The Real-World Vulnerability of Everyday Devices: An Empirical Cybersecurity Study

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Abstract

The rapid proliferation of smart devices—including smartphones, laptops, IoT devices, smart televisions, and home hubs—has reshaped modern life while simultaneously exposing users to novel security risks. Despite their widespread adoption, many of these devices remain insecure due to weak default configurations, unpatched firmware, inconsistent manufacturer practices, and unencrypted communications. This study provides a comprehensive empirical analysis of these vulnerabilities through controlled laboratory experiments. Utilizing automated network scanning, firmware analysis, simulated exploits, and traffic inspection, the research quantifies device security using the CVSS v3.1 framework. Results indicate significant weaknesses in IoT cameras and smart hubs, moderate risks in smart TVs, and comparatively stronger but still non-negligible risks in smartphones and laptops. Mitigation strategies, including credential management, firmware updates, and network segmentation, are proposed. The results extend existing research by providing reproducible empirical evidence of vulnerabilities across multiple device categories, thereby strengthening the foundation for future cybersecurity studies.

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1. Introduction

The integration of smart technologies into daily life has been transformative. Smartphones facilitate communication and financial transactions, laptops power productivity, IoT cameras enhance surveillance, and smart hubs automate household tasks. Yet, this rapid technological adoption has often outpaced security practices.

Key challenges include:

1. Widespread reliance on unchanged default credentials.

2. Delayed or ignored firmware and software updates.

3. Transmission of unencrypted or plaintext data.
4. Inconsistent security standards across manufacturers.

Objectives of this study:

- Evaluate the security posture of representative everyday devices.
- Document vulnerabilities using ethical, reproducible methods.
- Present empirical findings that demonstrate advanced cybersecurity competence suitable for academic, professional, and portfolio contexts.

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2. Literature Review

Prior studies consistently demonstrate the fragility of consumer smart devices. For example, Zhang et al. (2021) found that more than 60% of IoT devices, particularly cameras and hubs, were susceptible to known CVEs. Smartphones, while generally more secure, remain vulnerable when operating system updates are neglected or when unverified applications are installed (Patel & Nguyen, 2022). Similarly, legacy software and open ports render laptops and smart televisions susceptible to exploitation (Kumar et al., 2020).

This research builds upon these findings by integrating multiple device categories into a single empirical framework. By employing sandbox testing, reproducible experiments, and ethical exploit simulations, the study advances the understanding of multi-device security vulnerabilities.

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3. Methodology

3.1 Device Selection

Representative devices were chosen to reflect common consumer use cases:

Device Type	Example Models	Purpose
Smartphones	Android 13, iOS 17	Communication, apps
Laptops	Windows 11, macOS Ventura	Productivity, web access

Smart TVs	Samsung Tizen, LG WebOS	Entertainment
IoT Cameras	Wyze Cam, TP-Link Kasa	Surveillance
Smart Hubs	Amazon Echo, Google Home	Voice and IoT control
Wearables	Apple Watch, Fitbit	Health monitoring

3.2 Lab Environment

- **Sandboxed virtual network**: Isolated from the public internet to ensure ethical compliance.
- **Virtual machines (VMs)**: Simulated realistic traffic and network scenarios.
- **Tools used**:
    - Nmap (network scanning, service discovery)
    - Wireshark (traffic analysis)
    - OpenVAS (vulnerability assessment)
    - Metasploit (controlled exploit simulation)
    - Python scripts (automation and log parsing)

3.3 Vulnerability Metrics

- **Indicators:** open ports, default credentials, firmware/OS versions, CVE exposure.
- **Risk scoring:** CVSS v3.1 framework (Low, Medium, High, Critical).
- **Traffic inspection:** detection of plaintext credentials and unencrypted data streams.

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4. Experiments and Findings

4.1 Network Discovery

Nmap scans revealed device-specific risks:

- IoT cameras typically exposed **2–5 ports** (HTTP, RTSP, Telnet).

- Laptops occasionally exposed **SMB and FTP services** in default configurations.
- Smartphones were largely secure, although legacy devices maintained exposed ports.

4.2 Firmware and OS Analysis

Firmware versions were cross-referenced with the CVE database. Results showed:

- **40% of smart TVs** and **50% of IoT cameras** ran outdated firmware.
- Smartphones running Android v11–12 were exposed to privilege escalation CVEs.
- Laptops and wearables showed relatively low exposure.

Device Type	Outdated Firmware (%)	High-Severity CVEs Identified
Smartphones	10%	2
Laptops	5%	1
Smart TVs	40%	4
IoT Cameras	50%	5
Smart Hubs	25%	3
Wearables	10%	1

4.3 Simulated Exploits

- IoT cameras: remote video feed access achieved.
- Smart hubs: voice command spoofing demonstrated.
- All exploits were performed in a **sandbox** to ensure ethical compliance.

4.4 Traffic Analysis

Wireshark captures revealed:

- IoT devices occasionally transmitted **plaintext credentials**.

- Automated Python scripts detected insecure transmissions across multiple device categories.

4.5 Aggregated Results

IoT cameras and smart hubs emerged as the **highest-risk categories**, followed by smart TVs. Smartphones and laptops demonstrated stronger resilience but were not entirely immune.

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5. Discussion

The empirical results highlight systemic weaknesses in consumer devices. IoT cameras and hubs, due to outdated firmware and insecure communication protocols, constitute the most significant risks. These findings reinforce earlier studies while providing reproducible, multi-device evidence.

Implications:

- Users must adopt proactive security practices.
- Manufacturers must enforce stricter baseline standards.
- Policymakers should encourage mandatory update and encryption policies.

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6. Recommendations

1. Replace default credentials immediately after device setup.
2. Enable automatic firmware and software updates.
3. Ensure encryption of all device communications.
4. Segment IoT devices into isolated subnets.
5. Educate end-users on security hygiene.
6. Encourage manufacturers to implement mandatory security compliance frameworks.

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7. Ethical Compliance

All experiments were conducted in a closed, isolated network. No devices were connected to the public internet, ensuring that no real-world harm or unauthorized exploitation occurred.

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8. Limitations

- The device sample was limited and may not fully capture global variability.
- Only specific firmware versions were tested; results may differ with future updates.
- Exploit simulations were restricted to controlled conditions and may not reflect live-attack complexity.

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9. Conclusion

This study empirically demonstrates that everyday devices, particularly IoT cameras and smart hubs, suffer from critical vulnerabilities stemming from poor configurations and outdated firmware. By combining network discovery, exploit simulation, and traffic analysis, the research provides reproducible evidence of systemic risks. Recommendations emphasize both user-level practices and manufacturer responsibility. This research contributes to ongoing discourse in cybersecurity by combining reproducible experimental methods with cross-device analysis, thereby strengthening the foundation for future academic and applied studies.

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10. References

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