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Introspection on the Research Avenues of Robotic Process Automation as a Service (RPAaaS)

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Abstract

One of the newest business and technology developments is cloud computing, where several users approach the Cloud to complete various tasks. Cloud RPA is a technology that uses robotic process automation on Cloud-native using artificial intelligence. RPA-as-a-service: an automation software or bot that any user with an internet connection can use in the Cloud. It is an automaton self-service in cloud drag-and- drop actions and different GUI as a user-friendly software service. Cloud RPA ensures users automate any process via the Internet on the Cloud and can access it in their browser. RPA enables an intelligent agent to replicate typical manual decisions, such as rule based, well-structured ones involving vast amounts of data in a digital system, and eliminate operational errors. The highlights of the self-service aspect of cloud RPA, which allows any user with an

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internet connection to access automation software or bots in the Cloud. RPA, AI, and soft computing can achieve hitherto unheard-of levels of efficiency. It also identifies challenges related to RPA and emphasizes the need for objective reasoning and academic attention to achieve meaningful advances. This work focuses on the potential applications of robotic process automation to address the research avenue for the challenges in Cloud RPA.

Keywords: Cloud, RPA, Cloud RPA, Load balancing, AI based Load balancing.

1 Introduction

Artificial intelligence's rapidly developing robotic process automation (RPA) technology enables businesses to automate high-volume processes. Modules can record how these procedures were previously carried out by a human user on a computer system's interface and then simulate the user carrying them out in their place. The article explores experimentation on research challenges provided on Cloud RPA technology. It created a system for categorizing them based on a few essential aspects, which creates a variety of research problems for the development of intelligent RPA technology. Many firms have embraced new business methods, with the migration to "the cloud" being one of the most well-known of them, to help enable the requirement for dynamic expansion [1]. With the help of digital technology and gains services on the Cloud, it is becoming lower cost and standards for middle-level organizations to rely on cloud-based services to enhance them fully. The ubiquity of cloud-based services has increased the necessity for businesses to effectively share and use their data, resources, and software in order to stay competitive. As a result, we have been able to increase our robotic process automation efficiency (RPA). To

truly comprehend how RPA is utilized in a cloud context, one must first have a thorough understanding of the Cloud. With the use of robotic process automation (RPA), digital technology can modify a company's organizational structure and its business model, products, and procedures. RPA can accomplish process performance, effectiveness, scalability, security, convenience, and compliance. It can automate corporate processes to decrease human labor while improving functional quality. Unfortunately, because task types are not expressly logged in user interface logs, it can be difficult to understand the types and quantities of accomplished activities [2][3]. A shared pool of computer resources, including servers, storage, applications, and services, can be delivered on-demand through a network (often the Internet) using the cloud computing concept [4]. Users can access these resources from anywhere, anytime, and pay only for what they use. The organization can eliminate investigating in single storage infrastructure if cloud computing is available, providing flexibility. Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS), and infrastructure-as-a-service are typical examples of cloud services (IaaS). For ap- plications and services utilizing shared pool infrastructure, cloud computing is a highly popular networking approach. The device requires little effort or work to foster involvement. This cloud model includes three service models, four deployment types, and five key characteristics. [5][6].

1.1 Cloud Computing

It is a software technology that creates a program to complete redundant human actions while interacting with a computer to accomplish the required task. A rapidly developing artificial intelligence technology called robotic process automation (RPA) enables businesses to automate high-volume processes [7]. Mod- ules can record how certain procedures were carried out on a computer system's user interface when they were

previously carried out by a human user and subsequently simulate the user's actions in their place. A technique called robotic process automation (RPA) makes it possible to automate certain automation or operations. In a context where several IT systems or applications using, humans usually act as the middleman, transferring structured information between IT systems, often repetitively [8]. Figure 1 presents the architecture of cloud computing.

1.2 Robotic Process Automation (RPA)

It is a type of software engineering that develops a program to carry out repetitive human tasks while communicating with a computer to perform the necessary activity. A rapidly developing artificial intelligence technology called robotic process automation (RPA) enables businesses to automate high-volume processes [3]. Modules can record how certain procedures

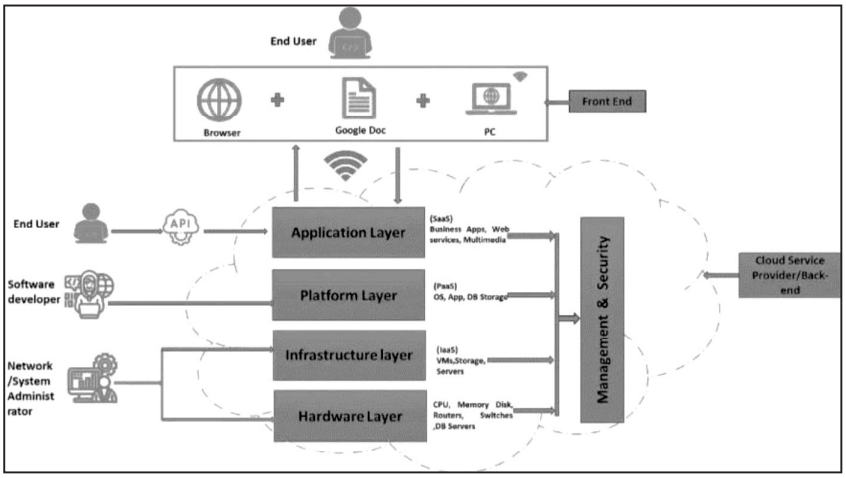


Fig. 1. Cloud Computing

were carried out on a computer system's user interface when they were previously carried out by a human user and subsequently simulate the user's actions in their place. A technique called robotic process automation (RPA) makes it possible to automate certain automation or operations. In a context where several IT systems or applications using, humans usually act as the middleman, transferring structured information between IT

