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COMPUTER VISION AND REGEX OBJECT DETECTION MODEL IN ROBOTICS PROCESS AUTOMATION FOR ENHANCE ACCURACY TO A SPECIFIC PROCESS

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Abstract: Robotic Process Automation (RPA) implementation with Computer Vision (CV) and Remote Desktop Protocol (RDP) involves automating a target process by using software robots that are able to interact with the user interface, perform tasks, and make decisions based on visual cues.

Throughout history, organizations have been able to increase their productivity thanks to technological advancements. The productivity of knowledge-based businesses can now be greatly increased by organizations/company work via robotic process automation (RPA). Companies now need to figure out how to integrate RPA into their processes effectively and efficiently in light of this possibility. Automation solutions for knowledge-based work must be specialized to each target process' requirements. The RPA provides necessary pieces to create a model for running an RPA solution for a specific process both project and RPA literature.

Index Terms **- RPA, Computer Vision(CV), RegEx, RDP**

1. Introduction

Humanity's technical horizons are ever-expanding. Researchers are continuously seeking for new technology advancements to boost productivity and make human life easier in every aspect of our society. Automation has been a significant driver of this innovation for more than a century, allowing businesses to become more productive and competitive. Automation has increased per-person productivity by requiring less focus and effort from human resource. As a result, society as a whole has been able to advance financially and technologically. First, automation transformed fields that required a lot of manual human resources. This study examines the viability of extracting the types and hierarchies of user interface elements from image-based material using various computer vision (CV) architectures. The primary goal is to enhance RPA (Robotic Process Automation) procedures. More specifically, the developed models are taught to identify which elements in an image are related to one another and which areas of the image are distinct elements.

The major objective of this study is to create a model that can recognize user interface elements better than the industry standard in the context of robotic process automation. Automation has transformed knowledge-based jobs in recent decades. The development of computers and the subsequent widespread use of them by businesses have revolutionized the way people work in knowledge-based sectors. Since then, workers have had access to an increasingly growing range of digital tools, from the first text editors to fully automated sophisticated corporate procedures. When it comes to raising the level of automation, there is still plenty to learn. Data transfer and data manipulation are two critical components that serve as the foundation for knowledge-based work. In the area of payroll, for example, payroll processors rely on input data from employment contracts to calculate the salaries of a company's employees. These two factors are at the heart of automation, and discovering new strategies to automate them could lead to an increase in the level of automation. For instance, data can be imported and sent automatically via file transfers, or spreadsheets macros can be utilized for calculations. It may also be possible to perform portions of data manipulation automatically. Not all systems are capable of increasing the level of automation, and that is the point.

2. Robotics Process Automation

Robotic process automation is known as RPA. It is a technology that enables businesses to use software robots or bots to automate routine, rule-based operations or processes. By gathering and analyzing data, generating actions, and interacting with other systems, RPA bots simulate human interactions with digital systems while carrying out a range of tasks.

