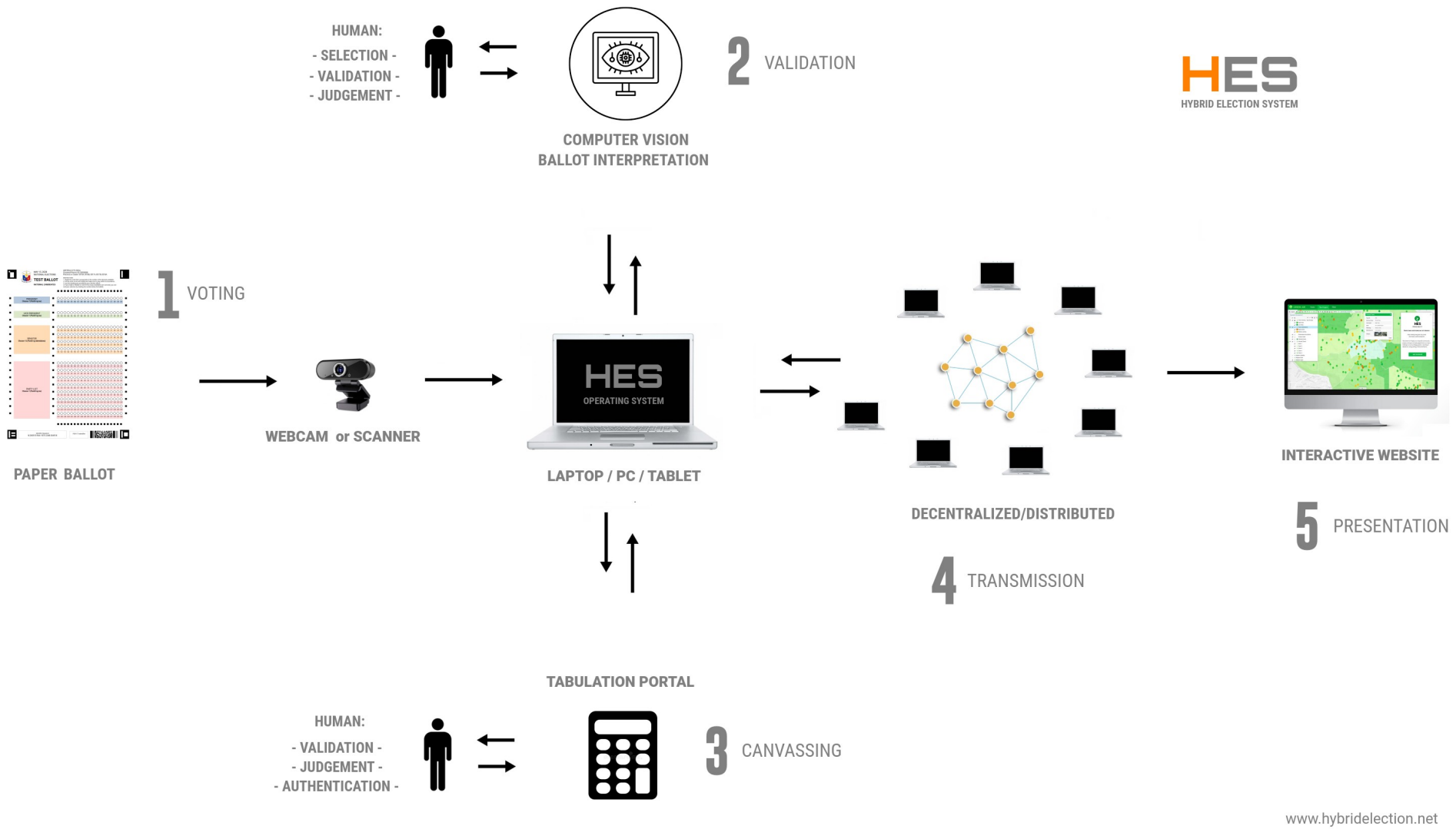
Hybrid Election System (HES)



www.hybridelection.net

Comprehensive Voting Process

The **Hybrid Election System (HES)** is a paper-based, **human-in-the-loop (HITL)**, digitally-auditable voting system designed to restore public trust through **transparency, verifiability, decentralization, and security**. It combines the reliability of physical ballots with real-time digital auditing and peer-to-peer data integrity.

