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Automation of networking tasks with the use of RPA

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Abstract

The purpose of this project is to use RPA (Robot process automation) to successfully execute actions and configurations duties. This Is done by using the software called UiPath which uses the principles of RPA; utilising as well as creating it in order for it to be programmable and allow the automation's actions to be fulfilled. The software will execute an automated code within a software called Cisco packet tracer. Cisco packet tracer enables and simulates how a normal network will behave in real time. Usually a network professional, would manually set up within Cisco Packet tracer however it will be automated with RPA. This automation will use the extent of Cisco Packet Tracer to create and configure devices according to situations and scenarios that would be used in the real world; rather than doing it manually, as time is saved and more can be achieved with the use of RPA. Within this report, the backgrounds of certain network fundamentals will be presented including how it can be automated as well as automation itself. The involvement of the root cause of why this should even be done by something else, rather than a networking specialists Is further explained and their association to the tasks that they currently carry out. These questions will be explored with the expansion on the understanding of a potential answer and reasoning with the use of automation. I will also touch upon other aspects as well as the importance of planning, reasons of human error and how robot process automation, can create a contribution within a business perspective. The artefact that is surrounded upon this report, will be presented in depth on how it executes displaying a prospective view on how well automation of networking tasks are done with RPA, can be achieved within the working world. Not only can these cover newly advanced technology, but at current times similar with projects in motion, these will be explored in this report developing on how they saw the same problem and took a different route in this current time. This project will create an expansion on the research I gathered on automation and network tasks; penetrating the multiple opportunities of combing both of these ideologies to produce something advantageous.

Acknowledgement

I would like to convey my sincere thanks to my project supervisor. Dr Syed Tazeen who has been extremely helpful to me with her guidance and support throughout the entirety of this project. I would also like to express the gratitude of having the opportunity to experience taking on this IT module which has enabled me to surpass my limits, and expand my knowledge in various fields of the working world as well as the world of developing IT.

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1.1 Introduction and problem background

The project idea consists on making a software that will automate inputs and actions for a networking solution. For my project it will do a task of configuring two networks. However, a simple task can take some time. So, making it tedious to do, making my project a solution to automatically do the procedure.

When researching articles, journals and data accumulated by professionals on my topic, it showed many approaches can be taken to tackle my significate problem. Considering this thought, my final product will be a script program which will do a task. A disadvantage that may occur would be debugging the program; a process for that would be established. I would need use UiPath to create this automation. Progression will be recorded, so implementation will not be having complications. As understanding is developed through the articles, it was clear the incorrect implementation was due to lack of understanding of the process of automation. A highlighted fact is linking two different ideologies. So, it will be an intricate; resulting from the lack of information available. However, as the task differs, it may be a lot more capable. As I will create the RPA to do network tasks (using UiPath) (IST Networks. 2020. RPA | IST Networks. By increasing my understanding in both ideologies', I believe I will improve my understanding in automation; exploring into networks and resolving my dilemma.

1.2 Problem Statement and functional requirements

As elaborated in the introduction the problem is being faced in the working world. With my idea, more convenience and efficiency can be created from it. In this moment of time, many companies and organisations, will experience around 75% of human errors; due to admin tasks within working environments (Heslin, 2021). Although these are admin tasks and can be easily fixed, this then creates a presentation where it is not seen as a dilemma that does not require further analysis. However, from the research obtained, the occurring human errors can cause an immense chain effect. Due to humans executing repetitive tasks, this can cause accuracy and the speed of tasks to falter; no matter how profound the user is and despite the matter of how many times they have computed assigned a task, there's always an opportunity of error. The fault within human errors cannot be fully comprised as well as justified as it is something that is eternally situated to error and inaccuracy in comparison with modern technology and computers.

With the work constructed at ground level, the problems which appear to be diluted at this stage will only present relevance of error; affecting the system later on in the process and configuration. This shows that it is evident to seek out problems from the earliest of stages and to create this as a priority to be fixed.

1.3 Project objectives

My problem initially is using RPA to do repetitive network procedures, similar projects have been attempted and are currently in motion. While gathering research I have seen many ways automation has been started or being used for networking. Two topics stood out to me as they felt similar to my goal, which is programmability for network automation and automation of network maintenance. Professionally it is not considered as RPA but automation of network maintenance, not using robot process. Although this might be seen unrelated the same mind set to create this goal can be implemented

as well to my goal and other projects that involve a level of automation with networks. At this point of time many tools have been industrialized for automation of network maintenance. These tasks would go from troubleshooting, monitoring (big brother software) and a life feed coverage of networks. These advantages have helped today's current age of networks in great way. The article further explains how automation is used to achieve network maintenance. The authors (Aiko Oi, Ryosuke Sato, Yuichi Suto, Kosuke Sakata, Myotome Nakajima, Tsuyoshi Furukawa) of the article have planned out the process of with the start being a "user report is sent to the network maintenance personnel after it is received by the customer-service desk"(Aiko Oi, Ryosuke Sato, Yuichi Suto, Kosuke Sakata, Myotome Nakajima, Tsuyoshi Furukawa,2020).The way most of the actions and data is being done is through automation tools on a system. As I discovered further the process must go through many stages to reach its end cycle. The article explains further stating the system "also has functions for connectivity test by keep-alive and ping, threshold monitoring using performance information concerning CPUs etc., and alerting maintenance personnel when an abnormality (such as when a threshold is exceeded) occurs" (Aiko Oi, Ryosuke Sato, Yuichi Suto, Kosuke Sakata, Myotome Nakajima, Tsuyoshi Furukawa,2020). The article then explains how the automation allows professionals at had to solve potential dilemmas the automation maintenance software has identified. Even though the goal is different to mine it is evident I will need to follow a similar process to this. Having in mind each step the automation goes through must run consecutively and successfully.

As mentioned before the other aspect that related with my goal was with the programmability. At recent, there are few currently usable automations Network Configuration Protocols; YANG, NETCONF, RESTCONF and GNMI. The authors also believe in automation will help reduce time when assessing problems with automation. From my findings from this specific research, it shows that programmability allows an even bigger impact. As mentioned before RPA would significantly improve work life however this source provides ideas of improving constructing future developments. Allowing to effectively reduce the service time of the creation and coding of switches and networks.

1.4 Motivation

As a completion of this project; cooperating a withholding section of my Bachelor Honours in Computer Science at University of Hertfordshire. The factor which penetrated my growing curiosity within the course, is the concept of developing and cooperating myself within a new growing industry; such automation within networks; to aid network specialists. Learning as well as working within a new developing industry would present an opportunity of challenge and prosperity, involving allowing explorations of learning the advancements of networking, adjusting to a different style of development and enabling my understanding and knowledge to surpass my limits.

1.5 Overview of Methodology and Research

Before establishing the idea for my project, I already had an open-minded curiosity with automation. I already had a vigorous number of sources to fuel my research; with this being a new topic in this day and time. I then expanded my knowledge with the similar authors and journals in this topic to aid my pursuit for my report.

As I mentioned before, I will be using the software called UiPath as well as cisco packet tracer. To understand how to use them and create a sustainable level of understanding to achieve my project, I did the courses available that taught me the essentials of the tools. From UiPath, (UiPath Academy, 2021) there are a few courses available to anyone. The site consisted as one main course with the starter;

offering a good grasp of the software to someone that lacks general knowledge and understanding of it as well as being an informative refresher to someone already familiar with the software. The starter course comprises of 4 hours of informative tutorials; explaining how to use certain tool in the app as well as attending to the code. My introduction with this software was a result of my time at my internship and as well as this, I had already gone through the course prior to the start of my project idea. With the available courses, I had enabled myself to expand my knowledge with UiPath with more courses; making me adequate to code and automate task as well as maintenance of the overall product.

With cisco packet tracer, it also provided some courses and guides. As this software was mostly designed for new network specialists to practice, this software is impartially simulating devices and stations in a network. With the guides available to present me with material to learn how to use cisco packet tracer, I felt I was equipped with the terminology and skill required as I had learnt a mass amount of material from the course I did within University of Hertfordshire (6COM1067-0901-Network Protocols and Architectures). Within the period, that of which I attended this course, I was exposed to the knowledge of how networks worked, and the front-line procedures done to network devices such as switches and what made them stimulate like clockwork. With the gathered knowledge and learning of the two software's, I was provisioned to make my project be brought into action.

This report will regard to exhibiting or touching upon topics that are accompanying the idea of automation with networks. As cited beforehand, this is a new topic; however, with automation alone, it obtains many themes that can be explored. This includes automation in networks not using RPA, due to the unfulfilled nature as it continues to construct within the world of technology. It consistently has new break throughs which creates a great influence on this idea and as shown on how and what this idea is, it can become the potential future. This came into perspective due to the various new research I had obtained, while prior to the beginning of the project. Along with betwixt and between of making the projects (which will be revealed and assessed in this report).

1.6 Project plan

Within this project, I had to allow myself to alter and justify my knowledge and general understanding, creating an opportunity to learn and discover new factors and sources of information in great detail. What I comprehend to conclude what is the most valuable upon all the potential new information gathered is expanding and refurnishing my knowledge with RPA (Robot process automation) and applying this towards a field I have high interests in. Automation is also a fairly new concept as well as it being new cooperating with networking (Oi, R. Sato, Y. Suto, K. Sakata, M. Nakajima and T. Furukawa, "A Study on Automation of Network Maintenance in Telecom Carriers for Zero-Touch Operations), which is constantly advancing and will be of high importance in the future within our developing world and surroundings. (Suri, V., Elia, M. and Hillegersberg, J., 2020. (PDF) Software Bots - The Next Frontier for Shared Services and Functional). I was first exposed to RPA, at my internship (Parker Hannifin) and since then, I was extremely intrigued and captivated by this concept of modern developing technology. I was self-taught from the start resulting this to be a very slow process. However, I managed to get more familiarized with RPA utilizing my knowledge from UiPath. Through this, the conclusion that RPA can be seen useful in many aspects of the working world is established. (Willcocks, L., Lacity, M. and Craig, A., 2017. Robotic Process Automation: Strategic Transformation Lever for Global Business Services Journal of Information Technology Teaching Cases, 7, pp.17-28.). Even though with the consistent advancements of technology, one would consider the fact that automation should be the norm. But there are still repetitive tasks executed every day in many different working environments. It is known that admin tasks within any type

of field will experience the routine of repetitive tasks without fail in order to carry out tasks persistently. *(* Hofmann, P., Samp, C. and Urbach, N., 2019. Robotic process automation. Electronic Markets*)* and from my own personal experience, I took on board this idea of repetitiveness. Whilst continuing my previous job and my internship, I had realised many tasks could be resolved with the involvement of RPA. At the time of working, it would have been virtuous to put my knowledge of RPA towards my work; however, I was not experienced with it at that current stage. Therefore, to construct what I intended and to become truly proficient in this area would succumb to be a true success to me, as well as to put this skill to an area I believe l I should pursue a career in, flourishing with my final embellishment of my aspirations.

With the initial idea, I had to create a systematic and thorough plan for the project. Therefore, it gave me the idea of a prediction overview consisting with certain tasks to be carried out in chronological order. The first task which was in need to be executed, was to identify which network task I would undertake to be automated. At first contemplated on considering using PUTTY to emulate actions and configure certain ports using the terminal language used by network professionals (Why developers like Putty, 2021). However, I then concluded that by using PUTTY, this would create potential of what my automation could do. As I began to progress at the start of the project, I allowed to endure myself within more exploration towards what would be more useful to present; concluding my decision to use Cisco Pack Tracer. With the target application ultimately being identified, I then began to design on what I will do. I decided to automate certain uses in cisco packet tracer which would be useful for a network specialist. The certain tasks of which I began to follow up with further research, were basic designs of network topologies as well as configure basic routines in a network device (such as a switch). With the understanding of how to create the topologies and to configure a switch, I then prepared how I will approach automating in UiPath. As I tried a few UiPath projects prior to this, I also planned out how to deal with problems by extracting the problem; allowing me to resolve it.

2.1 Automation

Automation is the process of creating a replacement of a manual step with one that occurs automatically. However, in this point in time, there is uprising controversy about the topic. Some people believe this is a major source of development towards creating benefiting everyone, sustaining it to be more convenient. Although the concept to allow automation to overcome certain tasks make some believe the development of a matter such as this, can cause many people to go jobless, creating a vast amount of conflict amongst the working environment and class.

Although there is an outlier of it not being agreeable to people, the potential advantages cannot be ignored. Automation, in another sense, can make any task easier. As the continuation of the never-ending development of human thinking, progresses through the future, the aspirations driving for improvement is creates a potential opportunity every day; evident by this, it is a clear innovation of humans. This idea of innovation made human work easier, and productivity rose. Innovation of automation had already existed before the 21st century which meant more staff or services could be produced per hour using the same number of human workers. This then led to a downfall with employment within the traditional working world, eliminating many jobs. However, this also created other jobs and opportunities for those who pursued paths of fulfilled education and construction of knowledge within the new world developing world, which is important as this allows the growing population to obtain work. So overall, innovation opens more potentiality to higher productivity; in this circumstance, this may create fewer traditional jobs and create more modernised and technological jobs. But with the current state of humanity's development within the work of a world-changing industry such as this, can be seen that this worked well for most people and living standards improved, involving this change in the work force as well as applying and collaborating these resources with other working fields.

In the context of a computerised environment, automation would tackle repetitive tasks with a high level of efficiency. For example, a human performing the same task hundreds of times will never be as consistent and withholding the precise accuracy as a machine carrying out the same task. Knowing this shows automation already has a favorable trait which is consistency. If a task is being automated by a computer, it will guarantee no chance of fatigue as well as regards of uninterest to the task or accidentally inputting something incorrectly, eliminating any opportunity of human error. However, it is not always the solution to every task as some tasks cannot be replicated with automation. This consists as a task such as something which needs a degree of creativity or flexibility, which automatic systems can simply not provide (Cole, Z., 2021). We would also need to realise that sometimes a task might not portray to be benefited to be replicated as the cost to develop and implement the automation would not create the wanted presentation and outcome of the profit it gives out.

In Information Technology, the automation of these tasks is commonly accomplished by encoding the logic to perform the task into a program or script (What is IT Automation and Why is it Used?, 2021). Automation is clearly a formidable tool when utilised in the right environment and time. It could save time and reduce errors to increase consistency. Thus, providing a way to centralise solutions and mistakes; making them much easier to tackle and resolve.

It can be seen within the spectrum of human progress; it creates this basis on the division of labor. As we have advanced over thousands of years, our jobs became had more specialised and purposeful. In our present day, while even our smartest machines perform unfulfilling at executing complicated jobs, they are very good and capable at doing narrowly defined and predictable tasks. However, if one looks at a complex task with a definite perspective, you will find that it is many narrowly defined and predictable tasks one after another continuously. Digital machines achieve automation via machine learning. Allowing them to acquire information and skills by analyzing data. This creates an opportunity for such technology to allow self-improvement on something through the interactions of discovery. This possibility is then achieved by giving a computer various amounts of data about the subjective we aspired to become better at.

An example of an automation being used in a company is a project management software. The software would first decide which jobs can be automated and precisely where its professional humans are required. (Frey and Osborne, 2017) On average, this software reduces costs by about 50% in the first year, and by another 25% in the second year. This is only one example of many. There are machines and programs which are developing, getting as good or better than humans in many fields. From pharmacists to analysts, journalists to radiologists, cashiers to bank tellers, or to the most simplified employment. From what has been asserted, it is understandable that the topic of automation has some controversy.

2.2 RPA

RPA stands for robot process automation. What this means, is that automating some of the white color work (a person who performs professional, desk, managerial, or administrative work) so the word robot is indicating we, the user would program a computer algorithm to do things that were previously carried out by humans and especially for some of the rule-based and more structured processes in companies which can then be automated (IST Networks. 2021). The manual tasks would also include data extraction, invoice processing, portal queries and prices maintaining consumer data validating files and many more. Without automation, this could be quite tedious and so the solution to this problem is robotic process automation.

To clarify, robotic process automation is a process of automating the tasks or processes with the help of robots or software to reduce the human intervention (Hofmann, P., Samp, C. & Urbach, N, 2020). These robots can follow the rules defined by the user or can be used in a machine learning capability to suggest the user with recommendations and generate significant results. Each industry can use RPA in their own way to reduce manual workforce and allow work with better efficiency. This ensures that the intelligence of the manual workforce is used in a better way to benefit the organization as well as creating the greatest amount and quality of production. However, a question would arise on how this would be applied in these industries as the world of RPA and physical robots do not perfectly go hand in hand. In this current period, RPA is applied in the industries using the enormous number of tools it obtains on a day-to-day basis. With the most popular tools being UiPath, blue prism and automation, these tools prosper in the market because of their user interface vendor experience.

To additionally understand how RPA would work in a certain environment, I will now go through a scenario. For this scenario it will explore a paperwork involvement of invoices. This type of job can be understood and taken through many work environments. The task would involve hundreds of invoices

where you must extract the data from those invoices, then store that data into specific cells in an excel file.

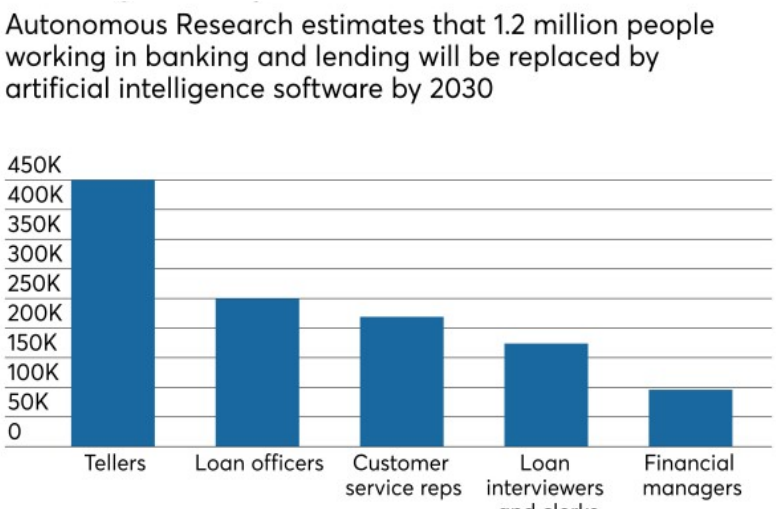


Figure 1 (Data showing predictions of jobs being replaced by ai software to automate work)

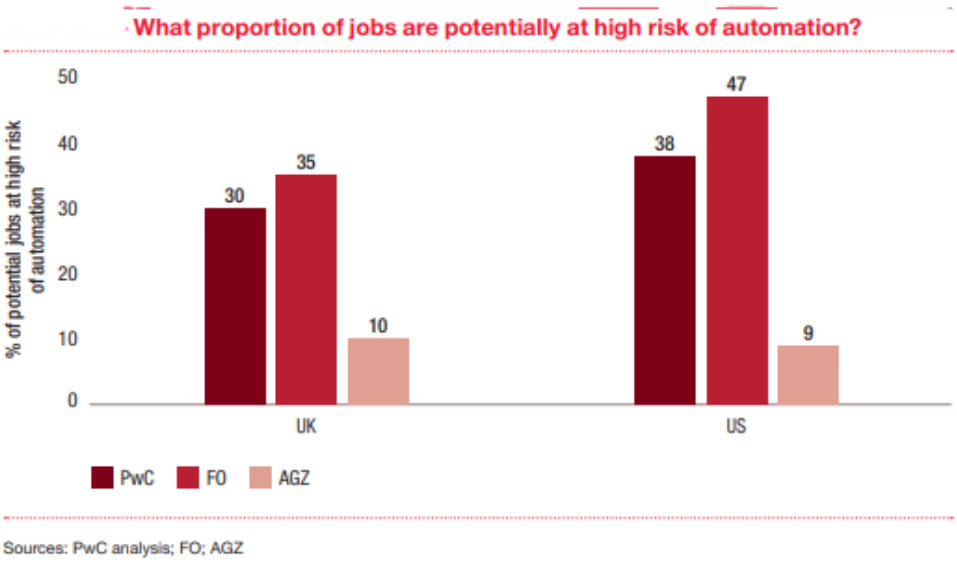
With figure 1 it displays an estimate on the potential progress of software that will automate work in the future (7data, 2021). Depending on what is required by the company, what is needed can differ. First the automation must locate all the invoices as this is best if it is all in a single folder so that the bot can easily access. Next, you can define the actions of a bot to read the files from the folder one after the other until all the files are ready to be used. Once the bot starts opening the files, it must extract specific data values and store it into an excel file. For this to work you have to next design a step to extract the data value or identify the field from which you want to store the data. This is done either by dragging your mouse over the area or by mentioning a variable. Afterwards you must indicate the relative area that is the area next to the field from which you wish to extract the data from. Similarly, you can repeat this action until all the fields are designed to extract (SearchITOperations. 2021)In this stage through the process, you have designed your automation to only extract data but have not defined the rules to store the data into specific cells. To define this, you can mention the starting cell name for one and automatically assign these to the other required cells. This will store the next extracted value of the same invoice in the same row but in the next column. Once all the data has been stored for a single file, you then must define the rules for your bot in such a way that it replicates the actions for the next file as well. For this, you would define the tool to go one cell below and at the beginning of the row of the active cell; this will then be a repeated action of extracted data and storing the values in the excel sheet. This will store the values of all the fields in the designated Excel sheet and that is how you can design the process of automation.

However, the life cycle of RPA does not end here. Once the business requirements are analysed and a bot is developed to automate a specific task, the next step that comes into picture is running the testing cycles. This section will analyse equality and correct defects in the automation workflow simultaneously. After the development and testing phases, a bot enters the maintenance phase in which it provides continuous support and helps an immediate defect resolution. This is how RPA works and how a single or complex process can be automated.

