AN INVESTIGATION INTO THE ACCURACY AND RELIABILITY OF SKULL-PHOTO SUPERIMPOSITION IN A SOUTH AFRICAN SAMPLE

BY

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DECLARATION

I declare that this thesis is my own unaided work. It is being submitted for the degree of Doctor of Philosophy at the University of Pretoria, Pretoria. It has not been submitted before for any degree or any examination in any other University.

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Abstract

One of the aims of forensic sciences is to determine the identities of victims of crime. In some cases the investigators may have ideas as to the identities of the victims and in these situations, ante mortem photographs of the victims could be used and identities established through skull-photo superimposition. The aim of this study was to evaluate the accuracy of a newly developed digital photographic superimposition technique on a South African sample of cadaver photographs and skulls, from the Pretoria Bone Collection.

Forty facial photographs were selected and for each photograph, 10 skulls (including the skull corresponding to the photograph) were used for superimposition. The investigator did not know which of the 10 skulls corresponded to the photograph in question. The skulls were scanned 3-dimensionally, using a Cyberware™ Model 3030 Colour-3D Scanhead scanner. Once scanned, the raw data for the skulls were 'cleaned' using Cysurf™ programme. The photographs were also scanned for superimposition in the 3D Studio Max programme. Superimposition in 3D Studio Max involves a morphological superimposition, whereby a skull is superimposed over the photograph and assessed for a morphological match. Superimposition using selected anatomical landmarks was also performed to assess the match.

A total of 400 skull-photo superimpositions were carried out using the morphological assessment and another 400 using the anatomical landmarks. In 85% of cases the correct skull was included in the possible matches for a particular photograph using morphological assessment. However, in all of these cases, between zero and three other skulls out of 10 possibilities could also match a specific photograph. In the landmark based assessment, the correct skull was included in 80% of cases. Once again, however, between one and seven other skulls out of 10 possibilities also matched the photograph. When using the morphological and landmark assessments combined, 97.5% of correct skulls were included in the list of possibilities, but between one and seven false positives per case were found.

This study indicates that skull-photo superimposition has limited use in the identification of human skeletal remains, but may be useful as an initial screening tool. Corroborative techniques should also be used in the identification process.

Abstrak

Een van die doelwitte van forensiese wetenskap is om die identiteit van slagoffers van misdaad te bepaal. In sommige gevalle het die speurders ‘n idee van die identiteit van die slagoffer en in sulke gevalle kan voordoodse fotos van die oorledene gebruik word om deur middel van skedel-foto-superimposisie die slagoffer te identifiseer. Die doelwit van hierdie studie was om die akkuraatheid van 'n nuwe digitale foto-superimposisie tegniek op 'n Suid-Afrikaanse groep van kadawer fotos en skedels uit die Pretoria Beneversameling te evalueer.

Veertig fotos van gesigte is gekies en vir elke foto is 10 skedels (insluitende die foto wat ooreenstem met die skedel) gebruik vir superimposisie. Die navorser het nie geweet watter van die 10 skedels ooreenstem met die betrokke foto nie. Die skedel is met 'n Cyberware™ Model 3030 Colour-3D Scanhead in drie dimensies geskandeer. Na skandering is die rou data van die model met Cysurf™ sagteware skoongemaak. Die fotos is ook geskandeer vir superimposisie met die 3D Studio Max program. Superimposisie in 3D Studio Max behels 'n morfologiese superimposisie, waar die skedel oor die fotos geplaas is en geëvalueer is vir morfologiese ooreenstemming. Superimposisie met die gebruik van geselekteerde anatomiese landmerke is ook gedoen om die ooreenstemming te evalueer.

'n Totaal van 400 skedel-foto-superimposisies is gedoen met gebruik van morfologiese evaluasie en ‘n verdere 400 is gedoen met gebruik van anatomiese landmerke. In 85% van die gevalle was die korrekte skedel ingesluit in die moontlike ooreenstemmings met ‘n spesifieke foto, waar morfologiese evaluering gedoen is. Maar, in al hierdie gevalle kon tussen nul en drie ander skedels uit 10 moontlikhede ook met ‘n spesifieke foto ooreenstem. Met die gebruik van die landmerk assessering, was die korrekte skedel in 80% van die gevalle ingesluit. Maar weerens, het tussen een en sewe ander skedels uit 10 moontlikhede ook met ‘n spesifieke foto ooreengestem. Waar die morfologiese en landmerk evaluasie tegnieke gekombineerd gebruik was, was 97.5% van die korrekte skedels ingesluit in die lys van moontlikhede, maar daar was tussen een en sewe vals positiewe per geval gevind.

Hierdie studie dui daarop dat skedel-foto-superimposisie beperkte aanwending vir die identifikasie van menslike oorskot het, maar wel nuttig kan wees as ‘n aanvanklike siftingsmetode. Stawende tegnieke moet ook gebruik word in die identifikasie proses.

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