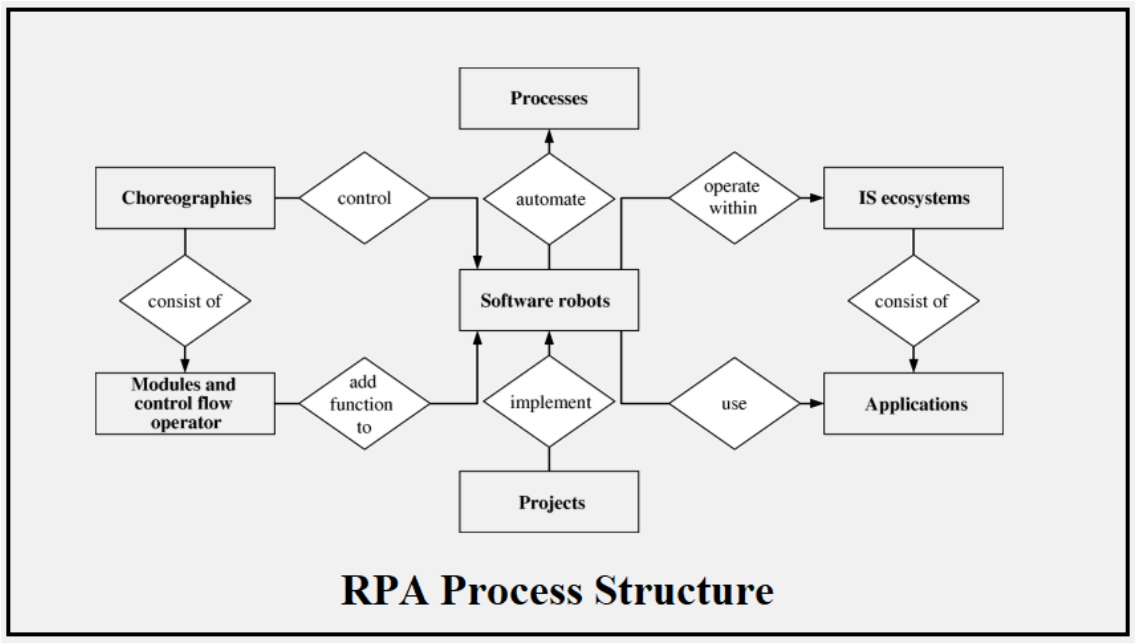

Figure 2.1 RPA Process Structure

• **Automation:** RPA seeks to automate repetitive and routine processes that are usually carried out by humans, such as data entry, form filling, information copying and pasting, and other rule-based activities.
• **Software Robots:** RPA bots are computer programs that interact with various systems and applications in a manner similar to that of a human user. These bots can work on a variety of platforms, including web browsers, desktop apps, and legacy systems.
• **Rules-Based Processes:** RPA works best for procedures with established rules and structured data input. It can complete tasks by following a set of rules and logic without the use of sophisticated cognitive processes or decision-making skills.
• **User Interface Interaction:** RPA bots interact with the user interface of programs, gathering and altering data, and carrying out tasks. They are able to follow instructions to click buttons, enter data into forms, extract information from papers, and carry out other tasks.
• **Integration:** Data sharing and communication between various systems are made possible by RPA's ability to interact with already-existing software systems and applications. Through this integration, bots can execute end-to-end process automation and access and retrieve data from a variety of sources.
• **Scalability and Productivity:** RPA can perform repetitive tasks 24/7 without breaks, resulting in higher performance and efficiency. It can scale up or down depending on the workload, allowing companies to adapt to changing business needs.
• **Non-invasive:** RPA only impacts the user interface and does not require major changes to infrastructure or underlying systems. Because it is non-invasive, it can be implemented quickly and is less reliant on IT teams.
• **Cognitive Automation:** while traditional RPA focuses on rule-based tasks, advances in RPA technology have led to the incorporation of cognitive capabilities. Artificial intelligence (AI) and machine learning (ML) are used in cognitive automation to process unstructured data, make decisions, and carry out more complex tasks.

RPA has gained popularity in various industries as it can improve operational efficiency, accuracy, and cost effectiveness. Companies can use RPA to free human employees from repetitive tasks so they can focus on higher-value activities that require creativity, critical thinking, and problem-solving skills. Robotic Process Automation involves executing a series of predefined business rules using automated software programs. RPA's main goal is to replace monotonous, repetitive clerical work with robots or machines in the virtual workforce. We teach the automated programs, or bots, what to do and then delegate the work to them.

2.1 RPA Tools: RPA tools are software that help users automate various tasks. Most organizations have regular and repetitive tasks such as data entry, data extraction and reporting. Employees perform these tasks manually in the software. Such repetitive tasks can be easily automated with the help of robots. Software that automates the use of robots is called an RPA tool.

UiPath: One of the top RPA platforms, UiPath provides a full range of tools for automating business procedures. It enables both attended and unattended automation and offers a user-friendly interface.

