to establish the peer to peer communication of the client computers.

When the peer-to-peer communications channel is established all the modules is then connected directly with the other clients through it and does not require the server anymore, courtesy of WebRTC as described in Figure 3.

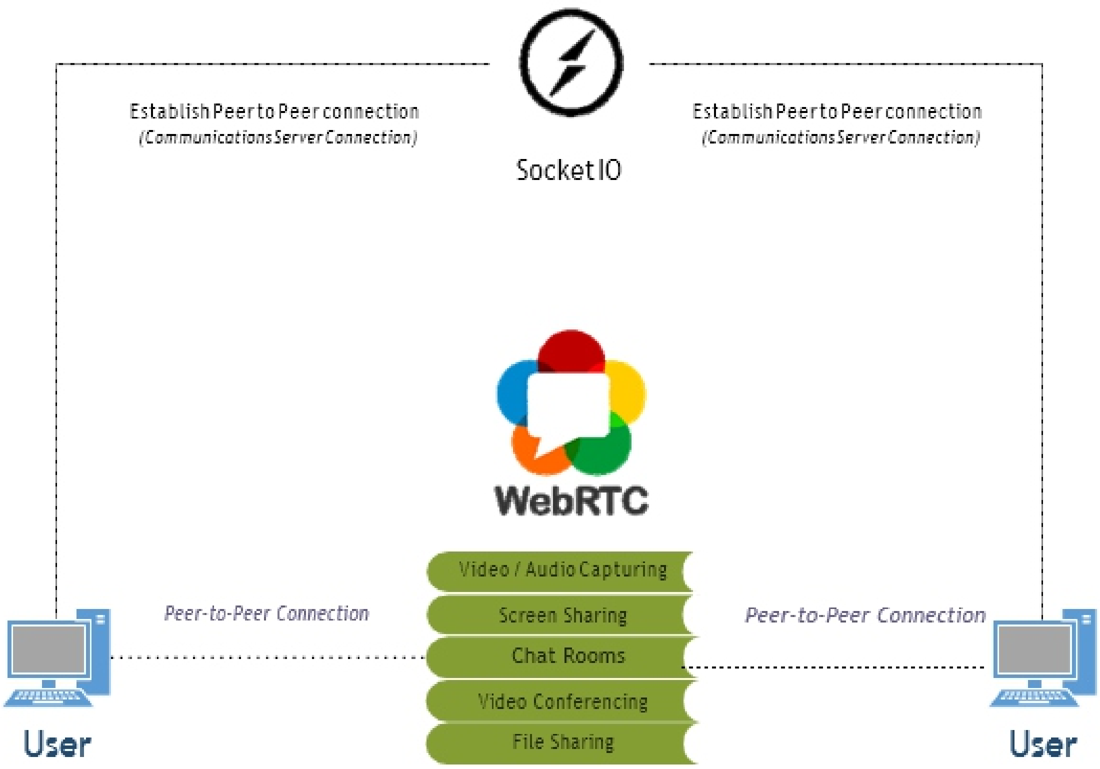


Figure 3.WebRTC Peer to Peer Connection Establishment

The collaboration tools are fired in sequence which starts with the session initiation on the user interaction of the system which is followed by the system prompting the client directly to other users with its guidance using the peer information within its signaling mechanism. Once peer information is exchanged then data is passed through the connected clients peer to peer. The subsequent connection requests of the software as described in the UML sequence diagram in Figure 4.

