A Synopsis on

Autonetics and Administration for IT Laboratories

Submitted in partial fulfillment of the requirements
of the degree of

Bachelor of Engineering

in

Information Technology

by

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CERTIFICATE

This is to certify that the project Synopsis entitled ***"Autonetics and Administration for IT Laboratories"*** Submitted by ***"Uddhabendra Maity (16104062),Karthikeyan (16104050),Atharv Shetty (16104061)"*** for the partial fulfillment of the requirement for award of a degree ***Bachelor of Engineering*** in ***Information Technology***to the University of Mumbai,is a bonafide work carried out during academic year 2019-2020

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Abstract

In this modern era of Automation,it has been observed that many of the University and college Labs dont have IT automation capabilities upto the current industrial modern standards.The latest technologies aren't being implemented in colleges and thus the students can't benefit from them.

The concept of automation has existed from couple of years but they typically just consisted of performing small tasks such as switching on and off of appliances automatically. In this automation project, we try to implement both the Lab as well as IT automation services together as a package.The IT automation tasks include many services such as automatic installation and uninstalling of several softwares whenever needed through SSH networking.

The Lab administrator has the option to deliver a set of messages or referral links to the students in a live time scenario. Also an online register would be really helpful for the staff to create a record of the student's activitites with timestamps.

Introduction

In this system,we try to eradicate the problem regarding the administration of labs. A powerful,systematical and efficient Lab management system is required which will resolve all these basic and generic problems with less human labor The basic technology that we implemented in our system is Ansible. It is used to automate the administration of labs. Here every lab will have its separate playbook. In that playbook a certain set of rules will be written and accordingly the automation of the labs will be done.

Therefore the main motive behind creating the system is to simplify complex orchestration and configuration management tasks. Previously it was observed that many of the PC's are remained switched on even when the labs are not in use,this results in an inefficient use of power and resources. Also the PCs have to be manually switched off by the lab assistants after the end of lab sessions if the students haven't shut it down themselves.

Ansible is simple open source IT engine which automates application deployment, intra service orchestration, cloud provisioning and many other IT tools.Ansible is easy to deploy because it does not use any agents or custom security infrastructure.Ansible uses playbook to describe automation jobs, and playbook uses very simple language i.e. YAML (It's a human-readable data serialization language is commonly used for configuration files)which is very easy for humans to understand, read and write.

Hence, the advantage is that even the IT infrastructure support guys can read and understand the playbook and debug if needed (YAML is in human readable form). Each playbook is an aggregation of one or more plays in it. Playbooks are structured using Plays. There can be more than one play inside a playbook.The function of a play is to map a set of instructions defined against a particular host.

Mainly, there are two types of machines when we talk about deployment –
–Control machine Machine from where we can manage other machines.
–Remote machine Machines which are handled/controlled by control machine.

Unlike most Ansible modules, network modules do not run on the managed nodes. From a user's point of view, network modules work like any other modules. They work with ad-hoc commands, playbooks, and roles. Behind the scenes, however, network modules use a different methodology than the other (Linux/Unix and Windows) modules use. Ansible is written and executed in Python. Because the majority of network devices can not run Python, the Ansible network modules are executed on the Ansible control node, where Ansible or Ansible-Playbook runs.

Ansible works by connecting to your nodes and pushing out small programs, called ”Ansible modules” to them. These programs are written to be resource models of the desired state of the system. Ansible then executes these modules (over SSH by default), and removes them when finished.Your library of modules can reside on any machine, and there are no servers, daemons, or databases required. Typically you'll work with your favorite terminal program, a text editor, and probably a version control system to keep track of changes to your content.

Modules are executed directly on remote hosts through playbooks. The modules can control system resources, like services, packages, or files (anything really), or execute system commands. Modules do it by acting on system files, installing packages or making API calls to the service network.Plugins allows to execute Ansible tasks as a job build step. Plugins are pieces of code that augment Ansible's core functionality. Ansible ships with a number of handy plugins, which we can easily write our own plugin as well.

