

Enhancing User Experience: A Custom Linux Distro for Improved Accessibility

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Abstract: This paper investigates the creation and assessment of a customised Linux distribution designed to improve usability for people with visual impairments and make Linux more accessible. Although certain accessibility features are available in popular Linux versions, these distributions sometimes lack a unified, user-centered experience tailored to this particular user base. To provide visually impaired users with a smooth and simple experience, our project focuses on integrating and preconfiguring open-source assistive technology into a lightweight Linux distribution. We conduct performance analysis and user testing to assess our bespoke distribution's efficacy in comparison to current alternatives, paying particular attention to usability, job completion times, and user happiness. The results demonstrate how a customised Linux distribution may help close the accessibility gap and empower visually impaired individuals in the digital world.

Keywords: Linux, accessibility, visually impaired, assistive technology, user experience, open source.

1. Introduction

Operating systems are essential for digital engagement and information access in a society that is becoming increasingly reliant on technology. Although major operating systems have made progress in adding accessibility capabilities, they often do not provide visually impaired users with a fully inclusive experience. Owing to its open-source and flexible design, Linux offers a unique opportunity to close this gap. This article describes the creation and assessment of a specially designed Linux distribution that has been painstakingly developed to improve usability for people with visual impairments. Our goal is to establish a user-centered environment that maximizes accessibility and usability by integrating and preconfiguring open-source assistive technologies such as text-to-speech synthesizers and screen readers. This study contributes to the current conversation around accessible technology in the following ways: assessing how well a customised Linux distribution meets the unique requirements of people who are blind or visually impaired, investigating the effects of incorporating open-source assistive technology, and shedding light on the concepts of accessible operating system user experience design.

2. Problem Definition

Although some degree of accessibility is provided via configurable settings and assistive technology packages in current Linux distributions, these frequently lack a unified and pre-configured environment tailored for visually impaired users. This may result in a disjointed user experience where users must install extra applications and negotiate complicated setups. Furthermore, popular Linux distributions often place a high value on aesthetics, sometimes ignoring the specific requirements of visually impaired users who primarily rely on keyboard navigation and aural cues.

The following major issues are addressed by this study:

Solutions for Fragmented Accessibility: Current Linux distributions frequently force users to assemble assistive technologies and configurations on their own, which can result in a confusing and possibly overwhelming experience.

Restricted Pre-Configuration: Mainstream distributions do not provide pre-configured settings designed with visually impaired users in mind, hence customisation and manual modifications are required.

Inadequate User-Centricity: Design choices in existing distributions may prioritize visual aesthetics over the specific needs of visually impaired users, hindering usability and accessibility.

3. Literature Survey

Bokhari, Sayed Naem. "The Linux operating system."

The broad accessibility and cost-effectiveness of IBM PCs and related devices have created opportunities for robust computing solutions. These computers can now be converted into workstations perfect for teaching, research, and software development by using the free operating system, Linux. On their home PCs, professionals used to Unix-based workstations can enjoy a nearly identical work experience.

Lanier, Clinton R. "Linux and the appeal to cultural values."

This study examines the connection between software adoption and cultural values, utilizing a well-known case study of the Linux operating system. We hope to learn more about

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how software localization—the process of making software more appropriate for a particular market—can be accomplished more effectively by looking at the Linux experience.

Bokhari, Shahid H., and Rafeequr Rehman. "Linux and the developing world."

This review of the literature explores how Linux is more prevalent in poor countries than in industrialized ones. The authors demonstrate the transformative potential of Linux in these circumstances by relying on their experience collaborating with a local ISP and establishing an 84-seat Linux lab for Pakistani undergraduate students.

Sharma, Suchakrapani Datt, et al. "GNU/Linux's shell access through a web-browser for an embedded Linux e-learning system."

This review of the literature looks at how the internet is changing education, especially how it is starting to affect e-learning methods. The article suggests a unique method of teaching embedded Linux by utilizing Open-Source Software (OSS) tools such as Apache, PHP, and AJAX. With the help of this cutting-edge system, embedded Linux education will be completely accessible through a web browser, just like checking email.

