Bahir Dar University

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Operating systems and system programming

Linux - Lite

OS INSTALLATION AND MKDIR() SYSCALL
IMPLEMENTATION

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SECTION A | BDU1601168

1. Introduction

Ubuntu LTS (Long Term Support) editions serve as the foundation for Linux Lite, a free and thin Linux system. To make Linux accessible to customers who were used to Windows but were searching for a free and open-source substitute, Jerry Bezencon initially built and released it in 2012. One of Linux Lite's main goals was to develop a system that would function well on outdated or low-spec hardware so that users may prolong the life of their current Computers.

The first Linux Lite version which was based on Ubuntu 12.04 LTS included the Xfce desktop environment, which was selected for its ease of use and low resource use. Linux Lite has remained based on Ubuntu's LTS releases over the years, guaranteeing stability, security upgrades, and long-term maintenance. Pre-installed software packages that are often used by most users, including a web browser, email client, media player, office suite, and system tools, are included with every edition of Linux Lite. With this method, new users can get a completely functional operating system right out of the box.

Dedication to usability is another important aspect of Linux Lite's development history. A Lite program installer and a Welcome Screen are included in the package to assist users with system setup and extra program installation. It is especially appealing to Linux novices due to its thorough and user-friendly documentation.

Features like Lite Tweaks, Lite Upgrade, and Lite Info were added as Linux Lite versions got more recent. Tasks like cleaning, updating, and system diagnostics are made easier by these utilities. While maintaining low resource consumption, the distribution has continuously enhanced its graphical user interface, system responsiveness, and compatibility with contemporary hardware.

In short, Linux Lite is the result of a ten-year effort to create a desktop Linux operating system that is not only open-source and free, but also incredibly user-friendly, particularly for individuals with a Windows background. It embodies the Linux values of openness, community involvement, and continuous development.

The fundamental goal of Linux Lite, which is to make Linux simple and accessible for everyone, irrespective of hardware capabilities or technical expertise, served as the driving force behind its creation. Providing a dependable, user-friendly operating system for people switching from Windows to Linux is one of the primary motivators. Linux Lite makes sure that users may continue to work effectively without having to learn a whole new system from start by simulating the classic Windows interface and including all required daily-use apps.

Another motivating factor is inclusivity. Linux Lite was developed to make sure that people in places or circumstances where upgrading to newer hardware is not financially viable can access contemporary, safe computing. Linux Lite prolongs the life of older devices by operating efficiently on computers with less resources, lowering electronic waste and promoting sustainability.

Linux Lite is a useful tool for presenting Linux and open-source software to students in educational settings. The learning curve that comes with conventional Linux systems is lessened by its user-friendly interface. In order to prepare them for the more complex use of open-source technologies, it offers a reliable environment for students and learners to experiment with Linux-based tools and command-line operations.

Linux Lite provides developers and system administrators with a lightweight environment that is simple to manage and deploy quickly. Access to thousands of extra packages that are easy to install, and update is also guaranteed by the system's interoperability with many Ubuntu repositories. All things considered, Linux Lite was inspired by the need to make computing easy, inclusive, effective, and available to everyone.

2. Objectives

- To install Linux Lite 7.0 in Oracle VirtualBox successfully.
- To learn the system-level programming capabilities using Linux Lite.
- To implement and understand the mkdir() system call.
- To explore Linux filesystem support and virtualization technology.
- To show the lightweight nature of Linux lite.

3. Requirements

Linux lite is probably the best of all lightweight Linux distributions. Based on Ubuntu LTS and designed with user-friendliness in mind, Linux Lite uses the Xfce desktop to create a UI that's clean and simple but doesn't miss out on features.

I.   Hardware requirements

recommended requirements:

- **CPU:** Dual core Intel or AMD x64 processor with 2 GHz or higher.

- **RAM:** 2 - 4 GB is recommended for a more comfortable experience.

- **Storage:** 10 GB of disk space.

- **Graphics:** VGA screen with 1024x768 resolution.

minimum requirements:

- **CPU:** 1 GHz processor.

- **RAM:** 1 GB.

- **Storage:** 8 GB of drive space.

Linux lite is created for the sole purpose of repurposing older computers to make them compatible with modern technology so its installation requirements are very limited. But installing it in a virtual machine would require a lot more specifications since virtualization can be demanding.

II.   Software requirements

- Linux Lite 7.0 ISO file which can be downloaded from their official website

If you want to install it in Oracle VirtualBox.

- Oracle VirtualBox
- Host OS (e.g. Windows/Linux).
- It will need at least 1GB for Linux and 2-4GB for the virtual machine
- It requires a modern multi-core processor like intel i5 or AMD RYZEN
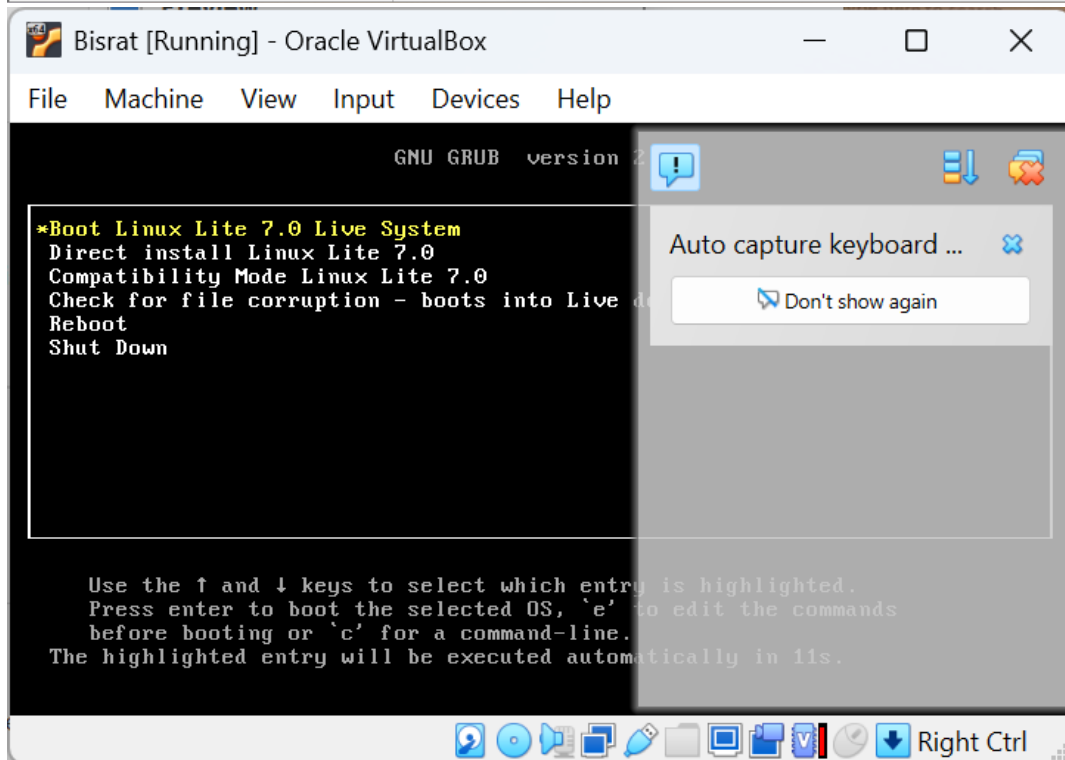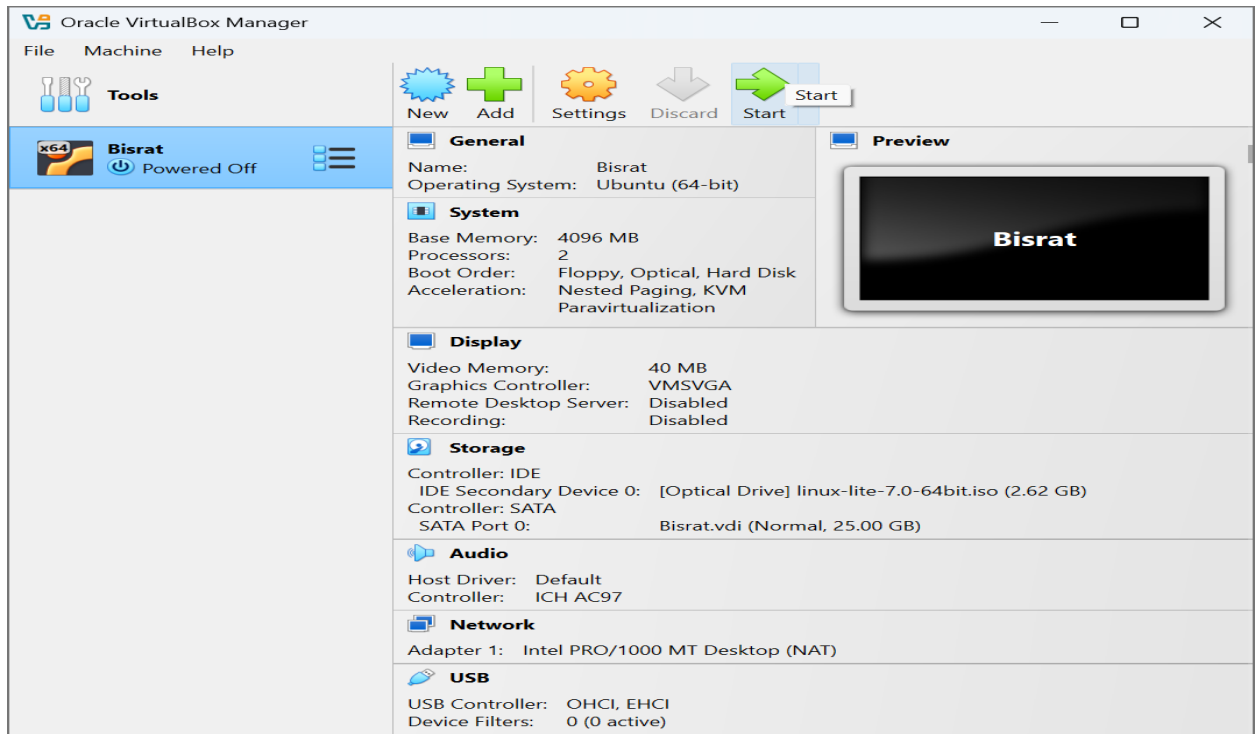
4. Installation steps