> 🔐 **Core Principle:** ***Technology assists, but humans decide every critical step.***

🔁 Overview: Three Phases of HES

Phase	Key Functions
1. Voting & Verification	Voter casts ballot, verifies vote privately, corrects if needed, affirms with VVPAT
2. Counting & Tallying	Public, live scanning; dual-screen display; human affirmation of each ballot
3. Results Compilation & Transmission	Human-signed results, authenticated upload via decentralized P2P network

---

🧭 Complete Voting Workflow

PHASE 1: VOTING AND VERIFICATION

Step 1. Voter Casts Paper Ballot

- The voter receives a **standard paper ballot** at the polling station.
- The ballot contains candidate names/options with corresponding **fillable bubbles** (like optical scan systems).
- The voter marks their choice using the provided pen.

> ✅ ***All ballots are pre-numbered with unique identifiers (Number, Series, Zone)***

Step 2. Ballot Scanning via Webcam

- Voter feeds the completed ballot into a scanner station: a standard **webcam attached to a locked-down laptop** running HES software.
- The webcam captures a high-resolution image of the ballot in real time.

> 🔒 ***No network connection during voting. System operates offline.***

Step 3. Private Voter Verification (with Privacy Shield)

- An image of the scanned ballot is shown **only to the voter** on the laptop screen, protected by a **screen privacy shield**.
- The system displays:
    - **Image of the physical ballot**
    - **Digital interpretation** (e.g., "You voted for: Candidate 3")

⚠️ ***Vote is NOT yet counted or stored — only previewed.***

Step 4. Correction and Confirmation

- Voter checks for:
    - ✅ Correct interpretation
    - ❌ Over-vote (more than allowed choices)
    - ❌ Under-vote (no selection where chosen)
    - ❌ Misread shade (too light/dark)
    - ❌ Ballot cloning/fake ballots
    - ❌ Wrong precinct/zone assignment

If an issue is detected:

- Voter returns the ballot.
- Uses **simple shading technique**:
    - **Void a choice**: Shade the candidate number beside the bubble
    - **Select new candidate**: Shade new bubble of choice

Then resubmits the corrected ballot for re-scan.

✅ ***Immediate correction ensures voter intent is accurately captured.***

Step 5. Human Affirmation & VVPAT Print

- Once satisfied, the voter clicks **"Print VVPAT"**.

- A **two-step confirmation** appears:
    1. “Are you sure?” → Yes/No
    2. Final OK required
- After confirmation:
    1. A **Voter-Verified Paper Audit Trail (VVPAT)** is printed.
        - Contains: Ballot ID, timestamp, voter’s choice, QR code.
    1. The original ballot is **dropped manually into a sealed, tamper-evident box**.
    2. The VVPAT will be kept in a separate box for archiving and recount purposes.

📦 ***The PAPER BALLOT is the definitive legal record of the voter's intent.***

*NOTE: The **Paper Ballot is the irrefutable legal record of a vote** because it represents the voter's direct, unmediated choice. VVPAT functions as a supplementary safeguard. It is a machine-generated printout that offers a tangible confirmation of the electronic selection. While invaluable for audits and building trust, the VVPAT is considered a secondary audit trail; it is evidence of the vote, but not the legal source.*

✅ PHASE 1 OUTCOME:

- Ballot image and metadata stored locally (not transmitted yet)
- VVPAT secured for audit
- Voter leaves verified and confident

🔍 PHASE 2: COUNTING AND TALLYING (Post-Voting)

Conducted **after polls close**, in full public view.

Step 6. One-by-One Live Scanning

- Each ballot is rescanned **one at a time** using the same webcam setup.
- Entire process is **live**, transparent, and witnessed.