With what has been explored, we have gathered that it is clear how there are many benefits with RPA, one being accuracy and consistency. RPA software's are generally less prone to errors and function with high uniformity and precision. Another clear benefit would be consistency as this software is built in such a way, that all repetitive tasks are performed in the same manner even if it is the thousandth time. Another benefit that can be seen with RPA is that it helps in reducing the cost and the manual work

force. It also increases productivity rate, meaning that the execution time to perform any task is much faster when compared to that of a manual approach. Finally, no or less coding is required with RPA with the software not requiring much programming knowledge; so it can be easier to understand and grasp, compared to other programming languages.

Although this may appear optimal, there are some disadvantages. One major potential problem is, if the application interface gets an update the entire script for the automation might not work. Another is the fact it is a newly developed skill meaning selecting skilled staff will be endeavored to be challenging. Even then, the cost will probably be a great deal upfront. One occurring theme with RPA is making less work as the work is being automated. This can be a positive outcome, but it can sometimes mean more human work. Depending on the task, the automation might need a long period of time to edit the process of the automation. So, it can be seen as situational when in clear use, that it does have some limitations.



From figure 2, data has been accumulated (Berriman, R.2017) showing jobs in the UK and US being automated, potentially losing jobs.

Figure 2 (Show predictions of three companies which are located in the US and UK that have a risk of being automated)

2.3 Social, ethics and legal

With this type of project, an ethical approval must be considered. An ethical approval is when accumulating data or using a certain application, needs a certain authorization. When someone plans to obtain research involving human participants or personal data, they would need to find explicit approval. When I discussed with my supervisor, we concluded that I did not require any ethical approval with my project. This is because I would not have data sustained through someone else by an ethical approval. Therefore, I would have information I had gathered from the many articles and journals, through prior investigation of my project as well as working on it.

2.4 Networking

It can be seen that this could potentially be the key to communication, of the modern age. With it be an everchanging field, I was most intrigued by it and wanted to pursue in it. This was the reason why this was the module of choice, making this my final year project. The reason of expansion within this

subheading incorporated in this chapter, is to expand on the aspects required to collaborate on the task at hand of automation to withhold the fundamentals necessary for the full understanding of executing automation within the entirety of this project.

But what does the presentation of networking mean. The definition of a network at the baseline is a group or system of interconnected people or things (Odom, 2021). When the terminology is transferred to a computing environment a computer network would be a group or system of interconnected computers. A computer network is anything where more than one computer is connected to each other, traditionally a computer network would consist of desktop computers servers, printers etc.

With my studies gathered from university I will show the basic understanding of networking. A basic network would have a switch, a router, a wireless access point, a desktop and a phone, all connected to the same network. In home networks the switch and wireless access point will be built into the Router. Any network in a single area is called a local area network or LAN. The LAN is usually connected to the outside through a connection which an internet service provider has installed. This connects you to something called the wide area network or WAN, the purpose of a WAN is to connect separate local area networks together. The most obvious example of a one would be the internet however businesses would have private WANs to connect multiple sites together.

However, in a business atmosphere were more of the heavy-duty networking gets applied, it is laid out slightly different. A normal IT office would have its standard computers and desks, along with the peripheral devices connected and assorted with desks. Then all the main connection would lead to a wiring closet. This room might also be called a patch room or a server room. In the wiring closet all these devices will connect to a stack of switches which are mounted onto racks depending on the size of the network (Odom, 2021). There may be multiple wiring closets which all connect to each other as there might be more devices connected on different floors.

With the creation of the internet and creations that involved a network, communication was key. Making it plausible that networks is a critical advancement to every working day. The clear advantage of a network is we can share resources.

To descend further into the domain of networking there is a lot more to it on how it operates. We can understand networking further by looking at the foundation of networks. This would be the devices that made and make the current networking possible which are to state a few Hub, Bridge, Router and Switch (D. Chernyshov,1999).

approval. Therefore, I would have information I had gathered from the many articles and journals, through prior investigation of my project as well as working on it.

2.4.1 Network devices

A hub's job is to create connections to devices in a network together. Within an example, we will be able to see how a hub works. To do this, we envision the host to be connected into a simple plus notion; being that the hub is in the middle and surrounding it, is host A, B, C and D. Host A sends some data to host C. When it receives the data, it repeats these pieces of information out of every port, excluding the receiving one. Host C then received this data simultaneously with host B and D, resulting them to discarding this data themselves. However, the hub has many disadvantages. It wastes bandwidth as we have learnt that host B and D receives unwanted data. The reason for this is due to its lucidity of how it

works and as a hub, it uses something called half duplex (Odom, W., 2021). This means it cannot send and receive data at the same time without causing a data collision. This would cause your data to become corrupt and need to be sent again. Therefore, a hub is a layer one device meaning it has no knowledge of addresses and its main course of action is to repeat any data it receives. They have one collision domain, and it uses half of duplex; this leaves an opportunity for security risks because all the hosts receive everyone's data, so a malicious user could claim an opportunity to steal this. Hubs are old technology, so they have now been replaced by switches.

Bridges were introduced to tackle some of the shortcomings of hubs. They were used to segment networks into smaller sections. When data reaches the bridge, it decides on if should forward this data. It does this by looking at the destination and source MAC address. Every time the bridge receives data, it learns the source address then looks at the destination address; deciding whether to send the data or discard the data. So, a bridge identified as a layer 2 device meaning it can understand and learn MAC, addresses segments of LANs into smaller sections; plus, it has two collision domains which means data can be sent or received on each section of the network at the same time. A bridge usually has two ports, but bridges are not used anymore; they too, have also been replaced by switches.

Switches can be presented as a hub and bridge rolled into one. It connects the devices together, but it can also learn which ports connect to which accorded hosts. This works as a result of the switch having an identifier called MAC address table. This table will list each MAC address and which port it is connected to. For example, host A will send some data to host C. The switch then receives the data, but the MAC address table will be empty within this section of the process. The switch will forward the data out of each port just like a hub; unlike a hub, the switch now learns host A's MAC address which can be reached on port 1 or when host C sends data back to host A. The switch now knows exactly where to send the data now. The switch has now learnt the host C's MAC address and it can be found on port 3 using this process very quickly a switch can learn how to reach each host connected to it. To sum this up, a switch is a layer 2 device. And like the bridge, it can learn MAC addresses which are also referred to as layer 2 addresses (Odom, W., 2021). A switch can use full duplex meaning and can send as well as receive data at the same time. This means each port has its own collision domain. This is a huge improvement over a hub because it has obtained the ability to learn MAC addresses. Switches saves huge amounts of bandwidth and now because only the destination host is receiving the data, other hosts are restricted from stealing it.

Routers can be seen as the passage out of your internal network and into the outside world. Within a basic home setup of a network, there would be a computer, a switch and a router. In today’s time and age, a home rooter has the switch built-in but in an enterprise network, there are separate devices. With the router connected to the devices, the other connection is to the internet. Considering any type of connection, it is being established between the devices to the internet. So, to visit a website, the computer will then send data to the router using the users IP address. The router will then forward the traffic out of your home network and into the Internet. When data comes back, the router will forward the data back to your computer. Overall, a router is the way out of your internal network. A router uses not only MAC addresses, but IP addresses as well, which means a router is a layer 3 device as IP addresses are also referred to as layer 3 addresses. It usually has two ports allocated to a router and is highly configurable. It also has numerous different features available for configuration.

2.4.2 TCP/IP Model

The bottom-line definition of TCP/IP is “It's a model to standardize computer networking” (D. Chernyshov,1999). The model consists of layers which are application, transport, network, data link and physical. Within the application layer there are certain protocols such as HTTP FTP and SMTP. The two most common transport protocols are TCP and UDP. Port numbers are also within the transport layer. At the network layer, it is the Internet Protocol or IP. Routers also operate at this layer. Finally, we have the physical layer, consisting of physical items such as cables and network interface cards.

This model is the key layout of how data communicates between devices. When data is sent to each layer, it will add on to this by inputting some of its own of information. This process is called encapsulation. When we hit the physical layer, the data is transmitted over to the receiving device. The receiving device then starts to decapsulate the data. Starting with the application data at layer 5, this is then passed down to the next layer where the transport information is added. For example, it will be the TCP header. Each time a header is added, this will contain significant and specified information. For instance, a TCP header will contain matters such as the source and destination port number, sequence numbers and a few more fragments of information. Next to the network layer, where we add the IP header, this will contain the source and destination of the IP address as well as excess other information. Lastly, we have the data link layer (Odom, W., 2021). Here, we add not only a header but a trailer as well. The header mainly contains the destination and source of MAC address, and the trailer contains some error checking information that the receiving side can check and make sure the data has been received correctly. Once the data hits the physical layer, it is physically transmitted.

The following process is the encapsulation process. One key piece of information, is that each stage the data has, obtains a specific name. At layer five, the data is at its base level; so, it is called data. Once the transport information has been added it is called a segment. Adding the network layer information, converts our segment to be what is, a packet. Lastly, once we add our data link information, the packet becomes a frame. Now once data has been transmitted, the receiving computer decapsulates the information. It will check the destination MAC address for that frame and if the frame is destined for our computer, it is processed further. The computer then checks the IP information of the packets again and if the packet is intended for the computer, it is refined further. The transport information is read, and the application data is sent to the receiving application.

2.4.3 Port numbers

Another vital aspect to networks is port numbers. With the obtained knowledge and understanding of the TCP/IP model, we can comprehend on how important port numbers are, by going through the model. Port numbers are essential for receiving any types of data. The port number can be seen as a unique label assigned to one section to obtain data and this will accept any application data to the specific section. Thus, the server could be running a mail, web or any other service; ready to send data. If one wanted to access the web server, we type in the web address or URL of the site we want to visit. The first course of action the computer will carry out, is convert this URL into an IP address; this is achieved by a DNS. The computer then sends the request to the webserver (Odom, W., 2021). However, we might not be fully aware of what the web server might be running; corresponding to the fact that HTTP is required. We could consider that it could be running SMTP or FTP. These are certain rules that allow specific communication to be declared. SMPT is usually used, to convey a mail server and with an

FTP, a file server. For the server to know which application to send, the applications have something called a well-known port number assigned to them. HTTP is assigned port number 80.

SMTP is assigned port number 25 and FTP is assigned port number 20 and 21. This is because the port numbers are standard numbers, and all computers will have justified knowledge about them. When we made our web request, our computer knew we were trying to access a HTTP site, therefore it added the destination port number of 80 to the TCP header. The computer will also choose a randomly generated source port number to receive a reply. It is sent to the web servers IP address and the well-known port for that service. The IP address and port number are usually arranged by the IP address, a colon then the destination port number. The server will receive this request, looking at the destination port number, to understand the request is for the web application and pass it to that application. The server would then respond and this time the port numbers are reversed. The destination port is now the randomly generated port, and the source port is our recognised known port number 80. As a result, when we receive this response, our computer looks at the port number. The port number allows the computer to know which application to send it to (Odom, W., 2021). In this case, our browser and even which tab of that browser to display it on. So, the IP address gets the data to the computer, but it is the port number that gets the data to the right application.

There are several port numbers that are called well-known ports. These are common protocols that have been assigned port numbers (Odom, W., 2021). Here is a very small list of some of the most common one's network specialist would find which HTTP port 80, HTTP port 443, SMTP port 25 and with list going on endlessly. It is important for networking specialists to know these for everyday troubleshooting.

2.4.4 IP Addresses

IP addresses are a crucial part of networking as it is established within the network layer. An IP address is a unique identifier assigned to each device connected to a computer network. The most common similarity for an IP address is the postal service. For the postal service to work in every house, it needs to have its own unique address. If you need to send a letter, you need to write the destination address on the envelope. It works in the familiar where when you send a letter, the postman knows exactly where to deliver it (Odom, W., 2021). The address must be unique; otherwise, your post could end up going to somebody else or you could start receiving somebody else's post. Thus, it is like how it would work the same within a network scene. Each computer in a network needs to have a unique address called an IP address and when sending data to a computer, just like letters we need to add the destination address. We also need to include a return address, so they know where to reply.

With ipv4 address it as 32 bits in length which means it contains 32 binary digits, an example of the ip address 192.168.1.1. It contains four sections which are called octets. These octets are separated by dots or periods. Each octet in theory can contain any number between 0 and 255. The reason for this is because our 32-bit number is separated into four lots of eight, and 255 is the largest number that can be made from eight bits. Now the address itself is separated into two parts. The first part represents the network, and the second part represents the host. To know which part of the IP address represents the network, we used to rely on the first few binary bits. But since the early 90s we have something called a subnet mask. A subnet mask is always paired with an IP address, used to identify the network section and the host section of the address. In its simplest form whenever you see 255, this is the network part

of the address whenever you see a 0 this is the host part of the address. To differentiate from a PC to the many other PCs to another; we have network numbers as well as host numbers to narrow someone even further. Here we have two networks 192.168.5.0 and 192.168.10.0 both with a subnet of 255.255.255.0. When talking about networks, you often just use 0 for the host section. Inside our networks we have our hosts 1,2 and 3. From this the IP addresses would be 192.168.5.1, 192.168.5.2 and so on. So, with all of that in mind, it would mean we would have some data to send to 192.168.5.3 with a subnet mask of 255.255.255.0. For this to be able to send, we must look at the subnet mask. We can see that the network is 192.168.5. So, we know that three is under host number, so we send it over to the host with the network 192.168.5.0.

With the start of IP addresses, it was decided to split all the available dresses into groups and these groups were called classes. The idea was to make address allocation accessible. The main ones being Class A, Class B and Class C. There is also Class D for something called multicast addresses and Class E which is reserved for experimental use. Each class has a range of IP addresses Class A addresses are between 1.0.0.0 to 126.255.255.255 with the subnet mask of 255.0.0.0. Class B addresses are between 128.0.0.0 to 191.255.255.255 where the subnet mask of 255.255.0.0 and Class C addresses are between 192.0.0.0 to 223.255.255.255 with a subnet mask of 255.255.255.0. As a result, this was all to control the number of hosts available on each network. Class A has three octets available for host allocation, which means we can have 16,777,214 hosts for a single class A network. Class B has two available octets for host allocation meaning we can only have 65,534 hosts to a single Class B network. Class C only has one available octet for host allocation. So, this means we can get 254 hosts per single Class C Network. So, you need to be able to look at an IP address and know which class it belongs to. The most efficient outcomes to do this, is to memorize the first octet. If an IP starts with the number 10, one will know instantly that it is a class A network. If it starts with 192, you will know its Class C and so on. However, around the time there was a problem (Odom, W, 2021). The problem was that no one could have predicted the enormous demand of computers and the Internet. In fact, there are no more unallocated IP version 4 addresses left. Therefore, the new IP version 6, has been designed. It will give us more than enough IP addresses for virtually everyone. Nevertheless, there is a solution to help prolong the life of IP version 4, which is to carve out small sections from all three classes and call them private IP addresses. All other addresses are known as public addresses. They still use the same subnet mask for that class, and they can still have the same number of hosts. The difference is where public IP addresses need to be unique and able for private addresses to use many times, thus saving a huge amount of public IP addresses.

2.5 The advantages of automated tasks

As mentioned before automation is already in use and it is also embedded in a day to day lives in a subconscious thought (Groover, 1981). However, there are further advantages as well as disadvantages following through the concept of automation.

Automation's inclusion of higher production rates is regarded to as a common advantage: with more efficiently used materials, reduced amounts of working weeks of labor contribution as well as reducing time of initiation and completion, increased production and improved quality of the product. In conclusion of the addition of productivity and increased output, these become the two boldest reasons for resulting to utilising automation. Using the understanding of automated systems, this can be enabled to the working world to contribute towards selectable environments in order to create greater amounts of

productivity; made with precision and consistency. This will defy any human variability or errors that could possibly occur; determining a fully compromised product with no thoughts considered to production of usefulness of given materials and resources as well as human capability.

Automation within an industrial operation regards to consisting the importance of safety for workers. The hazards within a workplace would be removed as the requirement for workers would be unnecessary within the working environment as automated systems would step in, to carry such tasks. An example of an automation system such as this was the Occupational Safety and Health Act of 1970 (OSHA) introduced in the United States(OSH Act of 1970). It was validated with the objective of creating a safer working environment for workers and maintaining their rights of well-being. OSHA has influenced robotics within factories as well as the use of automation within the working world.

Automation also results in the reduction of average hours put towards general production committed by factory workers as approximately, 70 hours was about the average workweek in 1900. As time progressed, it has been gradually reduced to around 40 working hours; with the interaction of mechanising automation this has significantly reduced production time and increased consistency with time management overall.

However, the main disadvantages consisting of worker displacement and an often association with automation is spoke through above. Although there are variations of social benefits from the result of reducing the number of displaced workers for required jobs and management; with virtually many jobs replaced with machinery. This then creates a new scenario where workers are in need to relocate themselves, introducing a displacement geographically. To find areas of work causes another cause of developing stress for original workers.

Another common disadvantage with automated equipment is the substantial financial amount required to invest within automation; as automated systems can cost up to millions of pounds to contribute towards fabricate, installation and design, as well as the requirement of a high level of maintenance to successfully operate the machinery. The possibility of products with manualised systems is considerably less flexible. In addition to this, this consists upon the fact that even automation cannot perform to full capacity and lesser flexibility than humans as they need constant maintenance and attention in order to flexibly work efficiently.

There are also potential dilemmas that could occur as automation technology could possibly subjugate instead of following on with the service for humanity. This introduces the security aspect of automation as this potentially causes interference with people's day to day lives as computers would obtain the power to access vast connections of computer data networks. As well as this, it creates a society with the lack of self-involvement, relying on the use of automation for the well-being of society on a social and economic scale.

Despite these outliers, with the correct use of automation we can enable a source of various opportunities in the future. These opportunities release humans from work that could possibly endanger their health and wellbeing as well as the efficiency of productivity and mass of production overall. It also allows further development of automation technologies to supply the growing population with endless social possibilities and improvement to the economic environment in which people can experience a better quality of life for themselves and sustaining this for future generations.

2.5.1 Human error

The authentic objective of my project is being aware due to human errors reality. Due to human error as well as other factors in play, utilising this artifact can enable elimination of human error, improving efficiency and environment of the working world. Human error is an unintended action or choice that ultimately leads to the failure of meeting a certain goal. In layman's terms human error is a mistake made by a person due to lack of attention focus or any other reason. Human error comes with many consequences that can range from relatively harmless to severely detrimental, humans make errors no matter how well trained, driven or motivated (Rasmussen, 1990).

It is one of many contributing causes of disasters and accidents in a wide range of essential industries. Including nuclear power, aviation, space exploration and medicine (Im and Baskerville, 2005). There are two different ways, in which human error can lead to failure. First the actions may be carried out as intended but the plan is not good which often leads to mistakes. These usually occur in situations where an individual does not withhold the needed amount of knowledge to carry out the task correctly due to unfamiliarity or lack of training (Woods et al., n.d.). The second, the plan could be perfect; but the execution can be poor which again leads to mistakes. These tend to happen when one is doing a familiar task such as pressing a button. One possibility is that someone may input the wrong button or forget to press the button on time: a very common example of this. Human error is said to be the primary cause of 90% of industrial accidents (Koen, 2021). This is a common factor of humanities work ethic. In today's time and age, the understood solution to avoid human error is to target the task and make sure it is properly designed to limit all possible errors as well as making sure that people are properly trained and motivated.

Even though the notion of human error has been around since the beginning of the 1900s; when they discussed about accidents prone to people or unsafe acts of workers (Hemenway, 2011). It was not until the Three Mile Island nuclear meltdown accident in 1979 that it really became a target of scientific study and intervention in the broader safety sciences. Soon after the TMI accident, several academic conferences gathered, the scientific elite of safety science and error studies, to specifically discuss the problem of human error. From these two types of ideologies, they were established to be called the Cognitive Psychological school and the Joint Cognitive Systems school.

A study by James Reason presents findings which are highly referred to within "safety science" which was represented the Cognitive Psychological school. He obtains his discoveries first, by studying diary notes in which people described their errors; allowing him to begin the development of a theory regarded as 'absent minded slips'. The TMI accident began James Reason's interests in the errors made by operators of high-risk processes, and he started analysing these errors using much of the theory he had already developed from everyday slips. Reason's cognitive psychological school saw error as a social fact of life and in his book of Human Error published in 1990. He defined four types of errors or unsafe acts. They are slips which are failures of attention; lapses, which are failures of memory. Mistakes: that according to Reason, can be rule-based or knowledge-based with finally, the violation of rule or procedure. Reason's view is that categorizing human error can help to explain and expand on the understandings of the natural occurrences of accidents. Human error can be labelled a cause. And the slip, lapse, mistake or violation are psychological cognitive models are used to explain behavior. While Reason, had developed his human error categorization for high-risk operations another set of data and theories formed that exemplified the other ideology, Joint Cognitive Systems school.

Professor Jens Rasmussen, together with others like Erik Hollande and David Woods, developed the joint cognitive systems school of human error.

The two schools (Cognitive Psychological school and the Joint Cognitive Systems school) focused on the same problem of managing increasingly complex high-risk processes, but they came to vastly different conclusions. They developed a naturalistic school - interested in naturalistic real-world high-risk work. Instead of studying errors as a psychological or cognitive construct, they studied error as a product of complex interactions between actors in space and time. They asked questions which consisted of “how do people and machines interact?” “What constrain human action?” “What principles should guide technological interface design, so it facilitates human understanding of the system state?” It was by looking at human error at this perspective, that they arrived at a radical conclusion: Human error is never the cause of an accident. Instead, human error should be seen as an attribution for other problems, located deeper in or higher up, in the system. Human error might then be the symptom of such problems but never the cause.

Depending on the actual problem that occurred, will only then show more significance of the error. For example, an unintended harm to a patient during a surgical procedure or a simple network error causing a chain reaction of problems. The two schools will suggest different means for system improvement. When we follow the joint cognitive systems school, we would take a broader perspective and analyse the accident in terms of what is contributed; to what later looks like a human error both in time and in hierarchy. The joint cognitive school will look at how we configure humans and technology in their working environments to understand the constant conflicts experienced within achieved goals that they face and the inevitable space between work as we imagine work and to work as it is done. It is not until we understand such highly complex relationships in organizational time and space, that we can suggest meaningful system improvements.

