Methodology for Determining an Individual's Height without Auxiliary Tools

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ABSTRACT

Height estimation of a person or object from a single 2D image presents significant challenges due to the absence of depth information, perspective distortion, and varying camera angles. Without a known reference scale or controlled environment, traditional measurement methods often yield unreliable results. Factors such as lens distortion, subject posture, and uneven terrain further complicate the process. This study investigates practical techniques using Adobe Photoshop's superimposition and scaling tools to overcome these limitations. By leveraging reference objects, perspective correction, and pixel-based measurements, the research aims to develop a systematic approach for height approximation in forensic analysis, architectural visualization, and digital photography. The goal is to establish a cost-effective, accessible solution that balances accuracy with real-world applicability while acknowledging inherent constraints of single-image photogrammetry.

INTRODUCTION

In forensics, estimating the height of a person from limited visual evidence—such as single or few images captured by random mobile phones, CCTV footage, or other uncontrolled sources—poses significant challenges for experts. Unlike controlled

environments, these images often lack reference scales, have varying resolutions, and suffer from perspective distortions due to unknown camera angles and lens properties. Additionally, factors like poor lighting, occlusions, and non-standard postures further complicate accurate height approximation (Gouse *et al*., 2018; Thakkar *et al*., 2022).

Traditional photogrammetric methods require multiple images or calibrated cameras, which are rarely available in such scenarios. Consequently, forensic experts must rely on improvised techniques using available visual data, often leading to approximations with considerable margins of error (Aber *et al*., 2010). This study explores practical solutions to enhance height estimation accuracy from such constrained sources, leveraging digital tools like Adobe Photoshop for perspective correction, reference scaling, and pixel-based measurements. The goal is to develop a reliable, accessible methodology that aids forensic analysis while acknowledging the inherent limitations of uncontrolled image sources (Gouse *et al*., 2018; Pedersson, 2018).

Anthropometric measurements — the systematic quantification of human body dimensions play a pivotal role in forensic science, security, and identity verification. Unlike transient features (e.g., clothing) or invasive methods (e.g., DNA), anthropometry offers a non-invasive, cost-effective, and immediate means of distinguishing individuals. Its significance spans multiple domains like forensic investigations (suspect identification, mass disaster), Security and Surveillance (Behavioural analysis, cross-border security) (Pedersson, 2018; Klepinger, 2006).

Alphonse Bertillon pioneered the first scientific criminal identification system in 1883, revolutionizing forensic science. His anthropometric system, called "bertillonage," relied on precise body measurements like skull diameter and limb lengths. Bertillon established that adult skeletal dimensions remain stable, making them reliable identification markers. He introduced standardized photography protocols for mugshots - front and profile views still used today. His system included detailed physical description methods (portrait parle) of scars, tattoos and peculiarities. Bertillon created the first systematic crime scene documentation techniques using photography and measurements (Gouse *et al*., 2018; Klepinger, 2006; Sabliov *et al*., 2002). He demonstrated that careful record-keeping could establish repeat offenders' identities before fingerprinting became dominant. Bertillon's filing system organized records by measurement categories for efficient retrieval - a precursor to modern databases. While replaced by fingerprints, his principles formed the foundation of modern biometric identification systems. Bertillon's legacy endures in forensic photography, criminal record-keeping, and the science of anthropometric identification (Klepinger, 2006).

Figure (A)

Methodology

The height estimation process was initiated using a complex outdoor setting containing multiple uncalibrated objects - chair, door, wires and wall - none of which possessed standard geometric markings or known dimensions. For initial testing, a subject was positioned adjacent to the wall to establish a potential vertical reference. However, the absence of measurable gradations on the pole's surface and the irregular background elements introduced significant challenges in establishing an accurate scale.

To improve measurement reliability, a subsequent image of the identical background was captured after systematically marking the wall at 5-centimeter intervals up to 200 centimetres. This modification created a calibrated reference scale within the same environmental context. The marked wall served multiple purposes: providing direct measurement indicators, enabling perspective correction by establishing known vertical intervals and facilitating comparison between the unmarked and marked scenarios to assess measurement accuracy.

Figure (B). The subject appears to be standing upright; however, the absence of reference objects or scale markers prevents accurate assessment of dimensions.

Figure (C). Perfect superimposition of the image with the person onto the marked background image results in precise spatial correspondence

This two-phase approach demonstrates a practical field method for converting unstructured environments into measurable spaces. The technique proves particularly valuable for forensic applications where investigators must work with existing scene elements rather than controlled laboratory conditions. The comparative analysis between unmarked and marked scenarios also helps quantify the margin of error inherent in improvised field measurements, providing crucial data for evidentiary reliability assessments.

The height estimation process employed an advanced superimposition technique in Adobe Photoshop, utilizing two photographs of the same scene: one featuring a subject standing before an unmarked wall, and another identical shot with the wall marked at precise 5-centimeter intervals up to 200 centimetres. Using Photoshop's ruler tool and layering capabilities, investigators meticulously aligned both images by matching permanent background elements such as chair, wire patterns, and wall textures, ensuring pixel-perfect registration (Sabliov *et al*., 2002;

Fornaro *et al*., 2009). This precise superimposition allowed the measurement scale from the marked reference image to be digitally transferred to the original photograph containing the subject. The process involved careful opacity adjustments and perspective corrections to compensate for any minor camera angle variations between shots. By maintaining perfect alignment of static environmental features, the method effectively transformed the ordinary wall into a calibrated measurement tool without altering the original evidentiary photograph (Aber *et al*., 2010; Kamble *et al*., 2024).

CONCLUSION

This Photoshop-based approach proved particularly valuable for forensic analysis of surveillance footage and crime scene images where traditional measurement references were absent, providing investigators with a reliable, non-destructive technique for accurate height estimation. The digital superimposition method not only preserved the integrity of original evidence but also minimized human error in manual measurements, offering court-admissible results through standardized software tools while overcoming common challenges of perspective distortion and environmental clutter in real-world photographic evidence.

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