🎥 *No batch processing — individual ballot scrutiny ensures accountability.*

Step 7. Dual-Screen Public Display

Two screens windows are used:

Screen	Content
WIndow-1	Shows live image of the physical ballot being scanned
Window-2	Shows the system's digital interpretation of votes

> 👀 ***Poll watchers, party agents, observers can see both simultaneously.***

Step 8. Human Watcher Affirmation

For **each ballot**, a designated **Election Officer** (with watchers observing) must click one of three actions:

Action	Meaning
✅ **Accept**	Digital interpretation matches physical ballot
❌ **Reject**	System misread; ballot set aside for manual review
⚖️ **Dispute**	Disagreement among watchers; flagged for escalation

> 🧑‍⚖️ ***Technology proposes, human decides.***

Rejected or disputed ballots go to a **manual adjudication panel** for resolution.

Step 9. Real-Time Tally Update

- Every **accepted vote** is immediately added to the running tally.
- Tally is displayed on a **publicly visible dashboard** in the precinct:
    - Candidate names
    - Vote counts
    - % share
    - Updated in real time

🕒 ***No hidden totals — everyone sees results grow live.***

✅ PHASE 2 OUTCOME:

- All valid ballots counted with human oversight
- Fully auditable record created per ballot
- Transparent tally established

📤 PHASE 3: RESULT COMPILATION & TRANSMISSION

Step 10. Generate Human-Signed Election Return (ER)

- Final tally results are printed as a **hard-copy Election Return (ER)**.
- This document includes:
    - Precinct number
    - Total ballots cast
    - Breakdown of votes per candidate
    - Unused/rejected ballot count
    - Timestamp
    - Names and signatures of:
        - Election Officers
        - Party Watchers
        - IT Supervisor

🖊️ ***This signed ER is the legally binding result for the precinct.***

Step 11. Final Human Authentication

- The signed ER is **scanned** into the HES laptop.
- All data now stored locally:

    - Scanned ballot images
    - VVPAT records
    - ERs (digital + physical)
    - Metadata logs (timestamps, user logins, etc.)
- Transmission is **blocked** until:
    - Election Officer enters a **unique authentication code**
    - This code acts as a **personal digital affirmation** of data truthfulness

🔐 ***Prevents unauthorized or automated uploads.***

Step 12. Decentralized Mesh Transmission

Instead of sending data to a central server (like AES), HES uses:

🌐 **Mesh or (Peer-to-Peer) Network Architecture**

How it works:

- Each precinct laptop acts as a **node** in the network
- Nodes sync when connected via:
    - Cellular (4G/5G)
    - Wi-Fi
    - LAN
    - Satellite
- Upon connection:
    - Data (ballots, ERs, metadata) automatically synchronizes across thousands of nodes nationwide
    - **No single point of failure**
    - **No central server to hack**

🛡️ **If one node is compromised:**

- All other nodes hold the same correct data
- System flags discrepancies automatically
- Authorities alerted to investigate

✅ ***Resistant to external cyberattacks and insider threats***

🌍 UNPRECEDENTED DIGITAL AUDIT TRAIL & PUBLIC DISPLAY

HES provides a **public-facing election results portal** (e.g., www.results.hes.gov.ph or www.philcast.org or similar):

🌐 Public Election Results Website

Accessible to:

- Citizens
- Media
- Observers
- International monitors

Features:

