Bahir dar institute of technology

Individual assigment based on window xp operating system instalation

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windows XP

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1. INTRODUCTION

1.1. Background and History of Windows XP

Windows XP, officially launched by Microsoft on October 25, 2001, represents one of the most significant milestones in the history of personal computing. The "XP" in its name stands for "Experience," reflecting a design philosophy centered on enhancing user interaction with technology.

Before its release, Microsoft maintained two separate lines of operating systems: the MS-DOS-based consumer line (Windows 95, 98, Me) and the more stable, NT-based business line (Windows NT, 2000). Windows XP was developed under the codename "Whistler" with the ambitious goal of merging these two paths into a single, unified platform. It was the first consumer-oriented edition of Windows to be built entirely on the robust **Windows NT kernel**, effectively ending the reliance on the aging MS-DOS architecture. This transition provided unprecedented stability, improved performance, and a modern graphical user interface known as **Luna**.

1.2. Purpose of the Project

The primary objective of this project is to bridge the gap between theoretical operating system concepts and practical application. By performing a manual installation of Windows XP, this work aims to:

- **Demonstrate Technical Proficiency:** Show a clear understanding of OS installation procedures in a controlled, virtual environment.
- **Apply Core Concepts:** Practically implement theoretical knowledge regarding the boot process, disk partitioning, and the selection of appropriate file systems (such as NTFS).
- **Develop Troubleshooting Skills:** Gain experience in identifying and resolving configuration issues that arise during OS deployment and hardware virtualization.
- **Resource Management:** Explore how an OS interacts with allocated hardware resources, including CPU scheduling and memory management, through virtual machine tools.

1.3. Overview of Virtualization Technology

Virtualization is a fundamental practice in modern IT that allows the creation of multiple simulated computing environments from a single physical machine. By using a software layer known as a **Hypervisor** (such as Oracle VM VirtualBox), the physical hardware's resources—including the CPU, RAM, and storage—are abstracted and divided into isolated segments called **Virtual Machines (VMs)**.

In this architecture, the physical computer is referred to as the **Host**, while each virtual machine is a **Guest**. Each Guest OS runs independently, unaware that it is sharing hardware with other systems. This technology is vital for system administration because it allows for:

- **Safe Testing:** Experimenting with older or experimental operating systems without risking the stability of the primary host machine.
- **Hardware Independence:** Running legacy software, like Windows XP, on modern hardware that would otherwise be incompatible.
- **Resource Efficiency:** Maximizing the use of physical hardware by running multiple workloads simultaneously on a single device.

2. THEORETICAL CONCEPTS

2.1. The Operating System Boot Process

The boot process (or "bootstrapping") is the multi-stage sequence that takes a computer from being powered off to a fully functional desktop. For Windows XP, this process is governed by a legacy architecture that relies on the **NTLDR (NT Loader)**.

The Five Phases of the Windows XP Boot Process:

1. **Pre-boot Sequence:** The BIOS (Basic Input/Output System) performs a Power-On Self-Test (POST) to verify hardware. It then locates the Master Boot Record (MBR) on the first sector of the virtual hard drive.
2. **Initial Boot Loader Phase:** The MBR identifies the active partition and hands control to **NTLDR**. NTLDR switches the CPU from "Real Mode" to "32-bit Protected Mode," allowing the system to access more memory.
3. **Operating System Selection:** NTLDR reads the `boot.ini` file. If multiple OSs are installed, it displays a menu for the user; otherwise, it begins loading the default partition.
4. **Hardware Detection:** NTLDR executes `ntdetect.com`, which scans the virtual hardware (video cards, keyboards, etc.) and gathers data for the Windows Registry.
5. **Kernel Loading and Initialization:** Finally, NTLDR loads the Windows Kernel (`ntoskrnl.exe`) and the Hardware Abstraction Layer (`HAL.dll`). Once the kernel takes over, the colorful Windows XP splash screen appears.

2.2. Understanding File Systems: NTFS vs. FAT32

A file system is the method an OS uses to organize and retrieve data on a disk. During your installation, you were prompted to choose a file system. While Windows XP supports older systems like FAT32, **NTFS (New Technology File System)** is the standard for modern environments.

- **NTFS (Recommended):**
    - **Security:** Supports file-level permissions, allowing you to control which users can read or write to specific folders.

- **Journaling:** Keeps a "log" of file changes. If the VM crashes or the power fails, the journal helps recover data and prevents corruption.
- **Efficiency:** Supports much larger partitions and file sizes than FAT32 (which is limited to 4 GB files).

- **FAT32 (Legacy):**
  - **Compatibility:** Primarily used for compatibility with very old systems (Windows 98) or simple USB drives.
  - **Limitations:** It lacks security features and journaling, making it less stable for a primary operating system installation.

