(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
21 January 2010 (21.01.2010)

PCT

(10) International Publication Number
WO 2010/007430 A1

(51) International Patent Classification:
G06K 9/00 (2006.01) *H04N 1/00* (2006.01)

(21) International Application Number:
PCT/GB2009/050859

(22) International Filing Date:
15 July 2009 (15.07.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0812897.7 15 July 2008 (15.07.2008) GB

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

(54) Title: SHOEPRINT IDENTIFICATION SYSTEM

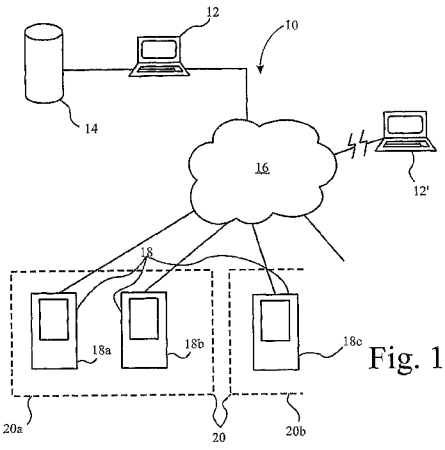

Fig. 1

(57) Abstract: A shoeprint identification system (10) comprises a central computer (12) including a central database (14) of known shoe types and key data applying to said shoe types, and crimes at which shoe imprints existed and key data applying to said shoe imprints. A plurality of remote identification units (18 are located in geographically spaced custody suites, each custody suite identification unit comprising a scanner (18) to scan a suspect's shoeprint image to produce a scanned image; a processor (48) to process the scanned image according to an algorithm to provide key data in respect of the scanned image; a custody unit database (46b) of known shoe types and key data applying to said shoe types; a custody unit database (46c) of crimes at which imprints of known shoe types existed; a comparator to compare the image key data against the key data in said custody unit database to provide one of three results: iv) no match; v) exact match; or vi) a number of possible matches, between said suspects' shoeprint image and said known shoe types. The custody suite databases (46a, b,c) are limited in the shoe types contained therein to sets of the shoe types typically worn by people in the local area of the custody suite and identified at local crime scenes, such that different custody suite databases include different data from each other and substantially less data than said central database.

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Shoeprint Identification System

This invention relates to a system for identification of shoeprints in connection with crime investigation.

BACKGROUND

It is well known that shoes provide distinctive imprints at crime scenes and that they have substantial evidential value. That value is both in terms of detecting criminals, as well as in convicting criminals, although, because shoes can be taken off and worn by other people, their value in providing incontrovertible evidence is generally not the same as finger print or DNA evidence. However, in identifying suspects for further investigation, the value of shoeprint evidence cannot be underestimated.

Generally, criminals are careful not to leave fingerprints, and they may be able to avoid leaving DNA identifying samples. However, even if they do leave fingerprints or DNA samples at a crime scene, the investigating team need to find a suspect against whom they can compare the evidence found at the scene. Comparison of DNA and fingerprint evidence against samples taken from suspects is time consuming, although ultimately may provide the best evidence of a connection between a suspect and a crime scene. However, it does not quickly advance an investigation, and time is often of the essence in, for example, extracting confessions or admissions of guilt from suspects. Furthermore, the reality of crime is that there are frequently suspects without a crime. That is to say, people may be arrested for one reason or another on suspicion of having committed a crime, but which crime may not immediately be known. Indeed, there may be many crimes committed by an individual that have yet to be solved. If a suspect could be confronted soon after arrest with a list of crimes in which there is some reasonable probability that the suspect was involved, this might enable investigating officers to pinpoint their investigation and questioning and clear up a substantial number of crimes. For example, if a person is found guilty of committing a crime at which a certain pair of shoes were worn and the same shoes were worn at a number of other crimes, this may not be sufficient evidence in respect of any one of those crimes to lead to a conviction, but may be more than enough to treat the relevant crimes as solved.

As mentioned above, there are numerous known methods and techniques for analysing shoeprint images and providing key data in relation to them that can be stored and subsequently correlated against data taken from other imprints in order to provide a possible match. EP-A-877990, EP-A-1125244, GB-A-2432029, CN-A-1936922 and CN-A-1776717 all disclose methods of analysing and identifying shoe prints. Similar identification problems exist with fingerprint and retina identification and US-A-20040114785 and GB-A-1593001 deal with them.

However, it is an object of the present invention to provide police in custody units with a system that enables the police quickly to identify a list of crimes in which a suspect might have been involved, firstly by identifying the shoe type that the suspect is wearing when arrested, and secondly by identifying crimes at which imprints were found that were made by that shoe type.