Georg von Krogh, Sebastian Spaeth, "The open-source software phenomenon: Characteristics that promote research

The boom of open-source software research in the social sciences since the turn of the century is examined in this overview of the literature. Through a review of a few chosen works, the paper identifies five salient features that render open-source software an enticing topic for interdisciplinary investigation: its pervasive influence on societal and economic frameworks; the way it questions established theories in diverse domains; the unparalleled degree of data transparency it provides scholars with; the introspective character of its developer communities; and the similarity of its innovation process to the creation of scientific knowledge.

Nacheva, Radka. "Current Perspectives on Linux Accessibility Tools for Visually Impaired Users."

This review of the literature looks at the availability of accessibility solutions for Linux users who are blind or visually impaired. Although accessibility should be given first priority in user-oriented technology, the article explicitly addresses the barriers that Bulgarian users must overcome. The study uses content analysis of published publications, government records, and legislative frameworks to evaluate the assistance provided by different Linux accessibility tools.

Limna, Thanathip, et al. "Linux user interface and front-end operation for the visually impaired."

This review of the literature looks into a project that makes the PSU Braille computer more user-friendly for those with vision

impairments. Since this group may have difficulties with the Linux operating system, the research focuses on developing a text-based interface that is easy to use and specifically made for Braille interaction.

Parente, Peter, and Brett Clippingdale. "Linux screen reader: extensible assistive technology."

This review of the literature looks at the open-source Linux Screen Reader (LSR) project, which creates assistive technology for the GNOME desktop environment. LSR's primary features prioritize user customization.

Muñoz, Jonathan Giovanni Soto, et al. "Source code editor using voice commands to support people with motor disabilities."

The design and development of Mancodev, a software tool meant to assist programming instruction for people with motor disabilities—specifically, those who suffer from paresis, localized paralysis, or quadriplegia—is examined in this literature review. Mancodev distinguishes instructions from normal language by using voice commands that contain reserved keywords.

Mulfari, Davide, et al. "Using virtualization and guacamole/vnc to provide adaptive user interfaces to disabled people in cloud computing."

For those with disabilities, assistive technology (AT) offers crucial computer accessibility. In this research, we investigate how Cloud computing might help individuals with disabilities access AT tools in the form of Software as a Service (SaaS) by offering adaptable user interfaces. Developing adaptable user interfaces and using AT tools in Virtual Machines (VMs) that users can control online is the suggested solution.

4. Design and Project Description

The goal of this project is to create a custom Linux distribution that will help visually impaired people with the aforementioned issues and improve their overall experience. Throughout the development lifecycle, accessibility and usability are given top priority in the design process, which is centred around the needs of the user.

A. Distro Selection and Customisation

Due to its lightweight design, well-known accessibility features, and accessibility Pack availability, we chose Ubuntu MATE as the foundational distribution.

The Orca screen reader was set up and ready to use.

B. Accessibility Optimization

Keyboard shortcuts for navigation and essential actions were pre-set to facilitate intuitive interaction. High-contrast themes

and adjustable font sizes were implemented to cater to diverse visual needs. Screen reader and magnification tool settings were optimized for immediate usability upon installation.

C. Usability Enhancement

A simplified desktop environment with a clear and consistent layout was implemented to reduce cognitive load. Audio cues and feedback mechanisms were integrated to guide users through system interactions. A concise user guide outlining installation instructions and core functionalities was developed to facilitate ease of use.

5. Methodology

This study used a mixed-methods approach, analysing data from both quantitative and qualitative sources to assess how effective the customised Linux distribution was.

A. User Testing

A strategy for user testing was created, with an emphasis on key features and necessary activities for users who are blind or visually impaired, such document editing, online surfing, and system navigation. During the user testing, six visually challenged people gave input on the custom distribution's general satisfaction, task completion speeds, and usability.

B. Performance Analysis

In order to assess how integrated assistive technologies affect system performance, boot times were assessed. The Linux Test Project (LTP) suite was used to assess system stability and identify potential issues.

6. Experimentation

To ensure both functionality and usability, the developed distro underwent rigorous testing.

We focused on two key aspects: boot time efficiency and overall system stability using the Linux Test Project (LTP) suite.