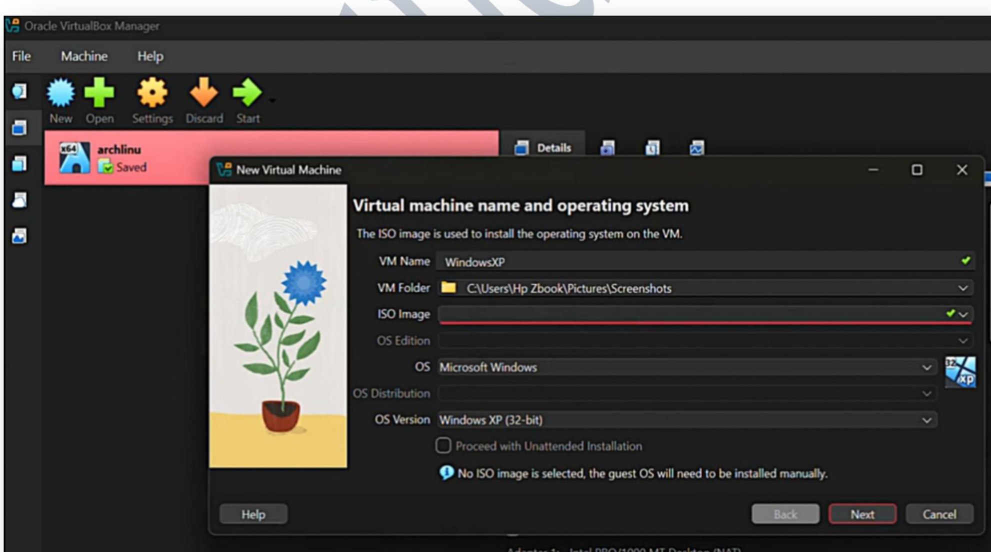
2.3. Principles of Disk Partitioning

Partitioning is the act of "carving" a physical hard drive into separate logical sections. In your VirtualBox setup, you created a **Primary Partition**.

- **The System Partition:** Contains the hardware-specific files needed to start Windows (like `ntldr` and `boot.ini`).
- **The Boot Partition:** Contains the actual Windows operating system files (the `C:\Windows` folder).
- *Note:* In most simple installations like ours, the **System** and **Boot** partitions are the same single C: drive. Partitioning allows users to separate their OS from their data, so if the OS needs to be reinstalled, the data partition remains safe.

CHAPTER 3 SYSTEM CONFIGURATION AND INSTALLATION

3.1 .1 Hardware Virtualization & Interface Settings



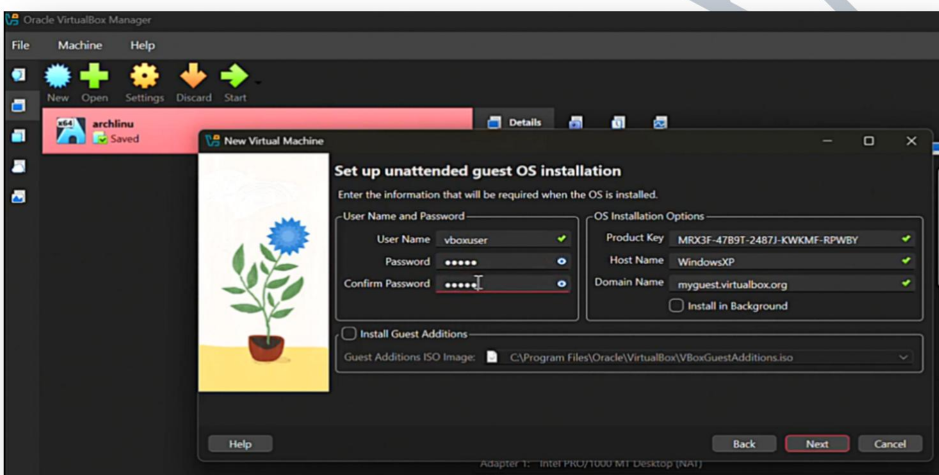
Technical Configuration of the Hypervisor Environment

To prepare for a Windows XP installation on modern hardware, specific "Extended Features" must be toggled within the Oracle VM VirtualBox interface. The most critical setting chosen was **Enable I/O APIC** (Input/Output Advanced Programmable Interrupt Controller).

How it works: In a physical computer, the APIC manages how the CPU receives signals (interrupts) from hardware like the keyboard or hard drive. By enabling this in a virtual environment, we allow the Virtual Machine to act like a modern PC. Without this, Windows XP (especially on modern multi-core laptops) often fails to boot, resulting in a permanent black screen because the legacy OS cannot communicate with the modern processor's interrupt system.

3.1.2 Hardware Virtualization & Interface Settings

Technical Configuration of the Hypervisor Environment



To prepare for a Windows XP installation on modern hardware... *(Keep the IO APIC explanation from before)*.

Deep Dive: The Purpose of Installation Options During the initial phase, the installer asks for "Regional and Language Options."

- **The Purpose:** This isn't just for the clock; it sets the **Locale**. The Locale tells the OS how to handle character encoding, currency symbols, and keyboard layouts. If this is set incorrectly, special characters in your files might appear as broken symbols because the OS is using the wrong "Code Page" to translate data from the hard drive to the screen.

3.1.2.1 File System Selection & Security

Deployment of the New Technology File System (NTFS)

Deep Dive: Product Key & Licensing Activation

- **What it is:** The Product Key is a 25-character alpha-numeric code required to unlock the installer.
- **How it works:** In Windows XP, this key is converted into a **Product ID**. Microsoft introduced "Product Activation" with XP to prevent "Casual Copying." The OS takes a "Hardware Hash" (a fingerprint of your virtual CPU and RAM) and links it to your key. If you try to use the same key on a different VM with different hardware, Windows may detect the change and lock the OS until you contact support.

