THE HAWK-EYE
TENNIS COACHING SYSTEM
INTRODUCTION

The Hawk-Eye Tennis Coaching System described in this document is the most technologically advanced tennis coaching system in the world. It represents a significant step forward from anything previously used in tennis coaching. The system builds on Hawk-Eye’s four years of experience of tennis ball-tracking for television and Official Review purposes, as well as the coaching expertise of creating two of the most technologically-advanced cricket systems in the world at the National Indoor Cricket Academy in Loughborough and the ECB Indoor School at Lords.

Hawk-Eye Coaching Systems provide valuable information to players, coaches and umpires to enable them to identify faults, measure performance, and improve tactical and technical awareness with a level of realism never before achieved. This will not only vastly improve the players’ levels of performance, but will also provide a commercial opportunity to generate revenue.

The Hawk-Eye Tennis Coaching System provides in-depth analysis of individual strokes, rallies and match play via customised, user-friendly software. Hawk-Eye’s signature ball-tracking technology can also be synchronised with high quality coaching cameras: this combination of Hawk-Eye Tracking and Video Replay Cameras allows users to see ‘how’ a player has performed and then determine ‘why’.

Hawk-Eye has become a standard component of all major tennis events throughout the world. Its use in television production and as the Official Replay System has created an unparalleled bank of data to which users of the Hawk-Eye Tennis Coaching System will have privileged access. By comparing their own data with that of the top professionals, athletes will be able to visualise the levels that are necessary to fulfil their own goals.

Hawk-Eye has earned a reputation for being alert and proactive in responding to its customer’s needs. This dedication to strong relationships with its clients will continue with Hawk-Eye’s commitment to its Tennis Coaching Systems: Hawk-Eye personnel will work alongside new clients to produce customised systems geared to allowing users to get the maximum value from their data.
SYSTEM DESCRIPTION

TRACKING AND VIDEO REPLAY CAMERAS

The Hawk-Eye Coaching System comprises of two main elements: a Tracking System and a Video Replay System. The Video Replay System offers the optional component of a high-speed camera, which can provide more in-depth biomechanical analysis.

Tracking System

High speed vision processing cameras track all the balls hit during match play or drill situations.

An operator or coach will enter the athletes’ names and activate the system via a Tablet PC. The same Tablet PC can be used to log subjective statistics such as winners or unforced errors. This method isolates the tracking information and will allow the coach to be on court; coaching and not spending unnecessary time operating a PC.

The system will automatically calculate the following information:

- The speed of the ball leaving the racket (first, second serve or a groundstroke).
- The reaction time for the receiver (first or second serve).
- The topspin, sidespin and/or backspin imparted on the ball during a serve or groundstroke.
- Where the ball bounced during a serve, groundstroke or volley.
- From where the returns have been played (first or second serve).
- Where the returns have landed (first and second serve).
- First serve percentage, first serve points won and second serve points won.
- The height of ball over the net during a groundstroke or serve (see Figure 1).

All of this information will be stored in the system’s unique archive facility. A simple-to-use interface will be provided so that a non-technical person can interrogate the information in a number of different ways, with the data being displayed numerically and graphically.
Video Replay System

Whilst the tracking data provides coaches and players with the information for HOW they have performed, it only partly answers the question of WHY. For this, a Video Replay System is an important tool. Hawk-Eye has installed Video Replay Systems at its cricket academies and feedback shows that coaches find it simple to operate and extremely beneficial.

Each individual camera’s field of view can be controlled remotely from the Analysis Suite (see Figure 3), or programmed to specific presets depending on the activity that is being analysed. The video will be captured, synchronised and stored digitally on hard disk and in the Video Archive. This, in turn, will be connected to the customer’s network, which means that users with access to a networked PC can see their data from anywhere around the world.

Several features for replaying the video will be provided:

- Continuous delayed feedback (approx. eight seconds behind the live action).
- Record and find mechanism
- Play forwards and back at any speed, including a frame in advance.
- A direct link between tracking information and the relevant piece of video.
- Half and split screen options to show up to four cameras on one screen.
- Cameras with high shutter speeds so that images are clear without any motion blur.
- Archived data in formats compatible for use on other biomechanical software, e.g. Silicon Coach.