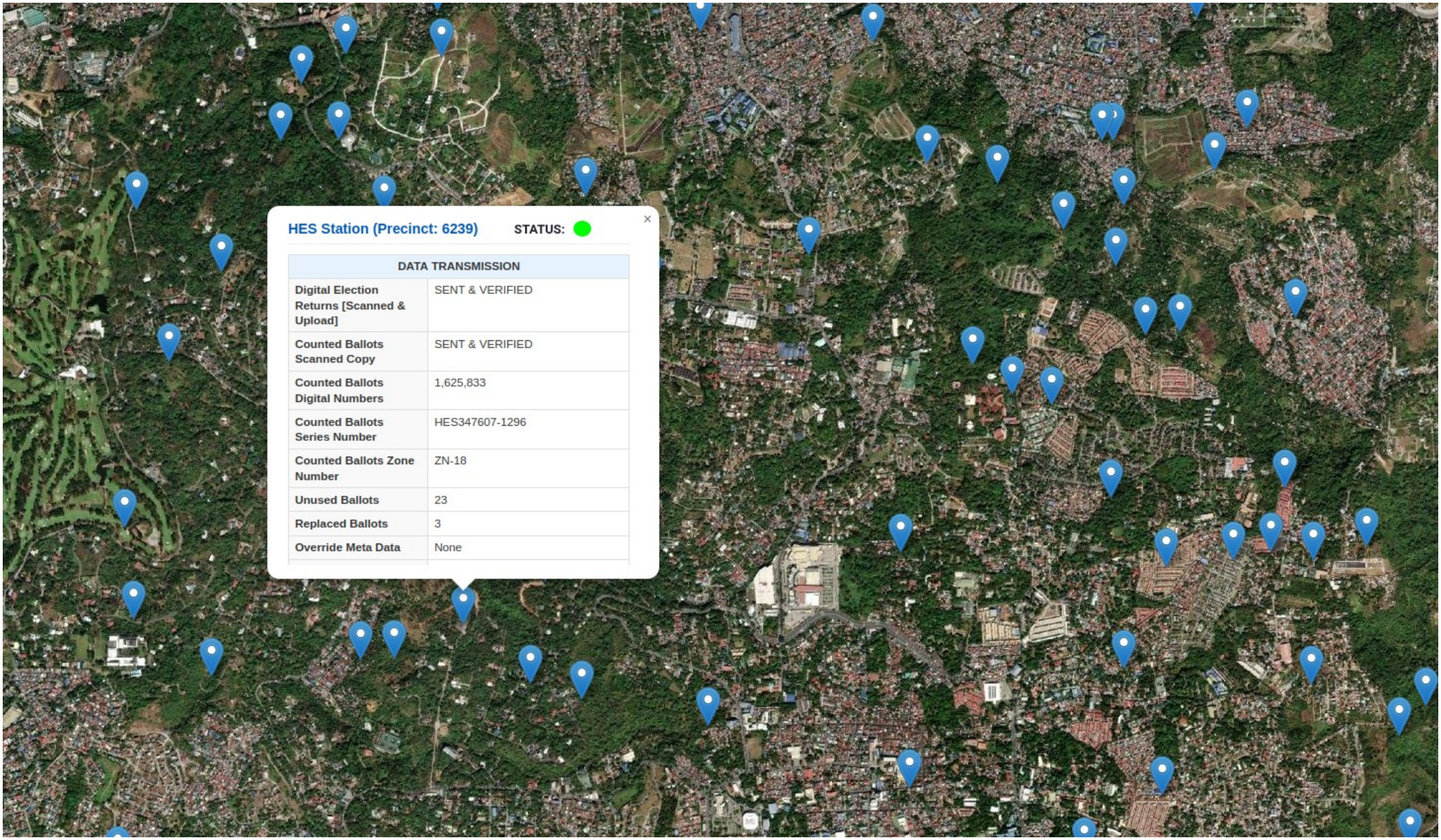
Live Interactive Election Map

- Presents thousands of **HES GPS PIN locations** scattered across the country that represent precincts
- PIN color indicates sync status:

Color	Meaning
🔴 Red	Synchronization Pending
🟡 Yellow	Synchronization in progress
🟢 Green	Completed and verified

🔍 **Click any PIN in the map → View full details:**

💡 Precinct-Level Forensic Data (Click-to-View)



Each precinct's data includes downloadable, auditable files:

Category	Contents
📄 **Documents**	Images of Scanned ballots, signed Election Returns, VVPAT
🆔 **Ballot IDs**	Unique numbers, series, zone codes
🗳️ **Ballot Management**	Records of unused, spoiled, replaced ballots
🕒 **Metadata Logs**	Login attempts, key-in prints, timestamps
👤 **Personnel**	Names of Election Officers, IT staff
💻 **Hardware Info**	HES station serial number
📍 **Location & Network**	GNSS (GPS) location, IP, MAC address
📶 **Connectivity**	Telco carrier, device type (laptop model, webcam ID)
📤 **Transmission Data**	File sizes, date/time stamps, session Ids, and more.