systems, often repetitively [8]. The following details define the requirement of RPA usage [9]: (I) Automation in different processes. (II) To cost- cut enhancement resource optimization resource (III) For standard compliance error-free system (IV) Defect mechanism is much better in scaling, modeling, and deploying (V) Cloud RPA It is an automation software available to access and use by anyone with an internet connection on any device. Cloud automation talks about automating the business process using the Cloud. With the help of cloud RPA, users can automate processes over the Internet and interface accessed in their browser. RPA bot works accordingly with the cloud platform through Cloud computing. Cloud provides the machine to the RPA bot to perform automation, Cloud Services to the bot and the platform. It Provides services to store data. They provide data storage. As it runs on the local machine bot will run on cloud infrastructure.

1.3 Cloud RPA

It is an automation software available to access and use by anyone with an in- internet connection on any device. Cloud automation talks about automating the business process using the Cloud. With the help of cloud RPA, users can automate processes over the Internet and interface accessed in their browser. RPA bot works accordingly

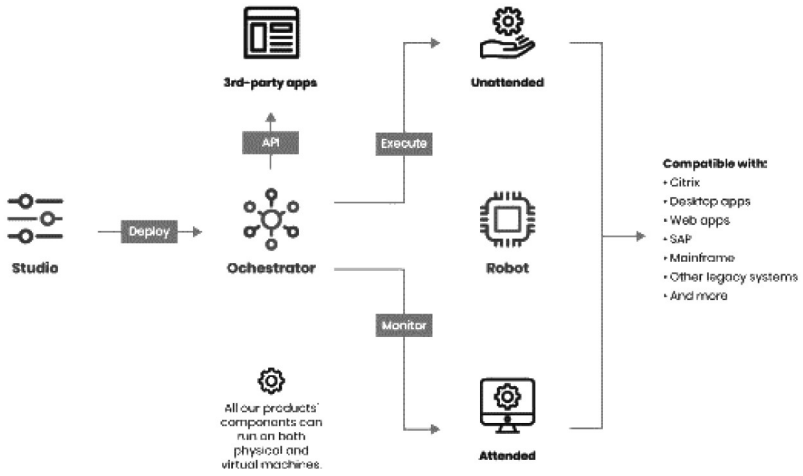


Fig. 2. Robotic Process Automation (RPA)

with the cloud platform through Cloud computing. Cloud provides the machine to the RPA bot to perform automation, Cloud Services to the bot, and the platform. It Provides services to store data. They provide data storage. As it runs on the local machine bot will run on cloud infrastructure. Figure 2 denotes the working procedure of Cloud RPA. Table 1 shows the different options to work with RPA.

Table 1. Cloud RPA Application tools.

Cloud Stack	Plugins	Simulation tools
Python / Java (for Web services) JQuery/JavaScript XML JSON SQL	Toolkit for Amazon Web Services (AWS) Toolkit for Amazon Web Services (AWS) Development stack (Eclipse and IntelliJ)	Cloud Sim Cloud Analyst

The figure 3 describes the number of users available to use the applications and data flow through different directions. Finally, the bot controls and send them to the database with the results.

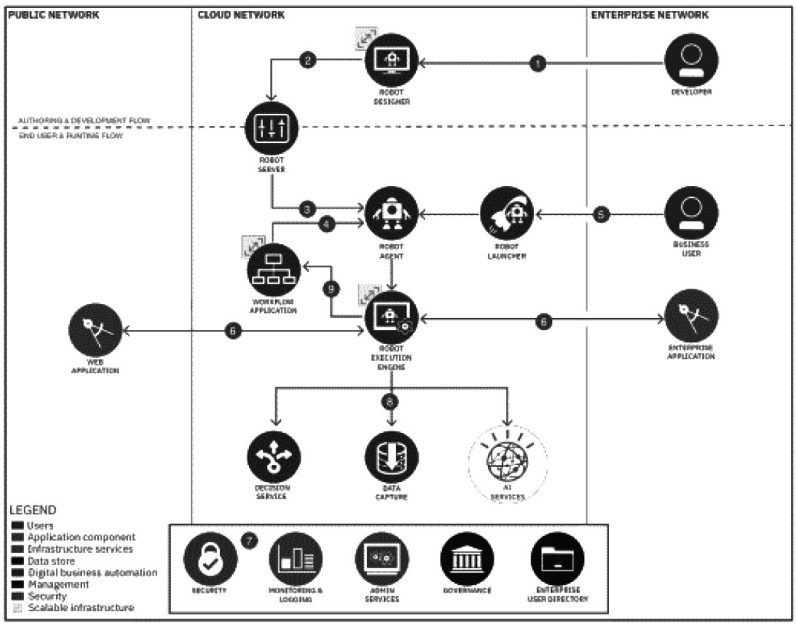


Fig. 3. Cloud RPA.