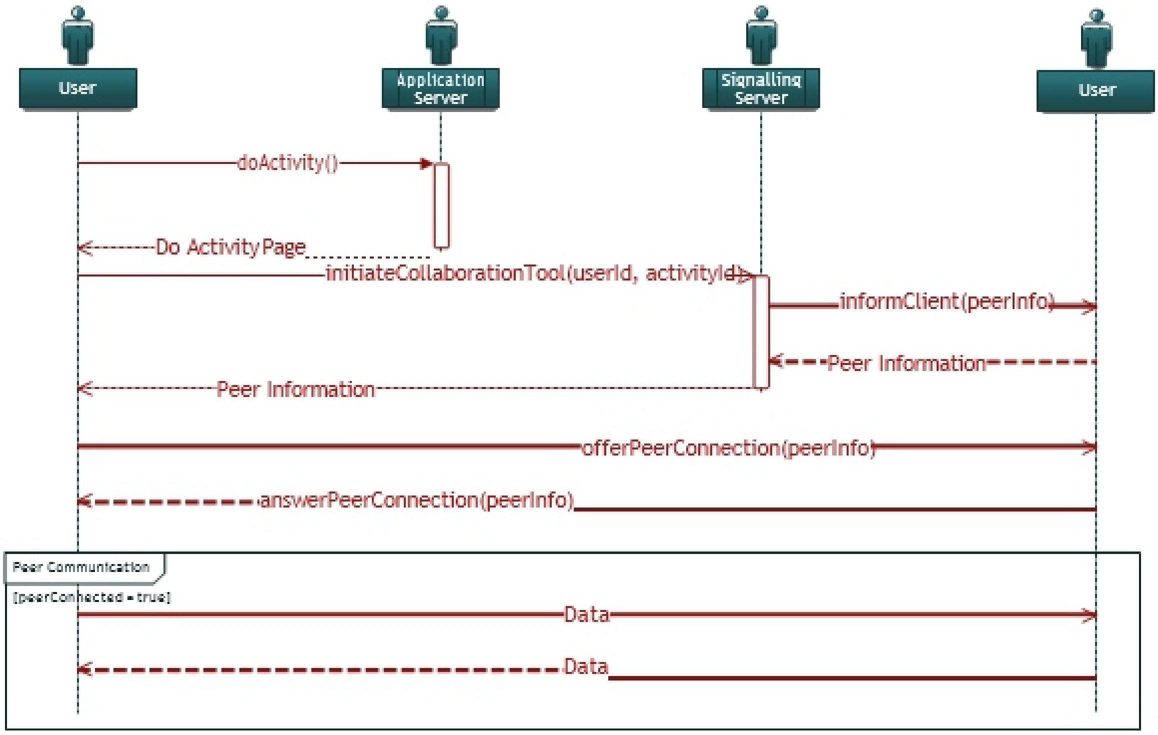


Figure 4. WebRTC High-Level Sequence Diagram

Client-Side Web Development Learning Environment with Utilization of Real Time Collaboration Tools (WEBLECT) using Web RTC For Blended Learning The application was configured to support up to one 200 simultaneous WebRTC connections in a mesh topology per web browser tab to function safely and efficiently. The file attachment limit is configured to 50 megabytes (50 MB) which is transferred in chunks of 16 kilobytes (16 KB) to avoid bad network traffic across simultaneous users. The application is estimated to handle 20,000 concurrent users with normal usage and data. The WebRTC currently supports open-source codecs in its implementation which are VP8 for video and G.711, G.722, iLBC, and iSAC for audio.

Table 1presents the technical features of WEBLECT.

Table 1 - Technical Features of WEBLECT

Features	Specifications
Simultaneous Users Per Browser Tab	200 Users
Concurrent Users	20000 Users
Data Transfer Chunk Size	0.000016 Megabytes
	(16 Kilobytes)
Maximum File Attachment Size	50 Megabytes
Signaling Server Memory Usage Per User	0.05 Megabytes
WebRTC Supported Video Codecs	VP8
WebRTC Supported Audio Codecs	G.711, G.722, iLBC, and iSAC

The features were measured against a machine hosting all the system tiers namely the application, signaling and database components with a processor of Intel Core i7-4710MQ 2.50 GHz, a random-access memory size of 16 gigabytes (16 GB), and storage space of 500 gigabytes (500 GB) on a Microsoft Windows 10 Pro Operating System. Error! Reference source not found.

shows the hardware specifications of the machine wherein the demo was run against during the time of the study.

Table 2 - Hardware Specifications

Hardware	**Specification**
Processor	Intel Core i7-4710MQ 2.50 GHz
Random-Access Memory	16 Gigabytes
Hard Disk Capacity	500 Gigabytes
Operating System	Windows 10 Pro

III. CONCLUSION

Based on the findings of the study there are challenges in learning through a web development course that can be addressed for learners to appreciate diving further in to web development.

The respondents' level of agreement on the importance of collaboration tools in a web development learning environment show that they agree in the inclusion of such tools on the subject's learning environment. The respondents' level of acceptance on the software based on its functionality, reliability, usability and performance implies that they find the software acceptable in such aspects.

And finally there are rooms for improvement and enhancements for the client-side web development learning environment with utilization of real time collaboration tools using WebRTC.

1. Future Works

Since the study will be focusing on the implementation of the technology the recommended way forward is to implement other smart systems to integrate with WebRTC. It is also recommended to proceed with further implementation of computer aided learning algorithms within the tool to further its usefulness. Collaboration definitely helps in having more control over the course flow of the lesson and learner inquiry so inclusion of these in a learning environment should step up the students' learning experiences. The software must apply the suggested improvements of the study's respondents which allows them to have a better learning experience.

2. Appendices

3. Tables

REFERENCES

[1] J. D. S. R. D. H. T. S. K. C. K. &. W. S. M. Bransford, "Anchored instruction: Why we need it and how technology can help," Cognition, education, and multimedia: exploring ideas in high technology, 1990.

[2] H. S. a. M. B. Horn, "Classifying K–12 Blended Learning," May 2012. [Online]. Available: http://www.christenseninstitute.org/.I. M. Weinstein, "The New Business Case for Video Conferencing," p. 2, 2013.

[3] R. L. H. T. S. a. J. S. Stephan Herhut, Parallel Programming for the Web, Berkeley, CA: USENIX, 2012.

[4] "Boot to Gecko," [Online]. Available: https://wiki.mozilla.org/B2G.

