COMMERCIAL / TECHNICAL OVERVIEW

Smart Devices Are Actually Smart

How BowPro+ turns the camera, motion sensors, microphone route and device-specific context into practical archery instruments.

A modern phone is not merely a screen that happens to run BowPro+. It is a compact measurement platform with calibrated cameras, fused motion sensors, multiple microphones, hardware-specific audio routing and enough on-device computing to interpret those signals immediately. BowPro+ uses those capabilities to remove manual steps, capture geometry that archers otherwise estimate, and attach better confidence information to every result.

01
Camera as a measuring interface
A live reticle defines the intended target direction, while on-device vision can read chronograph displays and validate the captured value.

02
Attitude and stability
Gravity-referenced pitch, roll, rotation rate and acceleration turn phone orientation into measurable shot geometry and a steadiness check.

03
Audio-path awareness
BowPro+ can inspect the active input route, microphone data source, orientation, polar pattern, sample rate and actual buffer configuration.

04
Device-specific confidence
The device model, operating-system context and tested calibration profile can refine detection parameters without pretending every phone behaves identically.

The phone is part of the instrument

The useful question is not simply whether a phone contains a camera, gyroscope or microphone. The useful question is whether BowPro+ can connect each sensor to a clearly defined physical quantity. The camera supplies a target-facing axis. Core Motion supplies orientation relative to gravity and a measure of movement. AVFAudio describes the actual input path. Vision can turn a photographed display into a candidate numeric reading. The ballistic engine then consumes those measurements in the same coordinate and unit system used by the rest of the application.

One sensor layer, several practical workflows

- Cut Chart Solver combines a known line-of-sight distance with the measured aiming angle and the active bow-arrow model.
- Chrono scanning reads a radar or optical chronograph display, checks the unit and plausible range, and asks the archer to confirm rather than retype the result.
- Phrono records the phone geometry, active microphone route and signal-quality context used to detect the bow shot and target impact.
- Stability gating prevents a transient measurement from being accepted while the phone is still moving or its attitude is changing rapidly.

The central rule
Smart sensing should reduce unknowns, not hide them. BowPro+ records what the device actually reported, exposes confidence and validation states, and falls back gracefully when a capability is unavailable.

Local-first intelligence remains an advantage

Camera analysis, motion processing, audio-event detection and ballistic calculation can all occur on the device. This keeps the workflow usable offline and off-grid, avoids a critical server dependency, and lets BowPro+ retain only the derived measurement data the archer chooses to save.

BOWPRO+ CAMERA AND MOTION WORKFLOW

Point, Hold, Measure the Geometry

Cut Chart Solver uses the camera axis and gravity-referenced attitude to turn a known line-of-sight distance into a bow-specific angle solution.

The Cut Chart Solver is a good example of a smart-device feature that remains technically disciplined. The phone does not need to pretend it is a rangefinder. The archer supplies or confirms the line-of-sight distance, points the camera reticle at the target, and holds the device steady. BowPro+ then measures the direction of that sight line relative to gravity and passes the resulting distance-angle pair to the ballistic engine.

1. The camera defines the intended line of sight

A centered reticle gives the user an explicit aiming axis. The camera preview makes alignment visible, while the app accounts for the current device orientation and the camera-to-device coordinate relationship. Focus, exposure and reticle placement can be monitored so the captured frame represents the target the archer actually selected rather than an arbitrary phone tilt.

2. Core Motion defines attitude and steadiness

Core Motion provides sensor-fused device motion, including attitude, gravity, rotation rate and user acceleration. BowPro+ can derive pitch and cant from the gravity vector or quaternion, average a short stable window, reject outliers and require the phone to remain below movement thresholds before accepting the angle. This is more robust than reading a single raw accelerometer sample.

Signal or input	BowPro+ use	Quality control
Camera frame and reticle	Defines the target-facing ray used by the workflow.	Require visible reticle alignment; monitor focus and exposure.
Gravity-referenced attitude	Provides uphill/downhill angle and device cant.	Average a stable window; normalize for interface orientation.
Rotation rate and user acceleration	Shows whether the phone is still moving.	Delay capture or reduce confidence until movement settles.
AR camera transform and tracking state, where used	Provides an additional camera-pose and tracking-quality check.	Use only while tracking is normal; degrade to Core Motion when limited.
Known line-of-sight distance	Supplies the scale required by the ballistic calculation.	Validate unit, range and plausibility before solving.