1.4 Cloud RPA Challenges

Cloud RPA is the latest technology that helps users avail software technology over the Internet to use robotic process automated software. It allows exploring the advantages of cloud RPA to use the technology. Some research challenges coining below, and through the obstacles, it will be able to explore more to overcome the difficulties of using the cloud RPA technology. All the processes in Cloud cannot automate. The following are the challenges while implementing Cloud RPA automation.[1] [3] The Cloud RPA challenges are described below. The Cloud RPA challenges are described below

Realization supports benefits: Although the advantages of RPA deployment are clear, it cannot be assumed that adopting RPA in an organization will inevitably result in benefits. The ability to realize benefits depends on several important elements, including organizational readiness for RPA, the technology's adoption capabilities, and the deployment and delivery of an RPA solution. Given varied corporate circumstances, these criteria frequently differ from one organization to the next. Guidelines or best practices regarding the benefits of RPA deployment are still few. So, creating a systematic strategy to promote the advantages and completeness of an RPA solution becomes an open problem to solve.

Metrics for comprehensive benefits [10]: about Robotic Process Automation (RPA). Here are some of the essential extensive metrics to measure in the RPA Productivity: RPA can free up employees' time from repetitive tasks, al- lowing them to focus on higher-value tasks that require creativity, critical thinking, and human judgment. Measuring the increase in productivity resulting from these re- allocated resources can be an essential metric for assessing the overall benefits of an RPA solution. Accuracy and Quality: RPA can significantly reduce errors and

improve the quality of work by automating tasks that are prone to errors, such as data entry or data validation. Measuring the reduction in errors or improvements in quality can be an essential metric for evaluating the benefits of an RPA solution.

Scalability and Flexibility: RPA can help organizations scale their operations by automating previously manual and time-consuming processes. Measuring the increase in capacity and flexibility resulting from an RPA solution can be an essential metric for assessing the benefits of RPA. Customer Satisfaction: RPA can improve customer satisfaction by reducing turnaround times and providing more accurate and timely information. Measuring improvements in customer satisfaction resulting from an RPA solution can be an essential metric for evaluating the overall benefits of RPA. Cost Savings: RPA can significantly reduce human labor and operation costs reduced. Measuring the reduction of the expenses resulting from an RPA solution can be an essential metric for evaluating the financial benefits of RPA. To measure these metrics, organizations can collect data on the relevant processes before and after implementing an RPA solution and compare the results to quantify the benefits. Some benefits, such as increased productivity and customer satisfaction, may be more difficult to measure quantitatively and require more qualitative assessments, such as employee or customer surveys.

Organizational assessment model [11]: Frameworks for assessing RPA maturity and readiness are necessary for organizations. By offering instructions and resources to be ready for realistic RPA implementations, these frameworks will help firms achieve strategic alignment. To accomplish their strategic goals, organizations can explicitly identify potential opportunities and impediments and maximize resource use.

Assessment infrastructural mechanism models [12]: There is currently a lack of a model to evaluate the technical infrastructure makeup of a company to support the implementation of RPA. A useful tool for practices, such a model would help firms determine the circumstances under which an RPA solution will best meet their goals.

Organizational capabilities assessment models [13]: Companies also require a paradigm for evaluating RPA competence. Such a model might methodically aid firms in analyzing their organizational capacities for RPA and assist in building the road map for RPA projects if it had clear instructions on how to adjust it within the various project and organizational contexts [3].

Analytical capabilities maximization [14] to increase the analytical capabilities in the cloud RPA, the best option will be to provide intelligence to the RPA models, which can think spontaneously in different situations and make decisions accordingly. Intelligent automation will be the future-related work in the Cloud RPA to modify the present scenarios, which are slightly struggling to find the critical answers with analysis. AI and different methodologies combined with Cloud RPA will lead to result-oriented research and, through that, can improve the analytical capabilities to the maximum.

Implementation with methodological support [15]: Although there is consider- able agreement that Agile development methodologies should be used to create RPA bots, there is currently no consensus on what a methodology for RPA deployment will look like. There is a need for a process that concentrates on technical issues for the adoption of RPA on a wide scale. The issues already covered in this work (such as Agile, the software development life cycle, and stage-based techniques) can be expanded upon using this methodology [3].

Success factors for failures [16]: An outline of the key success (or failure) elements and the potential effects they may have. They may be taken into account at various points of the RPA project life cycle or in various organizational or task/process contexts. Knowledge about Cloud RPA can easily be found to understand it, and critical success can help manage the elements in different ways to produce the result effectively.

Technical implementation with globally [17]: Cloud RPA is a rapidly growing technology in the current situation; the changes and performance can understand and managed better. To improve RPA-related IT/HR policies and aid in the creation of workable change-management strategies for RPA programs, organizational research that reveals the socio-technical consequences of Cloud RPA is required.

Task selection techniques [18]: One of the biggest obstacles to the successful adoption of Cloud RPA is finding appropriate automation-related activities. Lack of empirical validation of design concepts for RPA candidate task selection. The majority of RPA vendors that produce current methodologies may have a bias. As a result, rigorous, methodical, and evidence-based methods are required to assess whether a task is appropriate for RPA. Task selection plays a vital role in the Cloud RPA sector, through which the application can identify the proper way to find the solution.