The cognitive psychological school will target system interventions at the level of the brain and focus on motivation, selection, proceduralist of human work and functional allocation (Rasmussen, J., 1990). What this means, is the consideration of what tasks should be performed by humans and what tasks that should be performed by technology.

There is currently no right or wrong view of human error and possibly never will be. We will need to make up our minds of what reports of human error and that we believe in to find credible in our efforts to improve our systems. Different stakeholders, such as accident investigation boards, safety managers, unions, and journalists, will take different views in the stories that they tell. So, it becomes a question not only of how the story is told, but also of who tells it. Human error is a distinctive feature that can be tackled clearly by automation.

2.5.2 The efficiency of automation

As previously mentioned before in past sections of the report, the efficiency of automation was lightly touched upon. In this section, it will be explored in further detail and analysis. Automation does not just mean Robot agents or lines of code executing certain scripts as It is also achieved through other means. A clear advantage of automation is the creation of the mechanical convey belts heavily used in contribution of construction for parts or other objects.

In a world moving at the speed of rapid digital production each day, every business faces the challenge of increasing productivity. The key problematic tasks that automation tackles are to perform mundane tasks, while our employees pinpoint the focus of added valued activities. A tangible example on how automating an ordering process is carried out, is to reduce manual workloads by harnessing the best of both humans and bots. From receiving the request, filling in customer details to issuing a purchase order executing a single transaction, could consume a large amount of valuable time. Employees would have to navigate across seven different applications and put information time and time again. There would also be the need to manually create call summaries and apply rules, as well as checks along the way. In addition to being tedious, these repetitive steps can become seriously draining and efficiency of robotic process automation, allows to construct and reshape the way we operate and work. Virtual assistants now handle routine rules and based tasks while our team's focus on activities that require their skills & attention. Simply put, they mimic the steps a human would carry out and in order to get the job done, they pull data from multiple sources, forming these sources of information into a single view. Saving agent, the trouble of looking it up in separate searches (Coderre, 2013).

From this source (Bergl, 2021) It has shown how with customer service becoming such a critical part of business success, it justifies the need for businesses to automate. By letting automation speed up and streamline their business' routine processes, it means they will have more time and energy to spend responding to customer needs and cultivating new relationships while working towards the next big thing.

Customer service has become a reliant on the aspect of automation in conclusion of the success of businesses experience on a day-to-day basis. Enabling automation has allowed increased productivity within processes of routine tasks meaning more time and energy from human resources, will be put towards the attention of captivating new ideas to construct new bonds for customer needs as well as working towards bigger and better ideas for future business.

Factors such as a lack of consistency and the requirement for dependable customer service are the reasons for the fall of customer satisfaction concluding with businesses to undergo losses of general income. The main goal of many developing and large cooperating businesses to expand and to continue to develop to the next level of improvement in order to create the best quality of customer service.

Staff satisfaction is seen as a clear point too. The perspective of automation can be interpreted in a way where it reduces human interaction and job opportunities within the working world for humans. However, the outcome of the introduction of automation may bring the very opposite of this stereotyped view. With the reliance of automation within a working environment, this can create a more flexible working lifestyle for staff as this enables them to be free of backgrounded tasks such as lights in a building, etc (Bergl, 2021). This then allows staff to devote more time to experience with customers firsthand; enabling them to fulfill the entirety of their purpose; instead of using this time spent on organization of filing and paperwork; which can simply be executed using automation.

Improving productivity. By using automation tasks that are required in everyday activity, efficiency and productivity rate will rapidly increase allowing more focus and time to be put towards further progression for the business, increasing profits and income in general. Shown in figure 3, data that gives insight on how people think in both scales of the industry showing useful information on the prediction of automation through AI (Cournoyer, 2021).

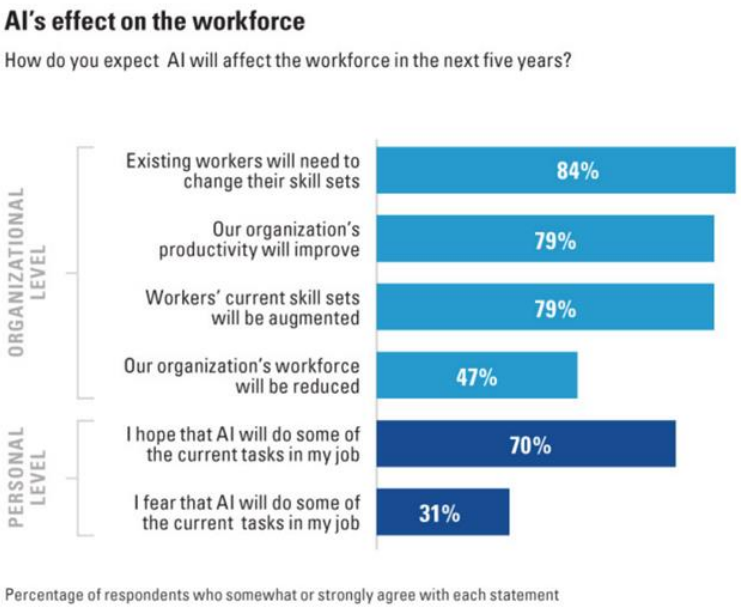


Figure 3 (Data from Cournoyer, 2021 displaying Ai automation effect on work level people as well as people who work on the organizational level)

Improving workflow accuracy and obtaining opportunity of improving skills. The involvement of automation will allow present engineering skills to be reduced, inputting more focus and attention towards increasing income within a growing business. The outlook on the idea of working more in the business rather than on it, is taken into perspective. With automation its provides businesses with opportunities of dedication as well as care for employee's wellbeing and health with day to day tasks carried out through automation such as sending invoices. Chances of coming across any problems decreases with the collaboration of automation within a working environment.

3.1 Repetitive tasks done by networkers.

By going through this report, it is evident automation can be beneficial and using this, the sole purpose of my goal is to combine this within networking for my artefact. Within the network field, there are many tasks done; with some appearing as repetitive and some being complicated as this is a profound provision, that many people study to get in to.

With having automation in mind with the utilization of RPA, I opted to develop an automation to do basic actions and tasks. Due to the nature of networking, there can be many tasks that can be chosen to be automated. For the best approach to take forward for the artefact, I decided to automate simple tasks that would be used in a working environment as well as certain design aspects. As a result for my project, what would be automated would be switch configurations as well as a visual aspect; topologies of networks using a software that simulated networks.

As previously mentioned, network tasks such as configuring network devices can be automated. These are highly vital for the network to play out these network devices as they must be configured. The network devices are switches, routers, load balancers etc. To set these up, a network engineer would have to configure these systems in a manner of routine. Regularly, a network engineer would go in a terminal to configure the network devices, respectively. Depending on what is needed of the device and what type the network devices, it can be a few lines in the terminal or even multiple inputs into the network device which need a result from the device. This can take many attempts; thus, concluding this process to be very time consuming depending on the situation. As this is all keyboard keys to a terminal, it is possible for automation. As discussed before, RPA have some limitations as the logic to solve a problem cannot be replace from automation. It would require a network engineer to enable their skill to tackle the problem. However, although automation obtains its repetitive and firmly established nature, the need for a specialist is required as the fixed set of tasks disables it from varying its ability to execute other tasks out of its knowledge and awareness.

Another network task that can be automated, would be network monitoring. Within the network field, the advancement of networking is forever advancing and so, network monitoring was established. To keep a network operating at its full capacity, enterprise networks are becoming more and more complex every day in order to meet the rising need and demand for digital business. Solutions for businesses are also required to ensure that its network is performing at the speed and efficiency required of its essential tool for enterprises to measure their performance network monitoring in the use of a system with a computer continuously monitoring a computer network to discover any faults or components lacking full performance. This is then notified to the network administrator to inform any outliers or potential dilemmas. Companies at this time would need a specialist on hand to monitor these issues and depending on the scope of the companies, it could potentially through time unremittingly. So, this task can be automated having a software to automate certain actions if a problem is in need attention. Some networks are currently being monitored automatically already; the technology being called big brother technology. This will be explored further in the next chapter.

An additional work that can be automated for network specialists, is update procedures (also notably known as patching). Patches are fixes for errors that have been discovered and then, need corrections. With software forever changing, it is in its nature to constantly present variation within it. To counter these changes or if an error has occurred, you would trace back these steps accordingly and apply a fix. Depending on what is needed to be updated, an automation can take and maintain the job to ensure these updates instead of human interaction. Patching is the most important part of a vulnerability management section. In vulnerability management, when something is identified as a vulnerability, one of the three things can happen: we can either accept that risk for our company, implement compensating controls so we can do something else to make the vulnerability of that machine mitigated or finally we can remediate. There is also a possibility of installing the patch, if available to fix the issue that is causing the vulnerability on that machine. These are key factors to deal with and can be seen as the root of potential big problems. As said before, human error is unavoidable. If someone accidentally forgets to update the network devices or other sections of the network, it can lead to huge failures.

3.2 Current automation

My problem initially is using RPA to do repetitive network procedures. Similar projects have been attempted and are currently in motion. While gathering research, I had acquired the knowledge of viewing many ways of automation that has been initiated or being used for networking. Two topics stood out to me as they held similarities with my goal, which is programmability for network automation (Clarke, J., Lindblad, J. and Claise, B., 2020) and automation of network maintenance (Willcocks, L., Lacity, M. and Craig, A., 2017). Professionally, it is not considered as RPA but automation of network maintenance, not using robot process. Although this might be seen unrelated, the same approach to create this goal can be implemented as well to my goal and other projects that involve a level of automation with networks. At this point of time many tools have been industrialised for automation of network maintenance. These tasks would go from troubleshooting, monitoring (big brother software) and a life feed coverage of networks (Willcocks, L., Lacity, M. and Craig, A., 2017). These advantages have helped today's current age of networks in great way. The article explains in further detail on how automation is used to achieve network maintenance. The authors (Willcocks, L., Lacity, M. and Craig, A., 2017) (Aiko Oi, Ryosuke Sato, Yuichi Suto, Kosuke Sakata, Myotome Nakajima & Tsuyoshi Furukawa) of the article, have planned out the process of with the start being that a "user report is sent to the network maintenance personnel after it is received by the customer-service desk"(Aiko Oi, Ryosuke Sato, Yuichi Suto, Kosuke Sakata, Myotome Nakajima & Tsuyoshi Furukawa,2020).The way most of the actions and data is being done is through automation tools on a system. As I discovered further into the process, they must go through many stages to reach its end cycle. The article explains that stating the system "also has functions for connectivity test by keep-alive and ping, threshold monitoring using performance information concerning CPUs etc., and alerting maintenance personnel when an abnormality (such as when a threshold is exceeded) occurs" (Aiko Oi, Ryosuke Sato, Yuichi Suto, Kosuke Sakata, Myotome Nakajima, Tsuyoshi Furukawa,2020). The article then explains how this use of automation, allows professionals to solve potential dilemmas with what the automation maintenance software has identified. Even though the goal is different to the one I wish to persue, it is evident I will need to follow a similar process to this in order to achieve my desired product and goal. As well as bearing in mind, each step the automation goes through, must run consecutively and successfully.

As mentioned before, the other aspect that related with my goal was with the concept of programmability. Recently, there are few currently usable automations Network Configuration Protocols; YANG, NETCONF, RESTCONF and GNMI (Clarke, J., Lindblad, J. and Claise, B., 2020). The authors also believe that automation will help reduce time when assessing problems. From my findings from this specific research, it shows that programmability allows an even bigger impact. As mentioned before, RPA would significantly improve work life. However, this source (Clarke, J., Lindblad, J. and Claise, B., 2020) provides ideas of improving constructing future developments. Allowing to effectively reduce the service time of the creation and coding of switches and networks.

As previously mentioned, a most revered current automation is BIG brother technology. Within the network field it is used for monitoring objectives. When it comes to systems, monitoring it can be adaptable with many different types of operating systems from one central management display; saving huge amounts of time as well as allowing administrators to work on other important projects. Whether it is Windows Unix Linux or Mac Big, it can detect and notify before there is any user interference. Critical infrastructure is about more than just servers alone, but through custom plugins big brother software gives the power to monitor all of your network devices as well things like routers switches printers network storage and much more.

I discovered an article which I then further explored, as it looked insightfully in detail of modern automation within this era of it becoming a new aspect in the endlessly developing world. The book is called Network Programmability with YANG: The Structure of Network Automation with YANG, NETCONF, RESTCONF, and GNMI (Clarke, Lindblad and Benoit,2019). This book explains how the complete networking industry is being compelled to automate in order to scale and move faster; it explains how to unlock the power of network automation using YANG.

YANG can be seen as a certain protocol. YANG is a data modeling language; meaning it declares the structure of our data to follow a certain hierarchy. So, if a computer is trying to connect to a network device and request data off it, they must agree on what the structure of that date is going to be so that computers will know what to do with the data originally. Computers need to know how the data has been organized for it to make decisions or actions on that data; and with YANG, it allows this to happen.

A pioneer in networking has also made development into automation; this company is CISCO. (What Is Network Automation?, 2021) The company has created a heavy influence within the networking world and will undoubtingly have a hand, in changing how networks work. As my idea was to allow automation through RPA, this consisted of doing tasks that are repetitive for configurations, troubleshoot devices, etc. Cisco went another step forward with this being seen as the true potential of automation and not just with RPA, but with other tools to work alongside it; creating a whole new way to cater a network. CISCO have achieved this through the creation of Cisco DNA Center. It is an appliance that industries can install in their network, or with the option of having DNA in the cloud. It presents a graphical interface and a programming interface; enabling them to design a network to add device and configure devices on the network monitor to troubleshoot our network. Cisco in the past has had other graphical front ends to router configuration such as Cisco configuration professional but this is way beyond that in the scope of what it can do. Cisco DNA Center tackles certain areas of networking with automation. With a design, one can take a map of the work office and can add an area. The user can import a floor plan and drag-and-drop devices onto that floor plan, like cisco packet trace but more visually orientated for real work ethic. Cisco DNA Center allows the user to say what our IP address allocation is. This is a way for users to design

the network through this graphical interface. In addition to this, Cisco DNA Center can apply policies. This means that the operators can assign a policy to an entire group; either allowing or denying them access to something.

Another action which is tiresome to do manually, is allowing IP based access control as well as provisioning, so it can essentially carry out a plug-and-play for network devices. The application allows introducing new devices too, have a new network device sent to whatever location where it is going to be installed, have somebody there plug it in and when the device boots up, it would be going to go out and get several IP address information from DHCP including some DNS server information. Then it would resolve the IP address of a DNA center server and go up to that server based on its serial number. It will also be able to download a configuration file; so, a network specialist that uses this, have zero touch on getting new devices installed. Having them just set up the profile of that device within DNA Center, will then result to having somebody plug it in and allowing it to be installed itself.

This application also has some ability of big brother technology meaning it can monitor the health of the network. This helps network professionals greatly with troubleshooting, if there are existing faults in need of attention as well as what those are. Based on experience of Cisco TAC Cisco DNA Center, it would give us feedback about what we should do to in order to resolve this issue. Some similar software is currently in use but for this being included within Cisco DNA tracer is helpful. Again, another great utensil is having path trace tool in it. What this does, is allowing it to investigate problems that would take longer without this automation. For example, if a problem appeared and are unable to go from point A in the network to point B in the network, a ping between these two devices would be attempted with an access control list in the way that might be blocking that traffic. This tool gives the opportunity to see this in a graphical representation of the network and show us exactly where the access control list exists, which is blocking our traffic.

We can also do something called network time travel, if there were some sort of an issue that came up at an irregular time in the night/early morning. We could take a view back in time from the night before to see what was going on in the network at that time. One of the most powerful things about Cisco DNA Center is its ability to act as a programming platform. Giving a large collection of application programming interfaces (API's), will allow users to do via a program allowing us to visualise what would be happening graphically. If we want to provision or set a policy or gather troubleshooting information, we could do that with a Python script. This situation could be even further optimised with RPA.

4.1 Chapter overview

In this chapter it will go through the progress of my artefact and the very start of its fabrication. It will consist of the planning, production of actually making it, testing and any problems I encountered along the way. And finally, the complete outcome of the artefact. With the research I have gathered and obtained expertise of my subject further I have made quite a few changes along the way and the final product being completely different from the first initial thought. To first initiate creating the artefact I had to plan a great deal. The planning entailed first with the basics, what tasks should be implemented, how big the scope should be so I can present how RPA can be useful, efficiently allocate my time to make the artefact as well as time for report etc.

With the planning ready to be expended I was ready to create the artifact. This process took along time and it became a routine to continuously go back with the progress and work from an earlier start. In this section it will have screenshots of the progress, each stage of the project and highlighting key moments. In this section I will also reflect and review what I learnt and accomplished. With the construction of the artefact, it will synthesize with the research gathered on its goal of being a useful tool.

After the prolonged workings of the project, it will cover the testing parts of the artefact. Here there will also be screen shots showing before and after of the desired result. Situations where I found it difficult to continue and portray the expectations needed from my project to achieve my goal. This part will also cover the testing to reflect on how useful it is recording how much time is saved and other similar themes that contribute to the practicality of the artifact.

Ultimately, the overall project in its eventual form will be evaluated and concluded; summarizing what made this artefact in to being. This will show screenshots of the final project, as it is an automation it will be exhibited through a story board like manner. Through my presentation of knowledge and experiences taken into perspective from my output on automation, the discovery of automated systems has allowed me to understand how this can be utilised within our world as well as its contribution towards the working world. Sharing and connecting my thoughts, which I have thoroughly embroidered through this project, provides me the opportunity to display my aspirations of the future working world in the hands of potential development.

4.2 Planning Phase

Many materials had to be accounted for, to primarily begin creating this project. The main questions were the scope. To display my idea which is “Automation of Networking Tasks with the use of RPA”. I had to realise and decide what my scope was, within the given the time. The complexities of congesting the use of automation within the concept of a network task such as RPA, was alone a challenge. The process of how to involve these two ideas of intuition, was the plan required to be taken into perception. This enlightened me on how important it is to plan before taking a specific course of action.

Eisenhower's (American President, 34th U.S. President) said that planning is everything and plans are nothing. What this meant is that plans are out of date the moment you create them; the value in planning is in the understanding that is created among people that form the plan. With that understanding, this allows them to be agile and react to what is changing in the world around them. Eisenhower further developed this model; where he suggested when you are trying to process situations or problems (Harpst, 2008).

So, with this ideology I then asked myself two questions for every item that came to mind. How important this is and its urgency and important but not a high level of urgency. This is often where our attention goes to; urgent matters. Figure 4 proposed by Stephen Covey illustrates as such.

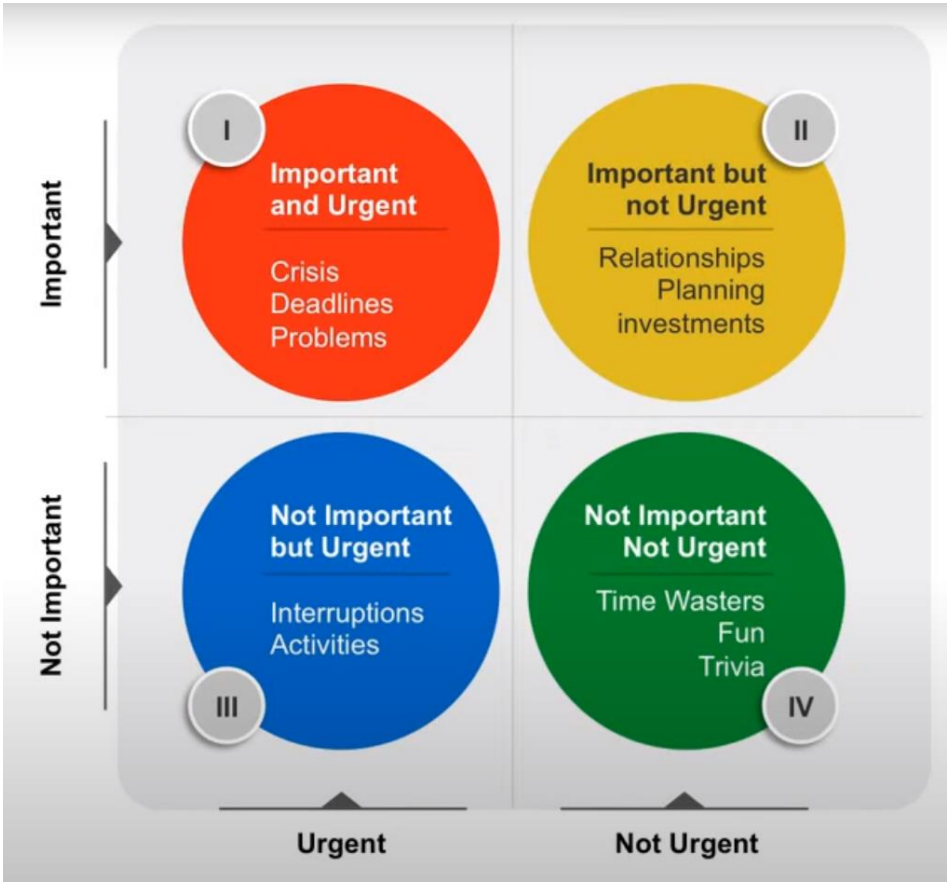


Figure 1 (Proprosed by Stephen covey THE 4 QUADRANT)

Sometimes stuff that are not urgent but important get pushed aside. However, aspects that are considered important but not urgent are things like planning itself or investing in training/skill development; factors that can be easily obtained. For explain one can wait till tomorrow and the other items, that are not in need of high urgency as well as not important but in need of attention, can be seen more trivial in those categories. The trick or the capability that the performance depends on, is figuring out how to improve your results output average.