1. Download Linux Lite 7.0 ISO from the official website.
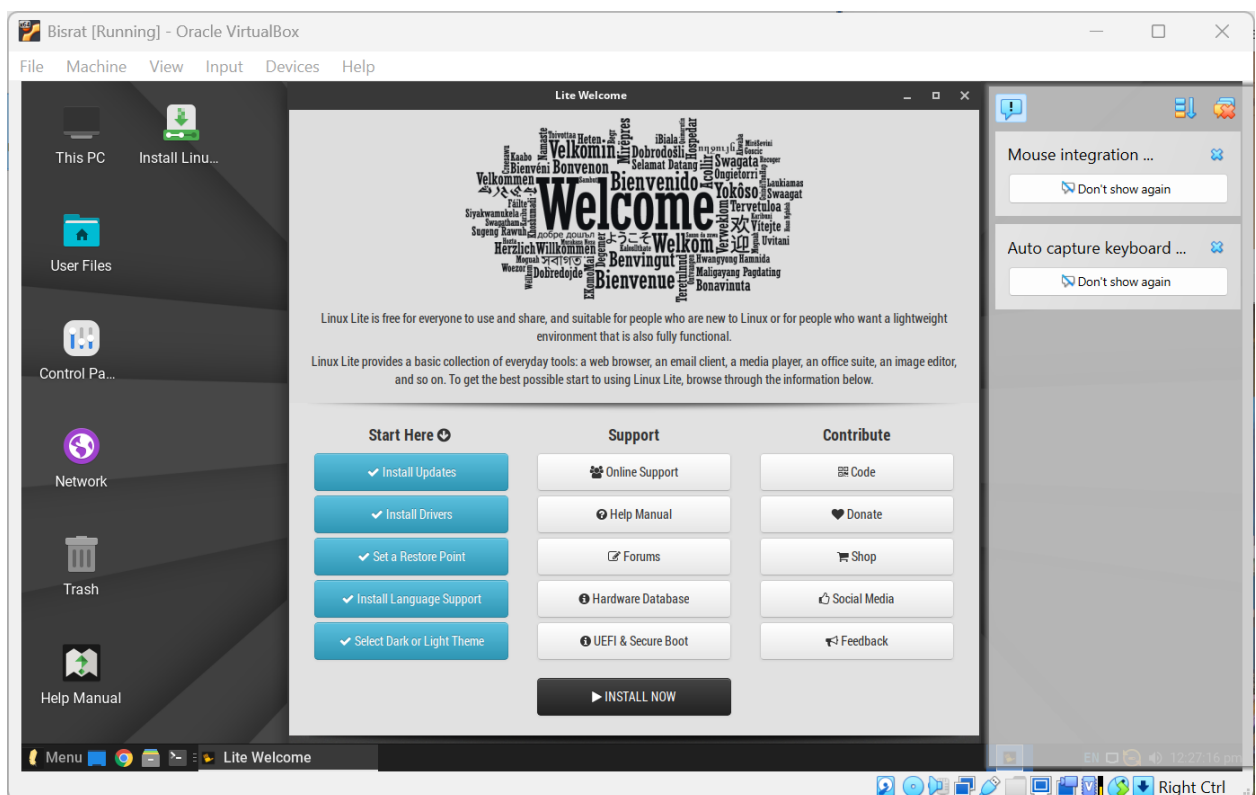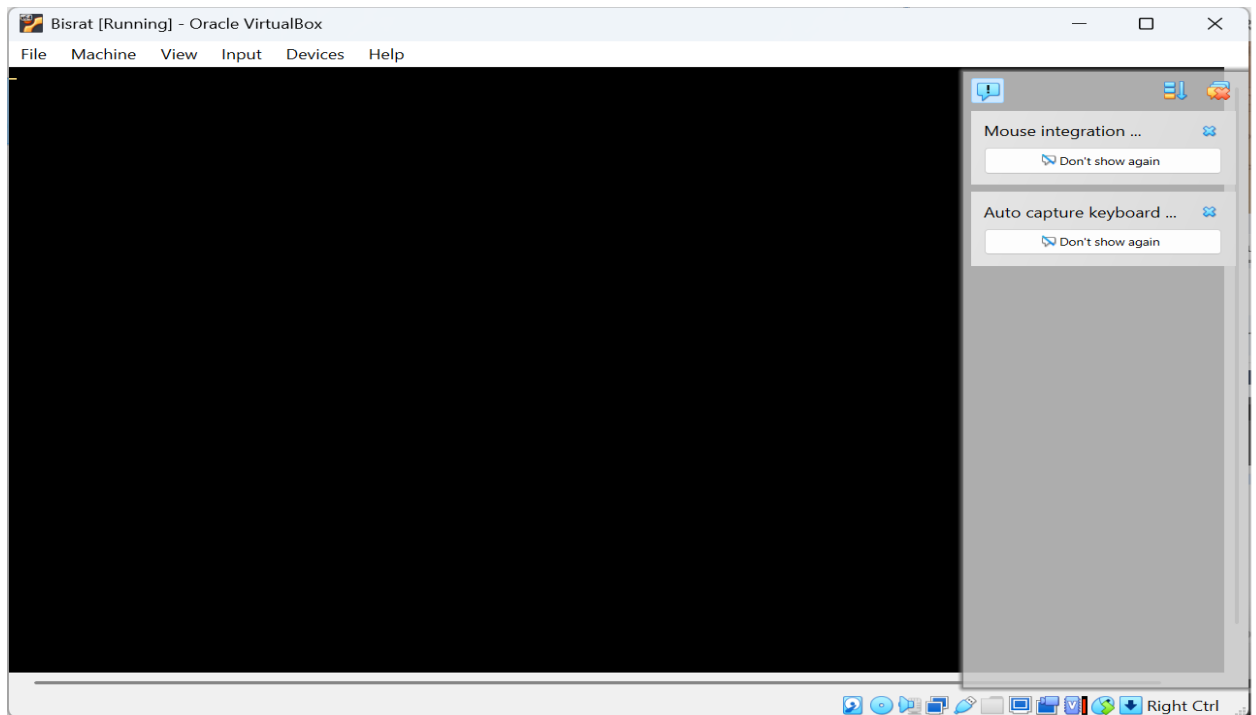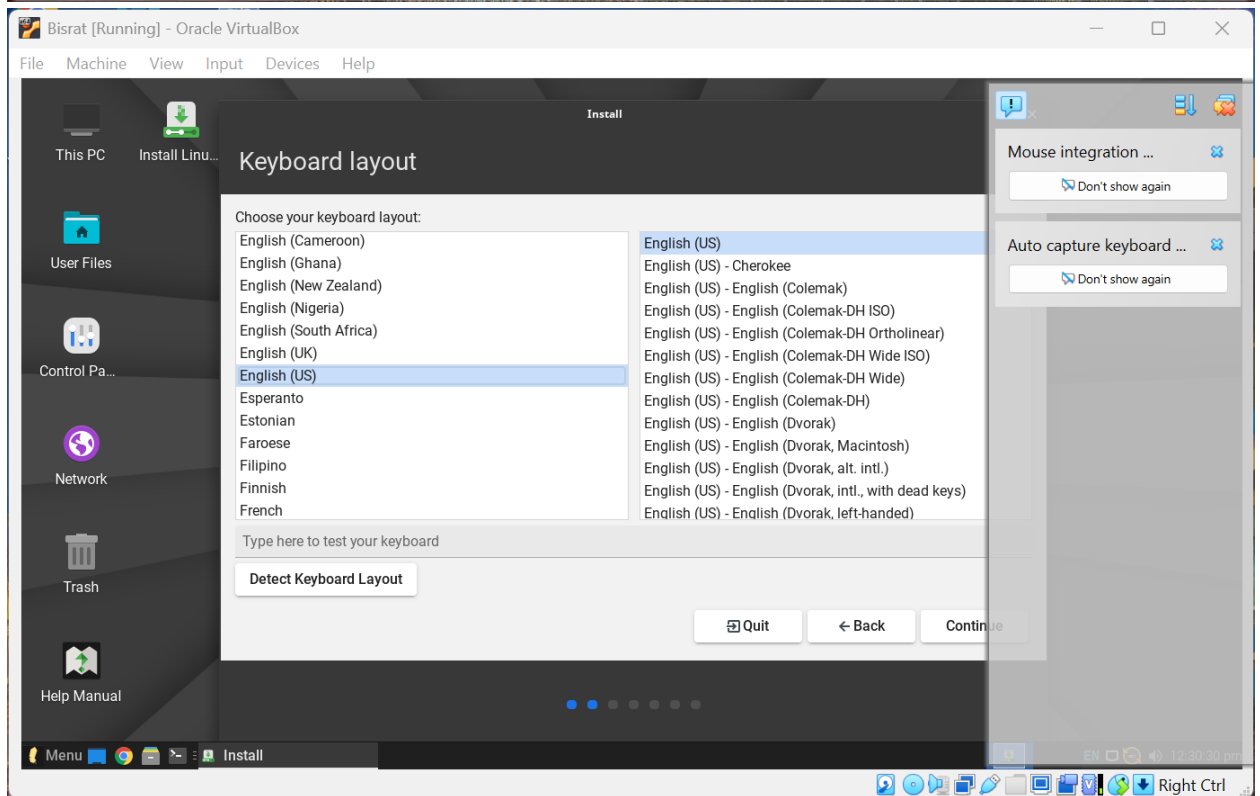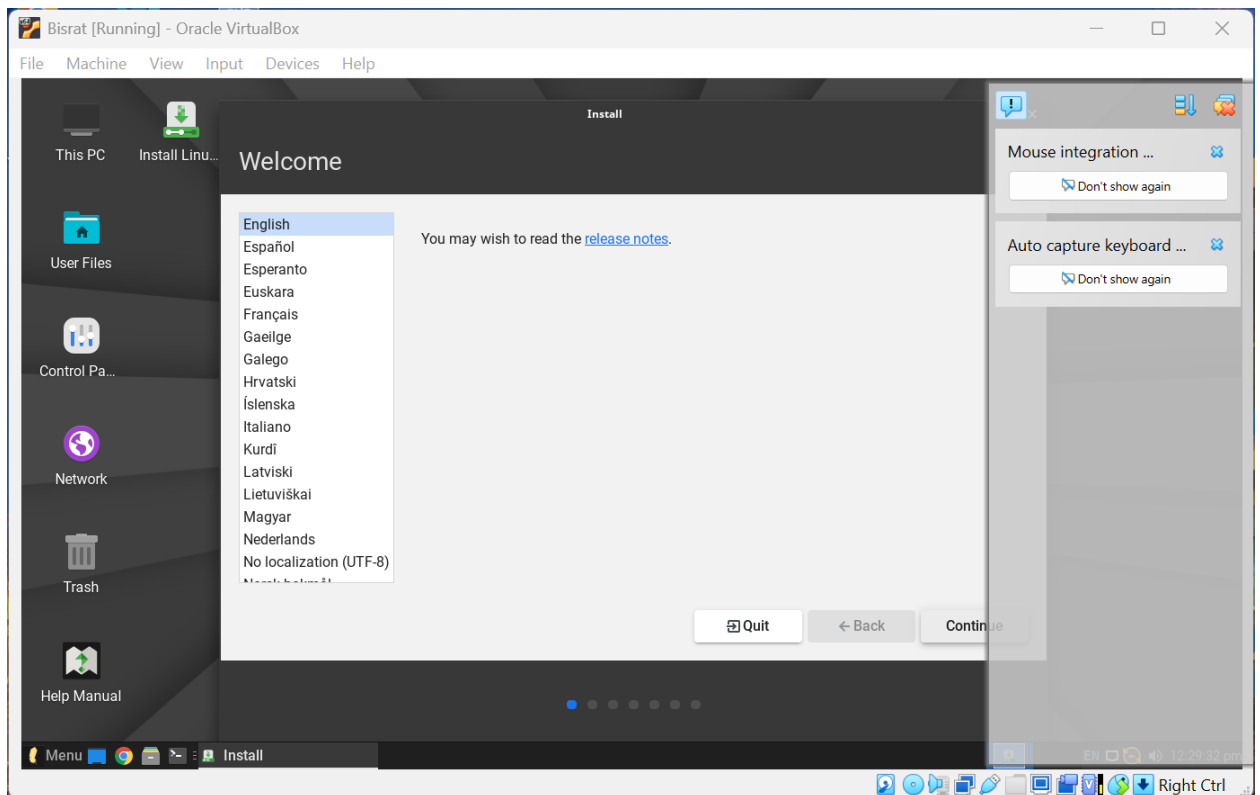2. Open