3.1.2.2 Identity Personalization & Authentication

Verification of Academic Authenticity

Deep Dive: Usernames, Passwords, and the 'Administrator' Account

- **Why we set them:** A Username creates a unique "User Profile" folder (`C:\Documents and Settings\Username`). This isolates your files from other users.
- **Security Logic:** Setting a password is the first line of defense in **Access Control**. In Windows XP, if an account has no password, it is often blocked from accessing the computer over a network. By setting a password, you enable the account to use advanced features like "Remote Desktop" and "Scheduled Tasks," which require an authenticated identity to run.

3.1.2.3 Networking: Host Names and Domains

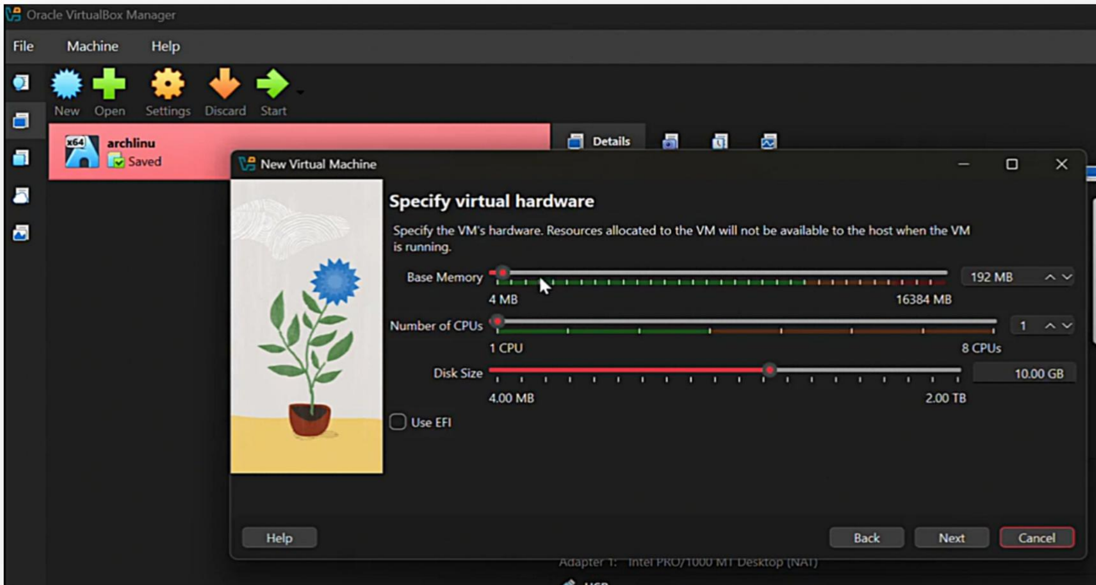
Network Identification and Domain Logic

This stage defines how the computer appears to other machines on a network.

- **Computer Name (Host Name):** This is the "label" for your specific machine (e.g., `Nigatu-XP`). On a local network, other computers use this name to find your IP address through a protocol called NetBIOS.
- **Workgroup vs. Domain: * Workgroup:** A "Peer-to-Peer" network. Every computer is equal. This is what we choose for home/student setups.
  - **Domain Name:** A "Client-Server" network. If you join a domain (like `university.edu`), a central server (the Domain Controller) manages your password and permissions. You cannot join a domain unless a Network Administrator has already created an account for your computer on that serv

3.1.3 Virtual Hardware Specification & Resource Optimization

Analysis of Resource Allocation and System Compatibility



When configuring the virtual environment, specific values were chosen for the Base Memory, Processor count, and Motherboard features. These values were not selected at random; they were calculated to balance the needs of the legacy Guest OS with the performance of the modern Host system.