Literature Survey

1] Automated Delivery in Pro NuGet
Authors: M. Balliauw and X. Decoster

NuGet is an open-source Visual Studio extension that makes it easy to manage libraries, componentsand configuration files from within your Visual Studio project. As every developer knows, the more complex your application becomes the more chance there is of a dependency conflict arising within the resources upon which you depend. Thissituation - known as ,,dependency hell" - used to be an arduous task to unravel and rectify. NuGet changes this situation completely saving you un- told time and stress. ProNuGet will give you a give you a solid,practical, understanding of both how to keep your software dependencies undercontrol and what best-practices have been developed within the NuGet communityto ensure long-term reliability. Whether you're working entirely with .NET assemblies oralso using CSS, HTML and JavaScript files within your applications this book- will show you how to manage their requirements smoothly and reliably.

As sponsors of the NuGet project Microsoft have lead the way in showing how NuGet can be used to great effect; showing how it is now virtually indispensable to anyone working with MVC and the .NET Framework.The only comprehensive guide to the NuGet technology to be published to dat.Covers everything readers need to know to use NuGet, from initial download, installation and configuration to advanced techniques of package integration and NuGet-as-a-Service. Written by an author team deeply involved with NuGet from the very start,who have kept themselves at the forefront of the NuGet community

2] Paper title: Topology and orchestration specification for cloud applications (TOSCA)
Authors: D. Palma and T. Spatzier

This specification defines a metamodel for defining IT services. This metamodel defines both the structure of a service as well as how to manage it. A Topology Template (also referred to as the topology model of a service) defines the structure of a service. Plans define the process models that are used to create and terminate a service as well as to manage a service during its whole lifetime.. A Topology Template consists of a set of Node Templates and Relationship Templates that together define the topology model of a service as a (not necessarily connected) directed graph. A node in this graph is represented by a Node Template. A Node Template specifies the occurrence of a Node Type as a component of a service. A Node Type defines the properties of such a component (via Node Type Properties) and the operations (via Interfaces) available to manipulate the component. Node Types are defined separately for reuse purposes and a Node Template references a Node Type and adds usage constraints, such as how many times the component can occur.

Service Templates can be based on and built on-top of other Service Templates based on the concept of Requirements and Capabilities introduced in the previous section. For example, a

Service Template for a business application that is hosted on an application server tier might focus on defining the structure and manageability behavior of the application itself. The structure of the application server tier hosting the application can be provided in a separate Service Template built by another vendor specialized in deploying and managing application servers. This approach enables separation of concerns and re-use of common infrastructure templates.

3] Unleashing Full Potential of Ansible Framework: University Labs Administration
Authors: Pavel MasekMartin ŠtůsekJan Krejčí

In the faculty's premises, a large number of computer classrooms is used for the teaching and research, which according to the purpose of teaching includes sets of physical and virtual machines with different operating systems and different software equipment and settings. However, some settings and applications are common to all of these cases. We developed a scenario that would unify the administration of such classrooms and save considerable amount of time spent on the maintenance of these classrooms.

The scenario must be capable of orchestrating all the stations located in the selected laboratory, which is composed of stations with different mainstream operating systems: (i) Windows 10; (ii) Windows 7; (iii) Ubuntu 16.04; (iv) Debian 8. It also has to be able to install and uninstall various programs: (i) Microsoft Office; (ii) Putty; (iii) Wireshark; (iv) Mozilla Firefox; (v) Google Chrome; (vi) Microsoft Visual Studio, and (vii) Total Commander accompanied by their latest updates. In addition, several system operations must be enabled: (i) Displaying information and status of stations; (ii) restarting and shutting down stations; (iii) creating users; (iv) creating and deleting a file; (v) installing system updates. The selected settings will be implemented with the usage of a remote management framework Ansible. Ansible framework works on clientserver topology, therefore the Ansible server application needs to be installed. To do so, a system with a Unix or Linux operating system that contains Python in version 2.6 and higher is necessary. The installation itself was done from a general repository which contains appropriate packages in all major distributions. Further it was necessary to configure Ansible Server to communicate with remote hosts

Problem Statement

In current labs of university most of the administrative work is done manually which consumes lot of time and efforts.With the help of Ansible framework and a proper supporting GUI which can unleash and maximize the full potential of the servers,many of the current lab administrative problems can be resolved. Lab automation systems which is referred here , face four main challenges, these are high cost of ownership,inflexibility, poor manageability, and difficulty in achieving security

Lab automation system using Ansible is capable of controlling and automating all the systems through an easy manageable web interface. The proposed system has a great flexibility by using Ansible technology to communicate with the lab automation server. This will decrease the time and will increase the ability of upgrading, and system reconfiguration.