Oracle VirtualBox and create a new virtual machine.
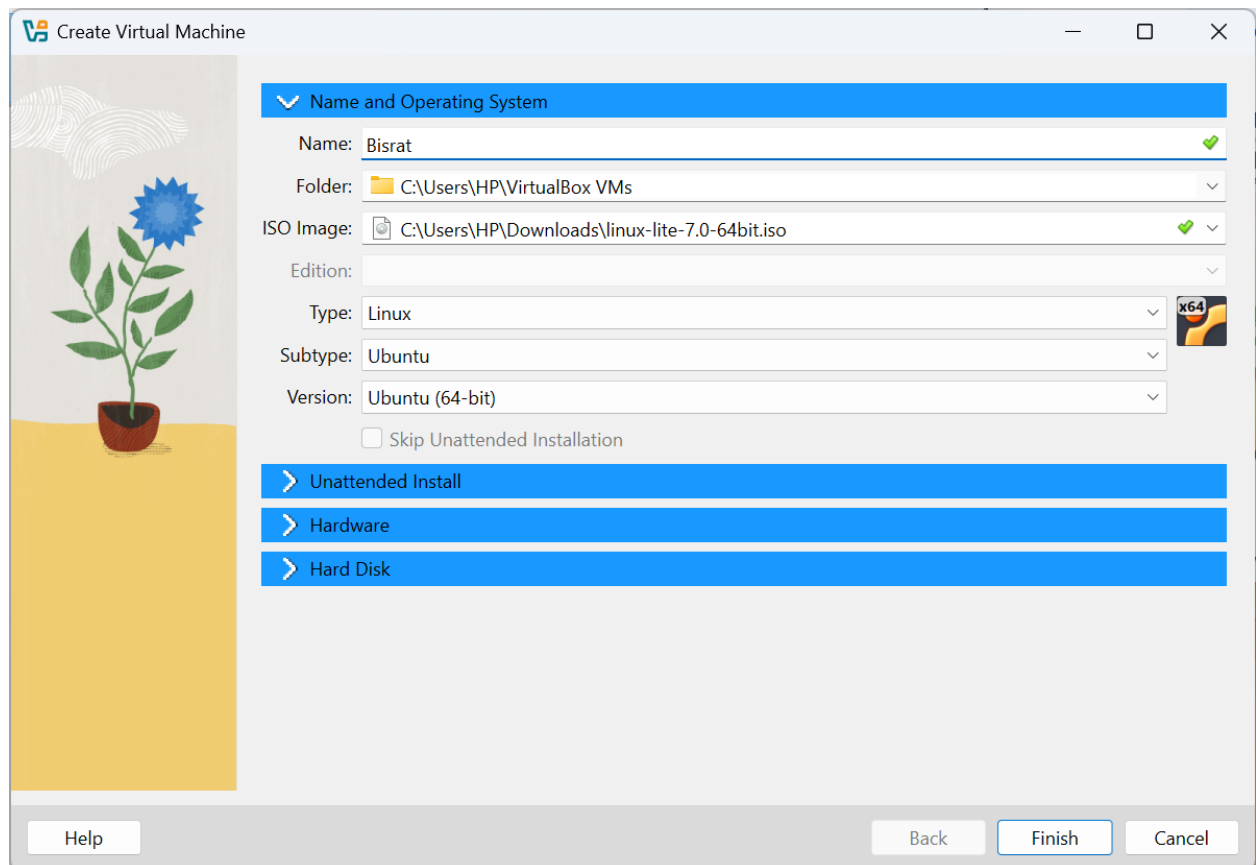
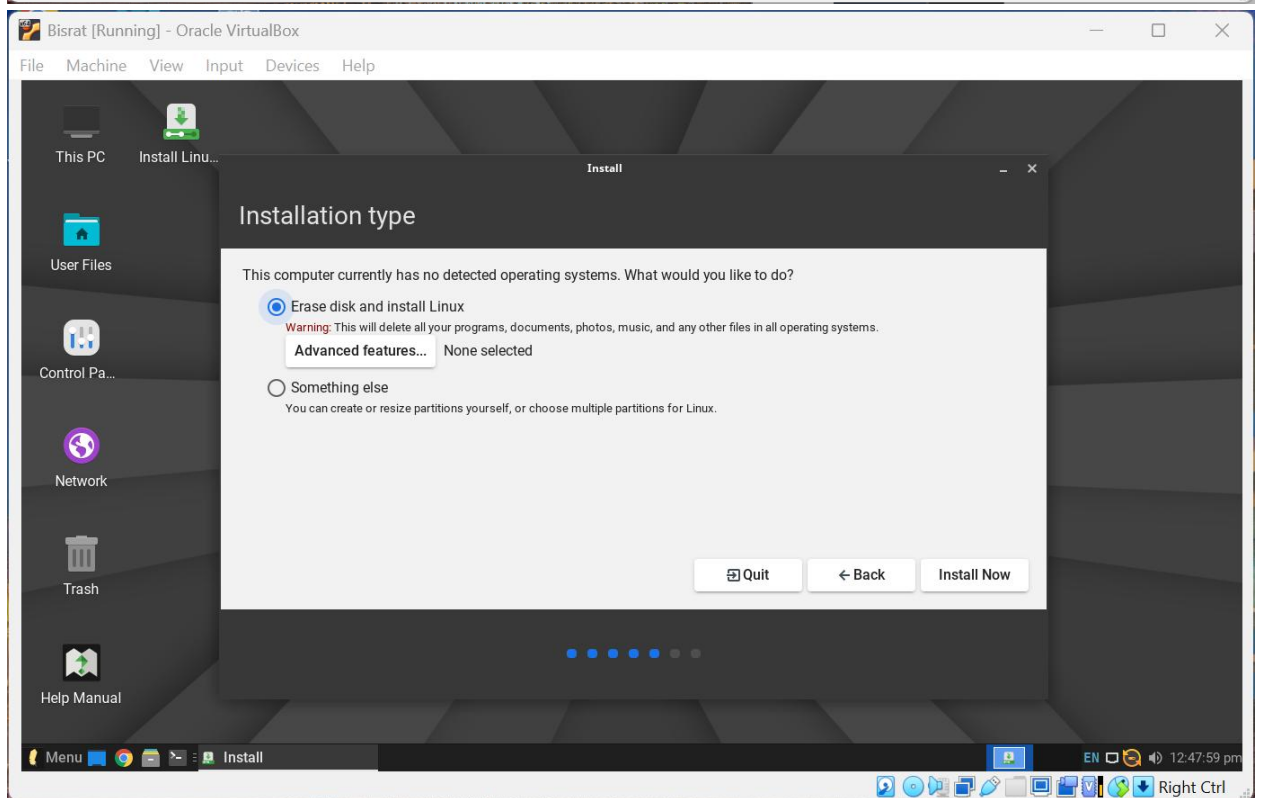3. Assign memory (at least 1GB) and create a virtual hard disk (at least 8GB).