3. Computer Vision in Robotics Process Automation

The goal of the branch of study and technology known as computer vision is to give computers the ability to decipher and comprehend visual data from pictures and videos. It entails the creation of algorithms and methods for deriving insightful data from visual information that resembles human visual perception. Image identification, object detection, image segmentation, pose estimation, image production, and other processes are all part of computer vision. To identify objects, comprehend their spatial relationships, and extract pertinent features or patterns, these activities analyze and process visual data. The basic algorithms in computer vision are frequently built using methods from deep learning and machine learning. In order to analyze visual data and extract features at various levels of abstraction, convolutional neural networks (CNNs) are frequently utilized. Large datasets are used to train these networks so they may discover patterns and characteristics that are useful for a variety of computer vision tasks. Computer vision is a field that

has given machines the ability to not just look at pictures but also to see them and identify their contents with a startling level of accuracy. This is one of the hardest things for a machine to achieve, as you can surely understand. Nevertheless, despite multiple failed attempts, it is now feasible because to a number of developments in artificial intelligence and a quick rise in our processors' capability.

The interpretation and interaction with visual data is made possible for software robots through computer vision, which is an important aspect in Robotic Process Automation (RPA). RPA is the automation of tasks that are rule-based and repetitive, which are usually handled by humans. Computer vision complements this automation by giving robots the ability to interpret visual information in the same way humans can.

Below are certain functions of computer vision within RPA.

- Image and Video Processing: Computer vision algorithms have the capability to examine images and videos with an objective to extract pertinent information, which is known as Image and Video Processing. One illustration is that robots have the capability to decipher written content from invoices, gather information from electronically scanned papers, or recognize items from a visual stream.
- Optical Character Recognition (OCR): OCR technology, which falls under the domain of computer vision, is employed to identify and fetch textual content from images or scanned documents. The utilization of OCR by RPA robots enables them to analyze information from disparate sources, including documents that are hand-written, forms and invoices.
- Object Recognition and Tracking: The ability of robots to recognize and follow objects in images or videos can be attributed to computer vision. The aptitude can be utilized to automate duties such as regulating inventory, ensuring quality control, or monitoring items on a production conveyor.
- Visual Verification: Robotic process automation (RPA) robots can utilise computer vision to confirm the accuracy of visual data. For instance, they can verify that the anticipated changes have indeed taken place by comparing screenshots of user interfaces taken before and after an automated operation.
- User Interface Automation: The automation of user interface can be achieved through computer vision, as it enables the RPA robots to engage with graphical user interfaces (GUIs) by visually detecting and selecting on-screen elements. Robots are capable of identifying buttons, input fields, and menus based on visual input, and then executing actions in the same way that humans interact with applications.
- Facial Recognition: Computer vision algorithms are capable of identifying and acknowledging faces in facial recognition, letting RPA robots automate tasks that need user authentication or customized choice-making opportunities. There are multiple uses for this, including but not limited to tracking employee attendance and engaging in customer service interactions.
- Fraud Detection and Monitoring: In RPA, computer vision can detect patterns or anomalies that suggest fraudulent activities through the analysis of visual data, making it ideal for fraud detection and monitoring. As an example, robots have the capability to examine pictures or video footage in order to detect questionable actions or phony paperwork.

Integrating computer vision capabilities makes RPA more adaptable and efficient in automating duties that depend on visual data. The ability to perceive and comprehend the environment elevates the capabilities of robots, resulting in improved productivity, precision, and broader opportunities for automation.

Uses for computer vision include:

- Production and assembly area for quality assurance
- Reduce downtime in retail
- In self-driving cars
- Healthcare streamlines the system and makes it efficient.
- Customer monitoring
- Theft surveillance
- Product evaluation

All industries and departments need to streamline their operations and become more efficient.

4. Computer Vision Convolution

From a computer vision perspective, convolution can be thought of as a type of filter that can be applied to an image. Convolution in mathematics is an operator that takes two functions and outputs a third function that most accurately captures the degree of overlap between the two, but in a fundamentally different way. At this point you may be wondering how this works and how the image can be filtered. Convolution creates a modified filtered image by first computing the value of the central pixel and then adding the weighted values of all neighboring points.