With this ideology in mind, I then committed on how I will bring this upon my plan and to executing the actual project. When researching articles, journals and data, it accumulated by professionals on my topic; showing that many approaches can be taken to tackle my significant problem. Considering this thought, my final product will be a script program which will carry out a task. A disadvantage that may occur, would be debugging the program; however, a process for that would be established. I concluded that I would need to use UiPath to create this automation. Progression was recorded, so implementations would not experience complications. As my knowledge developed through the intel of articles, it was clear the incorrect implementation was due to lack of understanding of the process of automation. A highlighted fact is linking two different ideologies. So, it was intricate, resulting from the lack of information available. However, as the task differed, it appeared more capable. I then created the RPA to do network tasks (using UiPath) (IST Networks. 2020. RPA | IST Networks). By increasing my understanding in both ideologies, I gathered that I would improve my understanding in automation, exploring into networks and resolving my dilemma.

While obtaining resources and projecting time allocations, I also had a meeting with my supervisor. In this meeting I discussed we discussed on what I should do in my definite phase of my projects production as well as the report. We discussed what I should write in each section of this report. When I reported my progress, I was told that I should record on how I obtained the necessary knowledge as well as the milestones. With the advice given to involve clearer referencing, I was recommended sites that had libraries of potential articles and journals to reference from.

The following explained, is my preparatory work. The main application to execute the automation was UiPath. The software also revolves around visual language and VB.Net or C#. A testing was then required, due to potential overwhelming of ram exposure (Clarke, J., Lindblad, J. and Claise, B., 2020. Network Programmability With YANG). The code ran in a virtual environment first, the software VMware.

I then needed to know what type of pc was available for the final demonstration in order to know if the automation software UiPath worked properly. The version I used was 20.10 and I had to take extra precaution to make sure that the PC could run as well as certain drivers updated for it, to be compatible. In this period of the process, I was comfortable to make this application and fix potential bugs and errors. However, to implement the automation to use for a networking configuration task, it required a fair amount of time to be established.

In this part of the process, I was reaching the final steps of my plans. Although it was clear, that possible risks would be taken into action during the implementation or risks after. Consequently, I decided to layout a certain chart displaying what problems may had occurred; noting them down so I could get ready if a situation would have potentially occurred.

Potential risks during project implementation

Risks that would potentially occur in chronological order

measure of the likelihood/ 1 unlikely, 10 most likely	The problem/level of the problem (green=low/medium=orange/ high=Red) measure of the likelihood/ 1 unlikely, 10 most likely	Reason of risk occurring	The potential consequences	How to solve
8	Unable to continue work. (reaching an error wall) 8	Multiple errors occurring unable to identify working point of code due to errors effecting other lines	Unable to continue work, would be hard to identify where the program/project was in working order	Make sure when testing code or compiling it I should make a separate application so if the programs breaks, I have something to fall back on
3	Unable to identify error in line of code. 3	When prompt of an error code and I am unfamiliar on how to solve it	Could cause slow development or potentially delaying the progress of the code	This will be a learning curve and should be solved quickly by educating further through online guides or tutorials.
4	Creating the program mid update. Making a new line of code and not checking previous code execution is compatible with the new update of the software. 4	Not checking old lines of code compatible is compatible with the update	Could cause compile issues but might not be severe problems.	Check everything can compile and in running order before continuing after the software has been updated.
9	Unable to do automation on network gui. 9	To do network configuration it would be run on a gui that needs administrative rights.	Unable to achieve the project at all	Must make sure the automation software is configured properly and is able to access necessary levels of administrative right
10	Corruption of progress. 10	unnecessary transfer of files/saving on a removable disk due to it being a big file	Complete halt and deletion of progress of project.	Must make sure it is on a secure and robust drive to avoid potential corruptions as well as to make sure to make backups.
5	Unable to continue where I left off. 5	leaving the code for some period of time due to needing to research other areas	Unable to continue developing the code potentially causing more errors due to retracing your code.	Make sure I maintain a report alongside my code as I update my progress/milestone as well as keeping a good coding standard by commenting my coding so it would be easier to get back to it without getting lost with it.
6	Ram errors, infit loop. 6	Due to more complex coding of automation tasks, it could cause problems with overloading the ram.	Will cause program to crash hard to get it to work again will likely occur again. Could cause damage to pc if overloading ram	To avoid potentially damaging the pc I will do tests that involve the ram by doing it in a virtual machine.

Potential risks due to implementation

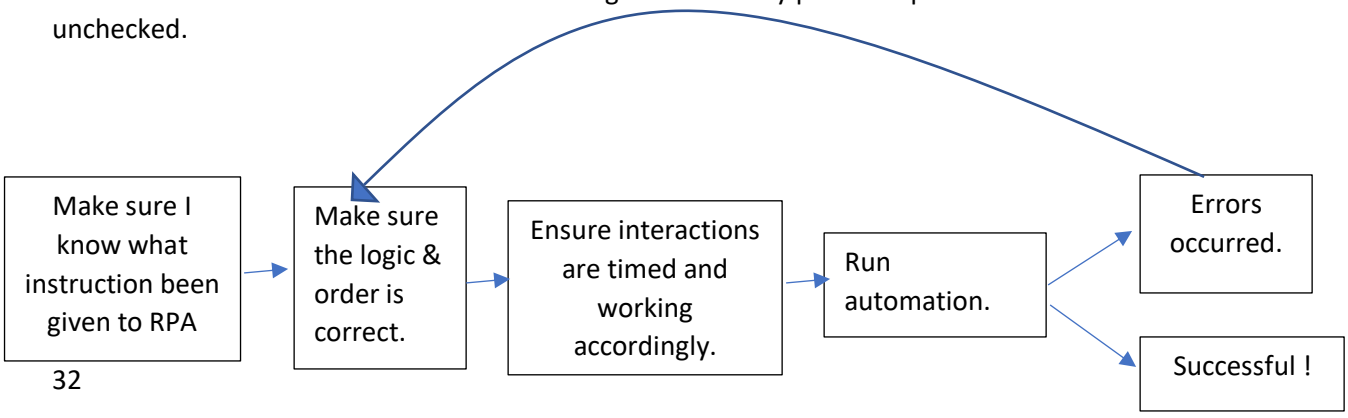
Risks that would potentially occur in chronological order

measure of the likelihood/ 1 unlikely, 10 most likely	The problem/level of the problem (green=low/medium=orange/ high=Red)	Reason of risk occurring	The potential consequences	How to solve
7	Automation unable to execute.	The current pc can't run the automation due to low specs	Unable to execute could cause pc damage as well to pc ram	If unable then would demonstrate the automation with another pc via remote access (team viewer).
4	Automation software unable to work on network terminals.	Administrate rights not given software to execute	Unable to activate automation	Make sure administrative right is given
5	Automation time window between actions might be different from tested pc.	due to different processing speeds on tested pc to pc being demonstrated on	Could cause automation to fail and cause run delay.	If automation is played on a different pc from tested one, I must make sure it works on the new pc.
8	If automation is demonstrated on a different pc, unable to start due to driver errors.	Due to a new pc being used on, drivers might not be updated and compatible with the software	Unable to run the automation.	Must make sure automation will run prior to demonstration. To avoid risk should run on tested pc or test before hand on the allocated pc.
2	Automation not match actions interface accordingly.	(If on a different pc from what it was tested on) The automation might not do actions accurately due to the change of the interface.	The automation might not run and do actions it was not intended to do.	Configure actions so they are calibrated properly, these actions such as clicking and typing will work accordingly through the automation software. (uipath)
5	Compile errors.	The program can become logically complicated and so errors might occur while try to compile.	Could cause many errors and cause the automation to not work.	I would have ensured to have a cache reset so any previous logical paths it took or unable to solve will be reset like new, allowing the code to compile.

With this project I had to learn and expand my knowledge in a great amount of detail. What I believe is the most valuable among all the potential new information I gathered, was increasing my knowledge with RPA (Robot process automation) and applying this to a field I regarded to with high interests and a growing curiosity for. Automation is a fairly new concept as well as it being new with networking (Oi, R. Sato, Y. Suto, K. Sakata, M. Nakajima and T. Furukawa, "A Study on Automation of Network Maintenance in Telecom Carriers for Zero-Touch Operations), presenting the fact that it is constantly advancing and will hold much importance in the future (Suri, V., Elia, M. and Hillegersberg, J., 2020. (PDF) Software Bots - The Next Frontier For Shared Services And Functional). I first was exposed to RPA at my internship and since then I was certainly captivated by it. I was first only self-taught from the beginning. Although it was a very slow progress, I managed to get more familiarized with RPA through UiPath. RPA can be seen useful in many aspects of the working world (Willcocks, L., Lacity, M. and Craig, A., 2017. Robotic Process Automation: Strategic Transformation Lever for Global Business Services Journal of Information Technology Teaching Cases, 7, pp.17-28.) and so, I felt the need to become completely familiarised with this topic. Even with the never-ending advancements of technology, one would think automation should be the norm of technology's developments. But there are still repetitive tasks done every day in many different working environments not acquiring the use of automation. It is known that admin tasks in any type of field will go through numerous repetitive tasks (Hofmann, P., Samp, C. and Urbach, N., 2019. Robotic process automation. Electronic Markets, 30, pp.99-106). I, myself, had to deal with them personally too, within the environment of a warehouse. While doing my previous job and my internship, I noticed that many tasks could be resolved by RPA. At the time of working, it would have been virtuous to put my knowledge of RPA towards my work. However, I was not heavily experienced with the concept of this at that current stage; even at the time of writing, this I am not as experienced to implement an automation to a working environment. Therefore, to create what I intended and to become truly proficient in this area, it would be a true success to me. As well as to put this skill to an area I feel I should do as a career; with the final embellishment of my aspirations.

4.2.1 Design Phase

With the planning established I then formed the design which consisted on a flowchart. This allowed me to see what should be done is a chronological order while I create the artefact. With this flow graph allowed me to work systematically to meet my goal. With my planning and this flow of thought made it so I can achieve to build my artefact. With the flow chart in mind the first action I would follow when starting a RPA process is to make sure the instructions and task is the right one, as I have made a few separate automations. Next, I ensure the instructions are in the correct order for the automation to systematically work through. Later, I guarantee all tools used within UiPath are right looking ready for the automation. Finally, I run the automation and see if it succeeded. If not I got back to the stage of the were I started with the automation and start again to find any potential problems that were left unchecked.



4.3 Production Phase

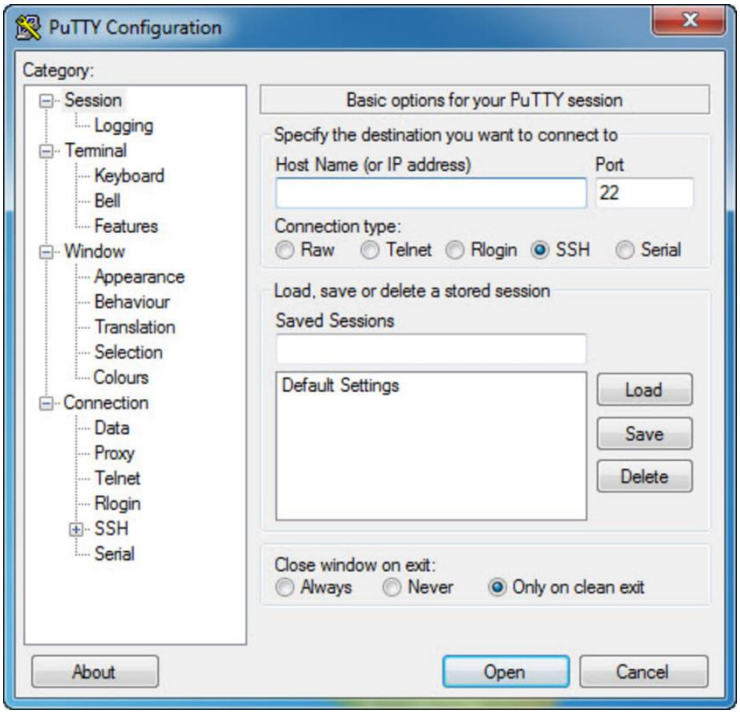


Figure 2 (PuTTY configuration UI)

With the plan in mind and a fixated infrastructure of my goal, I started on my artefact. Initially, as mentioned previously, my first idea was to portray automation using UIpath with Putty.

As seen in this screenshot, this was the interface. Putty is "an SSH and telnet client, developed originally by Simon Tatham for the Windows platform. It is open-source software that is available with source code" (Why developers like Putty, 2021). This can be used in a professional networking environment and the software obtains the ability to connect to live network device and it can be configured for any use. I was first going to go with this plan and use RPA to type up actions up in the interface, however I then realised this was limiting what I can portray about the potential effect; not truly showing "Automation of networking tasks with the use of RPA".

Therefore, I deciding to peruse RPA automation using Cisco Packet tracer (as mentioned in previous chapters). I was not familiar with this software therefore I then made myself familiar by doing introduction courses (CSCO. (2010) Packet Tracer Introduction to Packet Tracer). With me getting familiarised with the new application, I first made a basic Tree topology as shown in figure 6.

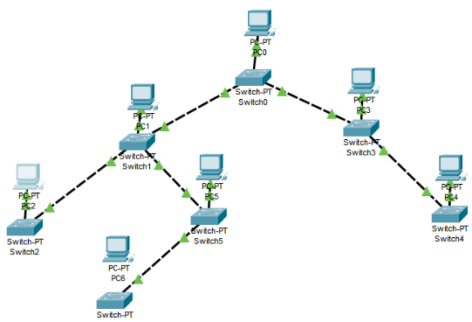


Figure 3 (Tree topology in Cisco packet tracer)

As seen in figure 7, this is the interface of cisco packet tracer. Cisco packet tracer is essentially simulating a legitimate network. A network specialist can not only do specific technically keystrokes within Cisco packet tracer, but they can also produce a visual representation which cannot be achieved through an application like Putty. This then became the correct and clear decision, to fully maximize the portrayal of my desired goal for my project.

With getting a robust understanding on cisco packet tracer, I then needed to utilise the automation in UIpath. Here is the interface of UIpath. With many tools and windows available it can be overwhelming at first glance.

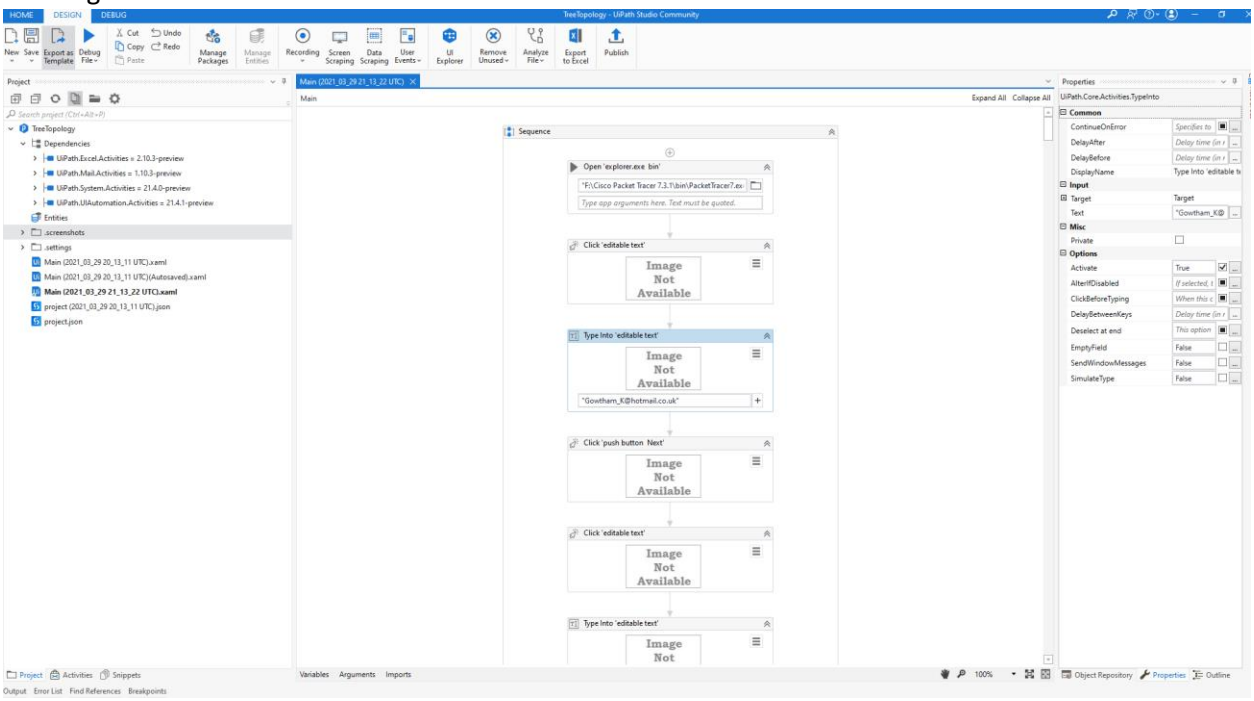


Figure 4 (The interface for uipath were the instructions for the uatmation is done)

UiPath also had training courses which I carried out; to understand how to use such a software, as well as my own self teaching with trial and error (UIpath. (2005) UIpath Academy). To show a good portrayal on how RPA can be useful to do networking tasks, I decided to automate a few scripts to fully show its capability and potential. My first automation I attempted, was to automate creating a Tree topology within cisco packet tracer. This involved basic networking configurations, which were assigned to each station as well as switches with the right IP addresses. Other than network aspects, the visual drag and drop as shown in the tree topology screenshot will be emulated too.

This application uses C# as well as tools built in the software that allows such automation. With this automation, I first had to open the application (Cisco packet tracer).

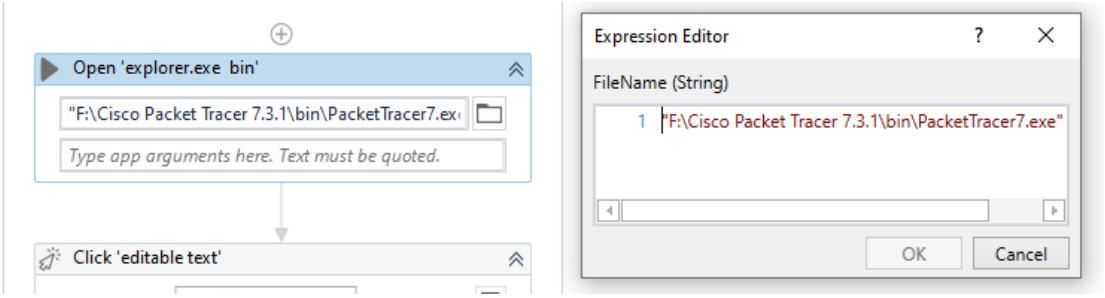


Figure 5 (The open application tool that allows to open a specific app)

In figure 8, it shows how UiPath knows where the application is; otherwise known as the file path location. This is done by using an effective tool that just starts an application to enter actions in. Within UIPath, these types of tools that utilise the automation process are called activities which are obtained in the activities tab shown in the screen shot below.

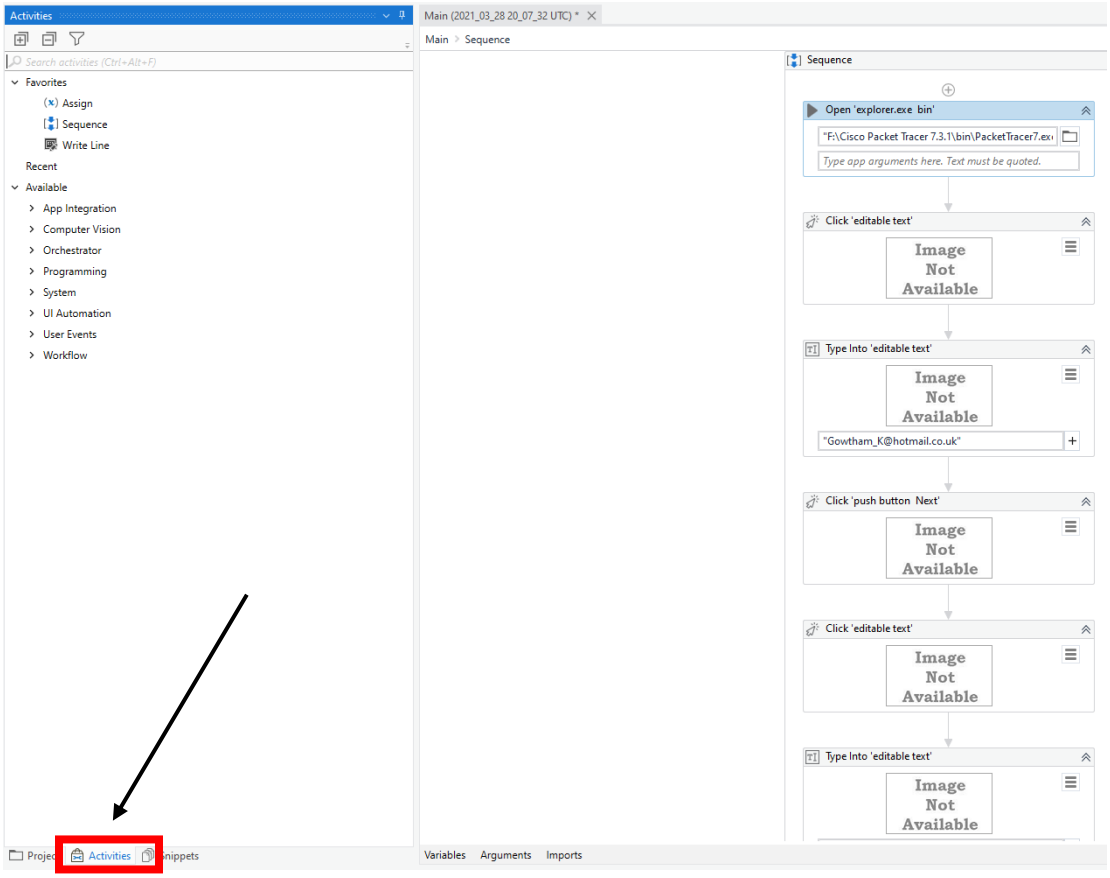


Figure 6 (Location of the tools/activities in uipath)

UiPath have many subcategories of tools for different situations and any specific type of tool can be searched for. For this situation, we needed the tool that opens an application.