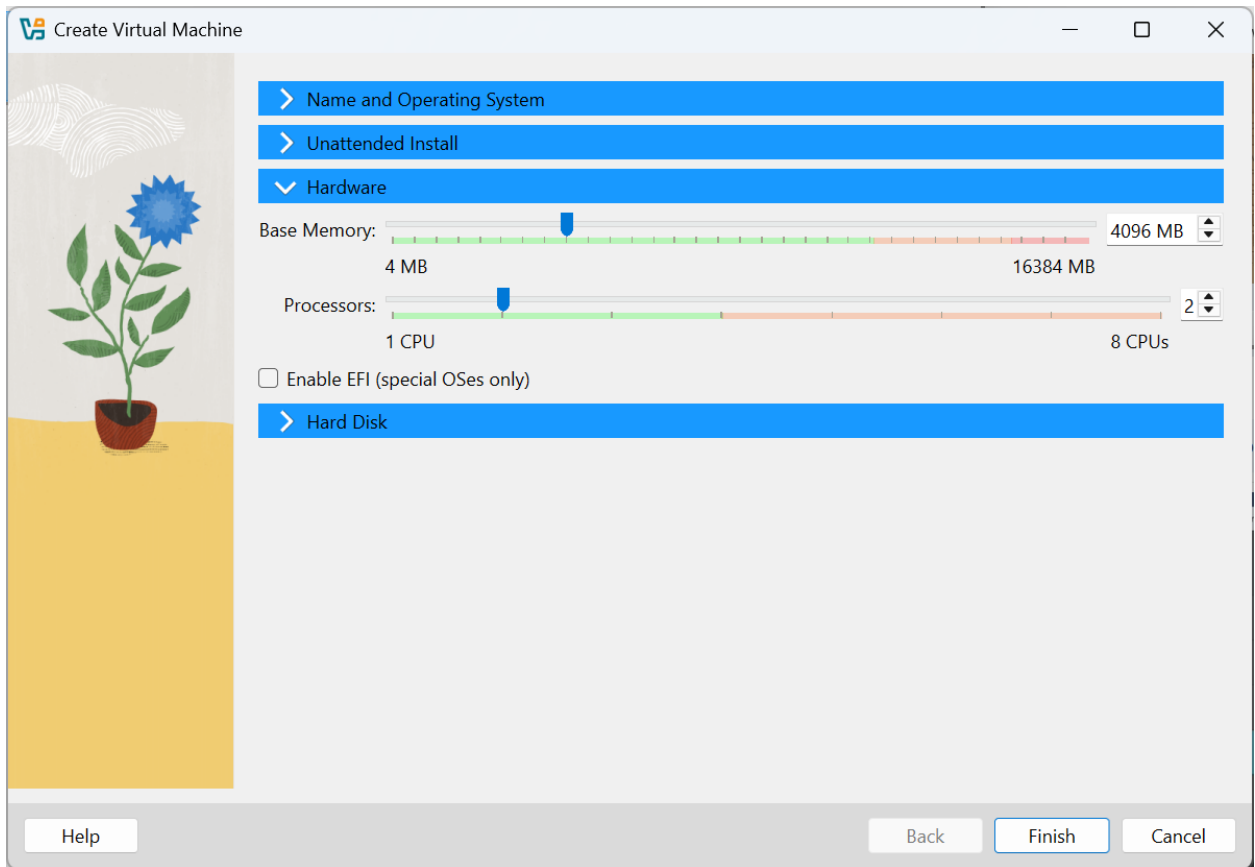
4. Attach Linux Lite ISO as the boot medium and start the VM and follow the on-screen instructions to install Linux Lite.