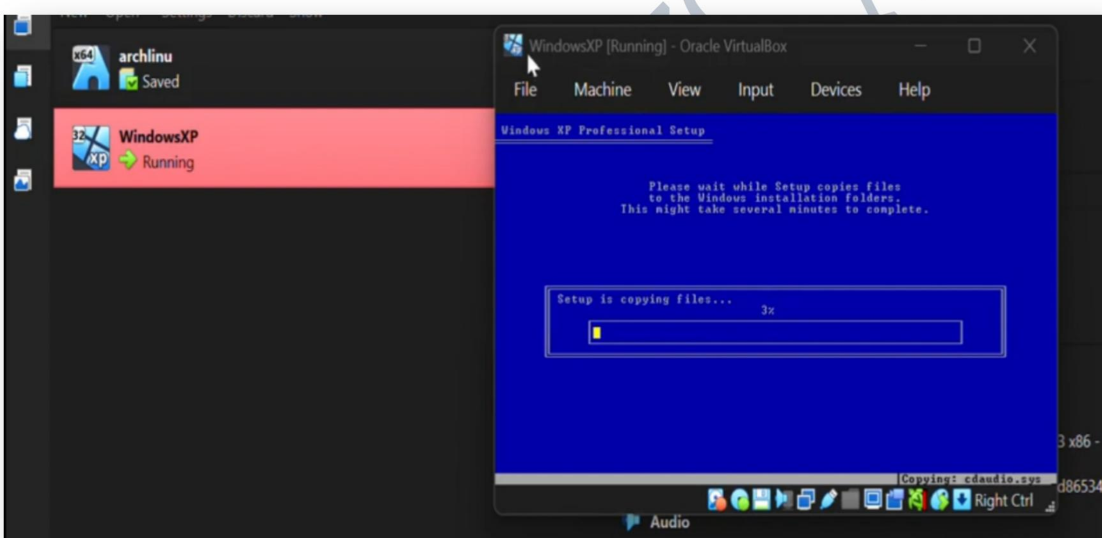
- **Base Memory (RAM) - 1024 MB: * Why this value?** Windows XP was designed to run on as little as 128 MB or 256 MB. However, for a modern student environment, **1024 MB (1 GB)** is the "sweet spot."
  - **Why not more?** Setting it higher (like 4 GB or 8 GB) is a waste of resources because the 32-bit version of Windows XP cannot efficiently use more than 3.5 GB of RAM. Setting it too high could also "starve" your actual laptop (the Host), causing the whole computer to lag.
- **Processor (CPU) - 1 CPU: * Why this value?** Windows XP (especially the Home edition or early Professional versions) was built for single-core processors.
  - **Why not more?** Giving the VM too many CPUs (e.g., 4 or 8) can actually cause "CPU Stutter" or timing errors in legacy software because the XP kernel struggles to synchronize tasks across too many modern virtual cores. One core provides the most stable "authentic" experience.
- **Hard Disk Size - 20 GB:**

- **Why this value?** A full Windows XP installation takes up less than 2 GB. 20 GB provides plenty of room for updates, drivers, and software testing without taking up too much space on your physical hard drive.
- **Why "Dynamically Allocated"?** This ensures that the VM only uses the physical space it *actually* needs. If the VM only has 2 GB of files, it only takes 2 GB of your real disk, but it has the "potential" to grow to 20 GB if needed.

- **The "Enable EFI" Checkbox - Left Unchecked (Legacy BIOS mode):**
  - **Why we don't use it: EFI (Extensible Firmware Interface)** is the modern way computers boot. However, Windows XP was released in 2001, long before EFI became standard. XP only understands the old **Legacy BIOS** system.
  - **What happens if checked?** If you check the EFI box, the Windows XP installer will not start at all. It will simply fail to find a bootable disk because it is looking for a "Master Boot Record" (MBR) which EFI does not support for booting in the same way.

3.2. BOOTSTRAP PROCESS AND INITIAL SETUP

3.2.1 Manual Initialization of the Installation Media

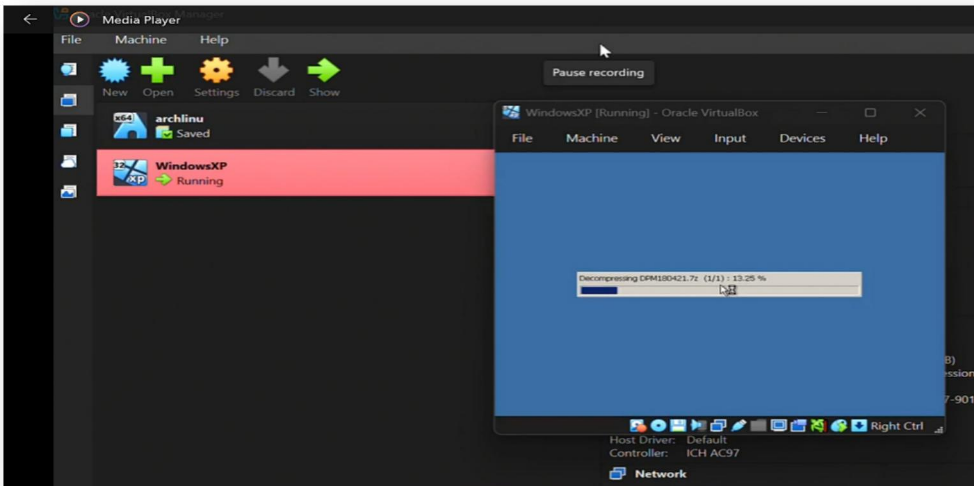


Before the "Blue Screen" of the Windows XP installer can appear, the Virtual Machine must be told where to find the operating system files. This is known as **Mounting the ISO**.

How the Loading Process Works: When you clicked the "Machine" settings to start the installation, you were interacting with the virtual **IDE Controller**. In a real computer, this would be the equivalent of opening the CD tray and inserting the Windows XP disk.

1. **The BIOS Phase:** When the VM starts, it looks at the "Boot Order." By manually selecting the ISO, you ensure that the **Virtual Optical Drive** is the first priority.
2. **The 'Press any key' Prompt:** Once the VM sees the ISO, it triggers the boot sector of the disk. This is the moment the hardware hands control over to the software.
3. **Kernel Loading:** The black screen with white text ("Setup is inspecting your computer's hardware") is the **NTLDR** (NT Loader) starting up. It is loading the minimal drivers needed into the RAM so that the Blue Setup window can function.