Digital Recorders

The Hawk-Eye Coaching System incorporates digital recorders which provide users with the facility to save up to 800 hours of video footage. Users can then copy Hawk-Eye data to CD or to the central archive facility. This can be given to players for analysis purposes or when they return to their specific training locations via the LAN connection.
OPTIONAL EXTRAS

Although the Hawk-Eye Tennis Coaching System is an effective and comprehensive system in its own right, experience has shown that customers like the “optional extras” that Hawk-Eye is pleased to offer. Interactive replay monitors and tablet PCs, for example, make the system even more user-friendly: helping customers to get the very best from the Hawk-Eye technology.

Interactive Replay Monitors

The Hawk-Eye System can include 42” touch screen monitors, which allow users to review their performance eight seconds after it has taken place via an easily-accessible format. The Interactive Video Replay Screen comes complete with a laptop that will have access to the full range of Hawk-Eye software. Users will be able to find their relevant clip and benefit from split and full screen options. Coaches can draw in digital ink over replays, illustrating concepts and technical points.

Tablet PCs

The Tablet PC will provide a manual logging system for the on-court coach. In addition to the standard tracking data, the coach can log statistics such as winners or unforced errors. By adopting a Tablet PC, Hawk-Eye is expressing its commitment to making its technology as simple to operate as possible. This means the coach can spend more time coaching and interacting with his or her players.

High Speed Biomechanical Video Analysis

The Video Replay system provides important information to answer many questions during the analysis of technical, tactical and behavioural aspects of the game. The use of a high-speed video camera, however, adds a further dimension.

As a tennis shot takes only a fraction of a second, it is important to be able to analyse a player’s technique in ultra slow motion. The CamRecord 600 is a state-of-the-art, compact and easy to use High-Speed CMOS camera. It can operate at up to 500 frames per second, whilst the high resolution (1280 x 1024 pixels) of its sensor will ensure that every detail of the athlete’s shot or serve is recorded.

The CamRecord600 comes with a laptop offering access to the software in the Analysis Suite. This flexibility will allow users to record and review data within seconds, utilise the camera anywhere in the academy and provide the opportunity to link its usage to other biomechanical software.
SOFTWARE

Video Replay Cameras

Users can control the Video Replay cameras remotely from the Analysis Suite or via the On-Court Interactive Replay Screen. The images can then be stored on the Digital Recorders, copied to disk or saved on the Video Archive System.

The images from the Video Replay cameras can also be viewed in a variety of ways. Wireless networks will allow coaches to monitor their player’s performance from a location outside the Analysis Suite, whilst the Interactive Video Replay Screen in the Court Area will permit the athlete to view his or her performance eight seconds after the event occurred.

As the print screens below show, the user can access a number of different images at any one time, thus benefiting from our half, split and full screen options.

![Figure 4: Full Screen Option](image)
Statistics Package

The Hawk-Eye Statistics Package is a further tool in helping users to analyse the raw data. It produces illustrative graphics, whilst it is also useful in integrating the tracking data with the video images.

![Figure 7: Cricket Example of the Hawk-Eye Statistical Package](image)

In the screen shot shown in Figure 7, for example, users could click on any ball in the left hand screen and be taken to the corresponding video image. The tennis equivalent will be developed according to your specification and will be updated upon your recommendations.

Virtual Reality Software

The Hawk-Eye Virtual Reality Software offers users the opportunity to review their data in a number of different forms and to see a full 3D shot of every shot. Easy to use and highly accessible, the programme takes the recorded trajectories and displays them in easily-digestible forms.

![Figure 8: Henman Return Hit Point](image)
The aim of the system is to make all elements as user-friendly as possible. In the immediate month after installation, there will be close communication and numerous visits to ensure that:

(a) The system is working according to the information detailed above;

(b) Specific software changes are made in order to assist those using the system on a daily basis.

Once this initial training period is over, ongoing support will be provided. On the whole, this will be provided via telephone, but a Hawk-Eye staff member will be available on-site if a problem occurs. Coaches’ feedback is welcomed in order to improve the system, with software changes being made to satisfy their requirements.

An annual training day will also be included within the agreed price. This will allow new staff and pupils to master all aspects of the system.

All Intellectual Property within the coaching system will remain entirely owned by Hawk-Eye Innovations Ltd.

CONTACT US

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