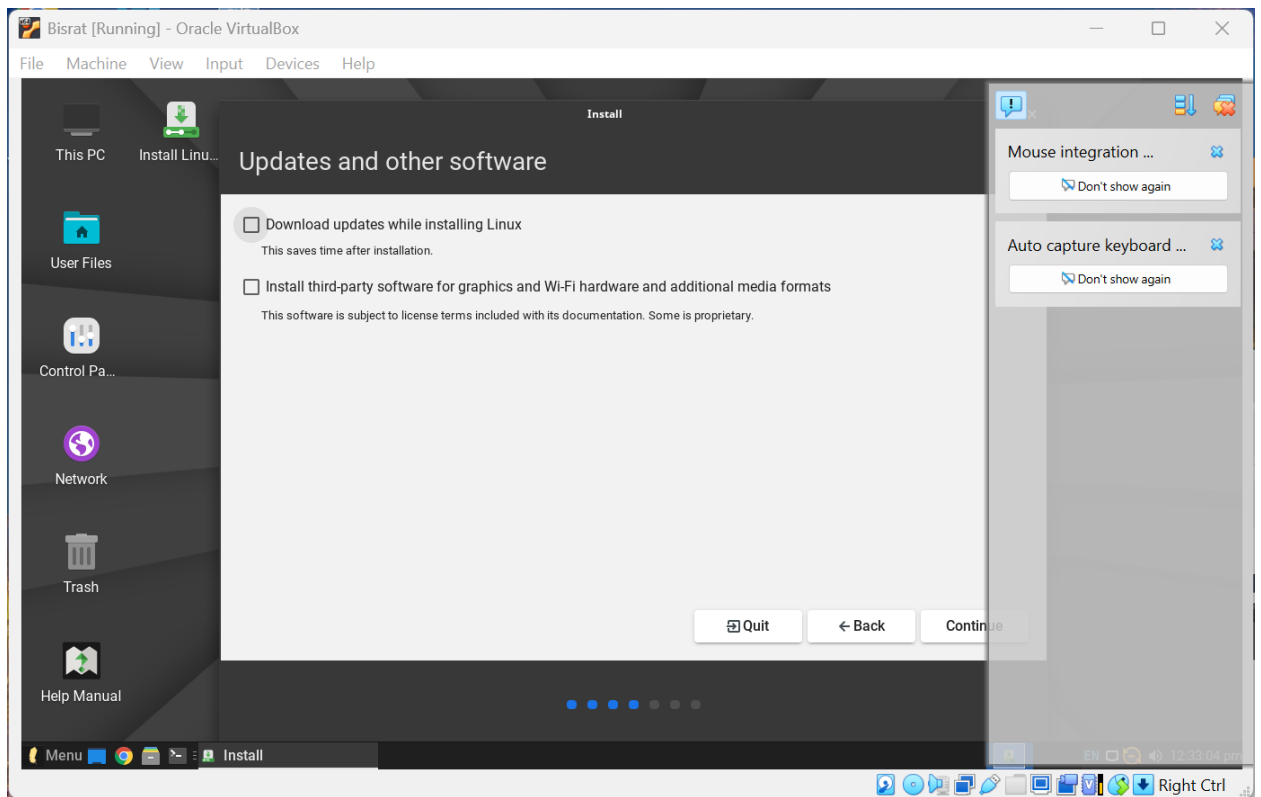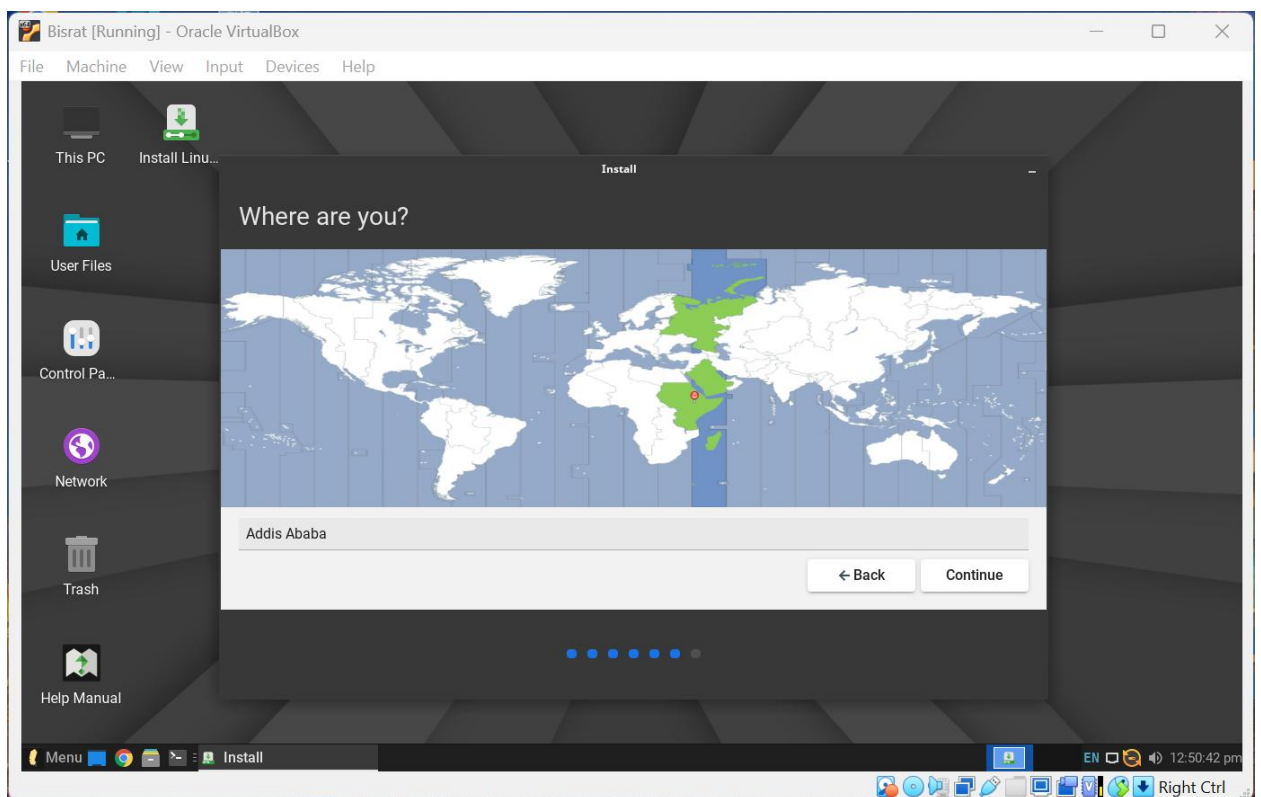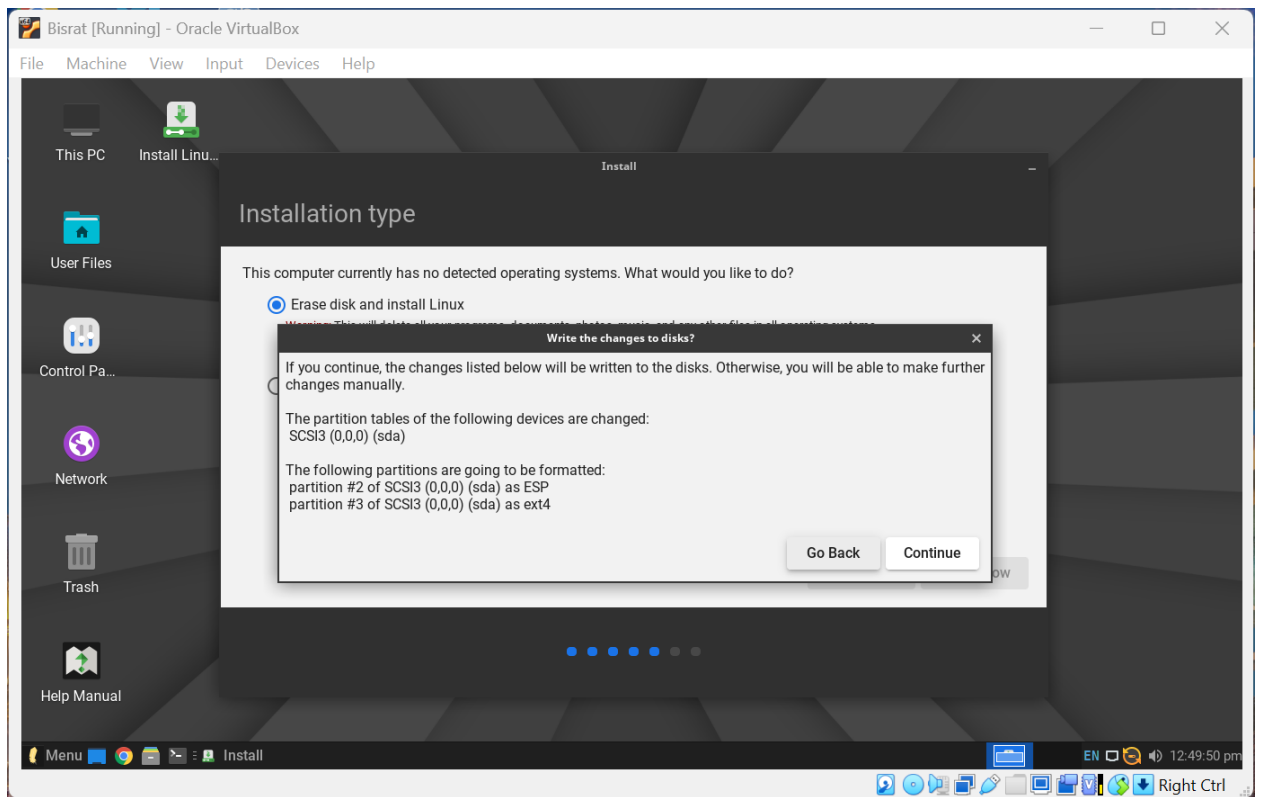
5. **Create account**
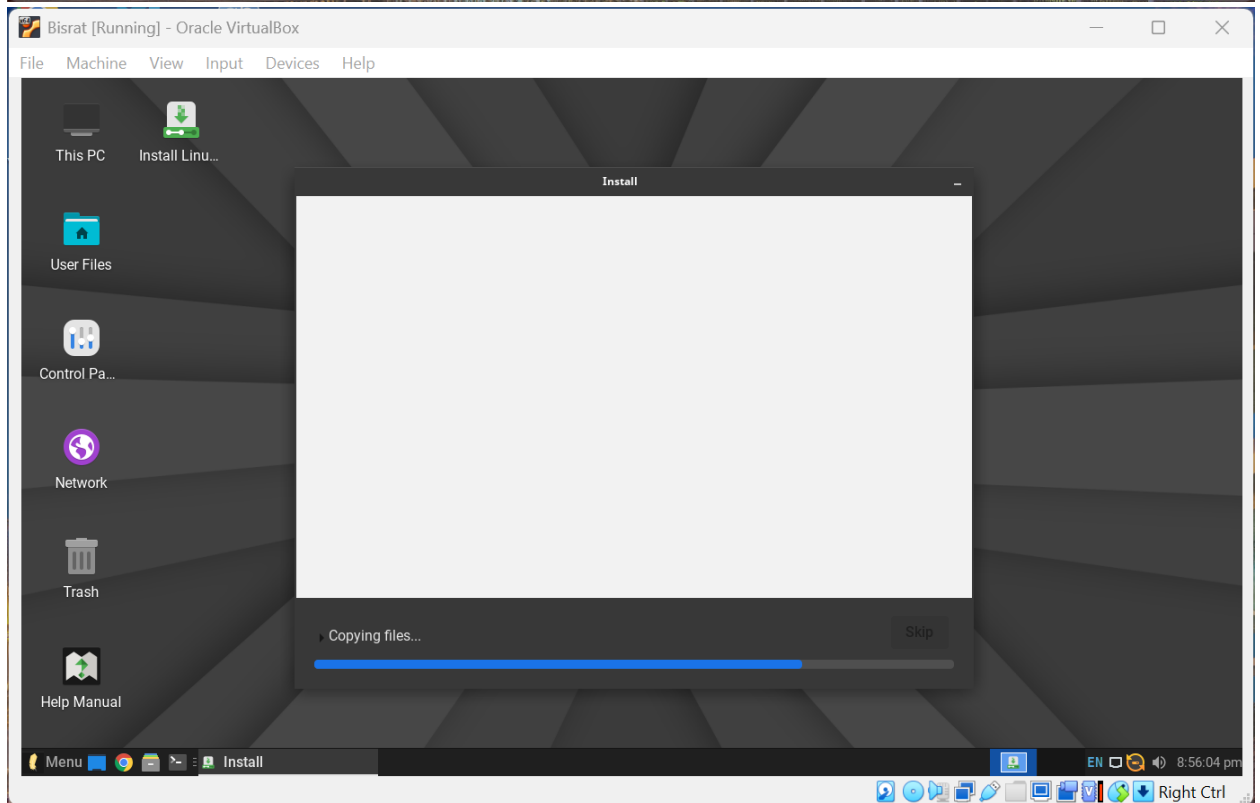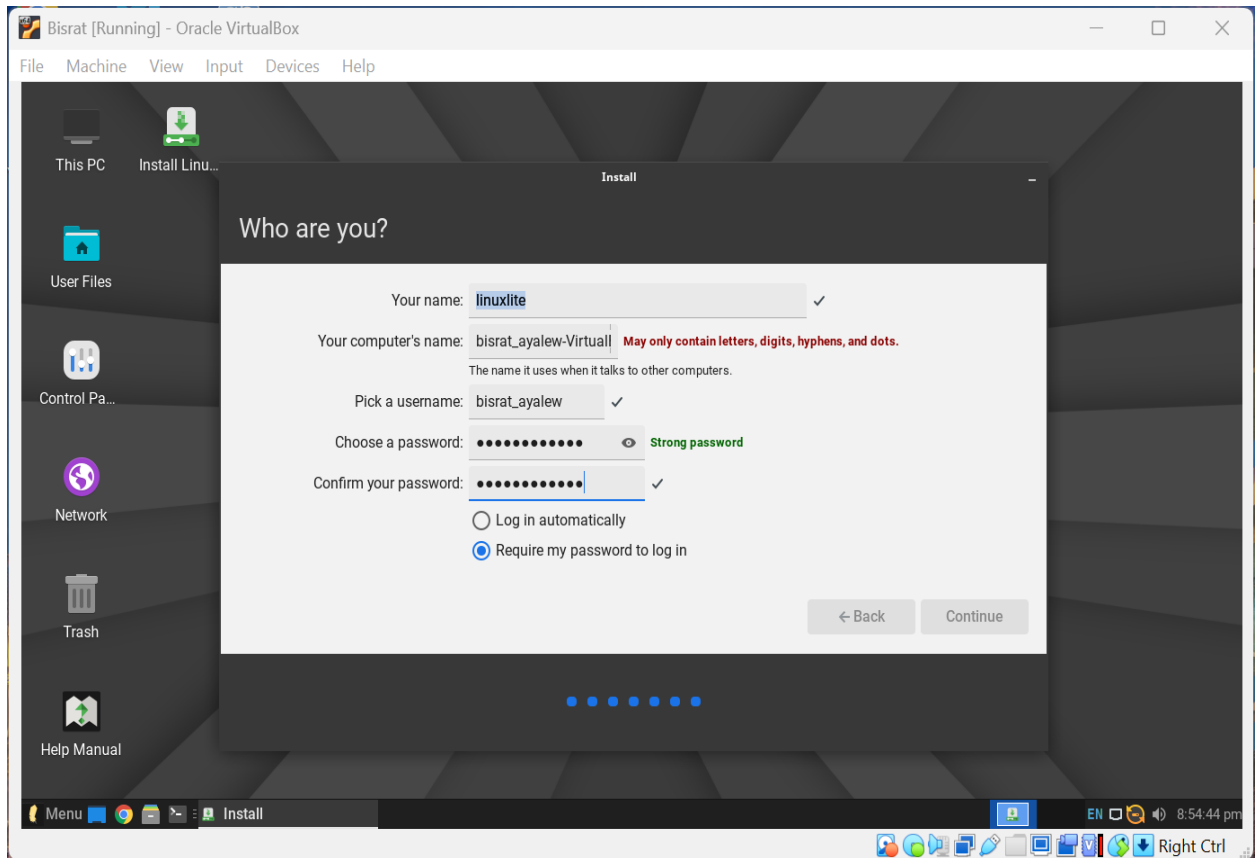