BRIEF SUMMARY OF THE DISCLOSURE

In accordance with the present invention there is provided a shoeprint identification system comprising a custody suite identification unit comprising:

a) a scanner to scan a suspect's shoeprint image;
b) a processor to process the image according to an algorithm to provide key data in respect of the image;
c) a database of known shoe types and key data applying to said shoe types;
d) a database of crimes at which imprints of known shoe types existed;
e) a comparator to compare the image key data against the key data in said data base to provide one of three results:
    i) no match;
    ii) exact match; or
    iii) a number of possible matches,

between said suspects' shoeprint image and said known shoe types

characterised in that

said database is limited in the shoe types contained therein to a set of the shoe types typically worn by criminals in the area of the custody suite and/or identified at local crime scenes.

By the term "shoeprint image" is meant the impression left when, for example, a wet shoe is walked on a flat surface – or what typically is left behind when someone walks

on soft ground wearing shoes. An existing and common method to obtain an impression of a shoeprint is to coat the outsole with a vegetable oil and then place the shoe on sensitised paper to obtain a permanent "inked" image. Thus shoe print image is any visual representation of the impression left by a shoe in these circumstances. The image may equally be obtained by photography, direct scanning and other three dimensional imaging techniques.

The terms "in the area of the custody suite" and "local crime scenes" define a distinction with a larger area and locality respectively. In the United Kingdom, the area of a custody suite might reasonably be the area covered by a given police force, and local crime scenes might be construed accordingly, whereas a larger database might cover the entire country. Similar considerations would apply in other jurisdictions. These definitions are therefore necessarily imprecise at their limit or boundary and in respect of particular applications, but a purposive construction of the limitation, bearing in mind the fundamental technical problem underlying the present invention, enables a person skilled in the art to understand the limits of the invention. Thus, the problem underlying the present invention is to produce no more than a few potential matches between the suspect's shoeprint and known shoe types, if an exact match is not possible, and so that custody suite officers not skilled in forensic analysis can screen the potential matches quickly. This is based on the premise that, while an absolute forensically reliable identification, possibly even down to the level of isolating a particular shoe and its imprint at a crime scene, may be desirable and ultimately necessary in the fullness of time, this is not what is practically possible in a local police station, potentially isolated from outside assistance in the event of a communication failure. Instead, the database is restricted in geographical area to the locality where crimes take place and local criminals live and operate. It necessarily ignores the rare occasions when criminals come from outside the local area, or wear shoes that are not common in the local area or have been used in crimes in the local area. Thus the database is much smaller than a wider or fuller database that could and does exist of the same data. Indeed, the database will be only in exceptional situations be the same as the database in the same system of the present invention employed in a different custody suite in a different geographical area.

Thus, said database is deliberately not a complete database of known shoe types. Indeed, many known shoe types will be explicitly excluded from the database. The reason for this is as explained above, namely that the process of comparing data is

necessarily time consuming. But more importantly than that, it is not an exact science. The probability of an exact match is always limited; it is more likely that there are a number of shoe types that have key data matching the key data of the suspect's shoe. Consequently, the third option that a number of possible shoe types may be presented to the officer in charge of the custody suite is most likely in many situations. If the number of possible matches presented by the system is small, a manual comparison of the suspect's shoeprint image with images of the possible matches enables a quick identification of the closest match, and potential identification of an exact match, with the shoe type in question. Of course, the human mind is capable of correctly identifying patterns much more efficiently than a simple, or even a complex, algorithm.

Accordingly, the database preferably includes images of the shoe types for which it has key data and the identification unit further includes a display device whereby shoeprint images of possible matches can be displayed. Preferably, the unit also includes means to display the suspect's shoeprint image simultaneously with display of the images of possible matches whereby a manual visual comparison can be made.

Preferably, said database includes details of crimes at which shoeprint evidence has been identified and matched to specific shoe types, and said unit provides a list of crime identification information, at least in respect of a shoe type corresponding with said exact match. Preferably, said crime identification information includes images of shoe imprints obtained from the respective crime scenes, whereby officers in the custody suite may make an initial comparison to see if the suspect's shoeprint image is an exact match, not just for the shoe type, but for the actual shoe whose imprint appeared at the relevant crime scene. Such circumstantial evidence would be highly suggestive that the suspect was involved in the relevant crime and lead the police to investigate closely the relevant circumstances.

Preferably, said identification unit includes user input means to enable operation of the system, including means to select one of the images corresponding with said number of possible matches as an exact match.

