Chapter 1

Multi-Sensor Recording System Appendices

1.1 Appendix A: System Manual — Technical Setup, Configuration, and Maintenance Details

The **Multi-Sensor Recording System** comprises multiple coordinated components and devices, each with dedicated technical documentation. The core system includes an **Android Mobile Application** and a **Python Desktop Controller**, along with subsystems for multi-device synchronization, session management, camera integration, and sensor interfaces [**?**]. These components communicate over a local network using a custom protocol (WebSocket over TLS with JSON messages) to ensure real-time data exchange and time synchronization [**?**].

System Setup: To deploy the system, a compatible Android device (e.g. Samsung Galaxy S22) is connected to a **TopDon TC001 thermal camera**, and a computer (Windows/macOS/Linux) runs the Python controller software [**?**]. Both the phone and computer must join the same WiFi network for connectivity [**?**]. The Android app is installed (via an APK or source build) and the Python application environment is prepared by cloning the repository and installing required packages [**?**]. On launching the Python controller, the user enters the Android device's IP address and tests the connection to link the devices [**?**]. Key configuration steps include aligning network settings (firewalls/ports) and ensuring system clock sync across devices for precise timing.

Technical Configuration: The system emphasizes precise timing and high performance. It runs a local **NTP time server** and a **PC server** on the desktop to coordinate clocks and commands across up to 8 devices, achieving temporal synchronization accuracy on the order of ±3.2 ms [**?**]. The hybrid star-mesh network topology and multi-threaded design minimize latency and jitter. A configuration interface allows adjusting session parameters, sensor sampling rates, and calibration settings. For example, the thermal camera can be set to auto-calibration mode, and the Shimmer GSR sensor sampling rate is configurable (default 128 Hz) [**?**] [**?**]. The system's performance meets or exceeds all target specifications: e.g. **sync precision** better than ±20 ms (achieved ˜18.7 ms), **frame rate** 30̃ FPS (exceeding 24 FPS minimum), data throughput 47̃ MB/s (almost 2× † 25 U/, ♪† ∞ 99 ♪†o|o o|o♪♪ ⋆ ♪† ♪† o|o†† o|o♪.

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1.2 Appendix B: User Manual — Guide for System Setup and Operation

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$1001[?].When the Python controller is running, enter the Android's IP address (from the phone's WiFi settings) in$
$1001[?].A successful test will show the phone listed as a connected device in the desktop UI.$

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1.3 Appendix C: Supporting Documentation — Technical Specifications, Protocols, and Data

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*−−thesystemusesanNTP−basedschemewithcustomoffsetcompensationtokeepdeviceswithin*25 *msofeacho*
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1.4 Appendix D: Test Reports — Detailed Test Results and Validation Reports

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[illegible] õ5all critical code paths are verified [?]. Appendix D describes how the test environment was set up (real devices vs. simulated, test data used, etc.) and how tests were organized (for example, separate suites for Android app fundamentals, PC controller fundamentals, and cross-platform integration) [?] [?]. It also lists the tools and frameworks used (the project uses real device testing instead of mocks to ensure authenticity [?]).

Results Summary: The test reports include tables and logs showing the outcome of each test category. All test levels exhibited extremely high pass rates. For instance, out of 1,247 unit test cases, 98.7passed (with only 3 critical issues, all of which were resolved) [?]. Integration tests (covering inter-device communication, synchronization, etc.) passed õ7.4sessions) had õ6.6rate [?]. Any remaining failures were non-critical and addressed in subsequent fixes. The appendix provides detailed logs for a representative test run --- for example, an execution log shows that all 17 integration scenarios (covering multi-device coordination, network performance, error recovery, stress testing, etc.) eventually passed 100fixes [?] [?]. This indicates that by the final version, all integration tests succeeded with no unresolved issues, giving a success rate of 100across the board [?].

Validation of Requirements: Each major requirement of the system was validated through specific tests. The appendix highlights key validation results: The synchronizatio precision was tested by measuring clock offsets between devices over long runs --- results confirmed the system kept devices synchronized within about ±2.1 ∞, ⌀⌀ ♩+ ±50 ∞ ∞♩ [[]]. ♩ + ⋆ ∞⌀♩ ♩ ♩♩ ♩+ ♩♩ ⌀ ♩ 1+ ♩ ⌀⌀ ♩ ⌀ o|o ⌀⌀ o|♩ [[]]. ∞ ⌀⋆⌀/⌀⋆⌀ + ♩++ o|♩♩ ♩ ♩♩♩ ∞ + ∞♩+ ♩⌀ 99.7 ∞ o|o [[]]. ∞♩o|o + ∞ o|⌀+ ♩+⌀ 12 +o|o ∞⌀♩⌀ o|+♩ ⌀ 8 ♩+ ∞♩♩ + ♩+ ∞ [[]]. ♩+ ♩o|⌀+ ⋆⌀ ⌀ ℧⌀±o|o +♩♩ ⌀ ♩+ , o|o +⌀ ∞o|o ♩+ o|∞ ∞ ♩ .

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1.5 Appendix E: Evaluation Data — Supplemental Evaluation Data and Analyses

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