[5] M. Siegler, "Project Spartan: Facebook's Hush-Hush Plan to Take On Apple On Their Own Turf: iOS.," [Online]. Available: http://techcrunch.com/2011/06/.

[6] Liu, "JavaScript and the Netflix User Interface – Conditional Dependency Resolution," AcmQueue, 2014. Google, "WebRTC," 2014. [Online]. Available: http://www.webrtc.org/home.

[7] S. P. K. Vamshi Ambati, "How can Academic Software Research and Open Source Software Development help each other?," 2004.

[8] M. Y. S. Buket Akkoyunlu, "A Study of Student's Perceptions in a Blended Learning Environment Based on Different Learning Styles," Educational Technology & Society, 2008.

[9] L. M. Miller, "Using learning styles to evaluate computer- based instruction," Computers in Human Behavior, p. 287–306, 2005.

[10] H. Chris Procter, "Reflections on the Use of Blended Learning," Education in a Changing Environment, 2004.

[11] M. B. H. a. H. S. Clayton M. Christensen, Is K–12 Blended Learning Disruptive?, Clayton Christensen Institute for Disruptive Innovation, 2013.

[12] H. Frances Bell, "With regard to respect: a framework for governance of educational virtual communities," International Journal of Web Based Communities, 2004.

[13] R. Donnelly, "Harmonizing Technology With Interaftion In Blended Problem-Based Learning," Computers and Education, pp. pp.350-359, 2010.

[14] E. D. Wagner, "On Designing Interaction Experiences for the Next Generation of Blended Learning," in The Handbook of Blended Learning: Global Perspectives, Local Designs, San Francisco, 2005, pp. 41-55.

[15] M. Keppell, "Authentic Cases and Media Triggers for Supporting Problem-Based Learning in Teacher Education," Authentic Learning Environments in Higher Education, 2016.

[16] C. B. Lorna Uden, "Technology and problem-based learning," British Journal of Educational Technology, 2007.

[17] Ö. Delialioğlu, "Student Engagement in Blended Learning Environments with Lecture-Based and Problem-Based Instructional Approaches," Educational Technology & Society, 2012.

[18] U. Köse, "A blended learning model supported with Web 2.0 technologies," Procedia Social and Behavioral Sciences 2, 2010.

[19] N. G. M. Kundi, "From E-Learning 1.0 to E-Learning 2.0: Threats and Opportunities for Higher Education in Developing Countries," European Journal of Sustainable Development, pp. 145-160, 2014.

[20] G. Salmon, E-moderating - The Key to Teaching and Learning Online, 2007.

[21] M. Ebner, "E-learning 2.0 = e-learning 1.0 + web 2.0?," The 2nd International Conference on availability, reliability and security, pp. 1235 - 1239, 2007. L. Ferret, "Wikis and e-learning," in E-learning concepts and techniques, Bloomsburg, Bloomsburg University, 2006, pp. 73-74.

[22] J. I. S.-J. X. G. Wendy Zhang, "Can E-learning Replace the Traditional Classroom - A case study at a private highschool," ISECON, 2007.

[23] K. P. Rena M. Palloff, Building Online Learning Communities, Jossey-Bass, 2007.

[24] G. Picciano, "Beyond Student Perceptions Issues of Interaction, Presence, and Performance," JALN, 2002.

[25] P. G. J. Ferdy Hanssen, "Real-time communication protocols: an overview," 2003.

[26] R. T. Fielding, J. Gettys, J. C. Mogul, H. F. Nielsen, L. Masinter, P. J. Leach and T. Berners-Lee, "Hypertext Transfer Protocol -- HTTP/1.1," June 1999. [Online]. Available: https://tools.ietf.org/html/rfc2616.

[27] "The responseXML attribute of the XMLHttpRequest object explained by the W3C Working Draft," 30 January 2014. [Online]. Available: https://www.w3.org/TR/XMLHttpRequest/#responsexml.

[28] M. Ian Fette, "The WebSocket Protocol," December 2011. [Online]. Available: https://tools.ietf.org/html/rfc 6455#section-1.1.

[29] J. Y. K. S. Alan Johnston, "Taking on WebRTC in an Enterprise," IEEE Communications Magazine, vol. 51, no. 4, 2013.

[30] E. M. T. E. H. Parmar, "Real-Time Messaging Protocol (RTMP) specification," 21 December 2012. [Online]. Available: https://www.adobe.com/devnet/rtmp.html.

[31] S. Jobs, "Thoughts on Flash," April 2010. [Online]. Available: http://www.apple.com/hotnews/thoughts-on-flash/.

[32] J. R. Lourenço, B. Cabral, P. Carreiro, M. Vieira and J. Bernardino, "Choosing the right NoSQL database for the job: a quality attribute evaluation," Journal of Big Data, 2015.

[33] V. R. B. Craig Larman, "Iterative and Incremental Development: A Brief History," Computer, 2003.