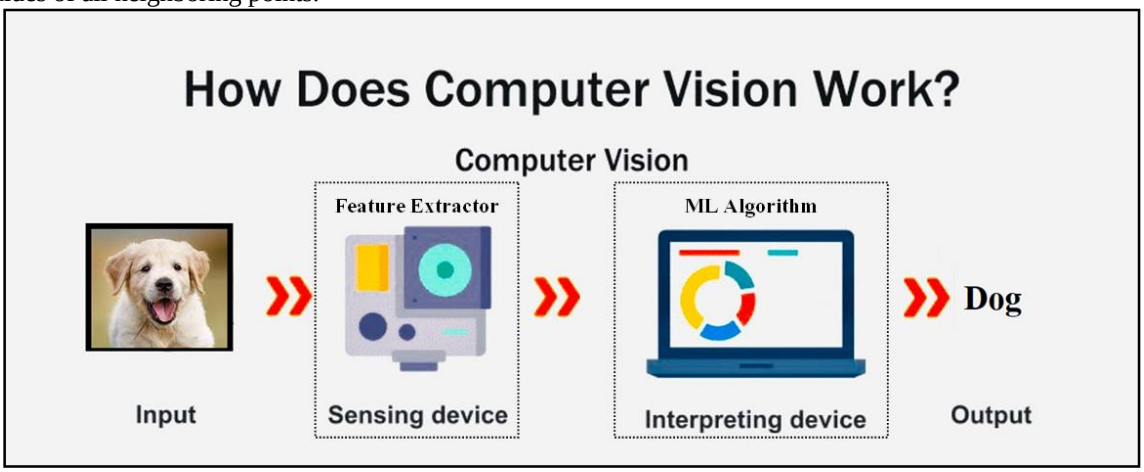

Figure 4.1 : How does computer vision function?

5. How Machine Learning and AI Use Computer Vision

Simply explained, computer vision is the process of understanding photographs and films available in digital form. Computer vision is used in machine learning (ML) and AI to train models to recognize specific patterns and store data in artificial memory to predict outcomes in real-world applications.

A fundamental goal of using computer vision technology in machine learning and artificial intelligence is to create models that function independently without human intervention. The entire process includes opportunities to collect, process, analyze and understand data for use in real-world environments with digital images.

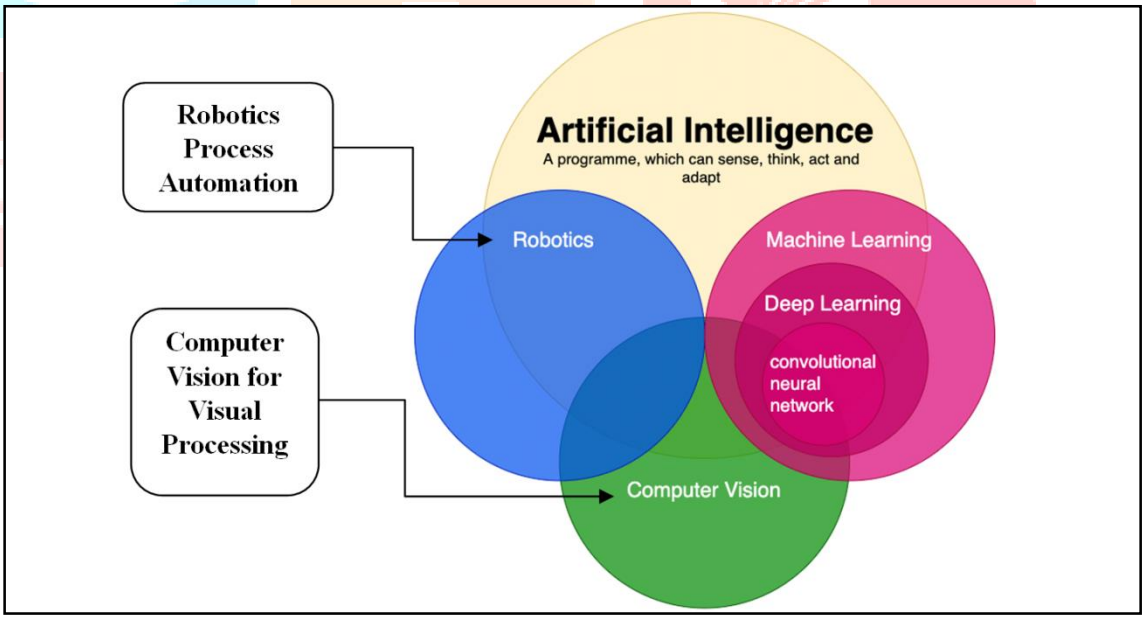

Figure 4.4.1 RPA, ML, Computer Vision, Deep Learning related to each other.