Techniques for Evolution, Design, and Development [19]: A bot needs a design blueprint that details all of the many action sequences it could take to complete a task. I still use physical labor to design the bot, which puts me in situations where I should not be or could take me in a different way. To solve these issues, capabilities that systematically extract logical structures from user activities and convert them into algorithms for bot execution must be developed and implemented. Additionally,

proactive and continuous knowledge acquisition, design, and application of variations related to those tasks are required.

smooth handling of exceptions Essential [20]: For successful RPA implementation. These architectures and frameworks should enable the bots to identify, diagnose, and resolve exceptions without human intervention. One approach to seamlessly handling exceptions is developing robust error-handling mechanisms within the RPA software. This can involve designing bots to detect and respond to specific exceptions, such as timeouts, server errors, or invalid inputs. Bots can also be programmed to retry failed operations or escalate issues to human operators when necessary. Another approach is to use machine learning and artificial intelligence techniques to train bots to learn from previous exceptions and adapt to new situations. This can involve analyzing historical data to identify patterns and predict potential issues or using natural language processing to interpret error messages and resolve problems autonomously. In addition, regular testing and monitoring of RPA workflows are crucial to identify and resolve issues before they become critical.

This can involve automated testing and monitoring tools to detect anomalies and report issues to the appropriate stakeholders. By implementing these strategies, organizations can achieve more efficient, reliable, and scalable RPA workflows while minimizing the need for manual interventions and ensuring a better return on investment.

Scalability managing strategies [21]: Scaling up the use of bots for enterprise-wide adoption can present significant challenges, but some strategies can help manage scalability. Here are some approaches to consider. Design for scalability from the start: When implementing RPA, it's essential to design the bots with scalability. This means ensuring that they are building to handle

large volumes of data and transactions and that they are flexible enough to adapt to changing business needs. Use a centralized control room: A centralized control room can help manage and monitor bots' performance across the enterprise. This enables IT teams to quickly identify and resolve issues while ensuring that bots using in a consistent and standardized way. Automate bot management: Automating bot management processes can help reduce the workload on IT teams and improve efficiency. This includes automating processes such as bot deployment, configuration, and maintenance. Leverage cloud computing: Cloud computing can help provide the infrastructure needed to support large-scale RPA deployments.

Cloud services such as AWS and Azure offer scalable computing resources that can be quickly provisioned and managed. Implement governance and compliance: As RPA adoption scales across the enterprise, it's essential to have a governance and compliance framework. This ensures that bots are used in a way that complies with regulatory requirements and is used ethically. Continuously monitor and optimize performance: Ongoing monitoring and optimization of bot performance is critical for ensuring they continue delivering value to the enterprise. This includes monitoring performance metrics such as response time, error rates, and throughput and optimizing bots to improve their efficiency and effectiveness. By implementing these strategies, enterprises can better manage their RPA deployments' scalability and realize the full benefits of automation.

Monitoring and control proactively [22]: Proactive monitoring and control of bots are essential to ensure that they continue to function effectively and generate accurate results even as business rules change. One approach to achieving this is implementing a system for continuous monitoring and testing

of bot performance against a set of known business rules. This system could automatically alert the relevant parties if any discrepancies or errors are detected, enabling them to take corrective action before significant damage occurs. Another approach is to develop bots that are capable of self-monitoring and self-adjustment. This could involve using machine learning algorithms that enable bots to adapt there be- behavior in response to changes in the business environment, including changes in regulations, policies, and customer preferences.

By continuously learning from new data and feedback, these bots could evolve and improve over time, reducing the risk and ensuring that they remain effective and efficient. In summary, proactive monitoring and control are essential to ensure bots' ongoing effectiveness and accuracy. By implementing a continuous monitoring and testing system or developing self-monitoring and self-adjusting bots, organizations can minimize the risk of errors and disruptions and ensure that their bots continue to deliver optimal performance even as business rules evolve.

Segmentation for self-learning [23]: The challenge described is known as log segmentation or log parsing, which involves identifying and grouping re-related events or actions within a log file. This is a critical task in process mining, where logs extract process models, discover process variants, and analyze process performance. One possible solution for log segmentation is to use unsupervised machine learning techniques such as clustering, which can group similar events or actions based on their features. This approach requires first extracting relevant features from the log data, such as the name of the action, the timestamp, the resource involved, and the input or output data. Once the features are extracted, they can cluster the events or activities based on their similarity. Another approach is to use

supervised machine learning techniques such as classification, which can learn to recognize patterns in the log data that correspond to different routines or tasks.

This approach requires first labeling a subset of the log data with the corresponding performance or study, which can be done manually or using some domain knowledge. Once the data is labeled, it is used to train a classifier that predicts the routine or task for new log data. A third approach is to use rule-based techniques, which rely on expert knowledge or heuristics to identify patterns in the log data that correspond to different routines or tasks. For example, one could define rules that determine sequences of events or actions likely to conform to a specific pattern or scheme. Regardless of the approach used. Metrics that reflect the accuracy and completeness of the identified routines or tasks, such as precision, recall, and F1-score, should be used to assess the segmentation's quality. It is also important to iterate and refines the seg- mentation process based on comments from subject-matter experts or users to improve its accuracy and usefulness.

Creation of flowcharts in an automated fashion [24]: Testing environments are weak in RPA tools. As a result, SW robots are created through a three-step, trial and-error process that is repeated until success: I To start, a human designer creates a flowchart diagram outlining the tasks the SW robot will execute on a target system.

Routines composition automatically: Technology is changing from handling a single operator to multiple operations in the modern context. Bots will be able to execute the process individually. To the orchestra's various routines, manual support will be enough to handle the process., The help of AI and intelligent orchestration will help manage complex and multiple operations at a time. Proper planning and data-saving systems

like black boxes will help to automate the routine composition effectively. This will help to generate the appropriate strategy to automate and compose them on a large scale that coordinates the workflow easily to orchestration.