> 🕵️ ***Any anomaly (e.g., GPS mismatch, unexpected IP) triggers alerts for forensic review.***

🔁 TEXTUAL WORKFLOW DIAGRAM (End-to-End HES Process)

```
[START]
   ↓
Voter receives paper ballot
   ↓
Voter marks choice (bubble fill)
   ↓
Feeds ballot into webcam station (offline)
   ↓
System scans ballot → displays image + interpretation (private view)
   ↓
IS INTERPRETATION CORRECT?
   ├── Yes → Proceed to affirmation
   └── No → Voter corrects ballot → Rescan
            ↓
Voter clicks "Print VVPAT"
   ↓
Two-step confirmation: "Are you sure?" → Yes
   ↓
VVPAT printed → VVPAT drops in separate box stored (for archive / evidence)
```

```
   ↓
Voter drops Original ballot into sealed box
   ↓
[END OF VOTING PHASE]

AFTER POLLS CLOSE
   ↓
ONE-BY-ONE PUBLIC SCANNING BEGINS
   ↓
Physical ballot shown on SCREEN WINDOW-1
   ↓
HES interpretation shown on SCREEN WINDOW-2
   ↓
Poll watchers compare image vs system read
   ↓
ELECTION OFFICER CLICKS:
   ├── ACCEPT → Vote added to live tally
   ├── REJECT → Ballot sent for manual review
   └── DISPUTE → Escalated to adjudication panel
           ↓
Running tally updated PUBLICLY in real time
   ↓
All ballots processed → Final count complete
   ↓
PRINT ELECTION RETURN (ER) – Hard Copy
   ↓
ELECTION OFFICERS + WATCHERS SIGN ER
   ↓
Scan signed ER → Store digitally
   ↓
ENTER UNIQUE AUTHENTICATION CODE (Human Final Affirmation)
   ↓
TRANSMISSION UNLOCKED
   ↓
DATA SYNC VIA PEER-TO-PEER NETWORK
   ↓
All nodes receive and verify data
   ↓
Discrepancies auto-flagged (if any)
   ↓
[OFFICIAL RESULTS ESTABLISHED]

PUBLIC PORTAL (results.hes.gov.ph)
   ↓
Live map: Red/Yellow/Green dots by precinct
   ↓
Click dot → View full forensic data package
   ↓
Download ballots, ERs, logs, GPS, network, personnel info
   ↓
TRANSPARENCY ACHIEVED
```

🔐 Key Security & Trust Features of HES

Feature	Description	Why It Matters
Paper Ballot + VVPAT	Physical record verified by voter	Prevents undetectable fraud
Private Verification	Voter checks vote privately before finalizing	Ensures intent is captured
On-Site Correction	Voter fixes errors instantly	Reduces spoilage, increases accuracy
Human-in-the-Loop	Humans accept/reject each vote during count	Removes black-box algorithms
Dual-Screen Public Count	Real-time visual comparison	Builds observer confidence
Real-Time Public Tally	Visible dashboard updates instantly	Eliminates suspicion of hidden counts
Signed Election Return	Legally binding, hand-signed document	Anchors digital data to physical reality
Authentication Code	Final human confirmation before transmission	Ensures data integrity at source
P2P Decentralized Sync	No central server; all nodes replicate data	Immune to server breaches
Public Forensic Portal	Precinct-level transparency with GNSS, logs, scans	Enables crowd-sourced auditing

---

✅ Why HES Restores Trust

The **Hybrid Election System (HES)** transforms elections from **opaque processes** into **transparent, participatory events** where:

- **Voters** verify their own votes
- **Watchers** observe every count
- **Officers** personally affirm results
- **Technology** supports but never overrides humans
- **Data** is open, traceable, and resistant to tampering

By combining **simple tools (paper, webcam)** with **smart design (mesh transmission, dual-screen, authentication)**, HES creates a system that is:

🔹 **Secure** 🔹 **Auditable** 🔹 **Resilient** 🔹 **Understandable** 🔹 **Trustworthy**

HES is not just a voting system — it's a new standard for democratic integrity in this digital age.

This is a Preliminary document. All information is subject to change without notice due to the system's active development.

Prepaired by:

Ed Millana – 11-11-2025 | update: 01-12-2025

Email: ed@millawave.com

🌐 Learn More:

🔗 www.hybridelection.net

Follow HES on social media for demos and pilot results