The process of interpreting photos and movies that are available in digital formats is known as computer vision. Computer vision is used in machine learning (ML) and artificial intelligence (AI) to teach the model to recognize specific patterns and store the data in their artificial memory to use the same for forecasting the results in practical application.

To build a model that can run on its own without human input, computer vision technology is mostly used in machine learning and artificial intelligence (AI). The entire process includes steps for gathering data, processing it, analyzing it, and comprehending digital images so that they can be used in a real-world setting.

6. Regular Expressions (RegEx)

For pattern matching and text manipulation, Regular Expressions (RegEx) are effective tools. To extract specific information from text, to check input, or to perform data transformations, they can be especially helpful in robotic process automation (RPA). RegEx may be implemented differently by RPA technologies, although its fundamentals and syntax are typically the same regardless of the programming language.
RegEx can be used in RPA along with the string manipulation tools that the RPA tool or the programming language you're using provides. A general strategy for using RegEx in RPA is as follows:

6.1 Load the Required Libraries: To use RegEx capabilities in RPA, you normally need to load the appropriate libraries. For instance, you can use the built-in "System.Text.RegularExpressions" namespace in RPA tools like UiPath.
6.2 RegEx Pattern: Define your RegEx pattern by selecting the pattern from the text that you want to match or extract. RegEx patterns are made up of rules and special characters that specify the search criteria. For instance, the RegEx pattern for extracting email addresses from a string could be something like [w.-]+@[w.-]+.[w]+.
6.3 Utilise RegEx Functions: To perform RegEx tasks, RPA technologies frequently provide functions or activities. With the help of these functions, you can frequently look for matches, extract substrings, alter text, or check input against a RegEx pattern. For details on accessible functions, consult your RPA tool's documentation or activity library.
6.4 Utilise the RegEx function on the text input: Give the relevant RegEx function the text you want to analyse or modify. For instance, you would provide the text to a function like Regex.Match() or Regex.Matches() if you wanted to extract email addresses.
6.5 Handle the Results: The type of results you get will depend on the RegEx function you used. In contrast to Regex.Matches(), which would yield numerous matches, Regex.Match() would only return the first instance of a match. For the sake of your RPA workflow, process or modify the extracted results as necessary.
6.7 Optional: Perform more string manipulations: If necessary, you can use other string manipulation routines to further handle the data after extracting or matching the desired patterns. You could need to concatenate data, separate strings, or trim whitespace, for instance.

7. Remote Desktops Protocol (RDPs)
The Remote Desktop Protocol (RDP) is an exclusive system created by Microsoft which permits a user to establish a connection with a remote computer and manage it through a network connection. Users are able to use the desktop and applications of another computer from a distance as if they were physically present in front of it. RDP transmits the graphical user interface (GUI) of the remote computer to the client computer and receives keyboard and mouse inputs from the client in order to operate the remote computer. By using this technology, individuals can interact with the distant computer just as they would if they were physically present.

The purpose of RDP is often for technical support, managing remote systems, and connecting to distant resources. It is simple for individuals to gain entry to their home or work computers from a different place, such as when they are on a trip or operating from a remote location.

A RDP connection can only be made between a client computer and a remote computer running an RDP-compatible version of Windows (such as Windows 7, Windows 10, or Windows Server). For Windows operating systems, Microsoft includes an RDP client called "Remote Desktop Connection" with the operating system. For other operating systems including macOS, Linux, iOS, and Android, there are also third-party RDP clients accessible.
RDP is a protocol used for remote access and control, which is worth highlighting. When enabling RDP, it's crucial to follow safe procedures including creating strong passwords, enabling network-level authentication, and keeping the RDP software and operating system patched to avoid potential security flaws.