The ansible server is capable of doing heavy operational tasks such as installation,upgrading, and heavy file transfers from one main server to other nodes at a same time remotely.Thus,this not only removes the time and efforts for doing the same task individually at each node but also utilizes the modern technology for automating and simplifying tasks at a greater extent.

Hence saving the time of the students as well as lab in-charges and helping the administrator to do all the tasks in a more progressive and modernised approach. through this system will improve the efficiency and scalability of the day to day work conducted in labs of the university labs.

Existing System Architecture/Working

Here in the figure shown alongside,the administrator will be provided with a remote access and with the help of the internet it is connected to the web server and through that web server, a web application will be hosted.

In the back end of that web application Ansible server will be integrated, and this web application will connect to all the host PCs within their range and it is supported by all OS

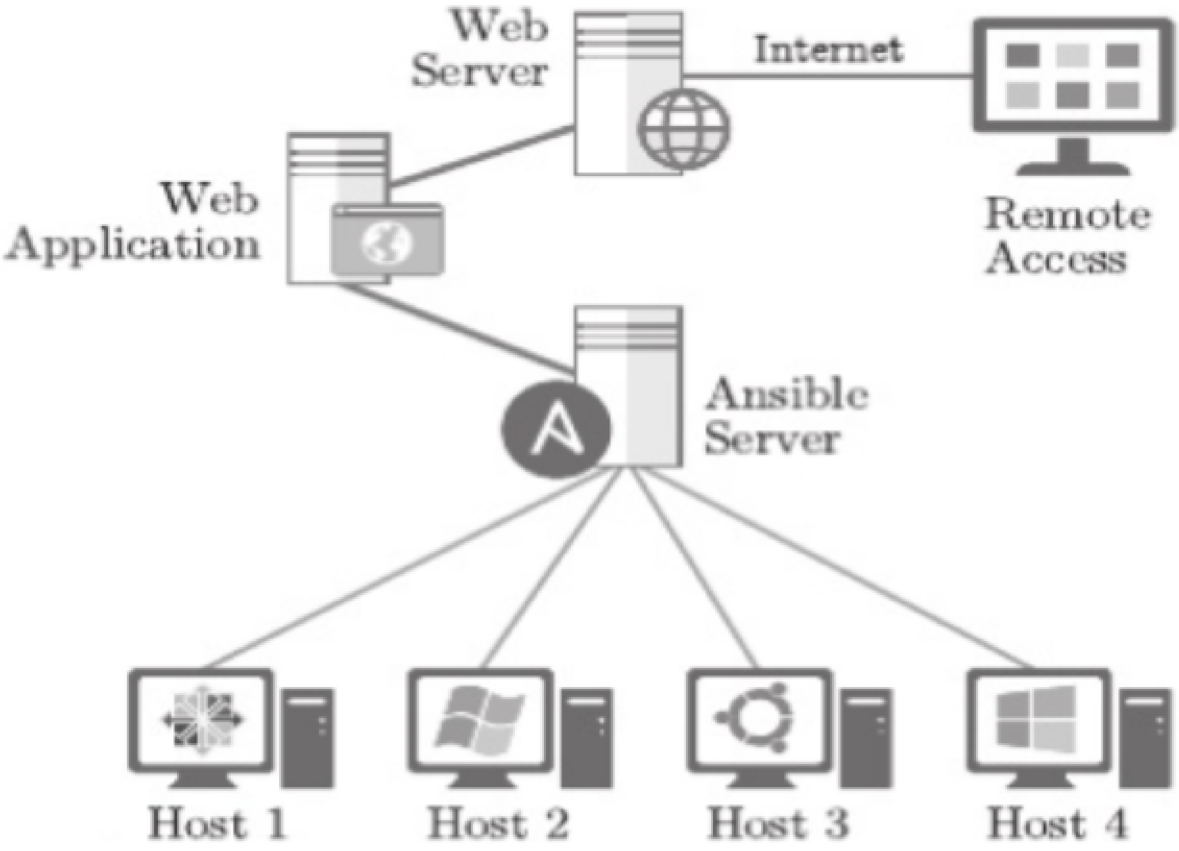

Figure 1 : Architecture of Ansible Remote Interface Management

Remote Access:

The Administrator will be provided with the PC,where he will have access to all the pc's which are connected in network. These systems should be connected to internet via WLAN

Web Server:

Here to host a website,web server programs must be present. Apache is one of the most leading web servers used nowadays

Web Application:

Here with the help of the server a web application will be hosted. In this web application,with the help of a proper GUI the administrator will easily perform necessary tasks.