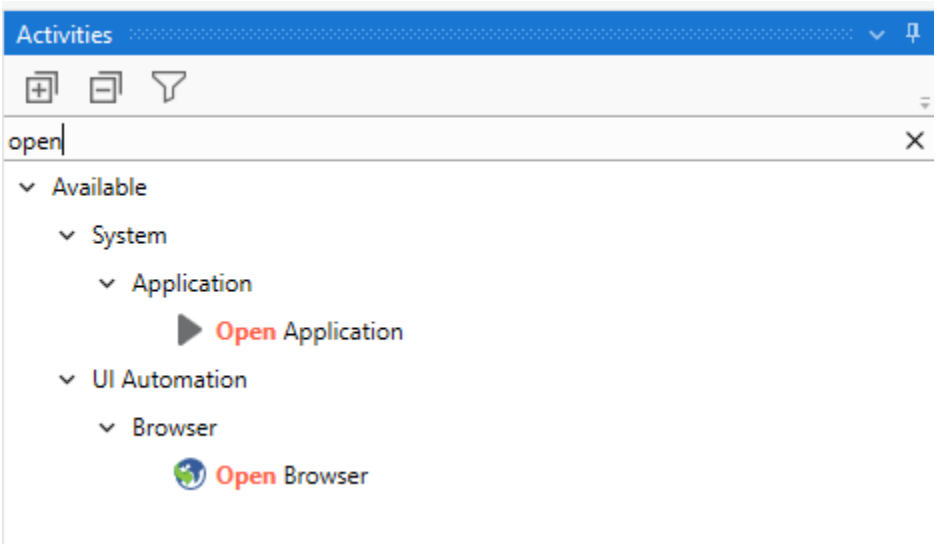


Figure 7 (Search function on uipath to find desired tool/activities)

With the tool open, I then let it know where the file location it "F:\Cisco Packet Tracer 7.3.1\bin\PacketTracer7.exe". This then opens the application; preparing it to enter automated inputs. In this screenshot the application (Cisco packet tracer), shows this to the user. I then needed to inform the automation software were to navigate the mouse coordinately, so it could navigate correctly and type necessary credentials in the email container.

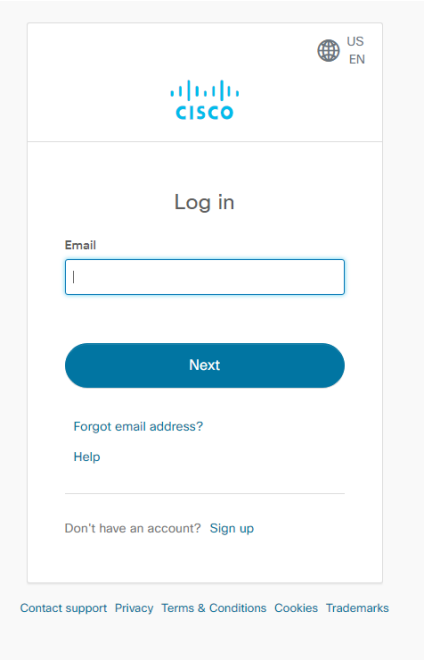


Figure 8 (Login screen for Cisco packet tracer)

This is accomplished by coding the certain actions.

```
<wnd app='packettracer7.exe' cls='Qt5QWindowIcon'
title='netacad.com Login' />
<ctrl name='Log In to Cisco' role='push button' />
<ctrl name='Email ' role='editable text' />
```

These instructions are the concrete for the logic of the automation to work. These let the automation know what icon it should click on, what application window and the role of the area being clicked.

To be able to automate the “click in to box” we then have to go to the activities section again and get the right tool to type up this lines of code in.

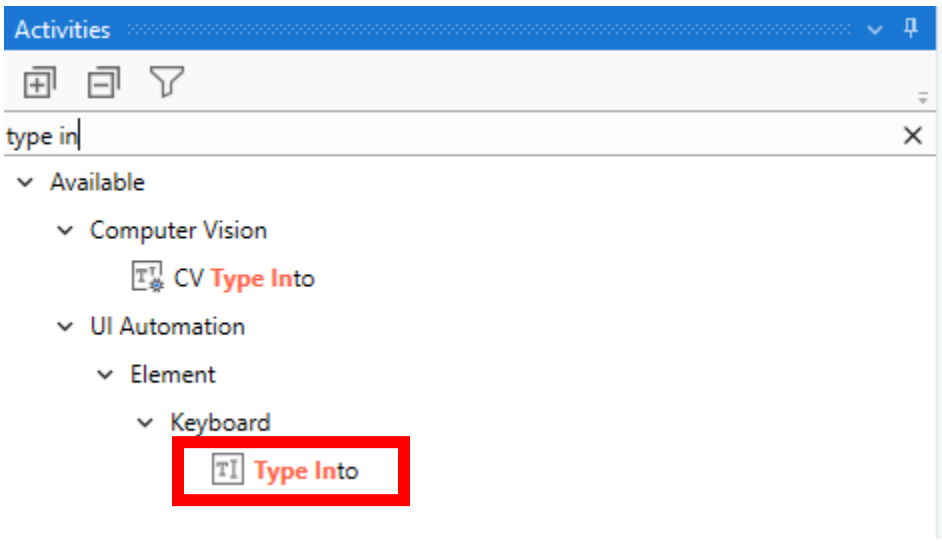


Figure 9 (type in tool/activity which allows to automate keystrokes)

Once the tool is selected and the lines of code are inscribed, the next navigation of the mouse is to click the sign in box in order for it to know where the position of it is. To navigate you must indicate where it should click by using “Indicate element”.

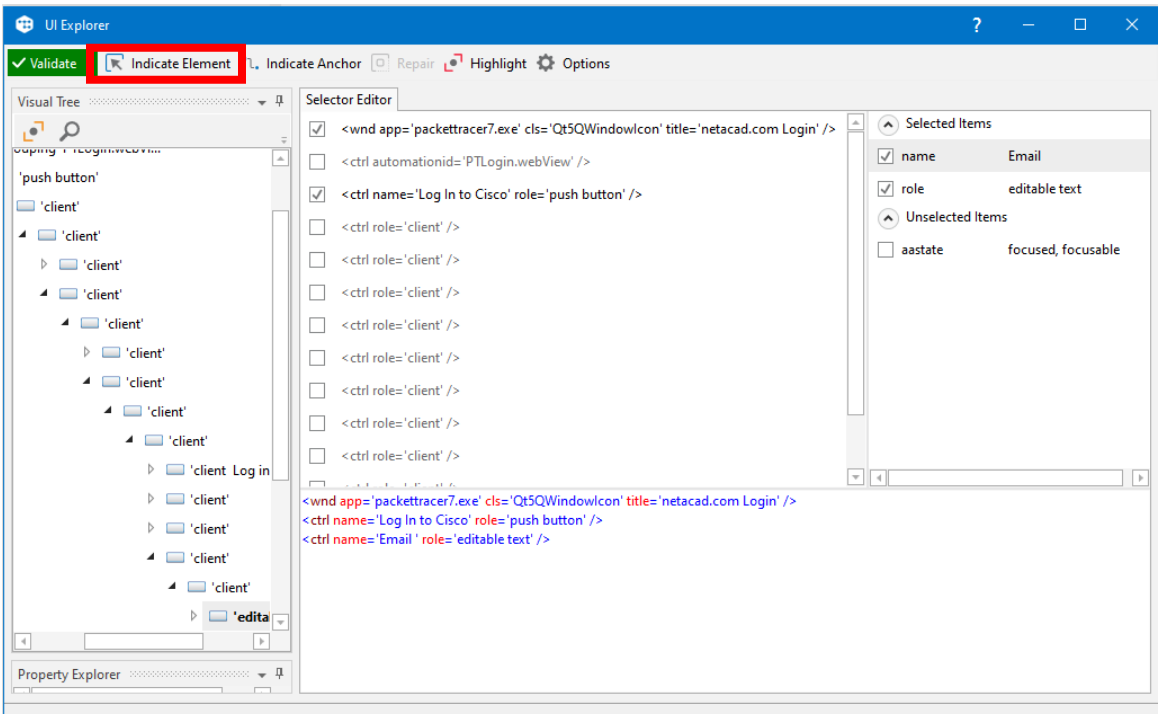


Figure 10 (Screen shot of “indicate element” which verifies where the automation should click)

Once the “indicate element” is clicked, it gives this option. This records the cursor position and the necessary position of the mouse so it can navigate correctly.

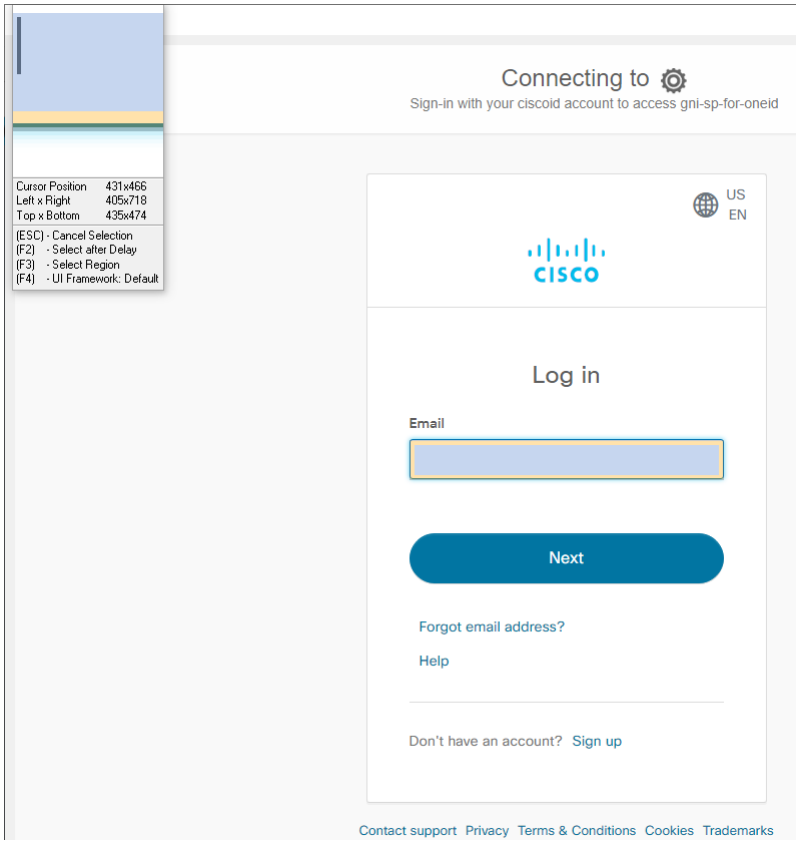


Figure 18 (The interface once indicate element has been chosen and about to verify the location cordninated of were the autamtion must click)

As presented in this screenshot, it follows a waterfall like structure; allowing a clear and chronological order of how the actions are to occur. As these steps are shown, it takes up the entire automation process, some situations and actions can become different from each other but more or less obtaining the same principle.

With just this simple automation, I experienced some problems with the first attempt. The first problem was with the first instruction. Due to the sign in, it is linked with cisco servers therefore there were occurrences of delays, and this then caused the automation to be inconsistent. I found it quite hard to accommodate to the random nature of the delays as first it would stutter following with then showing the Password. With automation it is instant, so I needed to direct it to possibly wait for it to appear.

Figure 19 (Start of tree topology autamtion sequence)

With UIpath, there is more than one way of solving an issue. This can be seen as a useful factor, but to someone that is not a complete expert, it can be supererogatory to find something that can work. If that does work, you would need to know the understandings of how it works to implement it in UIPath.

This application is very vast and moderately new; only exposed professionals have a good understanding of its tool and extensions. So, finding a resolution online or any resource for something specific became cumbersome. To solve this seemingly simple problem, I altered around through the software, with computing code in mind. It made sense as I put a loop for it for a while allowing it to work, but with my current knowledge of typing up the code and informing the automation to click on the Cisco packet tracer, the interface and the logic for itself, did not work and so, was not able to perform what I intended.

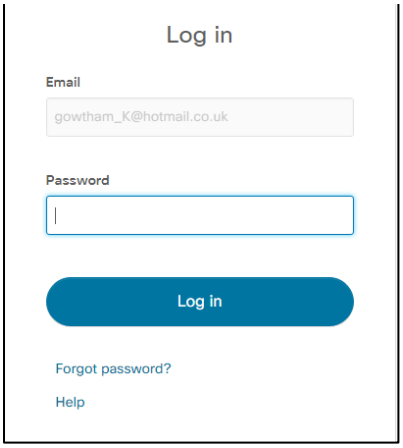


Figure 20 (Login page of csico packet tracer)

With some time, I discovered a critical utility that usually gets overshadowed as everything that can be instructed to the automation can be coded. With each activity tool, it had its own properties tab and so I discovered I could delay the click activity tool just enough seconds so it could always be prepared with the unpredictable load time of the password box.

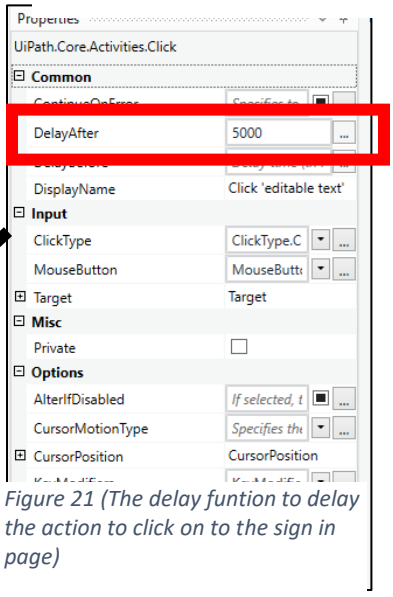


Figure 21 (The delay funtion to delay the action to click on to the sign in page)

When successfully logging in, the same principle is followed. Following the waterfall principle in UiPath, chooses the right activity tool, to indicate where to click and depending on the action type certain code.

The following screenshots will show the chronological order of UiPath alongside what action is being automated in Cisco packet tracer

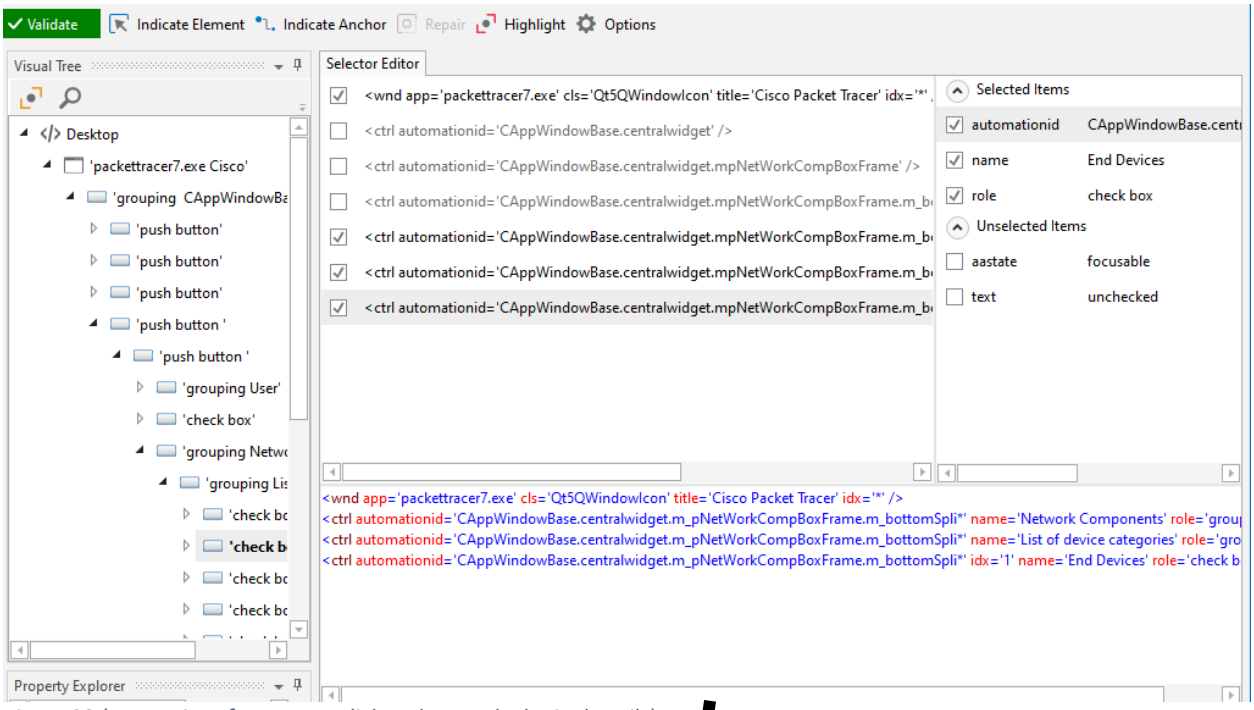


Figure 22 (Instructions for were to click and enter the login detatils)

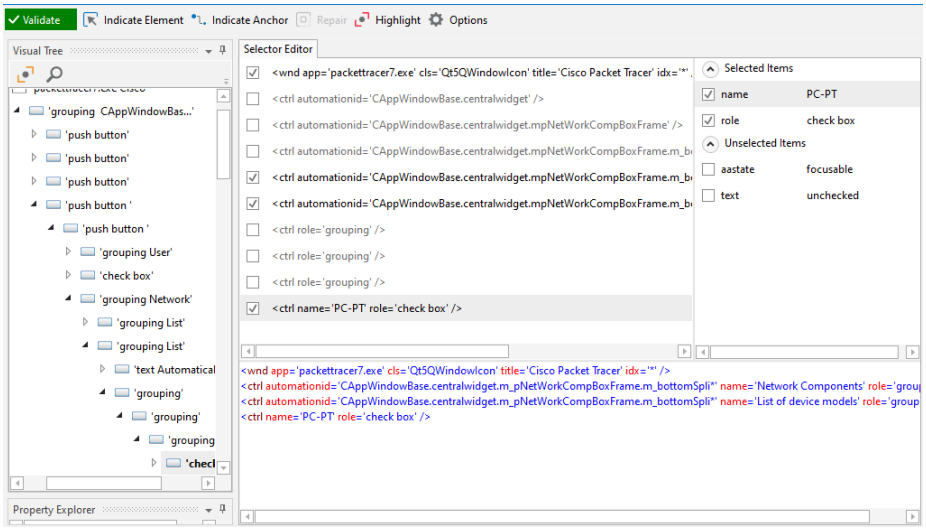


Figure 26 (Instruction for the actions of the mouse on were to click)

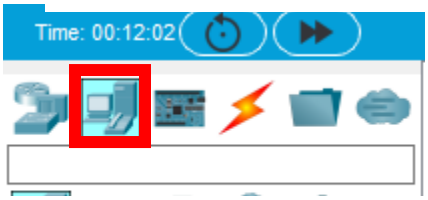


Figure 27 (clicks on this object within the cisco packet tracer interface)

Figure 28 (clicks further in the selected option from figure 27 PC station)

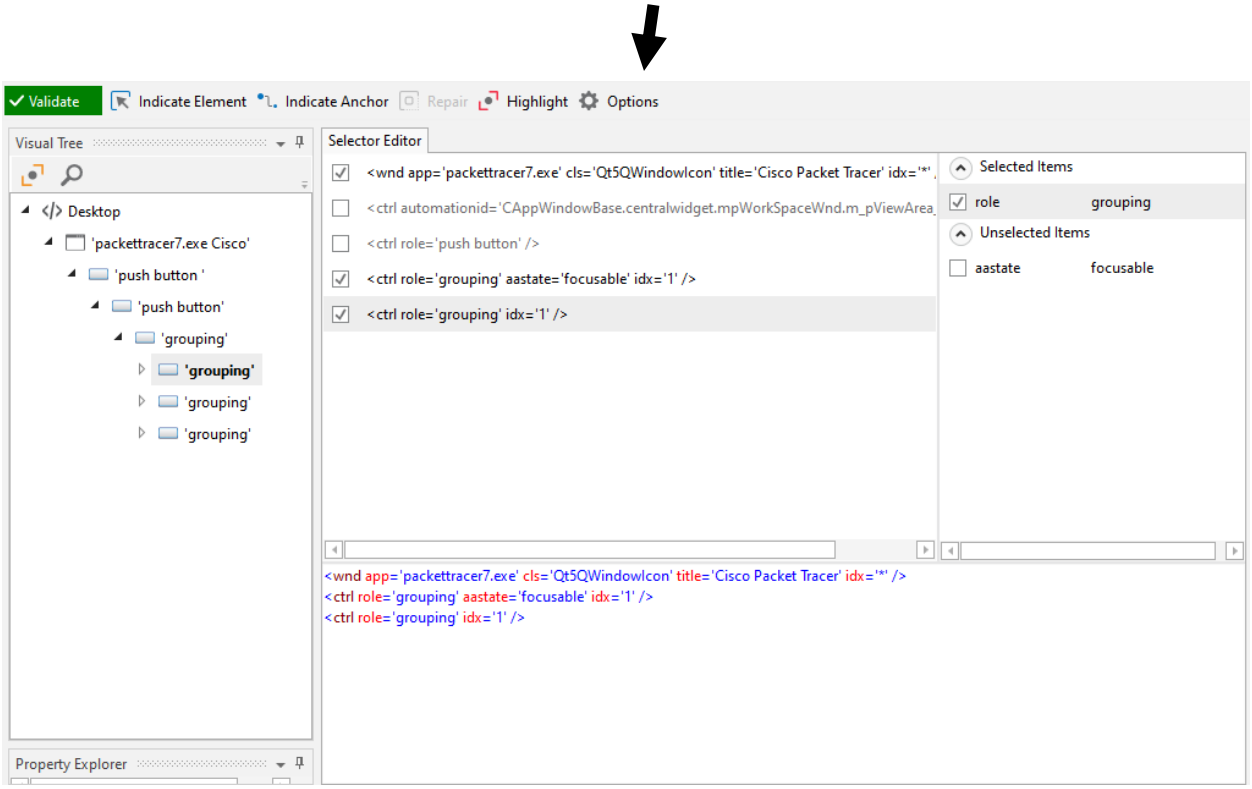


Figure 29 (instructions to place the clicked PC station)