Preferably, said identification unit includes user input means to enable operation of the system comprising a touch sensitive screen. Preferably, said processor displays a menu of user options on said touch screen.

Preferably said identification unit comprises a secure casing resistant to manual abuse by a violent but unarmed assailant. In a custody suite, suspects may be violent but are unlikely to have access to any weapon. It is desirable that equipment within their potential reach is resistant to abuse. Preferably, means enable said identification unit to be secured in place, so that it is not capable of itself being employed as a weapon. Said means may comprise holes in a base of the unit through which bolts may connect the unit to a fixed surface.

Preferably, said scanner is a double-sided scanner to scan simultaneously both sides of a sheet bearing said suspect's shoeprint image. The reverse side of said image may include bibliographic information including signatures of police staff and possibly the suspect. The image sheet provides the primary evidence relating to the footwear of the suspect at the time of his or her arrest. However, a contemporaneous scan of the image, particularly using a double-sided scanner provides secondary evidence that may be useful in the event of loss of the primary evidence or in any event. Preferably, the identification unit includes electronic security features hampering electronic tampering of the scanned image. Preferably, said security feature includes a time and date stamp of the time and date at which the scan was taken. Indeed, in time, formats may be standardised and machine readable, so that the scanner digitises and possibly encrypts not just bibliographic details entered on the image but the image itself.

Preferably, said unit includes communication ports, whereby the scanned image may be transferred to another computer at a remote location for comparison against a fuller database of shoe type images and key data. Indeed, said remote computer may be in more sophisticated computer environments, involving more esoteric and complex algorithms, which may be employed both to analyse the suspect's shoeprint image and produce further key data, as well as to compare key data. Such an arrangement may be required in the event that the suspect's shoeprint image is not an exact match with any of the shoeprint images on the database. This is an interesting conclusion in its own right, suggesting that the suspect is not necessarily a resident of the local vicinity. Instead, by comparison with a fuller database using more information and comparison criteria, an exact match may become possible to find. Nevertheless, with a much larger database of shoes, although a match might ultimately be found, it is likely that several, and possibly many, potential matches might be identified. In this event, a painstaking manual comparison might subsequently be needed. Such a process is inevitably time consuming and in the normal course of events may require several days to be

completed. A particular reason for that is the necessary involvement of humans in the process that introduce delays caused by working patterns etc. By the time such a process is completed, it will certainly be too late to spring on a suspect what might be surprising possibilities regarding previously recorded crimes and to which explanations have not yet been concocted (in those cases where the suspect is the guilty party, of course).

Preferably, said scanner has an opening accessible to the outside and through which the sheet on which said shoe imprint image is formed is fed, the sheet preferably dropping into a lockable compartment after scanning where it is securely retained until it is removed under satisfactory conditions for preserving the evidential value of the imprint sheet.

Thus the present invention provides a simple, relatively low-cost, arrangement for installation in every custody suite in a given jurisdiction. Custody suites are areas of police stations in which suspects arrested in connection with particular circumstances are held and questioned in the furtherance of the enquiries of the police. All sorts of suspects are held in such suites and sometimes they are violent and abusive. Police are authorised to take fingerprints and DNA samples from suspects, as well as shoe imprints. While the former may be conclusive in relation to a particular suspect and a particular crime, they are not necessarily very good for matching suspects and crimes when there is no other connection between them. Certainly, this is true in the immediate aftermath of an arrest. On the other hand, shoeprint information can quickly connect shoes worn by a suspect with crimes committed (in the event that the suspect when arrested happens to be wearing the same shoes that he or she was when committing a crime). However, the benefit in connecting suspects with crimes is most effective when it can be done quickly. Since most crimes are conducted by criminals local to the crime scenes, and since many shoe sole patterns known to the police and contained in relevant databases are not at all common in given localities, the present invention seeks to maximise the possibilities of a quick and easy match by eliminating many most likely irrelevant shoeprints from the identification unit of the present invention. This, in turn, means that the storage capacity (for the database) of the identification unit can be maintained within reasonable size and cost boundaries, which means that the system can be installed in each custody suite and, at least in this first-pass system, is not dependent on an external link to a central database. Rather, it is a stand-alone tool, although clearly it preferably does also have the capacity to

communicate with a remote central computer to upload suspect shoeprint image information for more detailed examination.