Ansible server:

These are the pc's which will be connected to the system of the administrator. The PC's must be in connection with each other These PC's can be installed with any operating system according to their choice

Objectives

- To Automate the Software installation process.
- To Automate the PC shutdowns.
- To regulate the user identity of every PC along with time in a digital format.
- To alert the users about the remaining time of the current lab session.
- A proper GUI will be created which will display the important announcements.
- To unleash the full potential of Ansible for IT automation.
- To remotely control the electrical appliances of the whole Lab.

Proposed System Architecture/Working

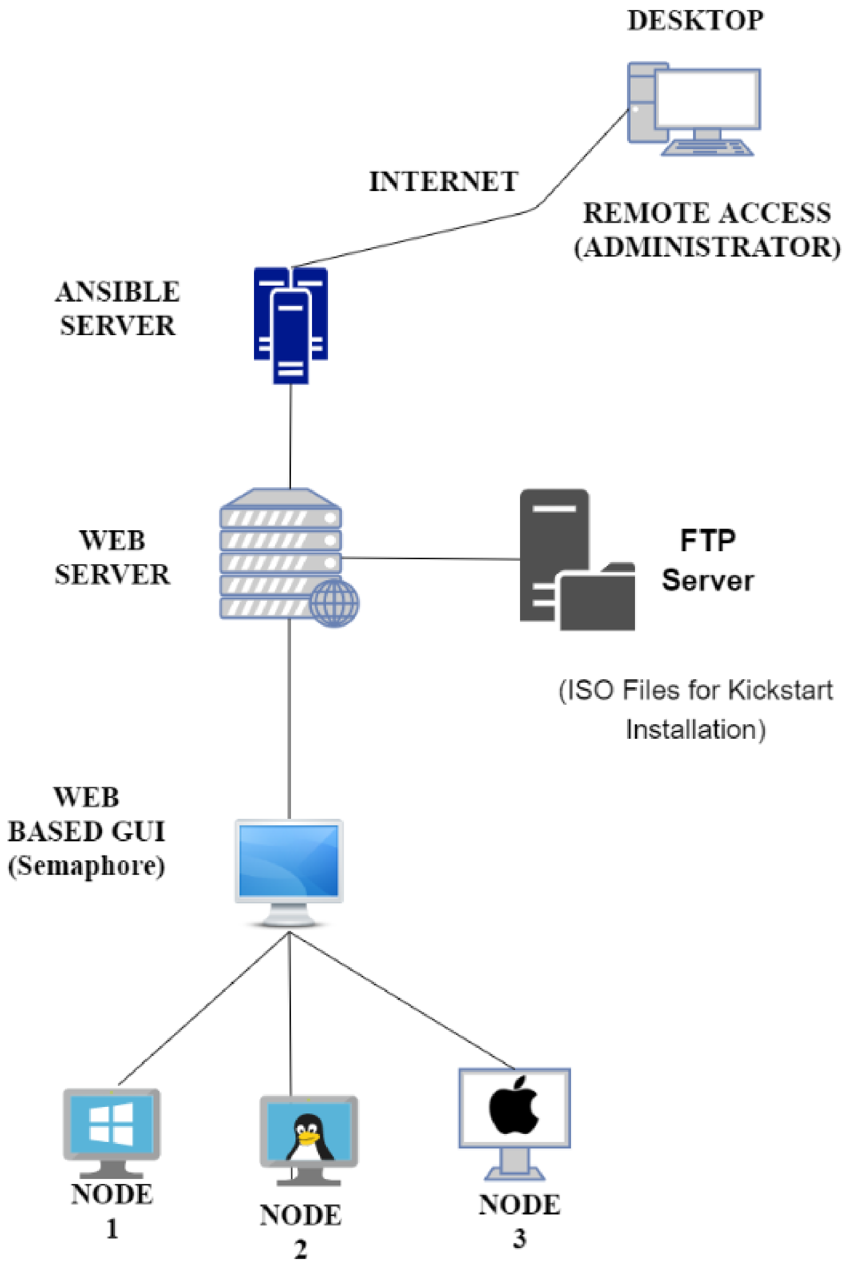
DESKTOP
INTERNET
REMOTE ACCESS (ADMINISTRATOR)
ANSIBLE SERVER
WEB SERVER
FTP Server
(ISO Files for Kickstart Installation)
WEB BASED GUI (Semaphore)
NODE 1
NODE 2
NODE 3

Figure 2 : Proposed System Architecture

Remote Access:

Desktops and mobiles will be useful for managing the lab which will be further connected to the main web server via internet medium.Here both web based GUI as well as an android application will be developed for more flexibility.