Using RPA (Robotic Process Automation) and RDP (Remote Desktop Protocol) in combination can enable automation of processes on distant systems, even though the two technologies have different identities. RPA involves automating routine tasks using software robots or bots, whereas RDP enables a person to remotely connect to and direct another computer on a network.

8. Research Problem and Research questions
What most interests' researchers about RPA is how it varies from current IT solutions, particularly in terms of implementation. In a nutshell, the design strategy is everything. RPA is not designed to operate independently like, for instance, Enterprise Resource Planning (ERP) systems would. Instead, it is built on top of other systems. RPA might be compared to a blanket that covers several systems, serving as a glue rather than an independent tool. The majority, if not all, RPA solutions must be customized for each system and process due to the design methodology. This emphasizes the interaction between programmers and others who engage with the fundamental procedures more than comparable automation instances that use typical IT initiatives. This claim makes the case that more research is needed since the study on typical IT project deployments does not entirely apply to RPA implementations as they currently stand. The major objective of this thesis is to fill in this gap by analyzing how RPA implementations differ from traditional deployments and what factors affect them. The execution success factors for RPA might serve as one definition of the focus phenomenon.

However, RPA is distinct from typical IT projects and its projects invariably have transferrable components, so there is no use in reinventing the wheel. It's critical to recognize the parallels and contrasts with the implementations of previous IT projects. After determining which components are most relevant to RPA deployment, testing is the only step left. A template for the implementation timeframe should be made in order to do this. By looking at studies on project life-cycles and including the most appropriate components, it is possible to construct a project life-cycle model for RPA implementation initiatives. The research questions for this thesis are as follows, using this logic as a guide:

- Research Question: 1. What aspects of IT project implementation have been deemed essential?

- Research Question: 2. What phases comprise an RPA-compatible project lifecycle?
- Research Question: 3. How will these components perform when used in combination and with RPA implementations?
- Research Question: 4. How to automate activities in remote desktop RDP?
- Research Question: 5. How does computer vision work in RPA Tools?

These issues will serve as the main focus of this investigation, and the conclusions section will revisit them.

9. Work Method and Structure

This thesis aims to increase understanding of RPA deployments and the variables affecting such endeavors. In order to achieve this, the study first conducts an analysis of applicable literature and synthesizes it to produce a template framework for RPA applications that may later be evaluated in a case project that takes place in the real world. The primary goal of this thesis is to create, test, and improve the RPA implementation model. The research issues outlined earlier can be resolved and the necessary understanding can be gained by carefully assessing the results from this course of study.

In this thesis, the research design will be based on a case study with a critical realism perspective. In this case, a case study makes sense because the occurrence is quite contextual.

Typically, studies in operations administration have focused on the conceptual side, examining prior strategies. However, it is important to first research the effects before considering the introduction of a new technology. To do this, design science serves as the foundation for the thesis. Design sciences, in general, concentrate on anticipating impacts rather than looking at results after the fact. This strategy more closely matches the nature of the investigation. A design theory for a fresh intervention can be built using a four-part logic that was first presented by Denyer et al. (2008).

You may use the work technique and structure described below to increase accuracy in a particular process utilizing computer vision and regular expression (regex) object identification in robotics process automation:

9.1 Defining the Specific Process : Using computer vision and regex object identification, pinpoint the precise procedure that you wish to automate and enhance. The components of the process that need to be more precise should be specifically defined, together with the inputs and outputs.

9.2 Gather Data: Compile a dataset of photos or videos that are pertinent to the procedure. Examples of the things or components that need to be correctly identified and recognized should be included in the dataset. Additionally, collect any relevant data for the model's testing and training.

9.3 Train the Computer Vision Model: To train a model for object identification, use an appropriate computer vision framework, such as TensorFlow or PyTorch. You may start with pre-trained models like YOLO, SSD, or Faster R-CNN and then fine-tune them using the data from your particular dataset. Utilising the labelled dataset, train the model and improve accuracy.