Business and IT alignment difficulties [25]: Cloud RPA, or Robotic Process Automation in the Cloud, can offer many benefits to organizations, such as increased scalability, flexibility, and cost-effectiveness. However, one common challenge with implementing Cloud RPA is the lack of alignment between business and IT stakeholders. Business stakeholders may have specific process requirements, such as automating tasks or improving process efficiency. On the other hand, IT stakeholders may focus on the technical aspects of cloud RPA, such as security, compliance, and integration with other systems. When these two groups are not aligned, it can lead to various issues, such as delays in implementation, increased costs, and sub-optimal solutions. To focus on this challenge, it is essential to establish clear communication and collaboration channels between business and IT stakeholders. This can involve regular meetings, joint planning sessions, and shared documentation to ensure that both groups under- stand the project's goals, requirements, and constraints. It is also essential to involve both business and IT stakeholders in designing and implementing the cloud RPA solution to ensure that it meets both business and technical requirements.

Another important consideration is to select the right cloud RPA platform aligned with the needs of both business and IT stakeholders. This can involve evaluating the platform's features, capabilities, and security, as well as its ease of use and integration with other systems. It is also essential to involve both business and IT stakeholders in the platform selection process to enhance a need in both groups. Finally, it is vital to continuously

monitor and evaluate the effectiveness of the cloud RPA solution to identify improvement opportunities and ensure ongoing alignment between business and IT stakeholders. This can involve regular performance metrics reporting, user feedback surveys, and constant communication channels between the two groups. By taking these steps, organizations can address the lack of business and IT alignment in cloud RPA and ensure their implementation is successful and sustainable.

Wrong selection of business strategy [26]: Understanding when the process has to be automated is one of the biggest challenges in business areas. Choosing an unappropriated business case for automation may lead to limited profit from the business. The automation topic should be precisely clear when to automate the particular business areas and to achieve the aim properly. Automation should focus on the most significant number of repetitive tasks, so the employee working on the project can channel his talent to another work set. Automation should be adequately understood and should not lead to hiring another employee with knowledge in the automated area.

Lack of clear RPA strategy [27]: Every business must have a plan before deploying RPA to determine what it needs to automate. The following questions will help. (I) How to implement Cloud RPA and what will be the result (II) Are Technologies considered when RPA presents a viable solution? (III) RPA can provide a long-term or short-term fix? (IV) What is the reason for scaling

Wrong process selection [28]: The characteristics described automation: Choosing the wrong approach for cloud RPA (Robotic Process Automation) can lead to various issues, including wasted time, resources, and money, as well as decreased efficiency and effectiveness. To avoid these issues, it's essential to evaluate and choose the right processes for cloud RPA carefully. These are the point for strategies for cloud

RPA: Look for repetitive, rule-based tasks: Cloud RPA is best suited for repetitive tasks involving following rules. These tasks can include data entry, file transfers, and report generation. Evaluate the complexity of the process: While cloud RPA can handle complex tasks, it's essential to evaluate the level of complexity of the process to ensure that it's feasible to automate. Some jobs may require more advanced artificial intelligence (AI) and machine learning. Consider the quantity of the procedure: Cloud RPA is best suited for high-volume tasks requiring a significant amount of manual labor. This can include charges such as processing invoices or orders. Assess the impact of errors: It's essential to consider the potential effects of mistakes when choosing a process for cloud RPA.

If the technique involves critical or sensitive data, it may be best to consider other solutions or take extra precautions to ensure the accuracy and security of the automation. Start small and scale up: When implementing cloud RPA, it's often best to start with a small pilot project to evaluate the solution's effectiveness and identify any potential issues or areas for improvement. Once the pilot is successful, the process is scaled up to handle larger volumes. By care- fully evaluating and choosing the right strategies for cloud RPA, organizations can maximize the benefits of automation and avoid the pitfalls of choosing the wrong ones.

A significant lack of trustworthy, adaptable options available [29]: There are plenty of RPA automated bots available in the market. The business is small, cannot rely on large and productive computerized tools, and can rely entirely on the available small-scale ready-made bots. But the problem may arise whether it suits the working culture of the particular business. Customizing automated bots can be another approach according to the business plan and need the complete knowledge of which part of the business needs to be automated and how to

improve productivity wisely.

Lack of suitable infrastructure [30]: to get the intended results with Cloud RPA automation, businesses require the appropriate infrastructure to enable the deployment. Before automating the process, companies must determine whether the infrastructure will support it. It talks about two significant criteria. (I) All the scripts should be able to run all the time (II) 24/7 automation should be able to provide.

Issues related to scale [31]: Here are some of the difficulties that organizations may encounter when scaling their cloud RPA: Infrastructure limitations: Cloud RPA requires robust and reliable infrastructure to support the deployment and management of bots. Organizations may face challenges when scaling their cloud RPA initiatives if they do not have the necessary infrastructure. Integration complexity: As organizations scale their cloud RPA initiatives, they may need to integrate their RPA bots with various systems and applications. It can be complex and time-consuming, especially with legacy systems and applications. Governance challenges: As RPA bots increase, organizations may face challenges in maintaining control and governance over their RPA processes. It includes issues such as bot access control, version management, and security. Talent shortage: Finding skilled RPA developers and engineers can be challenging, significantly when scaling cloud RPA initiatives. This talent shortage can impact an organization's ability to scale its cloud RPA operations. Cost management: Cloud RPA can provide cost savings over traditional on-premise RPA, but organizations still need to manage their costs effectively as they scale their cloud RPA initiatives. It includes issues such as monitoring cloud usage and optimizing cloud resources. Organizations must prepare to tackle these challenges as they raise their cloud RPA initiatives. By addressing these difficulties proactively, organizations can maximize the benefits of cloud

RPA while minimizing the risks and challenges associated with its deployment and management.