In another aspect, therefore, the present invention provides a shoeprint identification system comprising:

a central computer including a central database of

1. known shoe types and key data applying to said shoe types, and

2. crimes at which shoe imprints existed and key data applying to said shoe imprints; and

a plurality of remote identification units, one each located in geographically spaced custody suites, each custody suite identification unit comprising:

a) a scanner to scan a suspect's shoeprint image to produce a scanned image;

b) a processor to process the scanned image according to an algorithm to provide key data in respect of the scanned image;

c) a custody unit database of known shoe types and key data applying to said shoe types;

d) a custody unit database of crimes at which imprints of known shoe types existed;

e) a comparator to compare the image key data against the key data in said custody unit database to provide one of three results:

i) no match;

ii) exact match; or

iii) a number of possible matches,

between said suspects' shoeprint image and said known shoe types,

characterised in that

the custody suite databases are limited in the shoe types contained therein to sets of the shoe types typically worn by people in the local area of the custody suite and identified at local crime scenes, such that different custody suite databases include different data from each other and substantially less data than said central database.

Preferably, said central computer communicates with said custody suite identification units to upload said scanned image of the suspect's shoeprint image and/or the key data in respect of the scanned image. Such communication would be, inter alia, for the purpose of providing a match with a known shoe type if the custody suite identification unit had not itself produced a match or to confirm the match made by custody suite identification unit, particularly if the latter employs less sophisticated algorithms for

making a comparison and/or to identify crime scenes at which shoe imprints existed corresponding with said matched shoe type and/or at which shoe imprints existed which are a specific match with said scanned image.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention are further described hereinafter, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic illustration of an overall system in accordance with the present invention;

Figure 2 is a front view of a custody suite identification unit in accordance with a more specific embodiment of the present invention, but also as employed in the broader system illustrated in Figure 1;

Figures 3 a b and c are a perspective front, side and rear views (the former with image trays shown in an open position and the latter with a rear access hatch shown in an open position); and

Figure 4 is a schematic representation of the operation of the system.

DETAILED DESCRIPTION

In Figure 1 an overall system 10 in accordance with the present invention comprises a main frame or host computer 12 connected to a database 14 comprising:

a) image data relating to a plurality of shoe types, such image data comprising an image of the shoe imprint, as well as key data of the image pattern according to any algorithm that may be desired or useful in defining and matching shoe types, and including details such as shoe size, colour of upper, material, manufacturer's details etc; and

b) image data relating to crime scenes at which imprints of shoes have been left behind and captured by investigators at the scene, and details of the relevant crime, and specific identifications of shoe types where a match has been possible to make.

The computer 12 is connected to a plurality of custody unit identification units 18 located in different geographical areas 20, each area being under the control of a given police authority. The connection is through the internet 16, or by some other

communications link, possibly one less likely to be jeopardised by external threats, such as dedicated telephone or data transmission lines, but for the purposes of the present description, the internet is a sufficient and satisfactory connection. Each unit 18 is in the custody suite of one of numerous police stations, of which there may be several for each police department or authority having responsibility for policing the local geographical area 20.

It is likely that the central computer 12 is located in a national police centre covering a geographical area much larger than the individual areas covered by the local geographical areas 20. Indeed, it may cover all local geographical areas 20 of a particular country. Moreover, there is no reason why computer 12 may not be connected with other central computers 12' of different regional police forces in other countries or regions of the world.

However, the present invention is concerned primarily with the local scene. A police station at which suspects are brought following their arrest is a threatening environment, both for suspects and the police holding them. A significant concern of a policeman working in a custody suite is to get through a day without violence erupting, and it is an unfortunate reflection on society that this is the case. In the event that violence does erupt, a secondary object is to curtail it as soon as possible. Without going into the psychology of police custody suites, one rule of thumb is not to make objects easily available to suspects who have it in mind to create havoc and who might employ the objects they do find as weapons with which to attack police staff or police equipment and other property. Secondly, equipment that is installed in police custody suites should be robust in order to withstand abuse by unstable suspects.

On the other hand, on a different tack, suspects are most vulnerable to confess their crimes, or at least to concoct unbelievable or erroneous or contradictory stories (in the event that they are guilty of a particular crime) early during an investigation and soon after their arrest. Thus, being able to confront them with viable and plausible suspicions is a significant advantage to an interrogating officer. Suspects arrested in connection with crimes are frequently obliged to submit themselves to various tests, and in the United Kingdom these include providing fingerprints impressions, DNA samples, breath tests and, more recently, shoe imprints. It is a surprisingly common occurrence that, when arrested and brought to a custody suite, criminals will be wearing the shoes that

they were also wearing when they committed a particular crime. Moreover, footprints, perhaps more than any other clue, are frequently detectable at crime scenes.