Figure 30 (This is what UiPath stores on were to click on to)

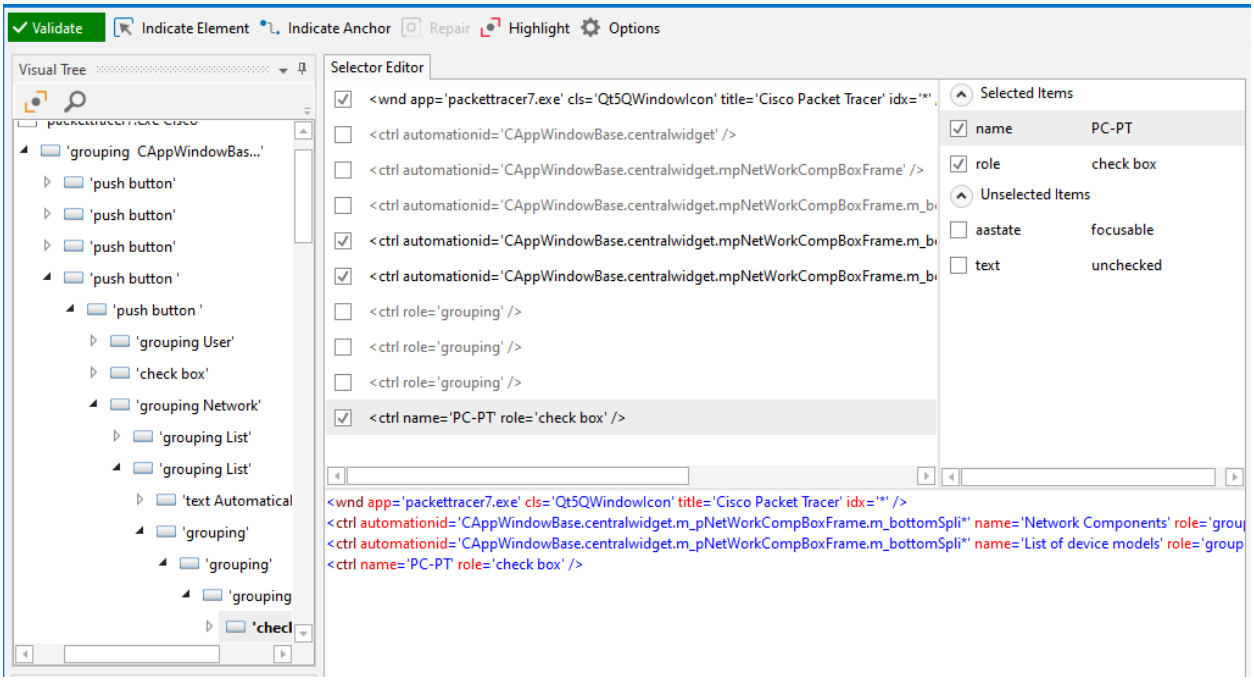


Figure 31 (Instructions of what has been clicked which is the pc station referred to PC-PT and were to be placed)

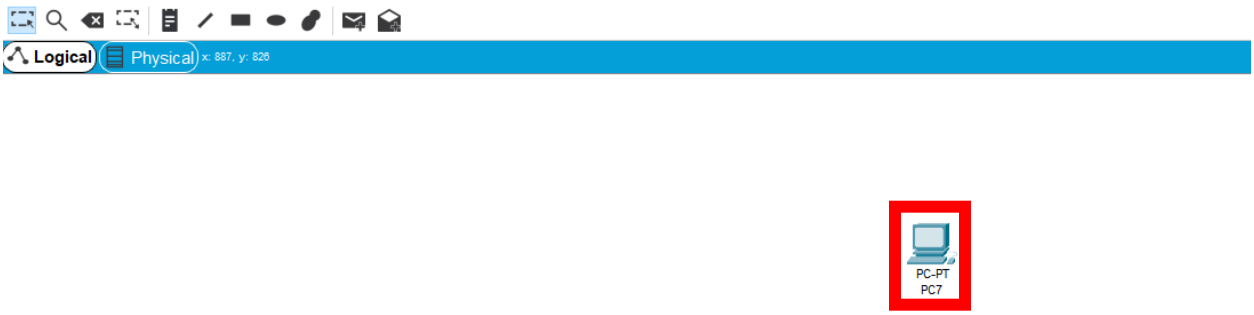


Figure 32 (The end and outcome to the PC station being placed in cisco packet tracer)

This is the order of what the automation is following to do. The first main course of action when it enters cisco packet tracer, was to click on a PC station and click on the open space. This is then repeated out until a result is reached.

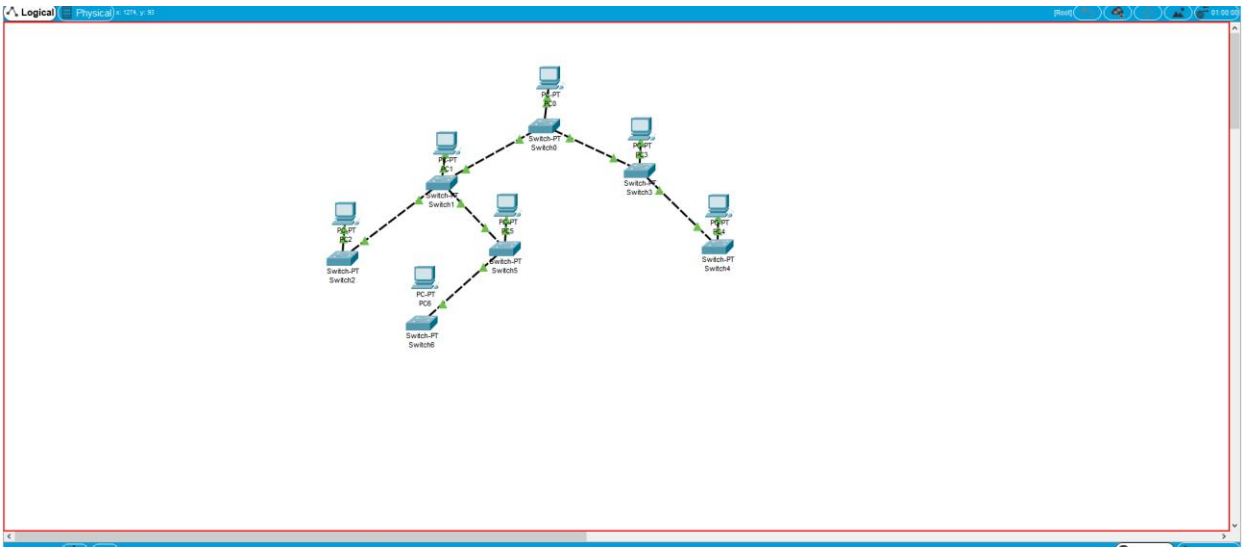


Figure 33 (What the automation will produce in cisco packet tracer, the previous steps will be done and changed accordingly to match assigned location to form the above figure)

To configure each station correctly so it can be simulated like a normal network, it required the same coding as these screenshots shown but this went on, to an extra interface.

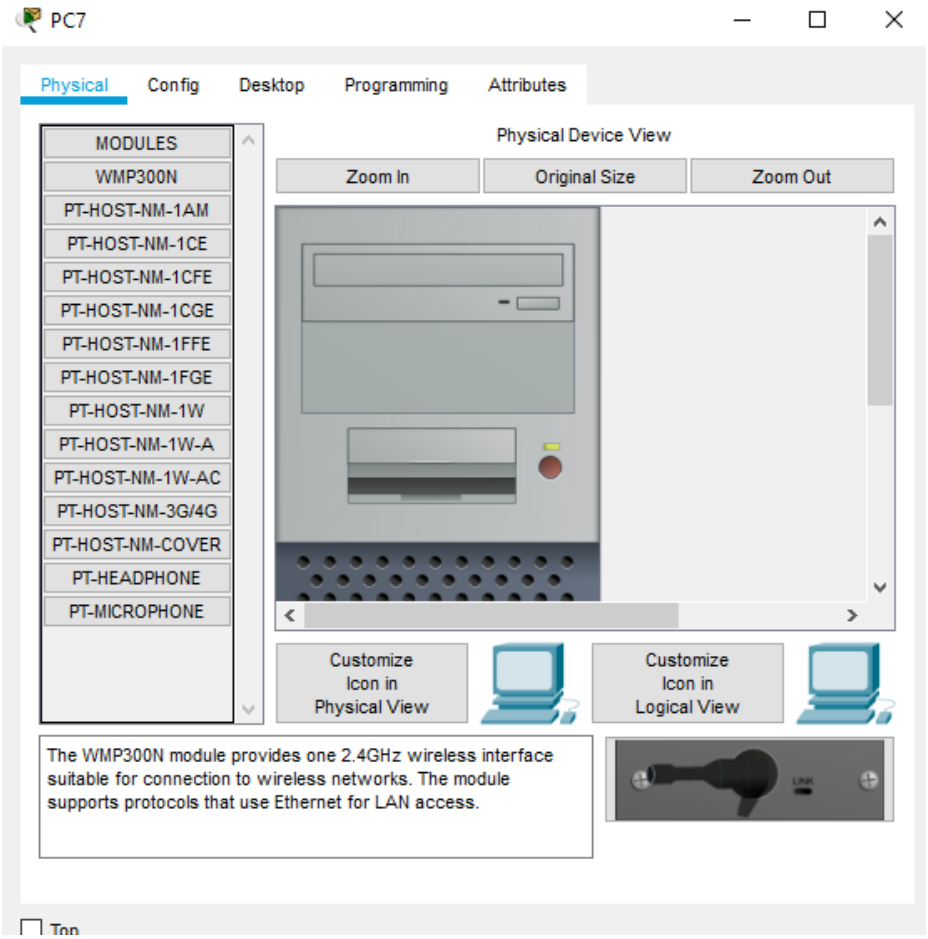


Figure 34 (The interface once clicked on a pc which allows to simualte real life configuration)

This is the interface of the PC simulating potential capability of real time configuration. The automation will do these same steps as shown, to automate navigating through this interface to assign the PC IP addresses.

Therefore it will go and click on the PC, config, IP configuration and then enter all the necessary information in the required fields. Fdgfdg

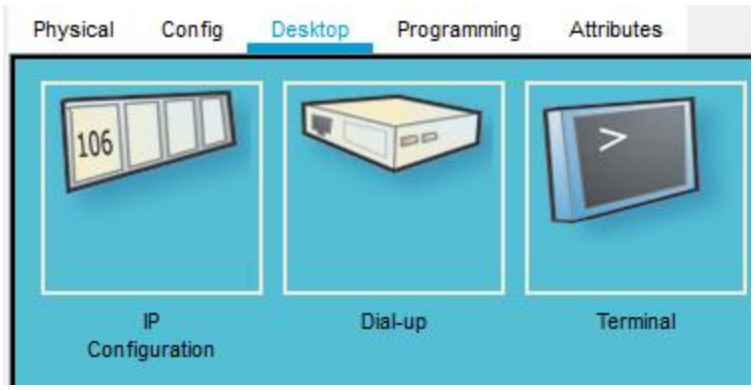


Figure 35 (The interface once clicked on desktop from figure 31)

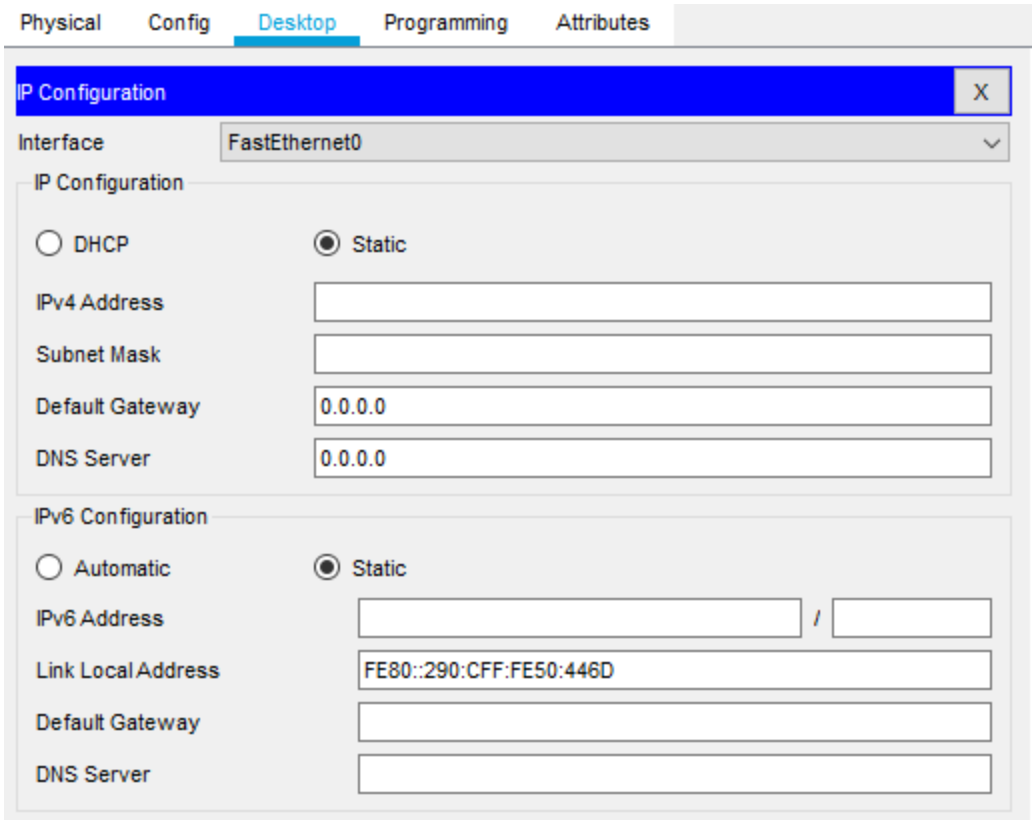


Figure 36 (The interface once IP configuration is clicked from figure 35)

This automation was successfully automated and with the same procedure, this was carried out to automate a mesh topology. I then decided to automate a single switch being configured as well as other automations, that took slightly longer than the first two. These automations also follow the same procedure, but some unique differences occur.

With the automation that just configures a switch with basic commands, uses real time behavior and so the terminal needs a period to accept the next command. The screenshots will go in chronological order showing what happens in cisco packet tracer as well as UiPath when configuring switches is automated.

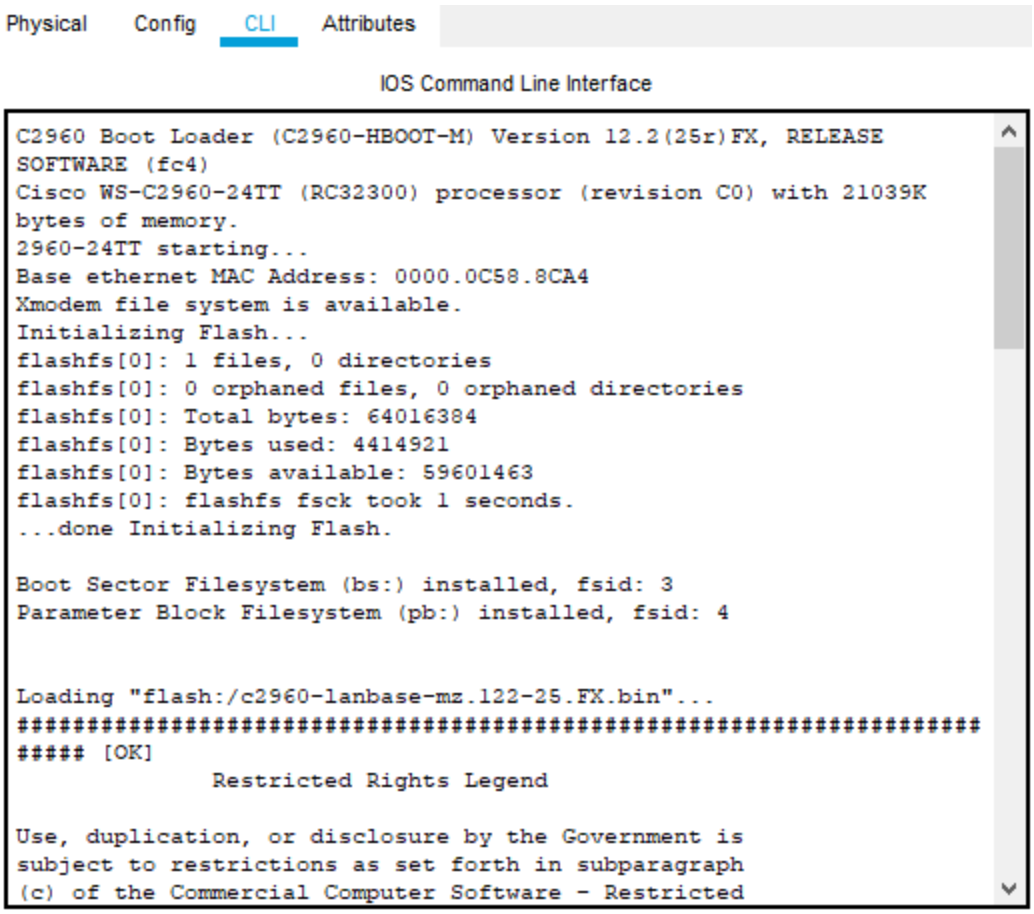


Figure 37 (Interface of command line of a switch booting up)

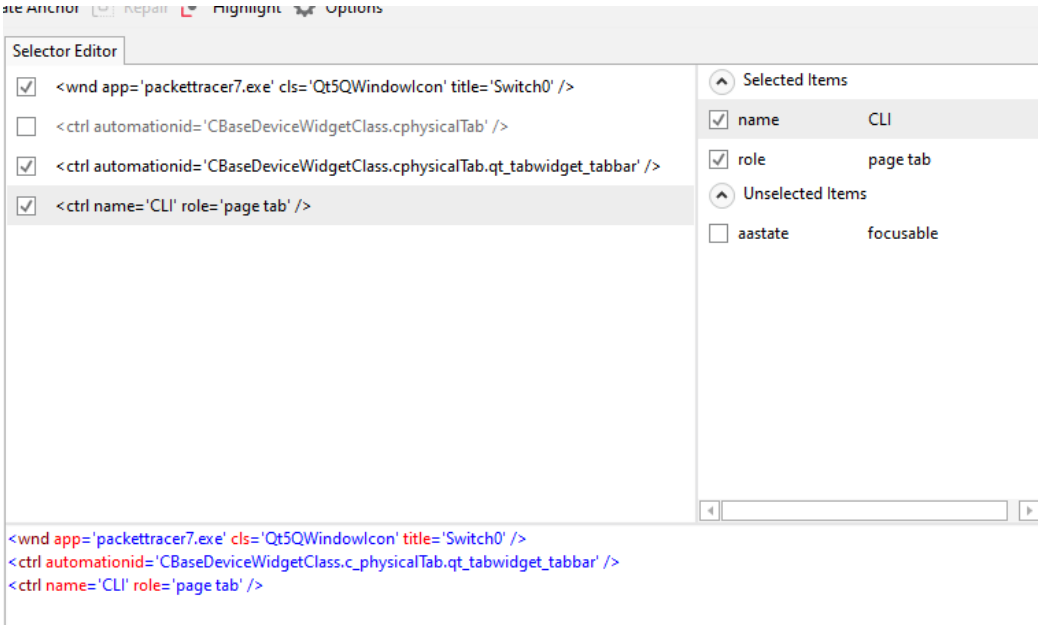


Figure 38 (Instructions to click within figure 37 to automate keystrokes in)

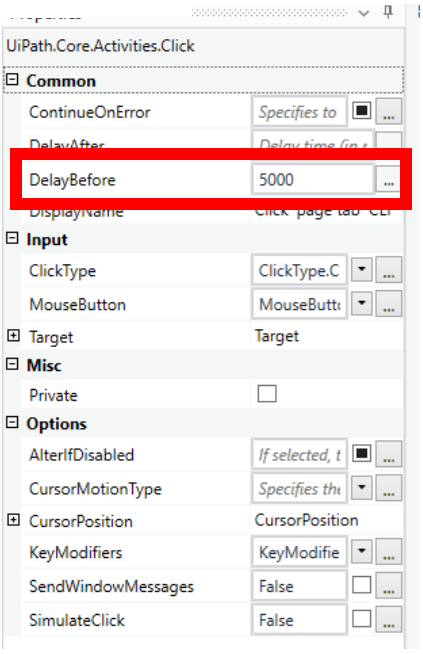


Figure 33 (Editing property of when the action should get triggered delaying it due to switch having a boot up time)

Here, the automation needed to wait for the terminal to load and know where to click. These screenshots display this being achieved by delaying the action in the properties tab along with the lines of code that tell the automation on where to click, and display the text stored.