Third party collaboration [32]: Using third-party input in an automation process can be a challenging task. Introducing a different procedure or data source may require significant modifications to the automation process to account for the new input or data format. It leads to delays and additional costs for the business. Therefore, it's essential to thoroughly evaluate the third-party input's uniformity and consistency before incorporating it into the automation process. It's also crucial to work closely with a third-party provider to understand their data formats and ensure they seamlessly fit into the automation process. Regular testing and monitoring can help identify any issues early and reduce the risk of disruption to the automation process.

Difficulties in maintenance [33]: Maintaining the automated bot created to work on particular procedures needs to be taken care of with the highest priority. When the business needs to regulate its change, the Cloud RPA tool must adapt these changes in the automation. Even If there is a slight change, monitoring the automated process will give an accurate result for the hidden issues. It changes; the bot couldn't find the consequence according to the procedure, which led to the error. To overcome these difficulties, an RPA process owner should always overlook the problem to maintain it perfectly. Some of the following reasons can make the proper maintenance of automated bots. (I)Cloud RPA software has undergone all the latest updates and changes. (II) All of the data must be stored securely in a specific folder, and the process owner must keep an eye on things and step in as necessary.

RPA failure regarding security [24] is another significant challenge that indulges in Cloud RPA. The bot needs to take

care of the security in different ways to ensure all the automated procedures are functional systematically. These are the following security challenges that look into in action. (I)The bot should be able to work on each unique credential which includes two-step verification factors. (II) Database access should be limited to all the bots and allow the bot to perform the task. (III) Video surveillance applies in critical areas. (IV) Automation should be 24/7, and that can produce consistent logs and reviews of suspicious activities. (V) Cloud RPA guidelines will help with deployment, development, and operation.

Issues related to coordination [18]: All levels of employee coordination in an organization are essential for adequately implementing cloud RPA. Top-level employees should guide the team in the completion of an automated process. It will help grow in all the aspects of companies' needs once the employees have the coordination. The organization's IT teams can help in all the required areas to ensure security.

Issues related to management [15]: When an organization requires an immediate solution, all the managerial levels need to address it with the same case. In the case of Cloud RPA, it is different levels. The approval is mainly required from the authorities on a particular segment of automation so that if any problem arises, that set of teams can quickly look into it and solve it immediately.

Customization of RPA [13]: The development of RPA solutions does require a skilled team that can handle all RPA-related activities, including identifying processes that can be automated, designing and implementing the automation solution, and testing and deploying the automation solution. However, as you mentioned, there is a shortage of skilled RPA developers, making it difficult for organizations to find the right talent to develop and implement their RPA solutions.

Lack of clarity in expectations [12]: A proper plan makes every process get the desired output. If we are unaware of what has to be automated and how the result will generate, it will reach a different scenario and won't produce the required goal. It's the same case in Cloud RPA automation as well. Clarity makes the procedure work smart and efficiently to reach the goal; lack of clarity will confuse the employees and have a significant impact. Awareness generates before going through the automation process. With the help of understanding, that can clarify what has to be automated and what kind of result it will generate after automation.

Connecting dots vigilantly [10]: RPA will be one of the significant steps toward a company's working culture. Implementing the cloud RPA will enhance the result undoubtedly. The challenges that arise here are if the employees lack work responsibility and how to make them work according to the automation culture need to be precise decently. Duties must be assigned equally to the employees to understand and make them work effectively to get the result more than expected with the help of automation. All the dots connect to be accountable, and everything should go according to the plan.

Ambiguity in techniques [8]: There is potential technical ambiguity in the statement regarding the ease of installation of RPA. While RPA may generally be considered easy to install, the ease of installation can vary based on the particular RPA software utilized and the context in which it was implemented. Additionally, the statement does not clarify what" configuration" means or what specific technological and operational issues may arise during RPA implementation. Furthermore, the information suggests that research is necessary to satisfy these issues, but it does not specify what research is conducted or what re- sources are available to the technical staff. It is also unclear

what specific regular maintenance protocols follow to prevent issues with RPA. While the statement highlights the importance of successful RPA implementation and maintenance, it could benefit from more specificity and clarity to avoid technical ambiguity.

Issues related to infrastructure RPA [5] implementation is the main challenge in setting up the automation infrastructure. It's not about the difficulty; all the employees should be aware of the procedures and the way automation works will be happening too. Companies without proper infrastructure led to confusion, and every time a set of employees should be there to look into the problem. Infrastructure is efficient, and employees know the process will be the best way to work on automation.

Wrong RPA selection [30]: Choosing the wrong RPA tool can lead to several organizational issues, including higher implementation costs, increased customization needs, and decreased productivity. It's crucial for organizations to carefully evaluate their RPA requirements and choose a tool that is well-suited to their specific needs. Some factors to consider when selecting an RPA tool include the complexity of the automated processes, the tool's scalable, the ease of customization, the support and training provided by the vendor, and the cost and ROI of the device. By considering these factors, organizations can ensure that they choose the right RPA tool for their needs and maximize the benefits of automation.