Web Server:

Web server will be used for hosting the whole automated enviroment.Web server will supervise important characteristics like Timezone,Hostname,User Informations and Domain Names.

Web application:

The web server will host the required Web application which will be connected to all the lab devices and can be easily managed and controlled via a user-friendly GUI.

Ansible Server:

Ansible server will be used for hosting the Ansible environment throught the whole network via the LAN connection and thus all ansible related queries and commands for lab automation can be easily carried throughout.

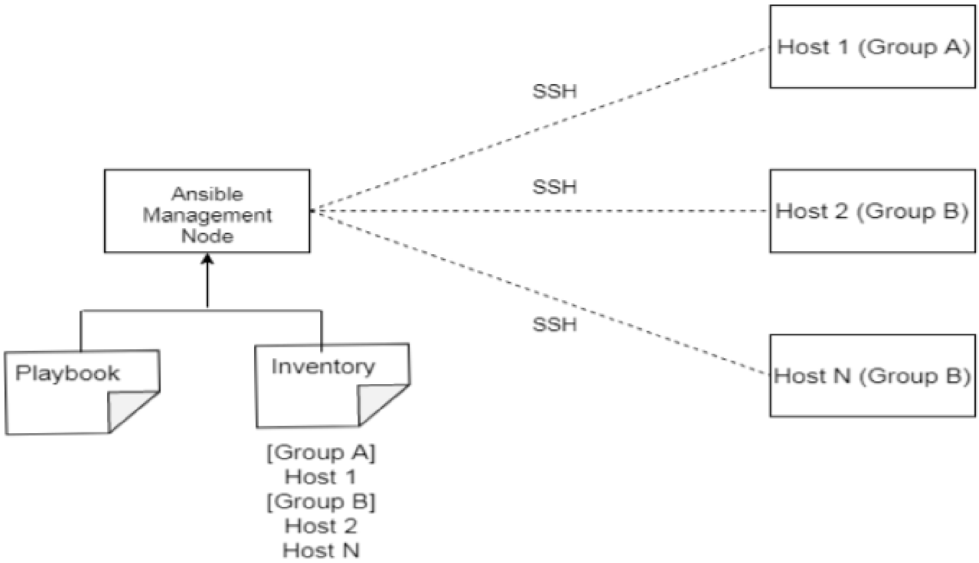

Figure 3: Working of Ansible

Client PC's:

No matter what operating system the client PC's are running on.Any activity can be easily carried out irrespective of what the Operating system is, through the network.

Kickstarter:

Os installation takes a lot of time. We are automating this task by integrating an open source tool into our system called as Kickstarter This will not only help in installing operating systems remotely but also make the required configurations such as disk management, network configurations, etc.

Semaphore:

Ansible Semaphore is an Open Source UI for Ansible, an alternative to Ansible Tower. The software is free to use and fully open source, released under MIT license. The backend of Semaphore is written in Go while the frontend is written in Angular.

This tool allows you to launch Ansible Tasks from a Web interface. It has support for LDAP authentication, provides RESTful API and alerting via email and Telegram.

As we are using a free open source platform for our system,many labs can be automated using the same architecture at a very feasible price. Ansible allows you to automate your IT infrastructure starting from creating VM, Installing Software, Docker/Kubernetes Deployment and Configuring in VM through simple Configuration file (YAML). Ansible provides Different modules like file, database, cloud, inventory to install and configure your VM/Cluster. Think of cluster, you can configure you cluster and make it up-and running without any human touch. You don't need any programming language knowledge to work with ansible. It is one of the keytool in DevOps ecosystem.