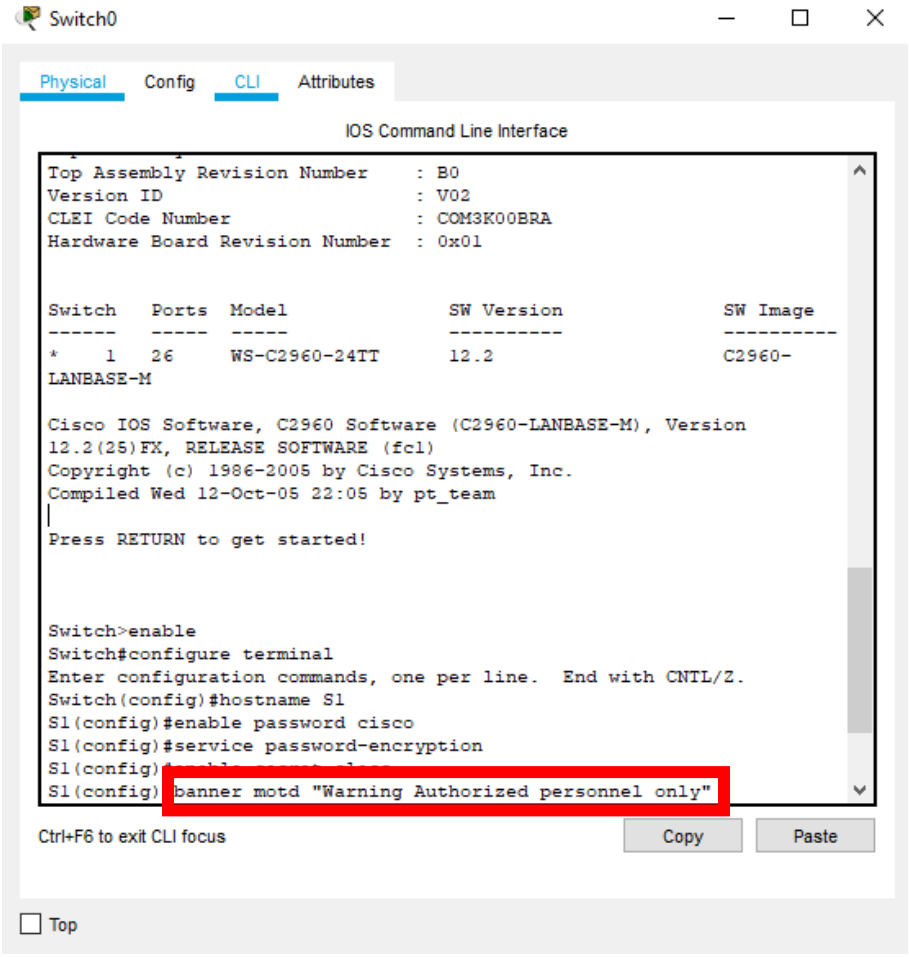


Figure 39 (Result of keystrokes being automated withing the command line interface)

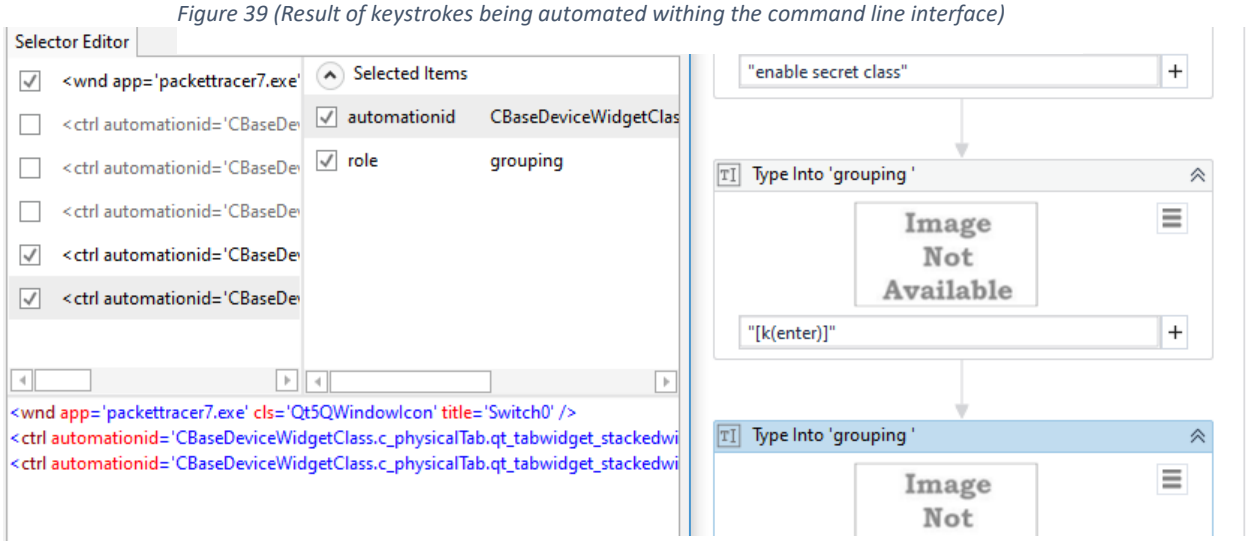


Figure 40 (Instructions for where and what to type in to the command line interface pop up window as well as the activities box were the instructions are located)

In these screenshots, the same procedure as before is presented. Code for where to click and automate and the activity tool; storing the switch terminology to be typed up into the terminal.

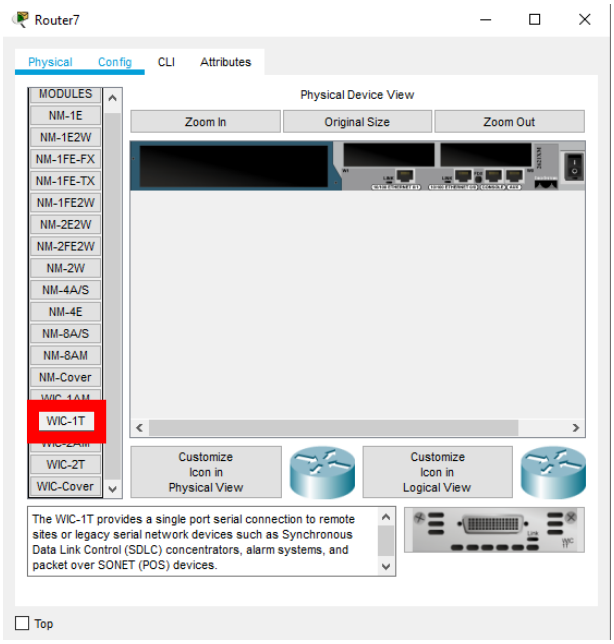


Figure 41 (Interface of drag and drop situation at first step)

These same procedures are moderately the same for all other cases of automation. One occurrence needed a new action that was not needed in the other automation, which was then, the action to drag and drop.

Here is the action shown in screenshots that needs to be automated to the drag and drop action.

The screenshots below show the automation process in UIPath.

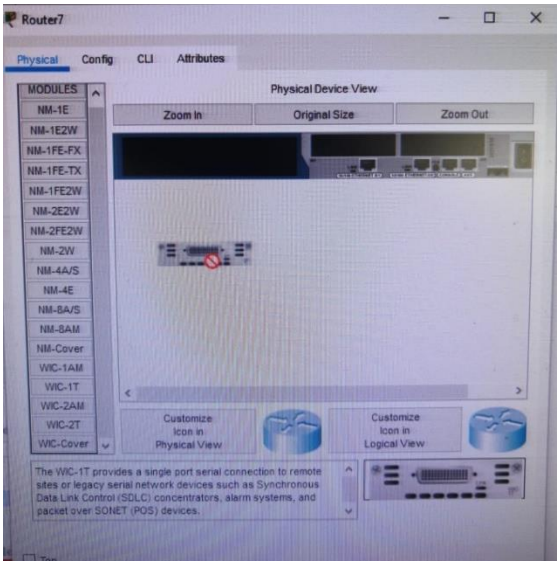


Figure 42 (Interface of drag and drop situation at second step)

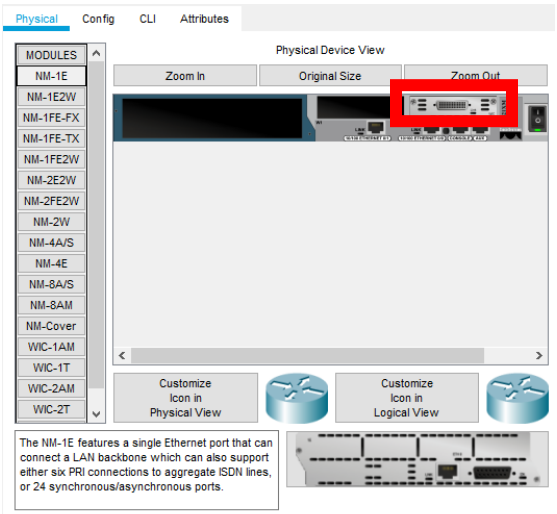


Figure 43 (Interface of drag and drop situation at third step)

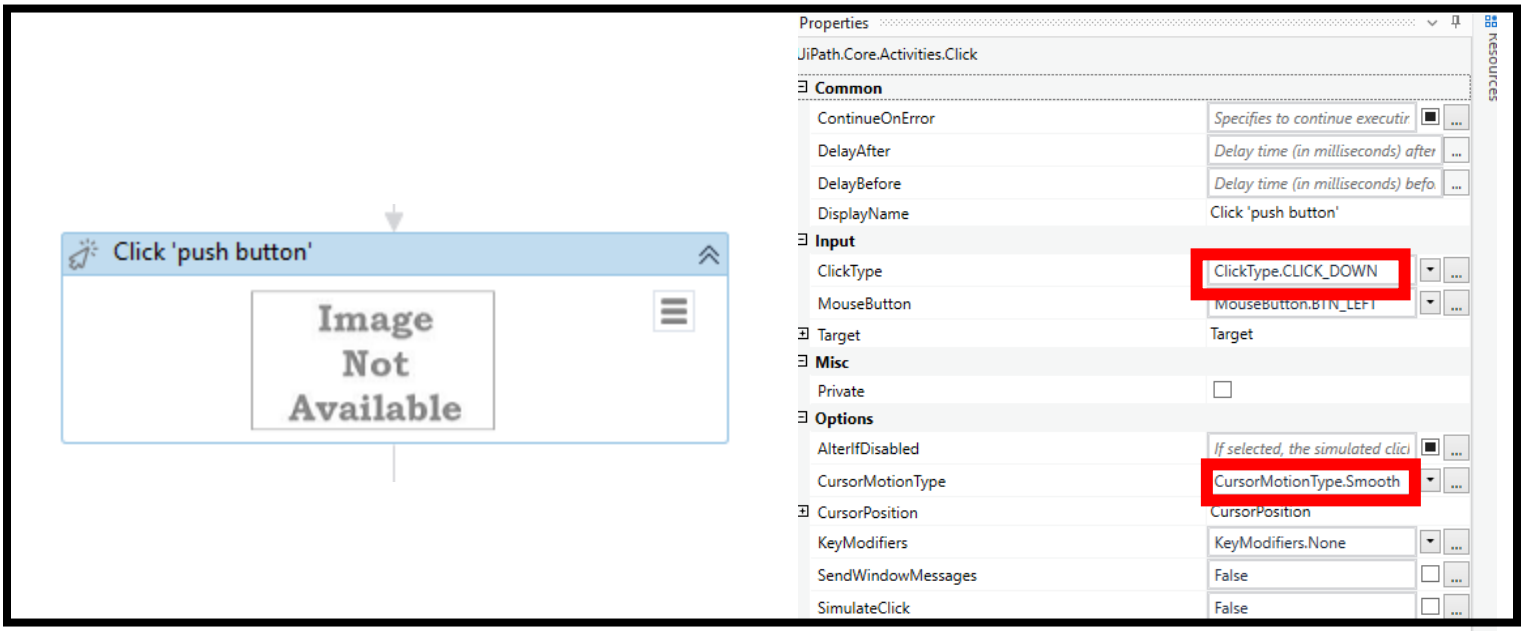


Figure 44 (Properties being edited which is automating the action of the left mouse being pressed down)

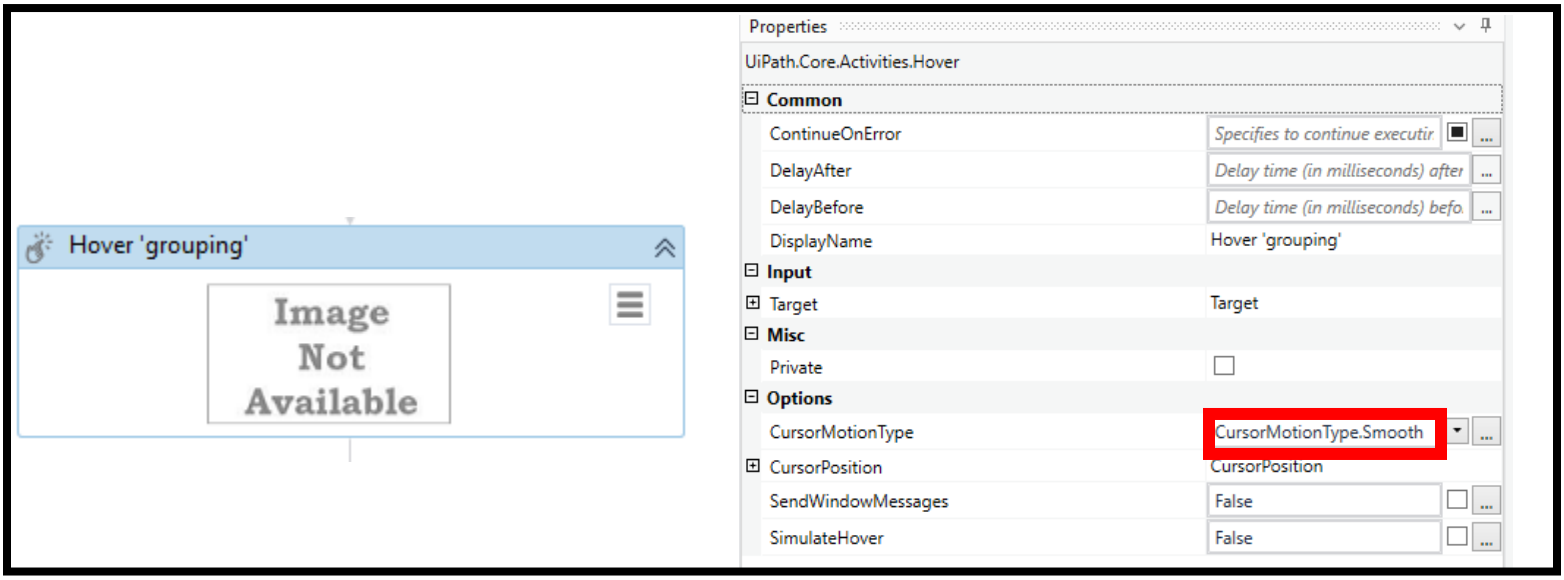


Figure 45 (Properties being edited which is automating the action of the mouse movement)

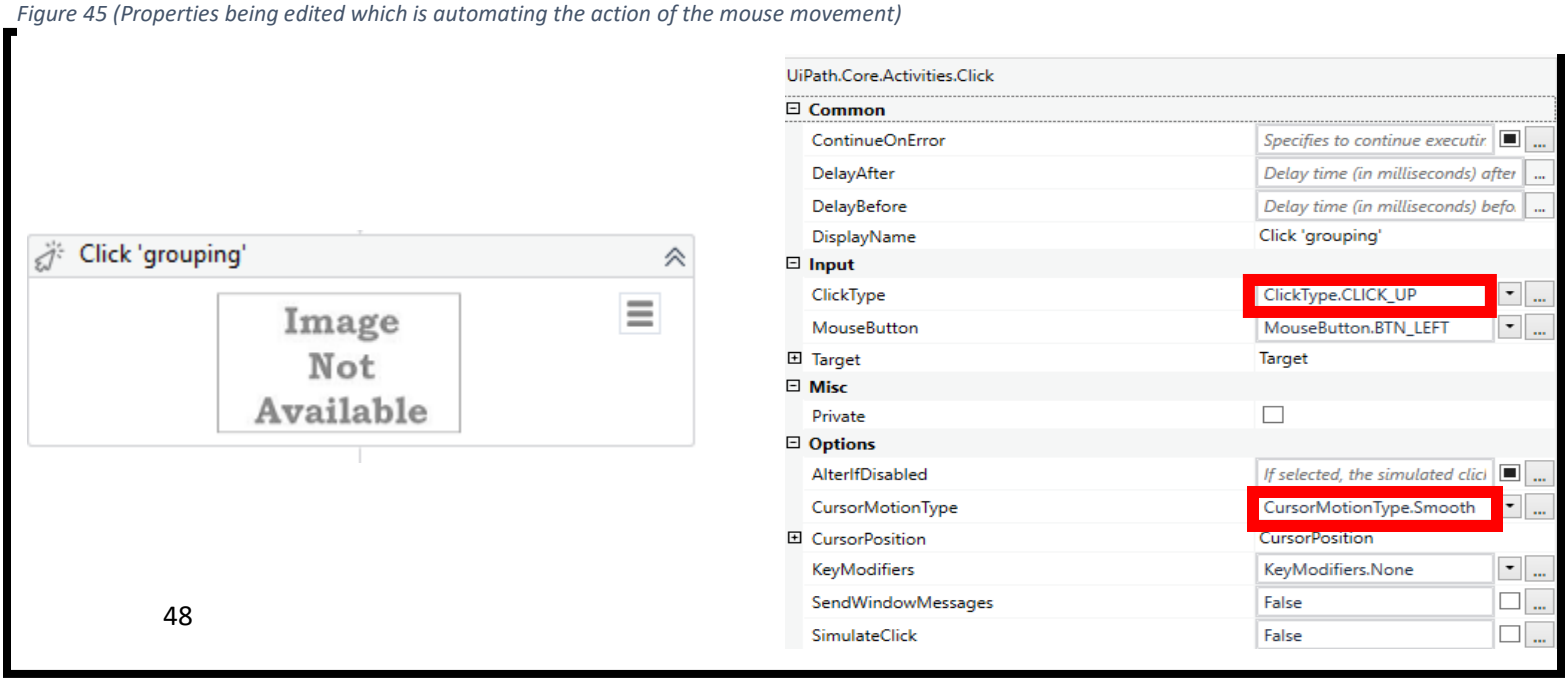


Figure 46 (Properties being edited which is automating the action of the left mouse being released to finally achieve the drag and drop action)

UiPath also allows to simulate mouse keystrokes so this can be done thorough the properties tab according to the right activity tool. The most recent screenshots show how this is attained. When taking into consideration of how a drag and drop action works, is that you would need to click on something then drag to the desired location to then let go of the mouse button (this is defined in the highlighted areas of the screenshots). With the first screenshot, it sets the rules of the first action which is to click on the object and hold on to the left mouse button to simulate, click and drag. To hold onto an object, the click type is defined as click down; locking in the action and making drag and drop possible. Another rule that must be defined, is the movement of the mouse as well as holding on to the object. This is defined in the highlighted screenshot Cursor motion type. The second acts as a confirmation of the movement of the mouse which comes under the hover activity. This also keeps the property of the mouses movement. Finally, the drop action is done by letting go of the object in the designated area. This is done by the click type being define as click_up; meaning lifting the mouse up, thus automating the action of letting go of a mouse button.

Therefore with these aspects, produces everything that is necessary for my goal for automation for network tasks.

4.3.1 Implementation phase

In the implementation phase what is done is essentially taking care of realizing the design of the artefact that I just created and create an actual software system. There are four fundamental principles, four pillars that can affect the way in which software is constructed (Udacity Academy, 2021). The first one is the reduction of complexity. This aims to build software that is easier to understand and use. The second pillar is the anticipation of diversity. Which considers that software construction might change in various ways over time. In many cases, it evolves in unexpected ways. Therefore, I Would need to be able to anticipate some of these changes. The third pillar is the structuring for validation. Also called design for testability. What this means is that we want to build software so that it is easily testable during the subsequent validation and verification activities. Finally, it is important that the software corresponds to a set of internal or external standards.

Utilizing this idea, I then ensured this with my artefact making sure it achieved the original problem that I wanted to tackle. By doing this I was able to implement this automation to work with the software of cisco packet tracer thus combining these two ideologies together.

4.4 Testing

Many tests were required to ensure all automations were working optimally; and as explored through the production phase, some errors occurred. With the testing, I did this by making sure a specific action was done first. Then to move on to the next stage, allowing me to work through it properly. With the right terminology for switches, I had to make sure they worked therefore it needed me to follow up with a dry run without the automation, to make sure they worked. These were then put in the automation UiPath.

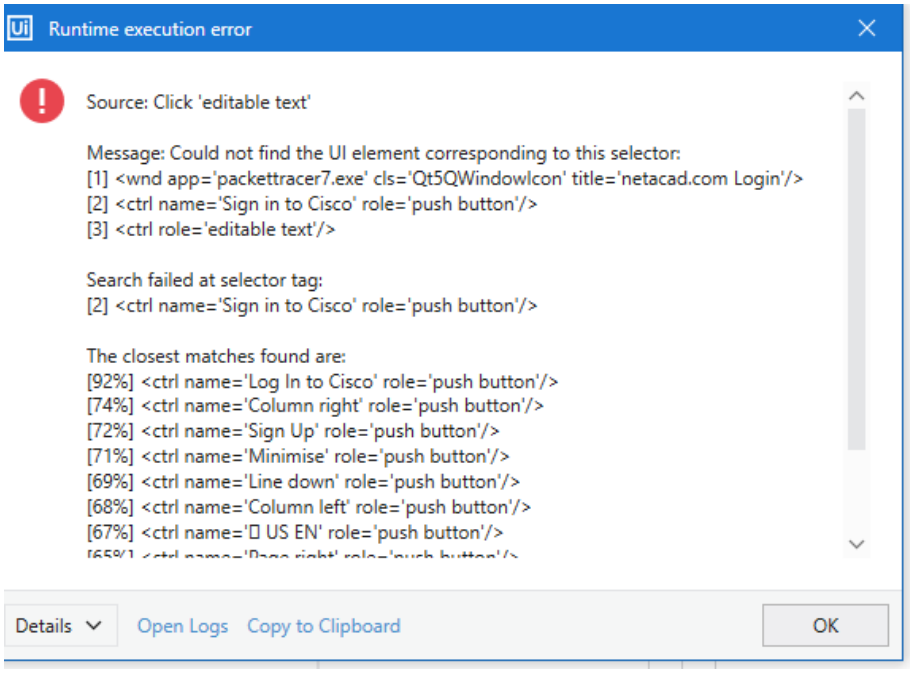


Figure 47 (Error message when a UiPath does not successful run the process)

When errors occurred this runtime execution error pop ups and stop the automation completely. This runtime error will come up for most problems that might occur within UiPath or what I have come across. The error will occur if the logic is wrong, the keystrokes, the mouse actions do not match the applications its operating on or something has changed with the software or the application its automating.

UiPath will highlight what section might need to be looked in to and so editing the lines of code or validating the location of where UiPath need to click in cisco packet tracers UI.