9.4 Implement Regex Object Detection: Determine the precise components or patterns that require regex detection. Give examples of regular expressions that match these components. Use Python or another appropriate programming language to put the regex object identification technique into practice.

9.5 Integrate Computer Vision and Regex Object identification: Combine the advantages of the computer vision paradigm and the regex object identification technique. For instance, select regions of interest using the computer vision model to determine the general context, then utilise regex to extract particular information from those parts.

9.6 Test and Validate: Determine whether the combined model's accuracy can be tested on a different validation dataset or in the actual world. To evaluate the performance, look at pertinent measures like accuracy, recall, and F1 score. To improve accuracy, iterate on the model and algorithm as needed.

9.7 Deployment and Monitoring: Deploy the model and algorithm in your robotic process automation system if you are pleased with the accuracy.

You may design a computer vision and RegEx object identification model that improves the precision of a certain process in robotics process automation by using this work technique and structure.

10. Robotic Process Automation Development Life Cycle (RDLC)

The prerequisites that have to be fulfilled are: installing a bot and continuing to track it once it completes a task. RPA is a concept with a development life cycle that consists of the organizational procedures that need to be automated as well. In order to carefully study, assess, and optimize each stage of the RPA process flow in order to increase delivery, execution, and performance, the process flow is tackled in segments. An RPA strategy for execution typically consists of the six steps listed below.

RPA Lifecycle: Different stages of Bot development

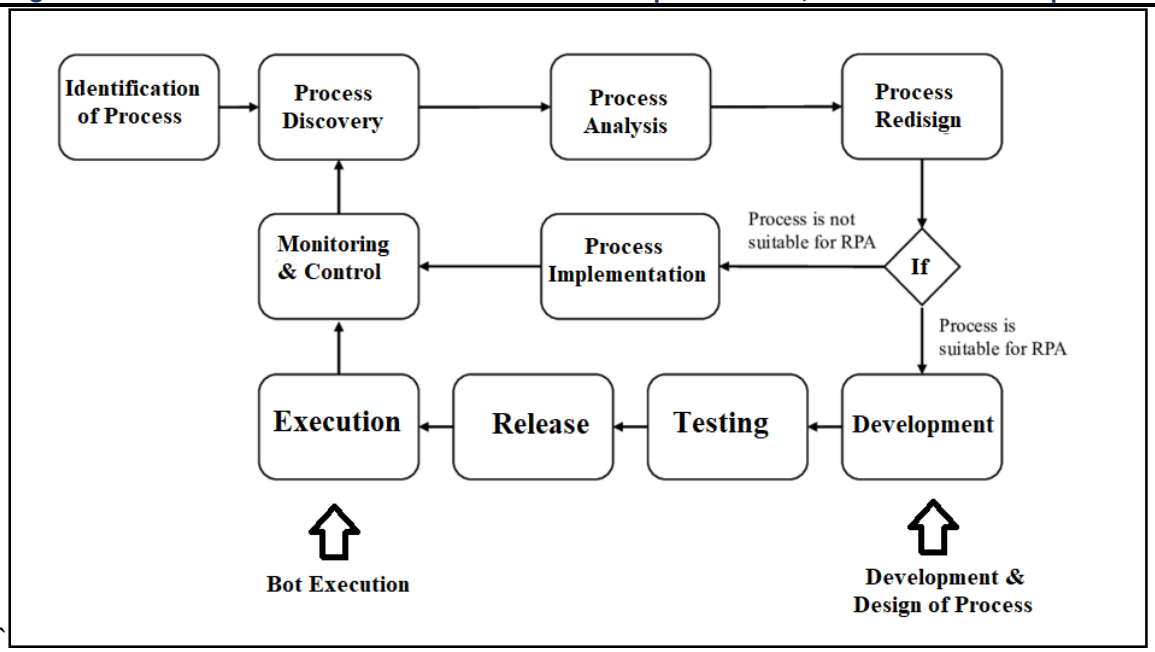

Figure 10.1 Robotic Process Automation Life Cycle

10.1 Process Discovery Phase: The initial and most important phase in developing and testing the RPA lifecycle is identifying prospective business processes that can be automated utilizing the technology. Not Any process can be automated using robotic techniques. In contrast to unstructured data, which accounts for more than 70% of all business-related data, RPA prefers organized data. Additionally, RPA was chosen because it works better in a process with rules than a process with judgment. Even though exceptions to these rules have demonstrated that AI and machine learning can be somewhat useful. In order to accelerate the development of RPA, it is imperative that business organizations and RPA stakeholders collectively establish the necessary processes.