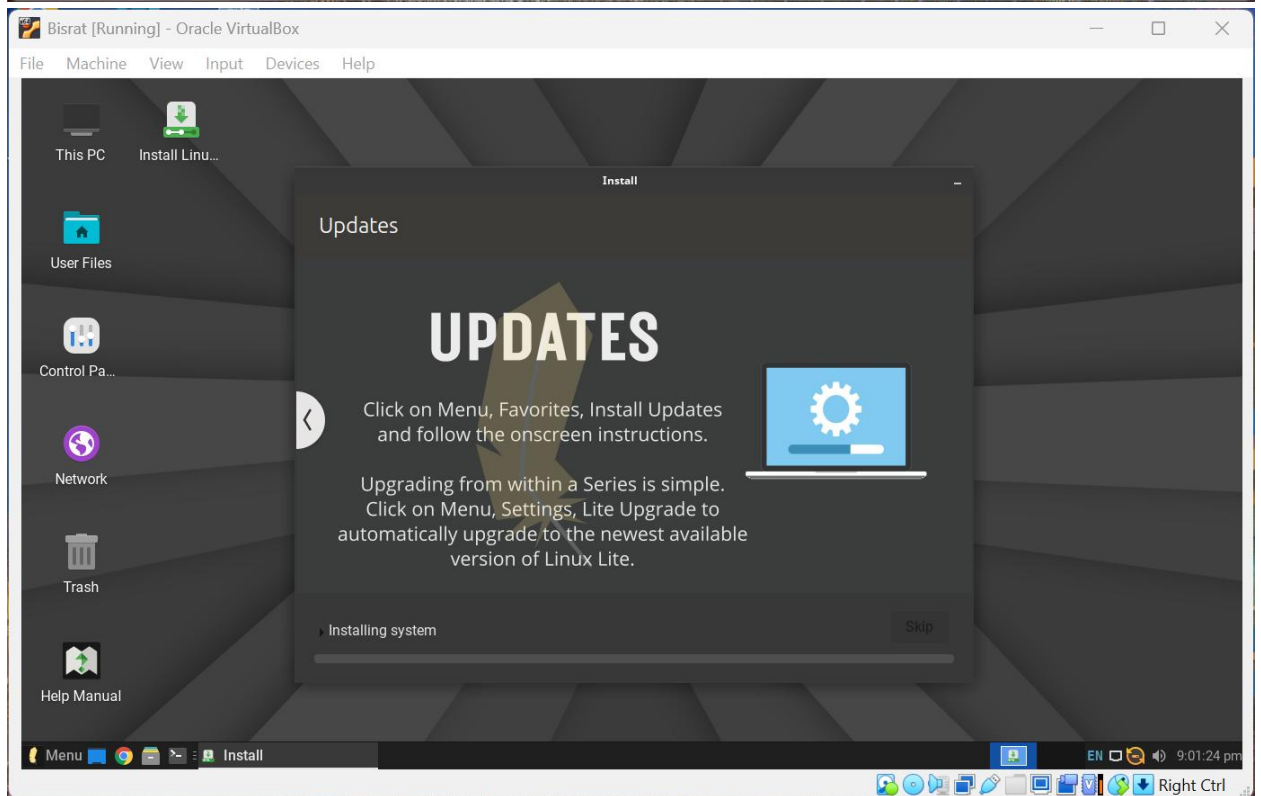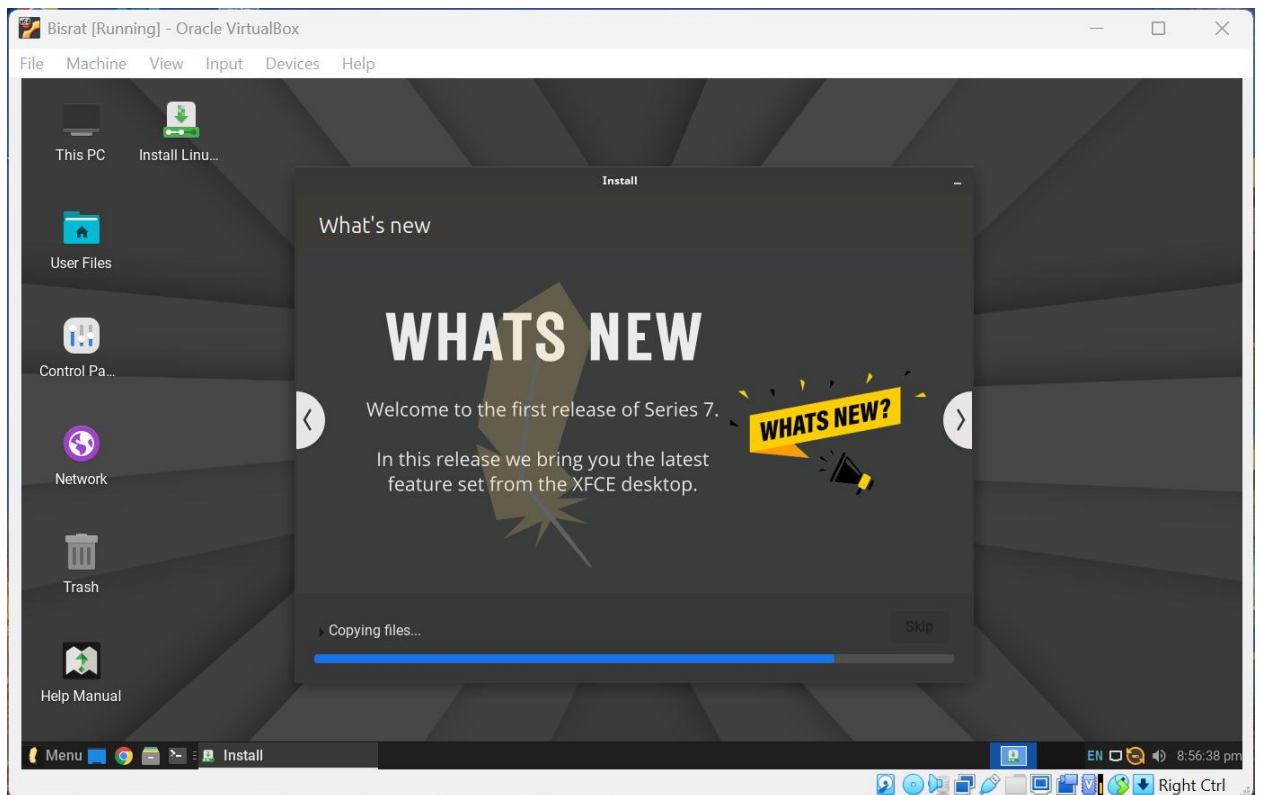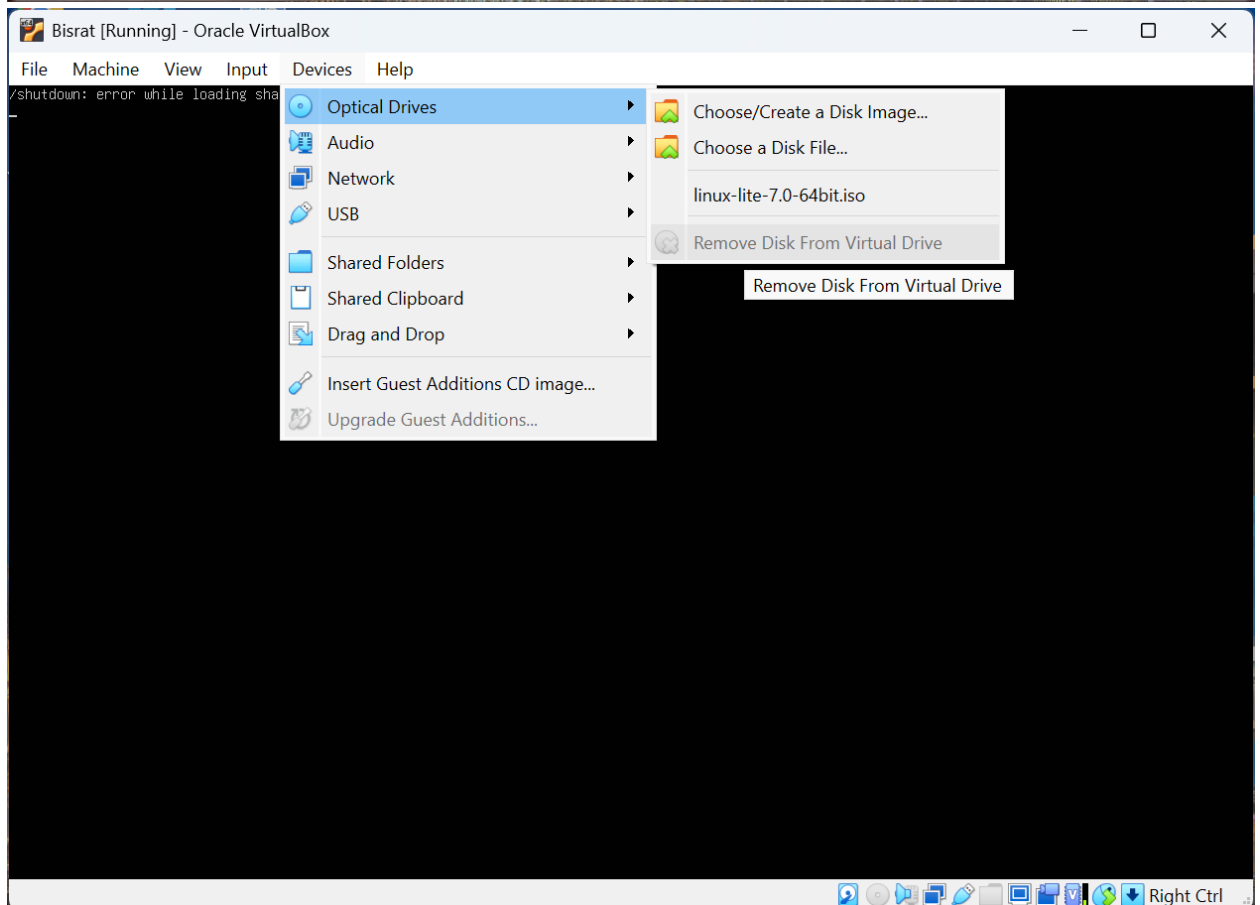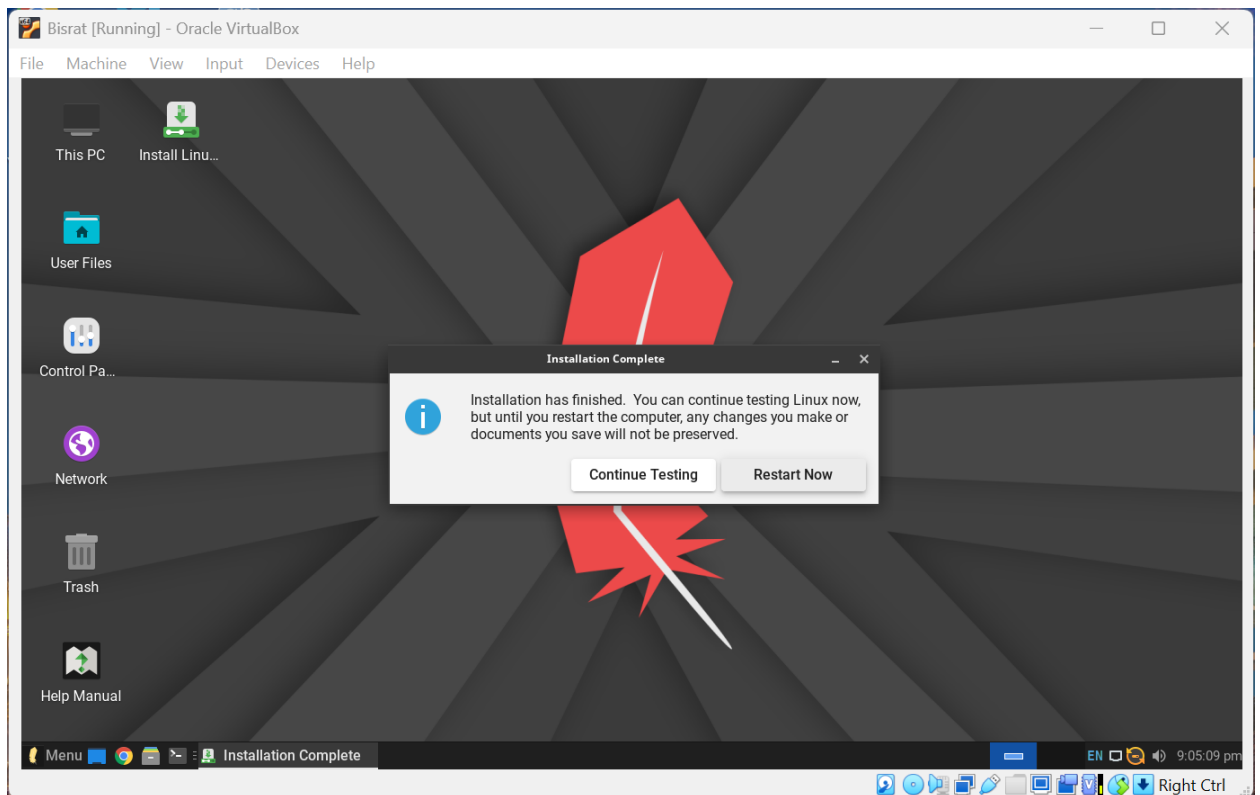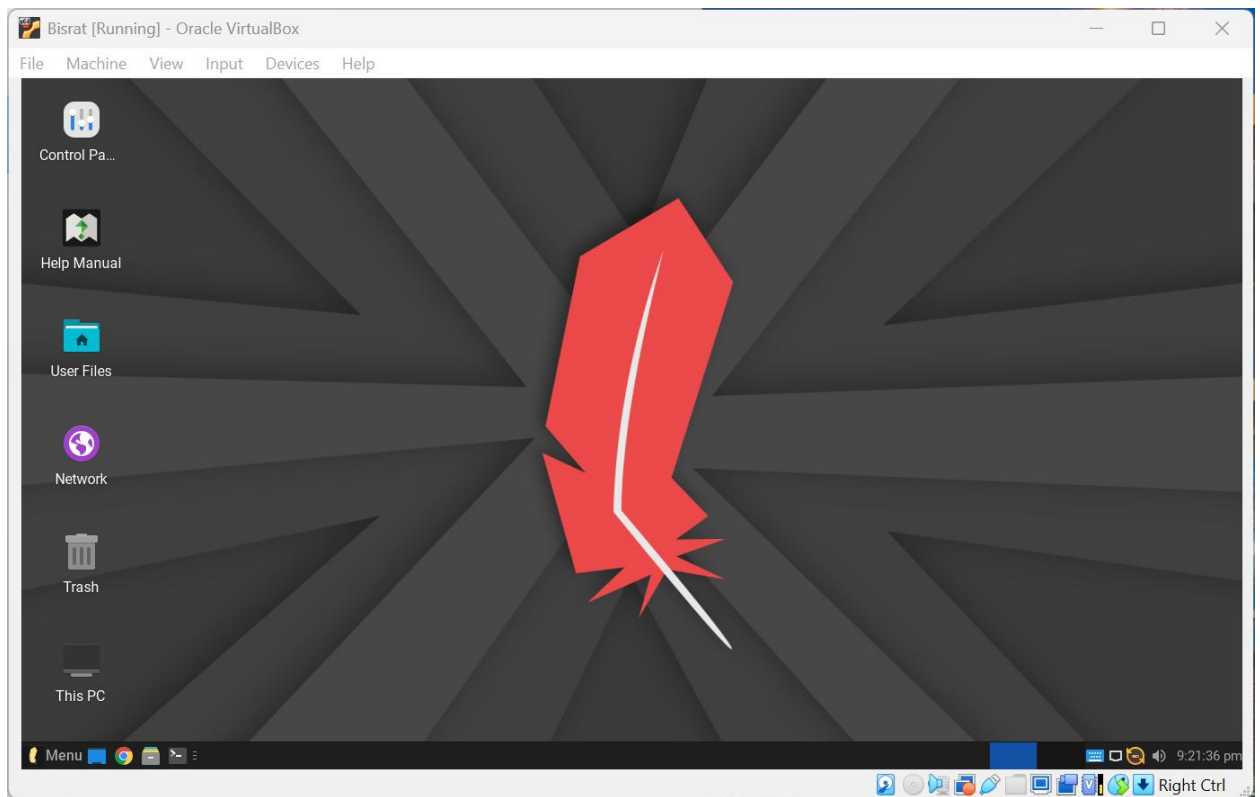
5. Issues faced