[34] "WebRTC 1.0: Real-time Communication Between Browsers," 13 September 2016. [Online]. Available: https://www.w3.org/TR/webrtc/#examples-and-call-flows.

ISSN (Print): 2321 -4058, (Online): 2321 -4392

Enabling Search Operations on Private Spatial Data in Cloud

[1] A. Merlin Monisha, [2] M. Lilly Florence
[1]M. Tech. Scholar, Adhiyamaan College of Engineering, Hosur-635109
[2]Prof / CSE, Professor Adhiyamaan College of Engineering, Hosur-635109
E-mail: [1]mailtomerlinmonisha@gmail.com, [2]lilly_swamy@yahoo.co.in

ABSTRACT

Cloud offering different kinds of services to users and organizations with different cloud model like public cloud, private cloud and hybrid cloud. Introducing public cloud which provides data storage and query services available for more users along with low cost. Data outsourcing is a common cloud computing model that allows data owners to take advantage of its on-demand storage and computational resources. The main challenge is maintaining data confidentiality regarding intruders. Present methodologies either conciliation the undisclosed of the data or undergo from high communication cost between the server and the user. To overcome this problem, suggest a dual transformation and encryption scheme for spatial data, where encrypted queries are executed entirely by the service provider on the encrypted database, and encrypted results are returned to the user. The user issues spatial related queries to the service provider, using the decrypt key the user can get the response. Finally our proposed method moderates the unique query communication between the authorized user and service provider. Encrypt the data using Advanced Encryption Standard and Indexing and ranking algorithm to process KNN queries.

Keywords - Spatial Databases, Data Encryption, Security, Query Processing, Database Outsourcing.

I. INTRODUCTION

The expansion of spatial information has driven associations to transfer their information onto outsider specialist organizations. Distributed computing enables information proprietors to outsource their databases, disposing of the requirement for exorbitant capacity and computational assets.

The admin was created to detail the working of a hospital record keeping system in respect to patient information from this project.

Then patient has to share their location, so that the patient nearby places are displaying. Now patient can give request to the admin. The admin has to receive the request from patient and he has to provide the AES key for each patient. After receiving the AES key from admin the patient can decrypt the records and receiving the original records of patient.

For a little cost, associations with constrained assets can outsource their extensive volumes of information to an outsider specialist co-op and use their powerfully adaptable capacity and computational power. In any case, the reality remains that the information is controlled by an untrusted outsider and this raises basic security issues, for example, secrecy and honesty. Information privacy necessitates that information isn't revealed to untrusted clients and information trustworthiness guarantees that information isn't adjusted before being prepared by the server.

As of late, unique areas, for example, the database and the cryptography network have investigated the issue of questioning scrambled information at the untrusted specialist organization. This outsourcing of information cuts down both venture cost and operational costs for colossal partnerships. In the meantime, outsourcing involves that clients lose essential control of their information and tasks performed on the information. This thusly infers the information is helpless to security concerns, for example, information privacy.

Recently, mobile devices and navigational systems have become exceedingly common and this has created the need for Location-Based Services (LBSs), which is a motivating application for database outsourcing. This in turn has led to an increase in spatial data which has to be managed and maintained effectively. Spatial data in a LBS includes the location information (i.e., latitude and longitude) besides other descriptive components which require huge storage capacity. Numerous users require LBSs on a daily basis and would like to issue spatial queries in an anonymous manner with a fast response. Also, the data owners do not want to reveal the data to the service provider in order to maintain the confidentiality of the data. With a cloud computing platform, it is possible to enhance query processing without burdening the user and manage the storage efficiently. Therefore, in this work, the aim is to effectively utilize the cloud environment to provide high throughput processing with low latency by performing queries at the service provider.

Thus, one has to consider the following requirements when outsourcing spatial databases in the cloud environment. First, the database content should be kept hidden from the service provider and malicious attackers.

Another important issue to resolve is the development of efficient query processing techniques that can be executed on encrypted data at the service provider, such that user queries are handled entirely at the service provider without requiring multiple rounds of communication with the authenticated users. Several specialized encryption techniques have been proposed for this purpose. A relatively new encryption scheme is the Fully Homomorphic Encryption technique proposed by Gentry et al., which enables direct computation on encrypted data which is stored in the service providers in the cloud. Different types of queries can be processed without decrypting the data. However, all known homomorphic schemes are too inefficient for use in practice and suffer from high performance overhead. One of the practical schemes, which is partially homomorphic, is the order-preserving encryption (OPE) technique introduced by Agrawal et al. OPE hides the original data values while allowing simple comparisons to be correctly evaluated on the encrypted data i.e., the order relation of plaintexts in ciphertexts is preserved. The cloud servers have no knowledge concerning the stored data, the processing function, the result, and any intermediate result values. Therefore, the outsourced comparison is performed in a fully secure manner. This permits range queries on the encrypted data directly at the untrusted service provider without having to decrypt confidential data.