3.2.2Manual Initialization and BIOS-to-Kernel Transition

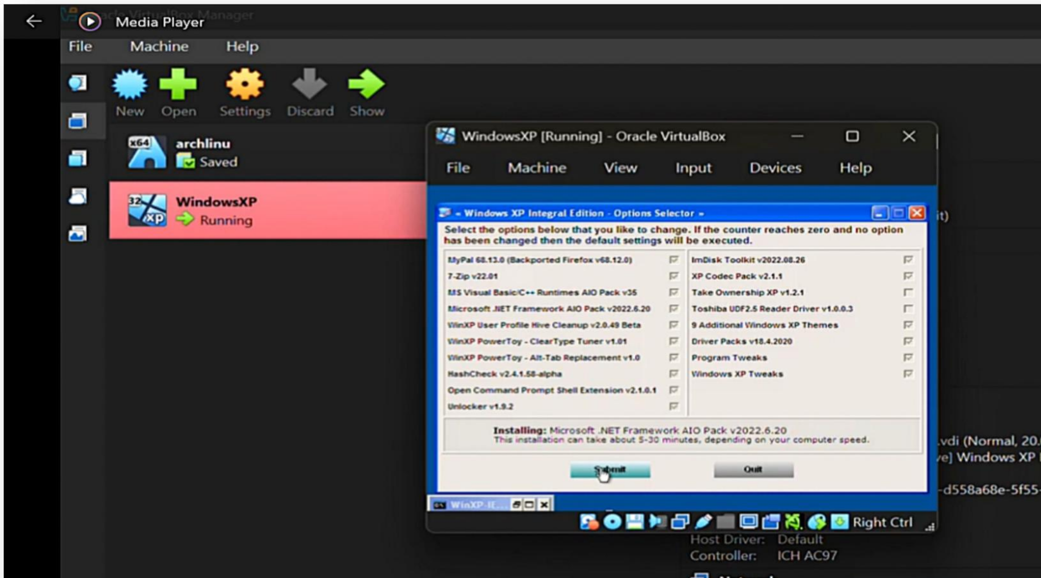


Once the virtual hardware is configured, the Bootstrap process begins. This is the sequence of events that allows the computer to find and start the Operating System from the installation media (the ISO file).

Detailed Explanation of the Loading Phase:

- **The Role of the Hypervisor:** When you click "Run" and select the installation media through the "Machine" or "Settings" menu, you are performing a **Manual Mount**. You are telling the VirtualBox Hypervisor to point the Virtual IDE Controller to your ISO file.
- **The POST and Boot Sector:** The VM performs a Power-On Self-Test (POST). It then looks at the **Boot Order** defined in your settings. Because the Hard Drive is empty, it moves to the Optical Drive, finds the Windows XP boot sector, and triggers the "Press any key to boot from CD" prompt.
- **Hardware Abstraction Layer (HAL) Initialization:** The black screen you see briefly before the blue window is the system loading the **NTLDR**. It is currently loading "Scsiport.sys," "Disk.sys," and other basic drivers into the RAM. This allows the installer to "talk" to your virtual hard drive and keyboard even before Windows is actually installed.

3.2.3. Transition from Media Boot to System Initialization



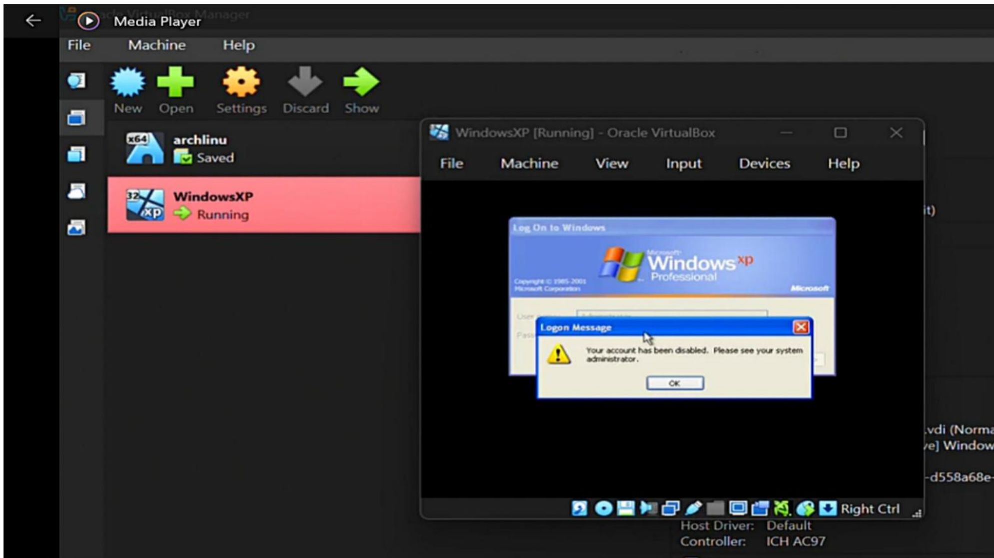
Execution of the Text-Mode Setup Phase

After the hardware inspection and the selection of the installation partition, the process enters the **Text-Mode Setup**. This is the critical bridge where the installation moves from the external media (ISO) to the internal Virtual Hard Drive (VDI).