Alternate tools like puppet and chef are available. Which can replace Ansible. But each tool has got it's own beauty. Ansible does its work like a pro. So it's not worth to compare Ansible with Chef or Puppet.Ansible works over SSH. You can Install Ansible in a Laptop, Desktop, Deployment server or CI-CD Pipe. It works every where. You need to make sure that the target Machine/Server is accessible over SSH. Ansible support all type of SSH authentication

-Username/Password Based SSH Auth
- Private/Public Key Based SSH Auth
- Jump Box and Tunnel based SSH Auth

Activity Diagram:

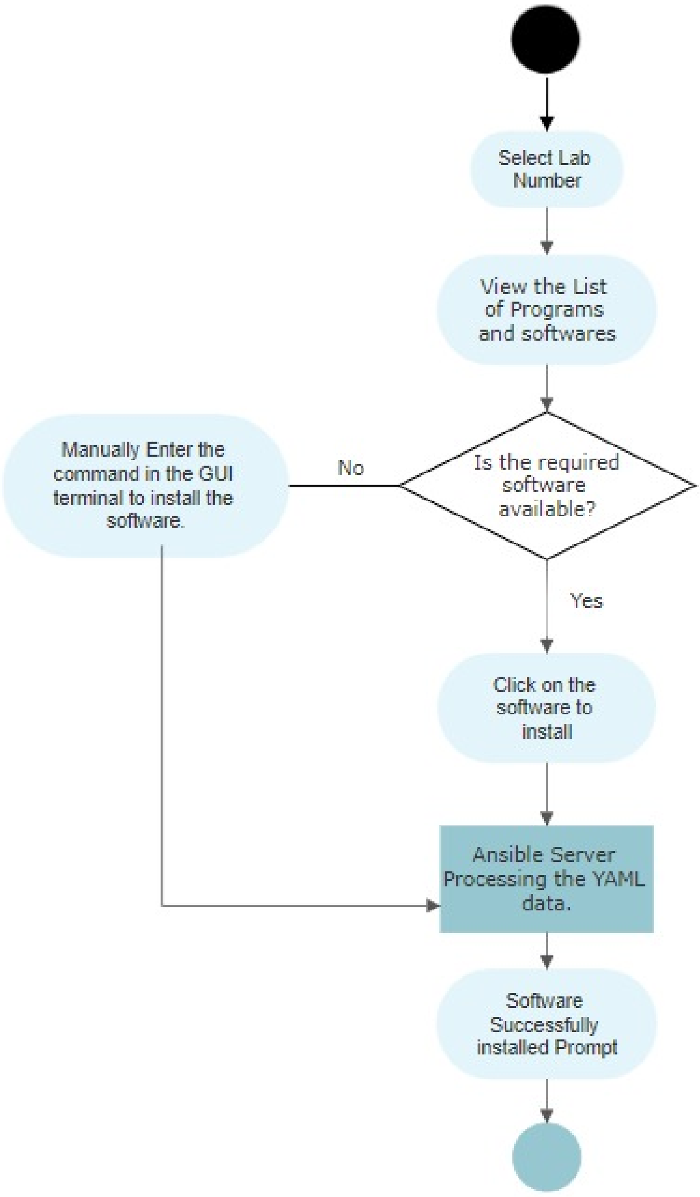
Select Lab Number
View the List of Programs and softwares
Is the required software available?
No
Manually Enter the command in the GUI terminal to install the software.
Yes
Click on the software to install
Ansible Server Processing the YAML data.
Software Successfully installed Prompt

Figure 4: Activity Diagram considering LAB in-charge's POV

The Lab incharge has to enter the lab number in which he/she is conducting the lab session. The full list of the available softwares for the lab will be displayed and the lab incharge has to just select the software which is needed by the students for that lab session and the software will be automatically deployed in the lab nodes.

The Admin can also install the OS with kickstart as per the requirements if any drive is taking place in the lab. The ansible server can install/un-install/upgrade or transfer the files efficiently.