3. The ballistic engine produces the cut

The measured angle is not the final answer. BowPro+ solves the selected arrow trajectory, sight geometry and atmosphere for the actual inclined shot. The output can be a corrected sight setting, equivalent mark or cut-chart entry. This avoids treating every angle as a universal cosine correction and keeps the result specific to the active equipment setup.

What “smart” does not mean

BowPro+ does not claim that one camera image can determine an unknown target distance. It also does not assume that the screen plane, phone case, camera optical axis and microphone axis are interchangeable. Every coordinate transform must be explicit.

Camera-assisted Chrono data entry

The same camera can remove another common source of error: manual transcription. Vision text recognition can locate and read the velocity shown on a Garmin or other chronograph display, return a confidence value and bounding box, and let BowPro+ apply archery-specific checks for expected units and plausible speeds. The user remains the final confirmer, but the app performs the repetitive reading and validation locally.

Technical basis: Apple Core Motion device-motion data; ARKit camera pose and tracking state; Vision on-device text recognition.

BOWPRO+ AUDIO INSTRUMENTATION

The Microphone Is Not an Abstract Point

Phrono accuracy improves when BowPro+ knows which input is active, where it points, how the phone is held and how that device behaves.

Phrono estimates arrow speed from the interval between the bow-shot transient and the impact transient, corrected for the known shooting geometry and sound propagation. The audio waveform is therefore only one part of the measurement. The physical location of the receiving microphone, the directionality of the active input, the phone attitude and the audio route all influence how clearly the two events appear and how confidently their onset times can be detected.

Geometry first, signal processing second

The speed of sound is not changed by rotating the phone, but the recorded evidence can be. Rotation may select or favor a different built-in microphone, point a directional pattern away from the bow or target, change shielding by the case or user, and alter the signal-to-noise ratio of one transient relative to the other. BowPro+ should therefore separate physical path correction from detection quality: microphone position changes the path length; microphone attitude mainly changes how reliably the arrival is observed.

Device context	Why it matters	BowPro+ response
Current audio route and input data source	Distinguishes built-in, headset, USB and other inputs and identifies which source is active.	Store the route; warn, reject or use a matching profile when the route changes.
Microphone location, orientation and polar pattern	Describes where the source sits on the device and the directionality the system exposes.	Apply the correct physical offset and choose detector weighting or guidance for phone placement.
Measurement audio-session mode	Minimizes system-supplied signal processing and uses a measurement-oriented input path.	Configure before capture and record the active mode in diagnostics.
Actual sample rate and I/O buffer duration	Defines the realized audio time base and buffering context, not merely the requested values.	Timestamp from the captured sample stream and preserve the actual hardware configuration.
Core Motion attitude and stability	Shows whether the phone was pointed as instructed and remained stationary during the shot.	Gate acceptance, calculate orientation statistics and explain reduced confidence.
Device model, OS and algorithm/profile revision	Makes hardware and software behavior reproducible across measurements.	Select a versioned empirical profile or fall back to conservative generic settings.

Device-specific calibration without magical constants

A device profile should be earned through controlled testing, not invented from a model name. Repeated recordings against a trusted chronograph can reveal stable differences in transient shape, noise floor, usable frequency bands and onset-detection bias for a particular hardware and audio-route combination. A versioned profile can then tune detector thresholds, band weighting, expected latency behavior and confidence limits. Unknown or changed configurations should use the generic path until enough evidence exists.

A better accepted-shot record

When the archer accepts a Phrono result, BowPro+ can retain the derived velocity together with the measurement context: shooting distance, phone offset, target direction, active audio route, data-source description, sample rate, buffer duration, attitude statistics, signal metrics, selected device profile and algorithm revision. Raw audio can still be discarded after analysis. The result is more reproducible without weakening the local-first privacy model.

Result

The device becomes a guided instrument rather than an unexplained sensor box. BowPro+ reduces setup mistakes, improves automatic quality control, makes calibration data portable between sessions and can explain why one measurement deserves more confidence than another. The phone is smart only when the software understands the coordinate system, active hardware path, measurement limits and uncertainty behind each reading - making sophisticated physics easier to operate without making the physics disappear.