Most existing approaches protect the outsourced data using spatial transformation schemes or conventional cryptographic techniques. However, to the best of our knowledge, with most schemes there is a trade-off between data confidentiality and efficient query processing. To overcome these limitations, we propose a two-layer encoding approach, in which the spatial data points are transformed and then an encryption technique is applied to the transformed spatial space. Encryption allows data to be securely outsourced to the untrusted service provider, while the transformation adds another layer of security to the approach by hiding the original location of the points.

In this paper, the cloud architecture model used comprises of 3 main entities, namely the Data Owner (DO), Service Provider (SP) and Authenticated User (AU). The DO guarantees security by transforming and encrypting the spatial database before outsourcing to the SP. To transform the 2D spatial data points, the DO employs the Hilbert space-filling curve. The DO forms a list of packets defined by the Hilbert ordering. Next, this list is encrypted using the OPE technique, which allows spatial range queries to be performed at the SP without engaging the user and reducing any additional communication overhead.

Additionally, the DO provides the Hilbert transformation key as well as the encryption key to the AUs. The keys are used by the AU to issue encoded range queries to the SP. The query is processed on the encrypted database at the SP and the results are returned to the AU. Lastly, the AU decrypts the query response using the encryption key to obtain the actual result.

The main issue with OPE is that it cannot provide ideal security desired by cloud consumers since the order of plaintext is revealed by the ciphertext. Moreover, with the basic OPE scheme construction, client-side decryption time is much higher than traditional encryption techniques. Thus, in this work, we build on the dual encoding approach proposed in to make it more secure by allowing search on encrypted data at the service provider without using OPE. The simple solution would be to store the encrypted spatial database using a strong and secure encryption method (such as Advanced Encryption Standard (AES)) at the server-side as in [10]. No information can be deduced from this stored encrypted data and hence no query processing can take place at the server. The only way is to send the whole encrypted database to the user, where the user can decrypt and extract the required result.

In spatial database outsourcing applications, the attackers have to be prevented from gaining illegal access to the data. To analyze the security provided by the proposed schemes, it is assumed that the users are trusted by the data owners and, the transformation and encryption key is only provided to the authenticated users. However, the cloud service provider cannot be trusted with confidential data, as the SP is an untrusted third-party that provides services to multiple DOs and they could release sensitive information to competitors. Furthermore, there are malicious attackers lurking around, waiting to eavesdrop and compromise the data confidentiality and query privacy required by the data owner using the cloud server. Outsourced data and user queries can be kept confidential by using cryptography to encrypt the data and prevent attackers and eavesdroppers from prying private information. Thus, in our approach, confidentiality is guaranteed by the dual encoding technique. We show that using both keys for spatial data provides security against known attacks defined in the literature.

A scenario of such an exchange in a LBS application is where a data owner outsources its data to a service provider like Google. In the process, the data owner does not want to expose the sensitive information to the server. The authenticated users send queries to the service provider for information but do not want to reveal their location to the server, which is capable of handling tens of millions of user query requests.

In our approach, we try and achieve a balance between efficient query processing and obscuring data at the server. We achieve efficiency by performing query search at the service provider on the Hilbert Packet List and thus, reduce the time taken to communicate the query response between the user and server i.e., a single round of communication. Efficient query processing is a key requirement of LBSs for the user and therefore database outsourcing techniques have to achieve a low communication cost. This requires schemes that encode the spatial data and queries, and then processes spatial queries over the transformed data at the service provider. Most of the existing techniques do not utilize the computational power of the SP and thus, we plan to overcome this shortcoming by performing efficient range queries on the encrypted data at the SP. We conduct an extensive experimental analysis to show the effectiveness of our technique and comparison is done with two existing approaches on different criteria. Furthermore, since LBSs have to handle a huge amount of spatial data, we have demonstrated the capability of our approach in the Experimental Evaluation with two large static spatial datasets (from OpenStreetMap).

II. RELATED WORK

Cloud computing provides benefits to both the data owner and the user. Data owners can store huge amounts of data on the cloud for a low cost. Users can enjoy on-demand provision of services, hence saving time. However, the cloud environment poses data security and privacy challenges. With the excessive use of mobile devices and navigational systems with GPS, location-based services have become widely popular in this domain. Database outsourcing has become common in recent times due to the large amount of spatial data available. Hacigumus et al. were the first to propose the notion of outsourcing databases to a third-party service provider.

Symmetric Cryptography Schemes

Yiu et al present a cryptographic based transformation scheme for two-dimensional data to enhance the security of spatial data. The DO uses the R -tree structure to index the database and encrypts each node using the AES encryption. Query processing requires multiple rounds based on the depth of the R -tree between the user and server, thus increasing the communication cost. The SP sends the encrypted root node to the AU and the AU decrypts the node using the key. The AU then requests the child node overlapping with the query region till a leaf node with the data points is reached. However, CRT indexes are built for static data and cannot handle dynamic updates.