Use Case Diagram:

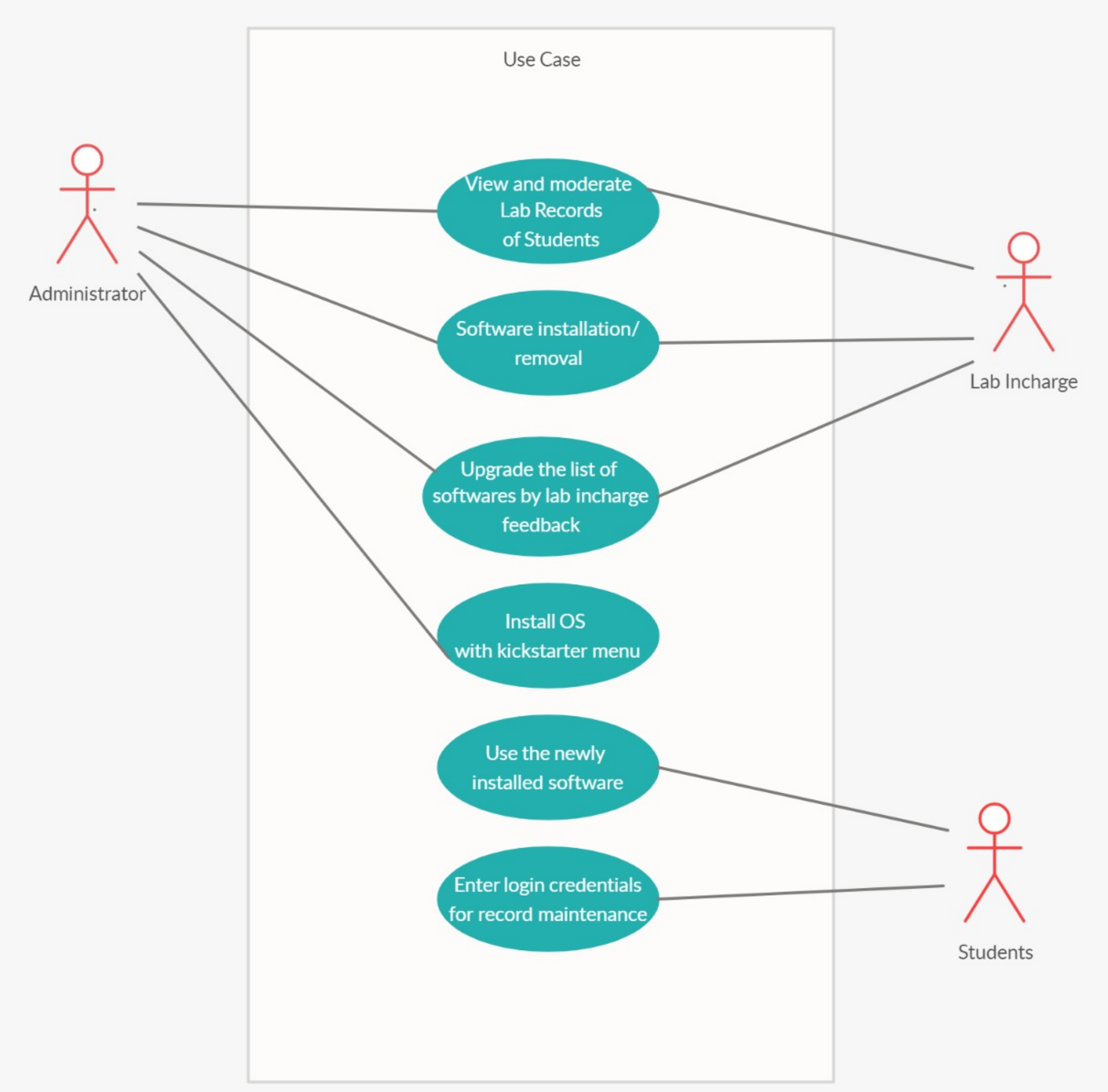
Use Case
Administrator
View and moderate Lab Records of Students
Software installation/ removal
Upgrade the list of softwares by lab incharge feedback
Install OS with kickstarter menu
Use the newly installed software
Enter login credentials for record maintenance
Lab Incharge
Students

Figure 5 : Use Case

The three main roles:

1)Administrator:The administrator takes care for upgrading the list of softwares, make changes in the system according to the lab incharge's feedbacks, carry out OS installations,etc.

2)Lab Incharge: He/She is responsible for conducting the labs and make the installations of softwares efficiently as per the required subjects and their softwares.

3)Students: The students will have to enter their details into the records manual and it will be stored on to our database.