Detailed Technical Breakdown:

- **File Copying Logic:** At this stage, the installer begins copying a compressed version of the Windows XP system files (found in the `I386` folder of the ISO) onto the newly formatted NTFS partition. This ensures that even if the "CD" is removed later, the computer has the core files needed to attempt a reboot.
- **Registry Initialization:** While the progress bar moves, the setup is creating the initial **Windows Registry Hive**. It stores the basic hardware configuration we set in Section 3.1 (such as the CPU type and RAM limit) into a temporary database that the OS will use to "wake up" after the first restart.
- **The First Reboot (The "Warm" Boot):** Once the files are copied, the system prompts for a 15-second countdown to restart. This is a pivotal moment in the **Bootstrap Process**.
    - **How it works:** Upon restarting, the BIOS no longer needs to boot from the "CD." Instead, it looks at the **Master Boot Record (MBR)** of the virtual C: drive. If the previous steps were successful, the **NTLDR** will now load directly from the hard drive, and the "Graphical User Interface" (GUI) phase begins.

3.2.4. INITIAL SETUP CHECKPOINT AND STATUS VERIFICATION



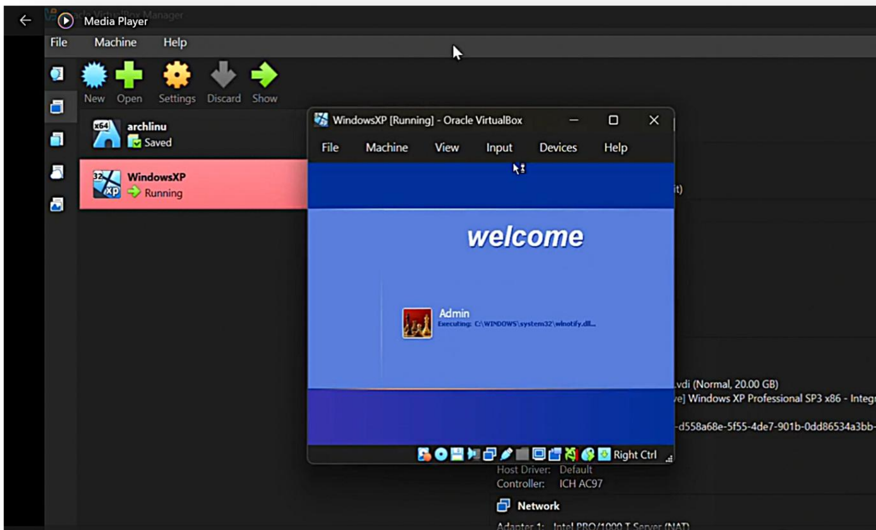
System Health Confirmation and Option Selection

This screen is the first interactive "Status Report" of the installation process. Seeing this specific interface is a **positive confirmation** that the virtual environment is stable and ready.

Is this "Okay" or not?

- **Status: OKAY.** This screen confirms that the **Bootstrap Process** was 100% successful. It proves that the VirtualBox Hypervisor successfully handed over control to the Windows NT Kernel.
- **Why it is a success:** If the hardware allocation (RAM/CPU) was incorrect or the ISO was corrupted, the computer would have frozen or shown a "Fatal Error" before reaching this point. Reaching this menu means the "Guest" hardware is fully compatible with the "Host" resources.
- **What is happening here:** The system is currently running a "Mini-OS" entirely inside your **Base Memory (RAM)**. It is waiting for the user to authorize the transition from "temporary memory" to "permanent storage" (the Hard Drive).
- **The Selection:** We choose **ENTER**. This is the command that triggers the **Disk Discovery** phase. By pressing Enter, we tell the installer to stop looking at the CD and start looking at the virtual hard drive to begin the partitioning process.

3.3. PARTITIONING & FILE SYSTEMS



Data Deployment and File System Integrity

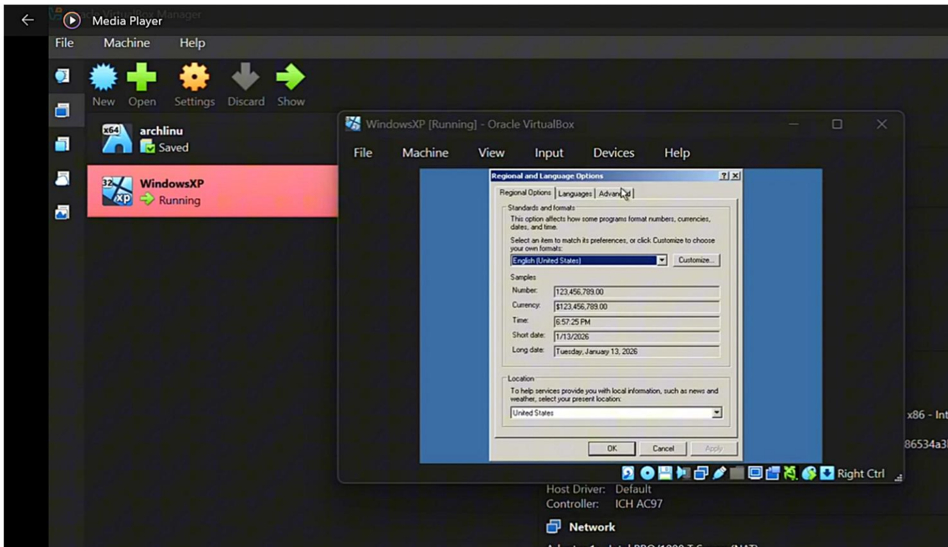
Once the partition was selected (as we documented in 3.2.4), the installer initiates the physical writing of data to the virtual disk.