Similarly, Kim et al. developed a cryptographic scheme based on the Hilbert-curve transformation (HCT) to balance between data security and query efficiency. They use the Hilbert curve to locally cluster the data by transforming two-dimensional data to a single dimension and thus hiding the coordinates of the original points. Then a straightforward approach is followed and the conventional AES encryption is applied to the transformed data. The encrypted file is securely stored at the SP. For query processing, the entire encrypted file has to be sent to the AU, decrypted and then searched for the records relevant to the query. Since this requires multiple communication rounds, this proves to be highly time- consuming and data-intensive for usual range queries that require only a portion of the database as the result.

Preserving Location Data Privacy

In addition to the cryptographic techniques mentioned above, Yiu et al. also present three different spatial transformation methods that are based on partitioning and redistributing the locations in the space. Namely: 1) Hierarchical Space Division (HSD), 2) Error- Based Transformation (ERB) and 3) a hybrid of HSD and ERB. However, these techniques preserve the coordinates of the original points and assuming that an attacker can gain background knowledge of the original points and coordinates of these points in the transformed space, information about close by data points can be exposed. Another spatial transformation scheme is proposed by Hossain et al.. Their scheme offers data security by applying a shear transformation as well as the rotation transformation but is not secure against the proximity attack. Data transformation methods provide a stronger notion of privacy despite being slightly more computationally intensive due to the encoding and decoding operations. In another solution, the data owner encodes the database prior to transmitting it to the service provider. An authorized user that possesses the secret keys, issues an encoded query to the SP. Both the database and the queries are not accessible by the SP and thus, privacy is assured. The main idea is to provide the SP with searching capabilities over the encoded data. Khoshgozaran et al. transform the points using the Hilbert mapping using parameters such as curve order, scale, orientation, etc. as the secret key. Their technique allows approximate search directly on the transformed points.

Privacy and Integrity Guarantee

On the other hand, Ku et al. proposed a technique for outsourcing databases while assuring both data privacy and query integrity. To preserve data privacy, the data points are encrypted with a symmetric key and indexed by the Hilbert value. Whereas, to ensure query integrity, a probabilistically replication method is applied to a portion of the data which is encrypted with a different space key. Then the two encrypted datasets are combined and stored at SP allowing the client to examine the reliability of the query results. Based on the current research in the field, the Hilbert- curve does not take the distribution of spatial points into consideration when transforming the original space. In fact, it divides the space using the same granularity and generated Hilbert values to construct the Hilbert index. Tian et al. resolve this issue by proposing an index modification method for the standard Hilbert curve, which compresses the null value segments to improve the security of the Hilbert curve. Moreover, they also formulate the privacy disclosure risk metric to help analyze the security risks posed by space filling curves.

Whereas in our approach, we assign Hilbert index values to each spatial point and then divide the points into packets based on the packet size. We store the spatial points in a packet list along with the startingand ending Hilbert index of each packet.

III. PROPOSED SYSTEM

Cloud computing services empower organizations and individuals to outsource the management of their data to a service provider, in order to save on hardware investments and reduce maintenance costs. Only authorized users are allowed to access the data. Nobody else, including the service provider, should be able to view the data. For instance, a real-estate company that owns a large database of properties wants to allow its paying customers to query for houses according to location. On the other hand, the untrusted service provider should not be able to learnig the property locations and, e.g., selling the ainformation to a competitor.

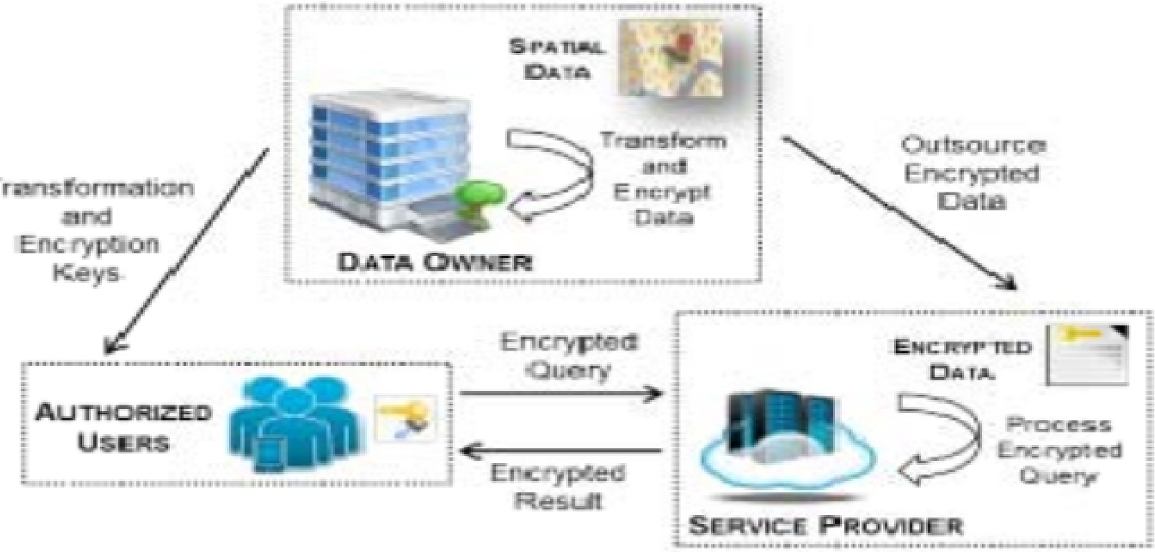
To tackle the problem, we propose to transform the location datasets before uploading them to the service provider. The application develops a spatial transformation that re-distributes the locations in space, and a cryptographic-based transformation. The data owner selects the transformation key and shares it with authorized users. Without the key, it is infeasible to reconstruct the original data points from the transformed points. The proposed transformations present distinct trade-offs between query efficiency and data confidentiality. In addition, we describe attack models for studying the security properties of the transformations. Empirical studies demonstrate that the proposed methods are efficient and applicable in practice.