10.2 Process Analyze Phase: The next phase in the RPA process flow involves analyzing the procedures that have been designated as potential stages or procedures for automation. The need for such operations is decided by a process architect after carefully analyzing the technological viability. The level of automated at this point is determined by the study and the various complexity levels present in the identified processes. What is the time and money saved, for instance? Can the entire business process be improved by automation? Does this automation actually result in a higher-quality output? What kind of business worth, once it is put into practice, can this form of automation bring?

10.3 Process Solution Design Phase: During this phase of the RPA life cycle's development, a Process Definition Document, or PDD, is produced. This PDD specifies the stages that will comprise the automated process, as suggested by the name. The possible dependencies of the automated process are also identified and mapped at this stage, including the systems it interacts with and the regulations that affect it. Making a flowchart or object model diagram that displays the steps of the computerized procedure in chronological sequence is the next step.

10.4 Project Development Phase: Creating automation scripts and code according to the definitions and standards defined during the design phase is the next step in the RPA lifecycle. There are many RPA solutions on the market, including BluePrism, UiPath, Automation Anywhere, and Pega, each with their own capabilities. Several tools are used depending on the task and expertise required. RPA developers create bots using the best technology for the task.

10.5 UAT (User Acceptance Testing): At this stage of the RPA lifecycle, the developed bot is tested by the test team or by the development team itself. The bot is tested in a pre-production environment to test how users can use it to automate specific tasks. If the test is successful, proceed to the next phase. However, if the test fails, the bot goes back to the development phase where any bugs found during the testing phase are fixed and tested again. After successfully testing your bot, the next phase in the RPA lifecycle is the deployment phase.

10.6 Implementation and maintenance phase: After the bot is developed and tested, it is deployed to production. Now that the bot is deployed, users can use it. However, if there is a problem with the bot, we go back to the development and test teams to fix the problem. Well, these were the major stages of the RPA lifecycle. The final step is to run the bot.

10.7 Execution of Bot: This phase checks if the bot runs and produces meaningful results. Well, that's it for this article.

See the following image to understand the bot creation flow.

7. Conclusion: Throughout history, the development of technology has made it possible to improve the efficiency of organizations. Organizations can now start to effectively increase the efficiency of data labor thanks to robotic procedure automation. Companies need to figure out how to use RPA in their procedures effectively and efficiently to take advantage of this opportunity. Automated solutions for data processing must be tailored to the requirements of each target process. The foundational elements required to construct a model for executing an RPA solution with an objective procedure can be found in both the RPA literature and the design literature. A number of elements need to be taken into account for an RPA project to succeed.

8. Future Scope: Combining robotic process automation (RPA) with computer vision and remote desktop protocol (RDP) greatly improves automation capabilities, enabling more sophisticated and intelligent robotic workflows. Using computer vision, RPA bots can perform tasks such as extracting data from documents, validating information in forms, reading and understanding text on web pages, and even recognizing and manipulating images. . Computer vision expands the reach of RPA by extending automation capabilities to processes that include visual elements.

A network connection can be used to access a computer or virtual machine remotely via the RDP protocol. It enables a user to operate and communicate with a remote system's desktop as if they were there in person. RPA and RDP work together to let bots remotely access and manipulate data and applications while automating processes on remote systems. When the target systems are not web-based or do not offer APIs for integration, RDP-based automation can be helpful. RPA bots can connect to these systems via a remote desktop connection and carry out operations just like a local human user would. This broadens the application of RPA by enabling the automation of operations across many platforms and systems.

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