- VirtualBox guest additions were not installed automatically.
- Internet connection was unstable during update phase.

6. Solutions to Installation Issues

- Manually installed VirtualBox guest additions from terminal.
- Used bridged network adapter setting in VirtualBox for better network stability.

7. File system support

Linux Lite 7.0 mainly uses the ext4 file system. This choice is made based on several advantages that lies with the system's focus on simplicity, reliability, and user-friendliness.

- o Reliability: ext4 is a mature, stable, and widely adopted filesystem in the Linux ecosystem. It ensures strong data integrity and has been tested across a vast range of systems and use cases.
- o Performance: It delivers consistent performance for both lightweight and intensive file operations, making it suitable for older hardware as well as modern systems.
- o Journaling: The journaling mechanism in ext4 helps recover data and maintain consistency in case of power outages or system crashes.
- o Compatibility: ext4 is supported across all major Linux distributions, making it easy to manage disks and partitions between systems.
- o Large File and Volume Support: ext4 supports individual files up to 16TB and filesystems up to 1EB, which is more than enough for desktop users.

Other Supported Filesystems

Being based on Ubuntu 22.04, Linux Lite 7.0 inherits strong support for a variety of additional filesystems, allowing users to easily interact with external drives, dual-boot setups, and legacy systems.

- I. FAT32
    - Compatibility with flash drives, memory cards, and older Windows systems.
    - Full read/write.
    - Limited to 4GB per file and 8TB per partition. Commonly used for bootable USB media and simple file transfers.
- II. NTFS
    - Used by Windows systems for internal and external storage.
    - Full read/write via the ntfs-3g driver (preinstalled in most setups).
    - Allows seamless access to Windows drives for file sharing in dual-boot systems.
- III. exFAT
    - Preferred for large-capacity flash storage (SDXC cards, USB drives).
    - Full native read/write support since Linux kernel 5.4.
    - No file size limit (unlike FAT32). Ideal for large file transfers between Linux, Windows, and macOS.
- IV. Btrfs
    - Advanced Linux users requiring features like snapshots, checksums, and built-in RAID
    - Available via kernel and btrfs-progs package.
    - Not used by default due to higher complexity and suitability for enterprise-level features.

V. ZFS
  - Enterprise-class filesystem with a focus on data protection, storage pooling, and scalability.
  - Optional. Can be enabled by installing the zfsutils-linux package.
  - Not installed by default due to licensing conflicts with the Linux kernel (ZFS uses CDDL, Linux uses GPL).