Methodology

Java:

Java is a general-purpose computer-programming language that is concurrent, class-base , object-oriented, and specifically designed to ha e as few implementation dependencies as possible.

Architectural Design



Algorithm Implement

To overcome these shortcomings of the preliminary approach, we propose to use the secure AES scheme. None of the well-known cryptanalysis attacks have been proven to break AES yet.

Since AES only allows equality comparisons on encrypted data, weenumerate the Hilbert cells between fPs, Peg and store them in each packet. Lastly, this data is encrypted using AES and sent to the SP. The AU issues an encrypted spatial range query to the server and all query processing is done at the SP, as it should be done in a true database outsourcing application. The index search at the SP does induce a high query overhead, almost linear with respect to size(D), but with the computing power of the SP, this is not a real concern. Moreover, the order of plaintext in the encrypted packets is obscured, and this makes the new approach attractive and secure. Lastly, the AU decrypts the query results using the AES key with almost no overhead. In this work, we show three different variations of the highlight their advantages over one another.

The end user can give the feedback to the each and every hospital.

RSA:

RSA involves a public key and private key. The public key can be known to everyone; it s used to encrypt messages. Messages encrypted using the public key can only be decrypted with the private key.

SPACE TRANSFORMATION AND ENCRYPTION:

To preserve the privacy of spatial data, we propose to hide the original spatial data points in two-ways. First, we transform the space by converting the 2D points to 1D using the Hilbert Space Key. Next, we encode the resulting Hilbert indices and data points using an encryption scheme. Both the transformation key and the encryption key are transmitted by the DO to the trusted AUs over a secure communication channel using SSL without the need for any costly tamper-resistant devices.

PROJECT IMPLEMENTATIONS

Modules:

Anti-Tamper Hardware

With a specific end goal to handle the security flaws posed by outsourcing databases, several prior works resolved the issue by adding a middleware or tamper- proof device at the SP to ensure security. This device assists in query processing by encrypting and decrypting the transmitted messages. Assuming a trusted device exists at the server, Damiani et al. propose a fast searchable encryption technique for the non-order preserving AES encryption. The database owners start by building a B-tree over 1D values and encrypt each record at the node level to protect the data from the untrusted SP. However, with numerous users, it is not practical to have an individual device for every AU at the SP. To overcome this, other techniques have to be explored.

PRESERVING LOCATION DATA PRIVACY:

The cryptographic techniques mean, the present three different spatial transformation methods that are based on partitioning and redistributing the locations in the space. Namely: 1) Hierarchical Space Division (HSD), 2) Error-Based Transformation (ERB) and 3) a hybrid of HSD and ERB. However, these techniques preserve the coordinates of the original points and assuming that an attacker can gain background knowledge of the original points and coordinates of these points in the transformed space, information about close by data points can be exposed. Another spatial transformation scheme. Their scheme offers data security by applying a shear transformation as well as the rotation transformation, but is not secure against the proximity attack.

PRIVACY AND INTEGRITY GUARANTEE

A technique for outsourcing databases while assuring both data privacy and query integrity. To preserve data privacy, the data points are encrypted with a symmetric key and indexed by the Hilbert value. Whereas, to ensure query integrity, a probabilistically replication method is applied to a portion of the data which is encrypted with a different space key. Then the two encrypted datasets are combined and stored at SP allowing the client to examine the reliability of the query results.

PARTITIONED INDEXING METHODS:

The trade-off between security and efficiency in outsourced data, propose a scheme based on the Rˆ -tree. The Rˆ -tree follows a hierarchical encrypted index mechanism where an asymmetric scalar-product preserving encryption is used. Moreover, the method uses the leaf Minimum Bounding Rectangle (MBR) to hide ordering and hence, protects the data from being disclosed. However, the authors do not provide any substantial definition of security guaranteed by the scheme.

IV. RESULT ANALYSIS

DISTRIBUTION OF ENCRYPTED VALUES:

We tested whether it is possible to statistically distinguish between the output of OPES and the target distribution by applying the Kolmogorov- Smirnov test used for this purpose.