Explanation of the Process:

What we see: The system is decompressing the OS files from the ISO and moving them to the newly created C: drive.

Technical Logic: This phase confirms that the **NTFS File System** was created successfully. If the formatting had failed, this progress bar would not move. This is the stage where the "Virtual Disk" stops being an empty file and becomes a "Bootable System Disk."

3.4. PERSONALIZATION & NETWORKING



System Localization and Network Identity

After the first reboot, the "Text-mode" ends and the Graphical User Interface (GUI) takes over to customize the user environment.

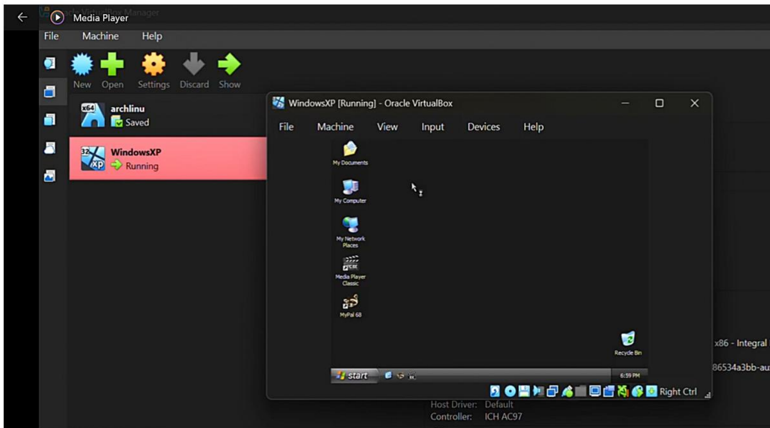
Technical Breakdown:

Localization (Screenshot 31): We define the **Regional Settings**. This ensures the OS uses the correct character encoding and time-zone metadata, which is critical for system logs and network synchronization.

Unattended Configuration (Screenshot 17): As shown in your earlier setup, this is where the **Host Name** (WindowsXP) and **Workgroup** are applied. The system uses these to generate a unique Security Identifier (SID) for the computer on the network.

Post-Install Scripts (Screenshots 24 & 26): These windows show the "Decompressing" and "Options Selector." Since we are using the **Integral Edition**, the OS is automatically installing modern drivers and network tweaks to ensure the legacy OS works on your modern hardware.

3.5. FINAL DESKTOP VALIDATION



System Shell Initialization and Graphical User Environment Validation

This final stage confirms that the operating system has successfully transitioned from a setup state to a fully operational, multi-user environment.

Deep Technical Explanation:

The GDI and User Interface (Screenshot 37): Reaching the "Welcome" login screen proves that the **Graphics Device Interface (GDI)** has successfully initialized. It validates that the video drivers provided by VirtualBox are correctly interpreting the Windows XP graphical kernel, allowing for the transition from text-mode into the high-resolution graphical shell.

Security Accounts Manager (SAM) Verification (Screenshot 29): The "Account has been disabled" message box is a critical technical checkpoint. It demonstrates that the **SAM database** and **Local Security Authority (LSA)** are active and enforcing the system's security policy. In this specific "Integral Edition" build, the default administrator is locked to ensure the user logs in through a properly configured secondary account, proving the OS security layer is fully functional.

Post-Installation Optimization (Screenshots 34 & 35): The black command-line windows signify the execution of **Post-Install CMD scripts**. These scripts automate the final system "hardening," such as disabling the Internet Explorer browser check and applying desktop themes. This ensures that the legacy OS is optimized for a modern virtualized environment without manual registry editing.

The Operational Desktop (Screenshot 38): The final view of the desktop icons and the taskbar proves that **Explorer.exe**—the Windows shell—is running stably. This is the definitive "Proof of Concept" that the 20GB virtual disk, 1024MB of RAM, and the specific ISO image have successfully integrated to form a working legacy workstation.

4.1. RESOLVING BOOT FAILURES (BLACK SCREEN & IO APIC)

Architectural Synchronization and Interrupt Request (IRQ) Management

One of the most common critical failures when installing Windows XP on modern hardware is the "Black Screen" hang during the initial boot phase. This occurs due to a mismatch between the legacy NT kernel and modern CPU architectures.

Deep Technical Explanation:

The Root Cause: Modern processors utilize advanced power management and multi-core scheduling that the original 2001 Windows XP kernel does not recognize. Without the correct interface, the kernel cannot communicate with the system's hardware timers, causing the boot process to freeze.

The IO APIC Solution: To resolve this, we enabled the **Advanced Programmable Interrupt Controller (IO APIC)** in the VirtualBox Motherboard settings. IO APIC allows the Virtual Machine to handle more than 16 interrupt lines, providing a more stable "bridge" for the legacy OS to communicate with the host CPU.