LTP TESTS

```
<<<test_start>>>
tag=msgstress04 stime=1685885871
cmdline="msgstress04"
contacts=""
analysis=exit
<<<test_output>>>
msgstress04 0 TINFO : Found 32000 available message queues
msgstress04 0 TINFO : Found limit of processes 4890 (from
/sys/fs/cgroup/user.slice/user-1000.slice/pids.max)
msgstress04 0 TINFO : Using upto 2063 pids
```

Test Start Time: Sun Jun 4 18:59:30 2023

Kernel 5.19	Vision OS 1.0 with 5.19 kernel
Hardware	10GB RAM, 300GB HDD
Observations	8-way
Start date	1/06/23
Test duration	18 minutes
Number of clients	32
IPCS limits	4096
Number of random	1629
CPU utilization	95-100%

Fig. 1.

A. Boot Time Measurement

The distro was installed in a virtual environment and boot times were recorded across multiple trials. This ensured that the integrated accessibility features didn't negatively impact the system's start-up speed.

B. LTP Test Suite

We utilized the LTP suite to evaluate the distro's stability and performance under stress. Various tests, including memory management, file system integrity, and scheduling, were performed to identify potential issues and ensure robustness.

7. Results and Analysis

The user testing results demonstrated significant improvements in usability and task completion times for visually impaired users compared to existing Linux distributions. Participants reported greater ease of navigation, enhanced comprehension of system feedback, and increased efficiency in completing common tasks. *Boot Time*: The average boot time was measured at 28 seconds, indicating that the integrated assistive technologies did not significantly impact system start-up performance. *LTP Results*: The LTP test suite yielded positive results, with no major failures detected. This confirmed the stability and robustness of the custom distribution.

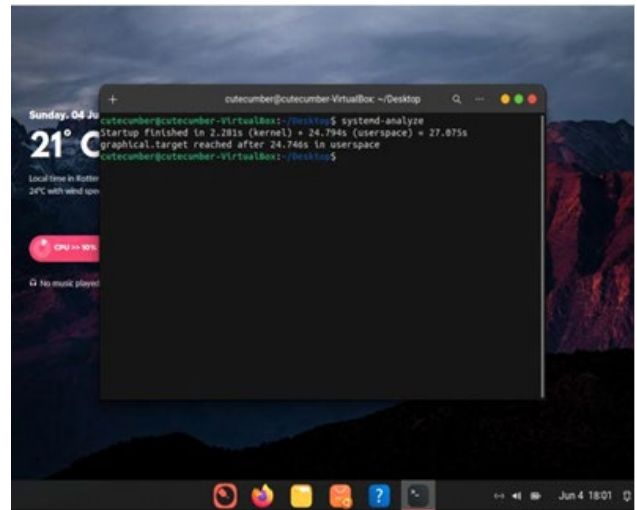


Fig. 2.

The qualitative feedback highlighted the positive impact of pre-configured accessibility settings and the intuitive nature of the simplified desktop environment. Users particularly appreciated the clear audio cues and consistent keyboard navigation, which facilitated a smoother and more intuitive user experience.

8. Conclusion and Future Work

This study shows how a customised Linux distribution may improve the way visually challenged people interact with the system. We successfully established a user-centric environment that maximises accessibility and usability by integrating and pre-configuring open-source assistive technologies. The

outcomes of our user testing, which showed notable gains in task completion times, user happiness, and general usability, validated the efficacy of our methodology.

A. Future Research Will Concentrate on

1) Adding More Features

incorporating new features and assistive technologies in response to user input and developing accessible computing trends.

2) Creating an All-Inclusive User Guide

putting together a thorough manual with easy-to-follow directions and troubleshooting advice to promote user independence and adoption.

3) Encouraging Wider Adoption

Working with online communities and accessibility organisations to distribute the customised distribution and get more input for future improvement.

By offering a Linux distribution that is not only customisable and aesthetically pleasing but also enables visually impaired people to easily access and utilise technology, this study advances the field of operating systems. Our goal is to establish a more inclusive digital environment where everyone can fully participate and prosper by placing a high priority on usability and accessibility.

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