Figure 48 (Error message will also highlight were the potential problem might of occurred)

4.5 Problems

A few unfortunate errors did occur but was overcome as one of them was the change of the login interface of cisco packet tracer.

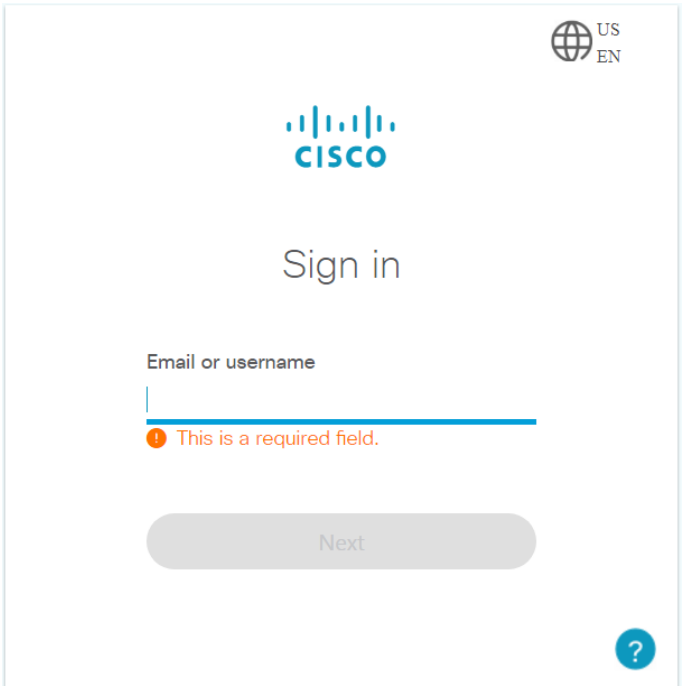


Figure 49 (Old login interface for cisco packet tracer)

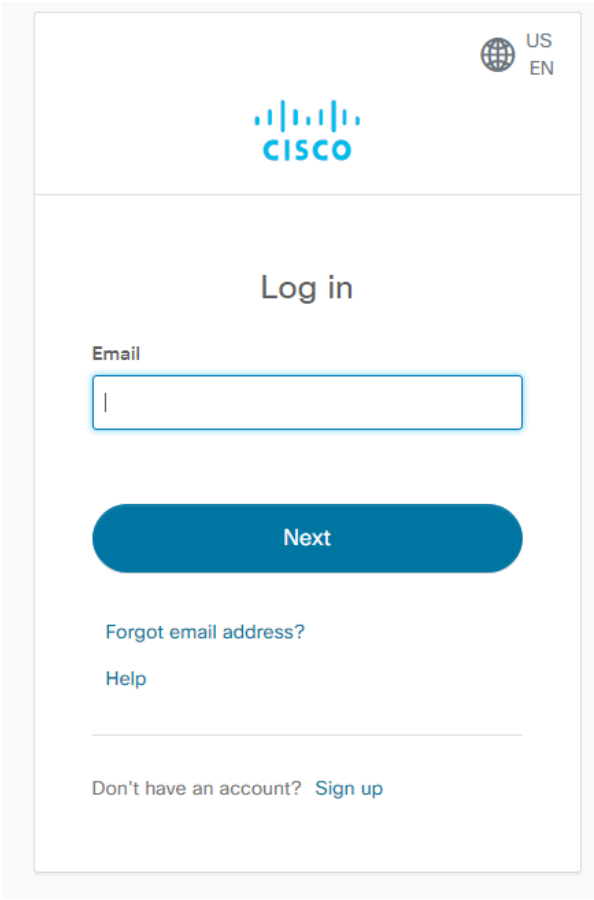


Figure 50 (New login interface for cisco packet tracer)

As seen from these screenshots they are slightly different. At the time of making the automation, the log in screen changed to one you see now on the right. A person would not have any difficulty to the change, but the navigation of the new login box does not match the old one. So, the automation could not continue the automation and resulting it to crash. Due to the login box being different, the navigation location recorded previously, did not match. It resulted to it not clicking in the right box to enter the credentials. However, this was fixed by indicating the new location so the automation could navigate properly, and this was needed to be done for all automations.

Many other errors occurred due to lack of knowledge of UIPath as well and networking terminology which was later resolved by digging deeper into the respected courses.

One other notable problem was at time when creating automation. There was a loss of data in need of process which resulted in reinstalling the software. Backups were made and the automation were saved but new and different versions of UIPath were currently available. The new version was not able to open the files that was created with a previous version. However that version was no longer available from

the official sight, so I needed to do some in depth research for the version I used, in order to successfully carry on my work.

Chapter 5 Analysis

5.1 Final end product

With all the problems and testing completed the overall project is completed. With my initial thought was to automate certain network tasks to be done automatically through RPA and this has been achieved. In previous chapters there were multiple reasons pointed out on why I opted for this idea to be fulfilled, one key reason time being saved as this is evidently true. Through just seeing the automation successfully automating all actions one can identify a person cannot compete with Robot processing automation.

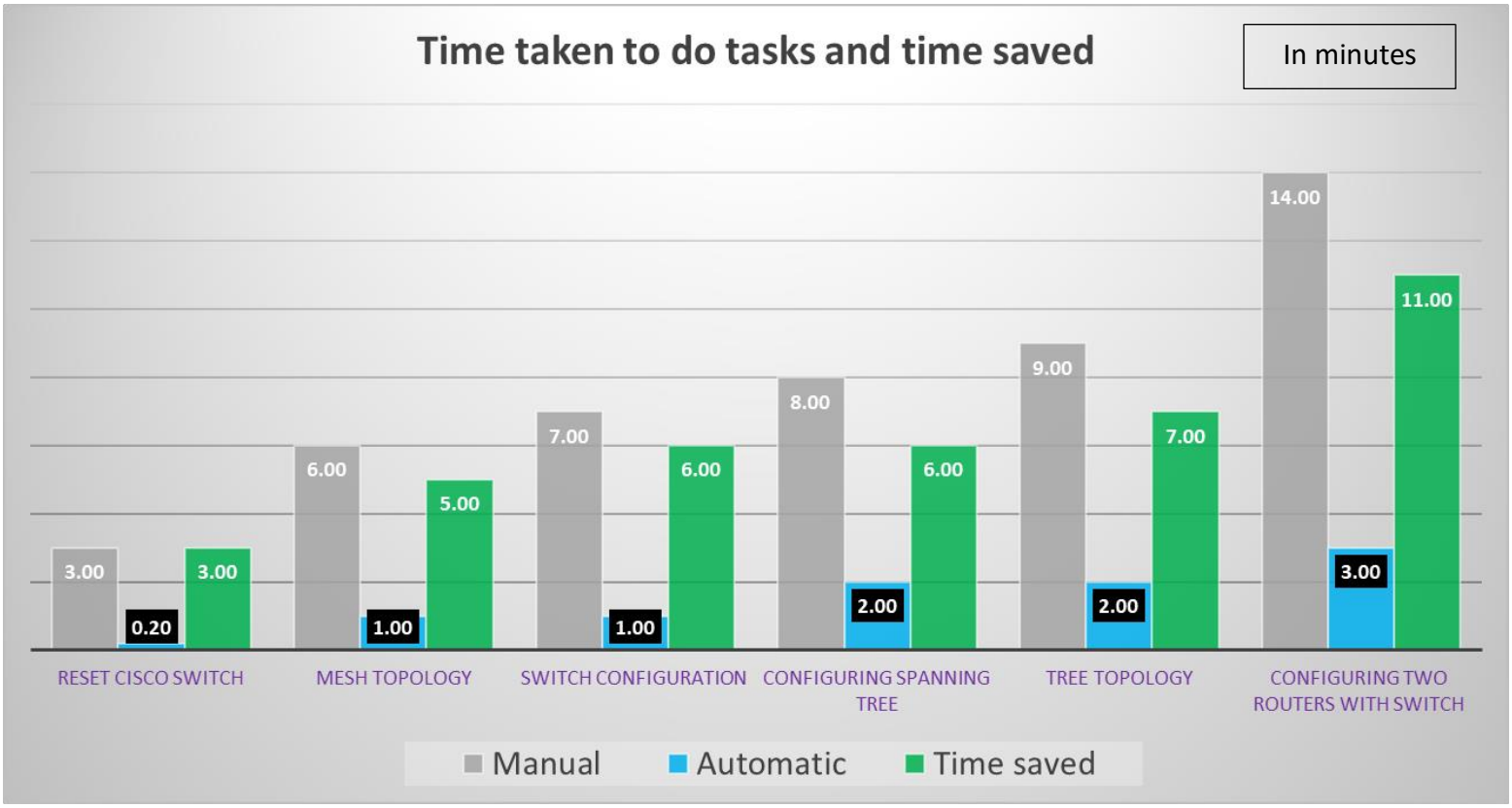


Figure 51 (Recorded times of tasks be carried out manually and automatically as well as displaying the value of the time saved))

From figure 51 that I have compiled by recording the times with cisco packet tracer, shows a visual representation of how long tasks take manually as well as being done by the automation. The tasks accumulate on how technically and more actions are needed from left to right. These results were taken three times each to get the best average for each tasks either manually or automatically. The recorded times were also rounded up to the nearest minute if applicable. The times have been logged through packet tracer as seen in figure 52. Packet tracer has a timer showing how long a session took and displays how long it took. Each task was done 5 times by manual and automatic to see the best value to use.

Figure 52 (Cisco packet tracer timer which recorded the time of sessions being complicated)

The data in green is a clear identify on how much time is saved when the task is automated. Not only is this due to the speed of a person compared to an RPA is done to other factors too. Such as input error, lose trail of thought and coming to a halt when a problem occurs. Even when I done these procedures more than once I do end up not being sure what has been assigned to certain devices and have to retrace my steps. But the automation does not need to do this and continues. A visual representation further shows how much difference is made by doing it automatically in figure 53 displayed here in a pie chart.

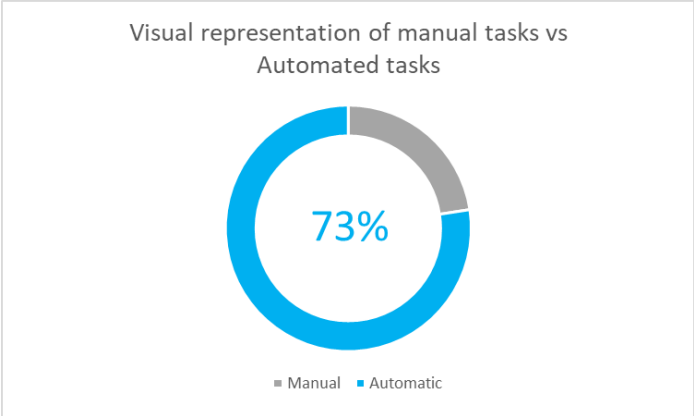


Figure 53 (Values of manual compared to automatic tasks in a whole)

5.2 Overview after production

With the six automations in working order, it showed the many pros of cons of automation. Each task that was automated have some differences from each other but were all able to be automated. A clear advantage is the time saved from these tasks, but it can be argued about the time used producing these automation using a software like UiPath. While creating these automation, the research I gathered that explored the background of this topic was still in thought as if this idea is implemented and advanced further it does affect other factors.

While creating this time management was a clear factor and I had to constantly make sure what I predicted I can do can be done within the time frame. A lot of learning was required for both applications to utilise them.

With the problem with data loss, it was quite easy to get up from were I left off compared to other technically applications however finding the application version I was working on took some time to find. This is a key variable if this was implanted in the real world, the applications must be up to date with the current supporting version.

The tasks that can be automated can be more than the ones portrayed in this project, this will be further explored later in this report. There is a definite learning curve for both applications, cisco packet tracer as well as UiPath have many tools and representations that have not been touched upon due to the advanced knowledge to be undertaken to use them. This could have been viable however due to the time given it was not suitable to uptake this challenge.

One situation that came up surprised me while making these automation. Even when getting a better understanding compared to me prior to the project. I did not comprehend how much the software relied on the step-by-step nature. Due to sometimes automating the multiple tasks on cisco packet tracer some tasks are the same, so I do them with quicker succession. However, the logic did not match and would not run at all. Unable to identify where the problem is it was hard to continue the automation, my preliminary thought of UiPath was it was clear-cut on what sections has problems but from this encounter is did not.

5.3 Pros and cons within a working environment

By going through this report many views and results can be met that can be seen as clear pros as well as cons. The advantages are less human error, taking care of mundane tasks, time saved on doing repetitive tasks to name a few.

Evidently with the automation not needing to know what actions it has inputted it just needs to process A to b meaning it will not lose its trail of thought or forget what is as assigned to a previous device, as long as the data given is correct it will input them accordingly without error. Human error can be seen as huge problem as said in previous chapters the root cause of many potential problems this is all avoided through automation.

With the results taken on the time of tasks being done automatically and manually, it is a clear indication that automation saves a lot of time. In the working environment time is a crucial factor and with the time saved can be used for something else. In the bar chart there is a correlation that is consistent which is the complicated and longer the task is you will doubly save a lot of time compared to doing it manually.

With the pros mentioned the reasons for them to be a inconvenience in the first place is due to it being a mundane task. Mentioned previously, humans can do certain tasks but are better and doing tasks they need creativity then repetitive tasks as there is always a chance of the person getting bored. So, if the task does not need to be different and specially the same the automation can outperform a human's ability in every way.

With mentioning the previous pro, it can also be seen that this is as well as a con. In a working environment it is forever changing so tasks might need the creativity of humans which the automation cannot perform unless the instruction is given to it. The reason of a network specialists is to be adaptable and constantly act on situations whenever need in their working life. Even if an automation is done with all the possibilities of all necessary networking tasks it cannot perform certain actions.

In addition, with the point of constantly changing application as well as the automation software will change too this can cause problems in itself which has be experienced with this project. In the working environment the network specialist would indefinitely update the necessary network application but now as well as the automation software, if automation is relied upon changed muse be made for it to work again adding to the interface changes. As my idea for this automation is built to save time and recourses this can actually lead to the opposite of that as time to just maintain with the new information can cause unknown problems and can halt the automation process in a whole.

Although there are some cons and pros it is unclear on what weighs the other. I believe if RPA can be used correctly with certain repetitive network tasks this can work impeccably and allow network specialist to be important.

6.1 Learning outcomes

Throughout my time with working with this project I have accumulated a vast amount of knowledge, this is not just with the technical aspects but with the process of work too. With all that I have learnt it was important for the creation of this project and I did not envision on what I needed to learn to achieve the idea of the goal. In the first staged just to have a concept I did not think of the bigger picture, on how much research and similar projects have been touched similar to mine that effect the real world. As A Result, by gathering this vast amount of research is showed a new perspective and made my approach to the report more refined and up to date.

Another key outcome that came to pass was time management. As this was the first time for me to start off a project like this, I could not determine how much time would be needed for this report as well as the artefact. Thus, bearing in mind my time I had constantly dedicate time wisely and efficiently. Usually if a problem occurs with coding project, I usually stick with it to try and find a solution. However, when I realise on how much time I put to the automation software I needed to pull myself away and dedicate time fairly to the report. With this behavior I have learnt along the way allowed me to recover from a great predicament. As mentioned before my pc had a fatal error causing my project as well as the report progression to a halt. But due to being well time managed I was still able to recover and continue even from this problem.

At First, I knew certain aspect of UiPath only basic knowledge to do certain actions with the application. Through my time with this project however I have advanced with this software a considerable amount utilising tools and execution within the application, allowing me to get improved understanding compared to prior allowing me to succeed in this project.

With knowledge with networking terminology was obtain through university studies. A certain amount was enough to be apply with cisco packet tracer. However, as I researched further there were some new terminology that I acquired. As well as Cisco packet tracer showing multiple devices, I am not familiar with and the environment of the software has displayed new information that intrigued me further of the networking field.

Constantly progressing this project has enabled me to learn continuously as well as understand the problem; ultimately leading me to the solution. I was constantly required to reflect upon why I was creating this and the entirety of my main idea as well as its many branched concepts that was a part of it. This was needed to be taken into consideration during the process of producing this report in order to finalise my understandings by presenting how I obtained the knowledge as well as how these sources of information were utilised throughout the expansion of my final and completed artefact.

6.2 Future work

By carrying out this project, the main goal was to achieve a solution to the problem which was to eradicated time wasted on repetitive tasks done by network specialists and so the title of this report "Automation of networking tasks with the use of RPA". This can be done evidently with the desired advantages shown which are saving potential time and eliminating human error. However, there are some disadvantages explored in previous chapters.

Due to time constraints, I was not able to utilise fully the tools within UiPath. UiPath has the potential to use ai which they said themselves "The potential of automation is vast. We believe the power of AI can make it almost limitless. And so, we have built AI into every part of the UiPath Platform" (New Level of Automation, UiPath, 2021). For this to be working in UiPath a much more greater understanding is needed which I was not able to obtain. With the statement made by the creators of UiPath I agree with strongly. Ai as well is a new topic so it will have the disadvantages of RPA tasks as well. Which is needing people to have steady knowledge of a on growing terminology.

This has more or less been achieved so far with Cisco with the newly created cisco DNA center. By utilising both ai and RPA can truly tackle the problem of repetitive tasks ensuring time save and preventing any potential problems to happen in the future.

6.3 Discussion and evaluation

To gather and compile my ideas, the final product of my artefact has been enabled to tackle the problematic lifestyle of the developing working world. With the introduction of automation in different environments such as computer-based offices to customer services, expresses how their cooperation within our day-to-day lives, could produce a new and profound future of technological advancements. Human error would become an issue that would later be not acknowledged and will soon allow people of today's society as well as future generations to focus on more upbringing and controversial dilemmas faced by the world and in this day and age.

Human productivity, historically presented, can only reach such limitations of productivity. However, the complexities of our never-ending developments and ideas can allow us to enter a new perspective and outcome of efficiency as well as improving well-being of human workers. With target systems such as the cognitive psychological school, this responds to how the requirement for human work that presents people with the motivation and endurance to work is a growing and ongoing issue faced by many employees of today. The concept of what should be taken into the responsibility of technology and a human can only show one side of the entirety of the spectrum.

Automation involves a concept where humans could be potentially susceptible to an environment where technology could increase the rate of productivity. With the different perspectives of whether human error is right or wrong will never reach a suitable justification. However, with the introduction and beginning of utilising the source of automation through businesses and large working cooperation's, environments such as customer services, would provide humans with better job opportunities as they are able to fulfill their role and purpose to their best potential as technology would continue to work behind the scenes, removing excessive and repetitive duties to human workers. With human errors' distinctive nature, it can be easily and simply tackled with the idea of automation.

The involvement with the fundamentals of networking incorporates sections previously mentioned, such as IP addresses, port numbers, TC/IP model and network devices. All showed a presentation of similarities proving potential and factors to evolve into greater concepts of technological devices that could be used for further purpose and fulfillment. From the continuous development of technology versions and enhancements was something I deeply understood when carrying out this project. An example of this was how there were no more allocated versions of IP version 4 addresses left therefore, the new IP version 6 was designed. This presents the ongoing progression that could potentially be the pillars of society's enhancement in efficiency, business, wellbeing and technological developments. With new more qualified and eager minds holding aspirations for the future developments of technology, will create new doors for these applicants to showcase their ideas in order to create a more efficient and sustainable environment for the world.

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Appendix

Weekly GANTT CHART

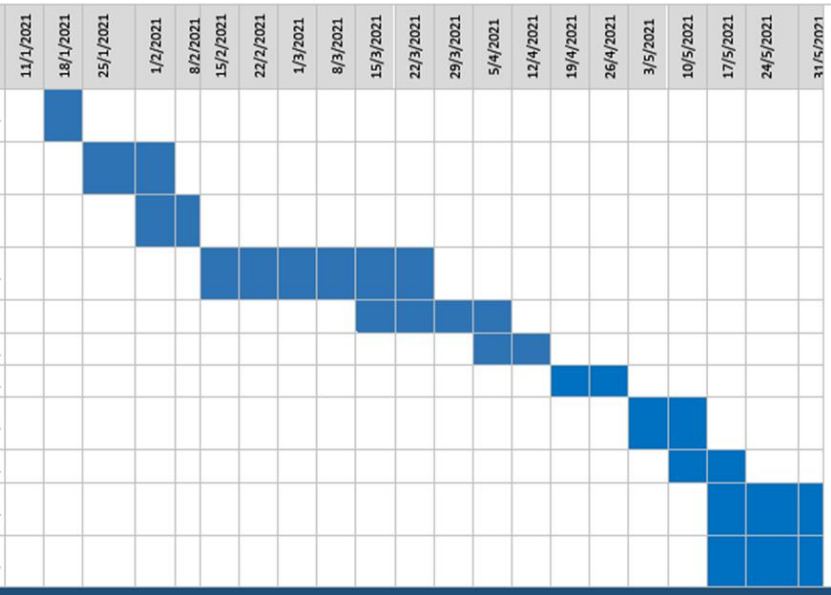
Automation of networking tasks with the use of RPA(UIPATH)
PROJECT NAME

Gowtham Kandeepan/15043329
Name/SRN

11-Jan-21
START DATE

31-May-21
END DATE

Task ID	Task Name	Start Date	End Date
T01	Identifying network task	11/1/2021	18/1/2021
T02	Design and Planning phase	18/1/2021	1/2/2021
T03	Obtain recourses for report	25/2/2021	8/2/2021
T04	Create automation on uipath	8/2/2021	23/3/2021
T05	Finales report/diary	8/3/2021	5/4/2021
T06	Bug fixes	29/3/2021	12/4/2021
T07	Finales coding	12/4/2021	26/4/2021
T08	Run through network configs manually	26/4/2021	10/5/2021
T09	Test and fix	3/5/2021	17/5/2021
T10	Test final automation on task	10/5/2021	31/5/2021
T11	Finalize reports/diary/program	10/5/2021	31/5/2021



Remarks:

Will report daily on progress and milestones.
Report on bug fix issues video diary. Book mark and information, I come across if being used or not.