Class Diagram:

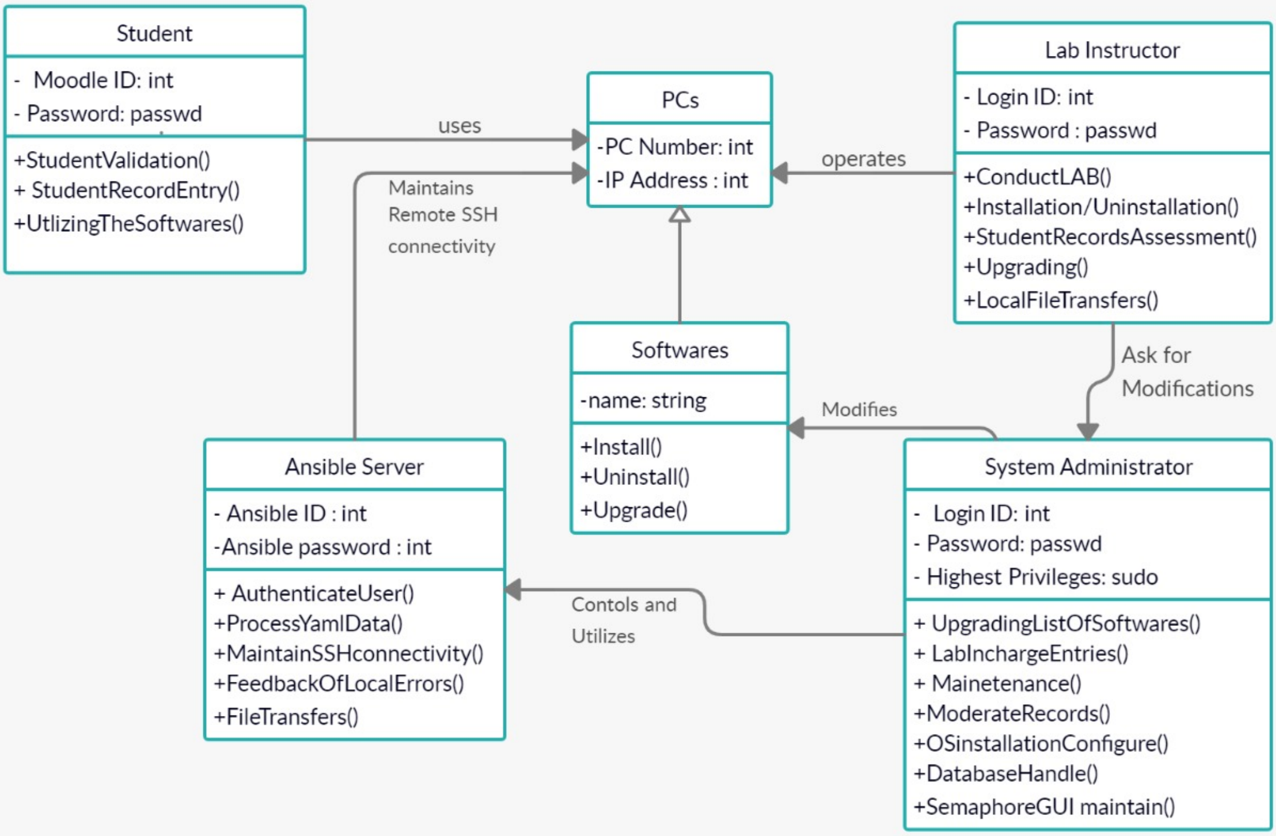

Figure 6 : Class Diagram

Proposed Technology Stack:

- Ansible- A red hat devops tool
- Python3 for running Ansible
- Semaphore-a web-based GUI interface for handling Ansible queries
- Kickstart- an open Source tool for remote installation of OS
- Nodes will be running on Ubuntu,Windows
- Front end developement :HTML5, Javascript,CSS

References:

1] Pavel MasekMartin ŠtůsekJan Krejčí, “Unleashing Full Potential of Ansible Framework: University Labs Administration” May 2018

2] Nishant Kumar Singh ,Amity University,”Automated Provisioning of Application” June 2017

3] J. O. Benson, J. J. Prevost, and P. Rad, “Survey of automated software deployment for computational and engineering research,” in System Conference (SysCon), 2016 Annual IEEE, pp. 1–6, IEEE, 2016

Publications

Paper entitled **“Autonetics and Administration for IT Laboratories”** is presented in **“International Conference on Convergence to Digital World (ICCDW- 2020)”** by **“Atharv Shetty,Karthikeyan Venkatachalam, Uddhabendra Maity, , Dr. Sameer Nanivadekar and Prof. Vishal Badgujar”.**