We conservatively try to disprove the null hypothesis at a significance level of 5%, meaning thereby that the distribution of encrypted values generated by OPES differs from the chosen target distribution.10 In addition to the Census data, we used four sizes for the three synthetic datasets: 10K, 100K, 1M, and 10M values.

For each of these input datasets, we experimented with three target distributions: Gaussian, Zipf, and Uniform.

We could not disprove the null hypothesis in any of our experiments. In other words, the distribution of encrypted values produced by OPES was consistent with the target distribution in every case.

INCREMENTAL UPDATABILITY:

For an encryption scheme to be useful in a database system, it should be able to handle updates gracefully. We have seen that with OPES a new value can easily be inserted without requiring changes in the encryption of other values.

Recall that we compute the bucket boundaries and the mapping functions when the database is encrypted for the first time, and then do not update them (unless the database administrator decides to re-encrypt the database afresh). We studied next whether the encrypted values remain consistent with the target distribution after updates.

For this experiment, we completely replaced all the data values with new values, drawn from the same plaintext distribution. But we did not update Kp or Kc. We did this experiment with all the four types of datasets, and for each of them we considered Gaussian, Zipf, and Uniform distributions.

KEY SIZE:

The size of the encryption key K depends on the number of buckets needed for partitioning a distribution, the total size being roughly three times the number of buckets. We found that we did not need more than 200 buckets for any of our datasets (including those with 10 million values); for Uniform, the number of buckets needed was less than 10. Thus, the encryption key can be just a few KB in size.

V. CONCLUSION

Database outsourcing is a popular model of cloud computing. In this work, we are trying to achieve a balance between data confidentiality at the server and efficient query processing. We propose to transform the spatial database by applying the encryption to the transformed data. We define several attack models and show that our scheme provides strong security against them. This allows a balance between the security of data and fast response time as the queries are processed on encrypted data at the cloud server. Moreover, we compare with existing approaches on large datasets and show that this approach reduces the average query communication cost between the authorized user and service.

Patient records are stored in cloud storage and those records are encrypted using AES algorithm which will give security of patient records (reports).

Patients lost their records in somewhere and they need those records to contact the doctor, in such a case patient can able to give request to the administrator. So the admin person can share the reports in encrypted format also he is providing the AES algorithm. So patient can decrypt the records using the AES key.

REFERENCES

[1] Z. Xiao and Y. Xiao, "Security and privacy in cloud computing," IEEE Communications Surveys & Tutorials,, vol. 15, no. 2, pp. 843–859, 2013.

[2] C. Gentry et al., "Fully homomorphic encryption using ideal lattices." In STOC, vol. 9, 2009, pp. 169–178.

[3] B. Hore, S. Mehrotra, M. Canim, and M. Kantarcioglu, "Secure multidimensional range queries over outsourced data," The VLDB Journal The International Journal on Very Large Data Bases, vol. 21, no. 3, pp. 333– 358, 2012.

[4] R. Agrawal, J. Kiernan, R. Srikant, and Y. Xu, "Order preserving encryption for numeric data," in Proceedings of the 2004 ACM SIGMOD international conference on Management of data. ACM, 2004, pp. 563–574.

[5] J. K. Lawder and P. J. H. King, "Querying multi-dimensional data indexed using the hilbert space-filling curve," ACM Sigmod Record, vol. 30, no. 1, pp. 19–24, 2001.

[6] Khoshgozaran and C. Shahabi, "Blind evaluation of nearest neighbor queries using space transformation to preserve location privacy," in Advances in Spatial and Temporal Databases. Springer, 2007, pp. 239– 257.

[7] W.-S. Ku, L. Hu, C. Shahabi, and H. Wang, "A query integrity assurance scheme for accessing outsourced spatial databases," Geoinformatica, vol. 17, no. 1, pp. 97–124, 2013.

[8] F. Tian, X. Gui, P. Yang, X. Zhang, and J. Yang, "Security analysis for hilbert curve based spatial data privacy-preserving method," in 2013 IEEE 10th International Conference on High Performance Computing and Communications & 2013 IEEE International Conference on Embedded and Ubiquitous Computing. IEEE, 2013, pp. 929– 934.

[9] M. L. Yiu, G. Ghinita, C. S. Jensen, and P. Kalnis, "Enabling search services on outsourced private spatial data," The VLDB Journal, vol. 19, no. 3, pp. 363–384, 2010.

[10] H.-I. Kim, S.-T. Hong, and J.-W. Chang, "Hilbert curve based cryptographic transformation scheme for protecting data privacy on outsourced private spatial data," in 2014 International Conference on Big Data andSmart Computing (BIGCOMP). IEEE, 2014, pp. 77–82.

[11] P. Wang and C. V. Ravishankar, "Secure and efficient range queries on outsourced databases using r-trees," in 2013 IEEE 29th International Conference on Data Engineering (ICDE). IEEE, 2013, pp. 314–325.

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