VI. HFS+
  - Older macOS systems.
  - Read supported by default; write support is possible but unreliable unless journaling is disabled.
  - Safe for reading macOS drives but not recommended for writing.

VII. APFS
  - Current macOS systems (High Sierra and later).
  - Only basic read-only access via third-party tools like apfs-fuse.
  - No official Linux kernel support or reliable write functionality due to Apple's proprietary implementation.

8. Advantages

8.1 Resource-Efficient and Lightweight

Linux Lite 7.0 has been designed to run on low-spec hardware. It's still able to run smoothly on hardware that has as little as a 1.5 GHz processor, 768MB RAM, and 8GB of storage. So, it's particularly well-suited to bringing old computers back to life that would otherwise struggle with more modern operating systems.

8.2 User-friendly Interface

Distribution gives a friendly, Windows-like appearance with the use of the Xfce desktop. For beginners, particularly those migrating from Windows operating systems, this reduces learning time.

8.3 Built-in Tools

"Lite Welcome", "Lite Software", and "Lite Tweaks" are some of the exclusive programs included in Linux Lite. By automating tasks like program installation, system optimization, and general configuration, these tools facilitate the use of the operating system for non-technical users.

8.4 Extensive Documentation and Community Assistance

Active community forums and thorough offline assistance manuals are features offered by Linux Lite. This documentation is particularly helpful for novices who need detailed instructions.

8.5 Security and stability

Linux Lite enjoys the advantages of long-term support, security fixes, and a thoroughly tested software base because it is based on Ubuntu 22.04 LTS. System security is further improved by adding firewall tools and automatic upgrades.

8.6 Preinstalled Productivity Applications

Several necessary programs, including Firefox, LibreOffice, VLC, GIMP, and Thunderbird, are included with Linux Lite. As a result, customers no longer need to install basic applications right away after setting up.

9. Disadvantages

9.1 Limited Advanced Features

Although adequate for everyday use, Linux Lite is devoid of several of the more sophisticated capabilities seen in other Linux variants. The default configuration could be restrictive for those looking for enterprise-level capabilities or sophisticated development tools.

9.2 Simplicity of Xfce Desktop Environment

Despite being lightweight, people used to more contemporary environments like GNOME or KDE Plasma can find the Xfce desktop to be antiquated. Additionally, it is devoid of capabilities like touch motions and dynamic visual effects.

9.3 Basic Software Installation Interface

A contemporary software shop like GNOME Software or KDE Discover is absent from Linux Lite. Rather, it offers a selected catalog of software through Lite Software and Synaptic Package Manager, which might not be as user-friendly for novices.

9.4 Limited Support for New Hardware

Because of the Linux 5.15 LTS kernel, some more recent hardware components, such as graphics cards and Wi-Fi adapters, could not be fully supported without additional settings or kernel upgrades.

9.5 No 32-bit Support

In keeping with most contemporary distributions, Linux Lite 7.0 no longer supports 32-bit computers. It is therefore incompatible with older 32-bit hardware.

9.6 Not Optimized for Gaming or Development

Game drivers, programming SDKs, and Steam are not supported by the distribution out of the box. These environments must be manually installed and configured by users who are interested in software development or gaming.

10. Conclusion

Linux Lite 7.0 emerges as a helpful and stable Linux distribution with a design philosophy that aims at ease of use, efficiency, and accessibility. Relying on the solid base of Ubuntu 22.04 LTS, it is able to offer an easy-to-use desktop environment on low system requirements, thus being a good contender for reviving old hardware. Through the deployment of the light Xfce desktop and the integration of required pre-installed software, Linux Lite ensures that users can perform routine computing tasks straight away out of the box without needing to have a wealth of technical knowledge.

One of the most wonderful things about Linux Lite 7.0 is how it caters perfectly to those exiting Windows. The GUI, complete offline help documentation, and novice software such as Lite Software and Lite Tweaks are all in place to eliminate the learning curve for making the move to Linux. The OS also benefits from extended security update support and package management stability by Ubuntu, positioning it as a viable choice both for home use and academic pursuit.

Linux Lite also supports natively a wide range of filesystems, making it even more versatile in different environments—from dual-boot installations to external storage and network drives. The project strongly emphasizes real-world usage over flashiness, aiming at what is most important to users looking for a solid, lightweight, and secure computing environment.

The distribution is not, however, without its defects. It does not directly support 32-bit hardware, and its overall software management frontend is not quite as refined in appearance as is the case for more contemporary application stores. Running the latest equipment might need some manual setup, and it will not be configured out-of-the-box for a more resource-consuming use case such as programming or gaming. Despite these constraints, Linux Lite still keeps to its roots of simplicity and dependability, the same factors that make it stand out among the vendors-saturated Linux market.

Overall, Linux Lite 7.0 does exactly what it set out to do: deliver a light, approachable, and user-focused Linux experience. It is especially well-suited to users who desire to revive ancient machines, learn about Linux through a welcoming interface, or merely enjoy a fast and clean desktop OS.

11. Future outlook

As Linux Lite evolves, its ability to bridge accessibility and performance in open source continues to be promising. The ideology behind the distribution i.e. to provide a lightweight and simple to use Linux experience for low-spec and older hardware aligns with the growing demand for sustainable computing. With technological advancements generally ushering in rapid hardware obsolescence in today's era, Linux Lite offers a clean and efficient solution, extending the lifespan of the existing hardware, reducing waste and making digital inclusion possible.

Future development of Linux Lite will probably continue to refine its graphical user interface, expand hardware support and add modernized user features without compromising system performance. With new versions of the linux kernel and ubuntu LTS arriving in the next couple of years, linux lite should be in a good position to take advantage of the future improvements in system security, file system management and virtualization. It's open source community development also guarantees that feedback from users remains at the center of determining it's usability and pertinence.

In addition, with increased usage of Linux among schools and emerging economies, Linux Lite could potentially become a de facto platform for general-purpose computing, IT literacy training, and light-weight app development platforms. Its simplicity and minimal resource footprint make it an ideal candidate for high-scale deployment in schools, libraries, and non-profit organizations worldwide.

12. Recommendations

In the hopes of benefiting from the popularity of Linux Lite 7.0 and overcoming some of its existing limitations, I suggest the following :

- Build a More Contemporary Software Center: While Lite Software and Synaptic Package Manager currently work, having a more visually intuitive and convenient software center to find and install applications would greatly simplify the app discovery and download process for novice users.
- Enhance Hardware Compatibility Tools: Including an auto hardware detection utility or system setup wizard with guided steps would simplify user installation of graphics, network, and peripheral devices—most notably with newer hardware components.
- Include a Developer and Gaming Mode: For programmers or gamers, Linux Lite could offer an optional setup mode that bundles common SDKs, compilers, and game utilities (e.g., Steam, Wine, Lutris) during or post-system installation.
- Grow Educational Adoption: Collaborating with schools and community centers to promote Linux Lite as a learning and teaching platform would expand its use. Pre-configured

educational versions with accompanying learning materials would
be an appreciated strength.
- Offer More Complete Virtualization Support: Since Linux Lite
  is frequently tested within virtual machines, making it faster and more efficient in a virtual
  environment (e.g., automated Guest Additions,
  VirtualBox hints) and providing better documentation for virtualization (e.g., USB support
  hints) would enhance the testers' and students' first impression.
- Enhance Update and Installation Feedback: More detailed progress reports and error
  messages during system upgrades and package installs would make users more aware of
  and able to correct problems themselves.

13. Virtualization

What is virtualization?

Virtualization refers to the technique which is used to allow multiple virtual machines with
dedicated operating systems and resources to exist on a single physical computer. Although
software virtualized, the virtual systems react as if they were real computers. This happens by
emulating hardware devices such as CPU, memory, disk and network interfaces by a software
running on a layer known as a hypervisor.

Why Do We Use Virtualization?

Virtualization is a natural part of modern computing because of its extensive list of benefits:

- ✓ Hardware Resource Optimization: Allows several systems to share a single physical
  system, maximizing available CPU, RAM and storage.
- ✓ Cost Savings: Reduces the need for physical hardware by lowering equipment, power and
  maintenance costs.
- ✓ Safe Test Environment: Offers the capability to test operating systems, applications or
  system configurations in a safe and isolated environment without risking the host system.
- ✓ Easy Backup and Recovery: can be saved as files so as to make cloning, backup and restore
  simple.
- ✓ Support for Many Operating Systems: Windows, Linux or macOS can be run simultaneously
  on a single hardware platform.

How Virtualization Works

Virtualization relies on a hypervisor, either

1. Type 1 (bare-metal): Executes natively on hardware (for example, VMware ESXi, Microsoft
   Hyper-V).

2. Type 2 (hosted): Run on top of a currently executing OS (for example, Oracle VirtualBox, VMware Workstation).

The hypervisor exposes physical resources to all VMs and separates them such that they may run independently. Each VM possesses a guest operating system of its own and runs like an actual computer.

Virtualization in Linux Lite 7.0

Linux Lite as a Guest Operating System (Running under a Virtual Machine)

Linux Lite 7.0 is suitable as a guest operating system in virtualization software such as Oracle VirtualBox, VMware, and QEMU/KVM.

In this project, I have installed Linux lite inside Oracle VirtualBox to create a secure, isolated environment in which to test and learn about system-level commands like mkdir(), and in which to test filesystem support. Oracle VirtualBox simulates hardware resources such as the CPU, RAM, and storage, and Linux Lite acts as if they were actual hardware.

Due to its lightness and optimization, Linux Lite performs well even with minimal virtual resources.

VirtualBox Guest Additions enhance the virtual experience further by enabling features such as:

- Seamless mouse integration
- Dynamic screen resizing
- Shared clipboard between host and guest
- Shared folders for easy file exchange