1.5 Identification of the potential research problem

From the challenges mentioned above, Cloud RPA will face the significant challenge of proactive monitoring and control, Strategies for managing scalability, Techniques for task selection, and Difficulties in scaling. To overcome these challenges in the cloud RPA, the solution focuses on Load balancing in the Cloud RPA will be the best option. Load balancing is one of the central

areas that will need to focus on in cloud RPA. Load balancing is a technique to divide the user requirements on the cloud RPA to a particular server. The load balancing technique will reduce the Load on the Cloud. The intelligent load balancing in cloud- based Robotic Process Automation (RPA) involves distributing tasks among a pool of available bots to optimize their utilization and ensure high availability and fast response times. To achieve this, an intelligent load-balancing system is implemented to monitor each bot's performance and workload in real-time. The system can then dynamically allocate tasks to the bots best suited for the job based on their processing power, memory utilization, and current workload.

In a cloud-based RPA environment, the load balancing system can also take into account the geographical location of the bots and the users accessing the system to ensure that tasks are distributed to the bots that are physically closest to the users, reducing network latency and improving response times. Intelligent load balancing can also help in scaling the RPA system by automatically provisioning new bots as the workload increases, and releasing bots when the workload decreases, ensuring optimal utilization of resources. Overall, intelligent Load balancing in cloud-based RPA can significantly improve the efficiency and reliability of the system, resulting in faster task completion, better resource utilization, and lower operational costs.

1.6 Load Balancing in Cloud RPA

A significant role of Load Balancing in Cloud RPA is to balance the Load intelligently. The primary concern is how to load the balance equally on each server if more users are. To balance that Load, there should be a load balancer as presented in Figure 4. The load balancer takes care of users' requests and solves the issues related to response time, accuracy, and failures in Cloud RPA. The pictorial representation says how a load balancer

can be taken care of if the number of users increases. The load balancer as shown in figure 4 needs to take care of each request with high priority, and each server should get the Load equally through that accuracy and response time can be reduced.

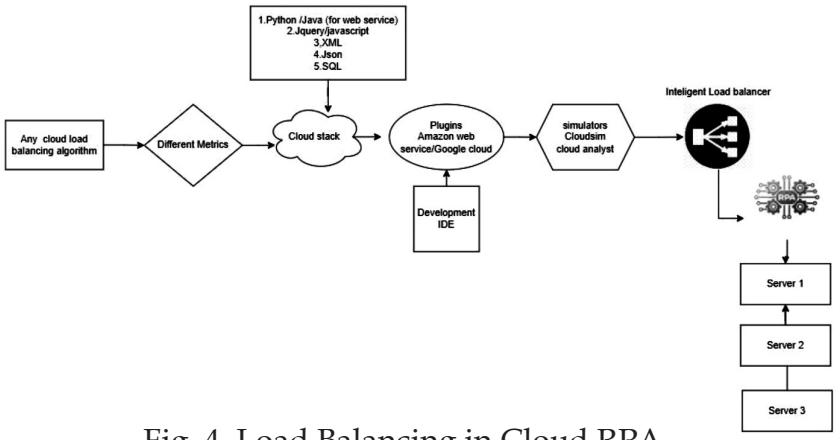


Fig. 4. Load Balancing in Cloud RPA.

1.7 Proposed methodology

The new technology, applications, and websites cannot function without balancing the Load in the new technological era. It is one of the reasons applications and sites can serve millions of requests from the end-users and have returned the accurate output data the user asked for without any delay. Cloud RPA refers to the automated process that always needs a Load balance to automate and end-user requests considered efficiently. [1]

Intelligent Load balancing in the context of cloud RPA, Load Balancing is the issuance of a set of jobs over different computing units. The process is easier to execute and much more efficient; an intelligent load balance should plan and send the request across the servers intelligently [2][3]. It will reduce the errors, and all the servers will be able to manage more precisely with the help of Load balance intelligence. The term intelligent ensures no single server bears too much demand and evenly spreads the Load; it improves the user's responsiveness

and availability of applications or websites [10]. Intelligent load balancing uses a load balance to distribute the workload