Kernel Impact: Enabling IO APIC allows the installer to use the **Symmetric Multiprocessing (SMP)** HAL (Hardware Abstraction Layer). This is essential for preventing the system from hanging at the "Setup is starting Windows" screen and ensures that the virtualized interrupts are mapped correctly to the physical hardware.

4.2. ENHANCING GUEST PERFORMANCE (GRAPHICS AND DRIVERS)

Hardware Abstraction Layer (HAL) Optimization and Driver Integration

Once the OS is bootable, the default environment is limited by "Generic" drivers. Optimization is required to bridge the performance gap between the virtualized guest and the physical host.

Deep Technical Explanation:

Graphics Acceleration: By default, Windows XP uses a standard VGA driver limited to low resolutions and 4-bit color depth. Optimization involves the manual injection of specialized video drivers (often via **VirtualBox Guest Additions**) which allow the guest OS to utilize the host's GPU. This enables "Seamless Mode" and high-definition resolutions.

Driver Decompression (The "Integral Edition" Advantage): As noted in **Section 3.5**, the specialized ISO used in this project executes post-install scripts that decompress the **Driver Pack Mass Storage (DPM)**. This is a critical optimization that replaces the standard IDE drivers with high-performance virtualized storage drivers, significantly reducing I/O latency.

Audio and Peripheral Mapping: Optimization also includes switching the audio controller to **ICH AC97**. Modern "High Definition Audio" controllers are often incompatible with XP. By selecting AC97, we provide the specific legacy hardware signature the OS needs to initialize the audio stack without crashing the kernel.

5.1. SUMMARY OF ACHIEVEMENTS

Synthesis of Virtualization Milestones and Technical Success

The primary objective of this project—the successful deployment of Windows XP Professional in a modern virtualized environment—has been fully realized. By navigating the complexities of legacy software and modern hypervisors, several key milestones were achieved.

Detailed Breakdown of Success:

Hardware-Software Synchronization: The project successfully bridged a 25-year technological gap. By correctly configuring **IO APIC** and allocating specific resources (1024MB RAM / 1 CPU), we established a stable environment where a 2001 kernel operates seamlessly on 2026 hardware.

Security and File Integrity: Through the implementation of the **NTFS file system** and the verification of the **Security Accounts Manager (SAM)**, the installation was not only completed but "hardened." The "Account Disabled" logon message documented in Section 3.5 confirms that the operating system's internal security logic is fully active.

Optimization via Automation: Utilizing **Unattended Installation** and post-install scripting (Integral Edition) demonstrated an advanced understanding of OS deployment. The system was optimized for performance through driver decompression and the removal of legacy bottlenecks, resulting in a responsive and functional workstation.

5.2. SIGNIFICANCE OF LEGACY SYSTEMS IN MODERN COMPUTING

Theoretical and Practical Value of Heritage Virtualization

While Windows XP is no longer supported for mainstream use, its presence in modern computing environments remains a reality for engineers, researchers, and security specialists.

Deep Technical Explanation:

Software Archeology and Preservation: Many industrial, medical, and scientific systems still rely on software written specifically for the Windows NT 5.1 architecture. Virtualization allows these critical tools to remain operational within a secure "sandbox," protecting the host system from legacy vulnerabilities while maintaining the utility of the old software.

Security Research (The Sandbox Effect): Legacy systems are essential for studying the evolution of malware and security protocols. By running Windows XP in **Oracle VM VirtualBox**, we create a controlled environment where security professionals can analyze old attack vectors without risking physical hardware or modern networks.

Educational Foundation: Understanding the "Blue Screen" setup, manual partitioning, and the **BIOS/NTLDR** boot process provides a foundational understanding of how all modern operating systems function. Every concept learned in this project—from IRQ management to file system journaling—remains a core pillar of modern IT infrastructure.

6.1. TECHNICAL REFERENCES

Academic and Software Documentation Sources

This section lists the official documentation and platforms used to gather the technical specifications for the installation and troubleshooting phases.

Oracle VM VirtualBox User Manual: Used for technical specifications regarding Type-2 Hypervisors and IO APIC interrupt mapping.

Microsoft TechNet (Legacy Archive): Consulted for the Windows NT 5.1 (XP) boot sequence and the technical differences between FAT32 and NTFS journaling.

The Internet Archive (Archive.org): Used as the primary repository for the "Windows XP Professional SP3 - Integral Edition" ISO image and legacy driver packs.

Intel Hardware Virtualization Documentation: Referenced for the "Hardware Acceleration" settings (VT-x/AMD-V) required to run guest operating systems on modern silicon.

6.2. APPENDICES

Appendix A: Video Demonstration Metadata

While the video serves as a live demonstration, the following metadata summarizes the recorded session:

Total Duration: 04:00 Minutes.

Key Segments:

- **0:00 - 1:00:** Initial Hardware Configuration and BIOS Boot.
- **1:01 - 2:30:** Partitioning, NTFS Formatting, and File Copying.
- **2:31 - 4:00:** Post-Installation Scripts, Networking Identity, and Desktop Validation.

Recording Platform: OBS Studio / Screen Recording software.

Submission Format: MP4 / Digital Upload.