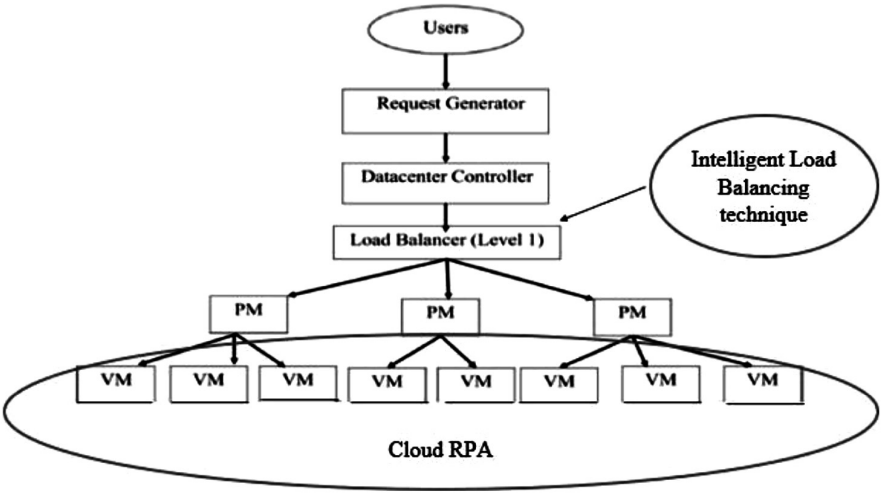
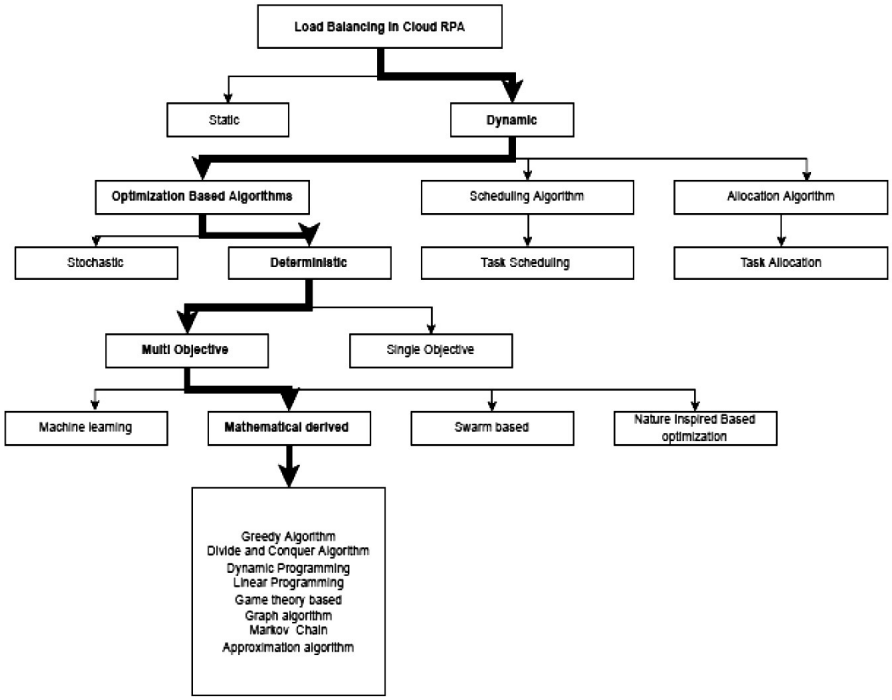


Fig. 5. Intelligent Load balancing

across application servers intelligently as presented in figure 5. It considers each server's current availability, workload, and health. It utilizes the advantage of Cloud Scalability, agility flexibility, and cost effectiveness. A constant need for an efficient load balance in Cloud RPA to achieve the user requirements quickly and effectively without any delay or failure plays a vital role in maintaining the rhythm to complete the accuracy and task promptly. It will lead to designing and implementing an intelligent Load balancing technique on Cloud RPA for the private digital workspace to reduce the load balance in each server and the response time. The main objective of intelligent load balancing is balancing the Load effectively, and each server should be able to make use once more users are using the cloud RPA at a time [10]. Load balancing will use all services, like HTTP, SMTP, DNS, FTP, and POP/IMAP. It reduces the workload on the server and the end user's response time, and the server's failure reduces to an extent. Achieve the prediction of auto-scaling of computing resources.

Cloud load balancing is an essential computing component to distribute workloads and compute resources directly proportional to customer satisfaction. The intelligent Load Balancing technique in Cloud RPA presented in figure 6 can be applied to the Educational System to overcome the difficulties of using a single server or the physical server and manages the user requirement intelligently without human intervention. The user requirements reach the server, and the load balance, with the help of the queuing models, will be able to balance the servers, which can complete the task in the stipulated time. Here the concept of Intelligent load balancing takes place where the Load has to transfer or which server should be able to



respond at a particular time. The queuing models help the load balance acts intelligently in such situations. With the help of the intelligent load balance, the Cloud RPA can complete the task, and user response time will be able to make it less. Cloud RPA

uses the intelligent load balance for all the user requirements to manage the proper response.

1.8 Conclusion and Future work

Cloud RPA technology's significant research challenges highlight in this research. A recent and cutting-edge technology is cloud RPA. The challenges listed in the paper show how Cloud RPA can benefit in the future by enhancing the technology through bots and indicates that Cloud RPA technology will improve the working procedure in the following years. RPA has been used by many businesses to streamline processes. Effectiveness, financial success, flexibility, security, ease of use, and compliance. This research has tried to focus on the challenges which can help to overcome the difficulties of Cloud RPA. Theoretically, the challenges of RPA in research have. It gives future work to the research to work more in the relative areas to excel in Cloud RPA technology. This research adds to the increase in research on RPA and Cloud RPA. It's a new research area in all fields, Education, hospital, and bank. The research proposal gives an idea about how it will help practitioners enhancing in the automation of the digital workforce. This study also provides information about the methodology to try a new way to relate the Cloud's challenges. Therefore, we draw the conclusion that Cloud RPA is essential for automating possibilities in the new era of technology. Yet, a rule-based automation system might benefit more from cloud RPA technology. Automating very complex cognitive processes that need logical reasoning, creativity, and a lot of exceptions is difficult. Future AI solutions will be dominated by cloud RPA and intelligence in all areas, including machine learning, computer vision, and language processing. This research work presented the challenges related to the cloud RPA for the research community to take up further research.

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