Accordingly, there is a need to collect efficiently and effectively an imprint of the shoes worn by a suspect; to identify rapidly the exact make and model of the shoe; and to identify crimes at which shoes imprints were left that match the shoe type that a criminal is currently wearing. If this can be done a list of crimes in the local area that have matching footprint evidence can be put to a suspect soon after arrest, then, if they were involved, this surprise element is potentially more likely to lead to useful and perhaps evidentially persuasive information being disclosed to the police.

Many shoe soles possess complex raised patterns composed of discrete features, such as square, circles, textures and manufacturers' logos. By detecting these localized features and representing them in an efficient and robust manner, it is possible to match on presence/absence of a variety of distinctive features, number of such features and their spatial arrangements. These parameters can be directly employed to classify an unknown shoe to a specific shoe model. This is an example of a feature-rich description of an image, in this case an outsole pattern. A variety of feature-rich descriptions are well-known to experts in image processing and pattern recognition. Other examples are based on transforming the spatial pattern of the outsole into the spatial frequency domain, of which Fourier Transform methods are probably the best known.

Thus, the present invention provides a custody suite identification unit 18, shown in more detail in figures 3a, b and c. The unit 18 comprises a strong, preferably metal, casing 30 having a floor 32 which is provided with apertures (not visible) by means of which the unit 18 can be bolted to a solid surface such as a desk. This prevents the unit 18 being picked up by a suspect and used as a projectile or other weapon.

The casing 30 has front opening 34 through which a sheet of paper 36, bearing an ink imprint 38 of the suspect's shoes, may be inserted. The sheet 36 has on one surface 36a (see Figure 4), the imprint 38, but on its reverse surface 36b, contains bibliographic information about the identity of the suspect, the time and date of arrest and other required information, including signatures of the suspect and arresting officers. Within the opening 34 is disposed a double-sided scanner 40 that produces a facsimile image 42 of both sides 35a and 35b of the sheet 35.

The scanned image is accepted by a processor 48 within the casing 30 that, using a software programme stored in part 46a of a memory device 46 (also disposed within the casing 30), analyses the shoe imprint image 42a to produce key data associated therewith. The key data will relate to features of the imprint and numerous algorithms exist for reducing a facsimile image to numerical, alphabetical and relational indices that can be classified and searched. The skilled person is aware of such techniques, such as for example as disclosed in GB-A-1593001, CN-A-1936922, CN-A-1776717, GB-A-2432029, EP-A-877990 and EP-A-1125244.

The processor 48 next compares the key data derived from image 42a with key data stored in a database section 46b of the memory device 46 and identifies potential matches of the imprint 38. That is to say, it identifies records in the database 46b which have the same or similar key data as the image 42a and reports records which most closely meet the same criteria. Again, algorithms exist to enable such comparisons to be done electronically.

A large touch screen 50 (shown as a transparent screen in figures 3a to c), is provided on the front of the unit 18. A touch screen is a desirable input device since it is less susceptible to abuse than a separate keyboard. Moreover, they are more straightforward to operate for users not familiar with the system, whereby simple menu-driven commands can be employed. When the scanning and comparison described above is complete, the processor causes display in a first part 50a (see Figure 2) the image 42a of the suspect's shoe. Next, in a plurality of smaller areas 1-6, are shown shoe imprint images 52 stored in the memory device 46 from the records therein that have key data (nearly) corresponding with the image 42a. These maybe sorted in order of those images most likely to be a match. A custody suite police officer can quickly scan the images 52 to identify, potentially, an exact match.

In database 46c of the memory device 46 is a list of crimes and details relating thereto classified according to the shoe types that left shoe imprints at the crime scene. Thus, once a police officer has identified a match between one of the known shoe types 1-6 (eg shoe type 1) with the suspect's shoe imprint image 42a, the database 46c can produce a list of crimes at which imprints made by that shoe type were found. This can be employed in the questioning of the suspect.

However, because police officers in custody suites are generally not forensic experts, and nor is it their task to painstakingly find a match, however long it takes, it is extremely desirable to show them as few potentially correct images 52 as possible, otherwise the task of identifying the correct one soon overloads them. This is despite the fact that even the untrained eye is much better at comparing images than even sophisticated machines. Indeed, that is the problem because in order to reduce the number of false positives it is necessary that the comparison algorithms, not to mention the algorithms that extract the relevant key data, are as sophisticated as possible, so as to enable the processor to eliminate non-matches. This also implies that the database 46b must be comprehensive in the sense of the corresponding key data of known shoe types.

However, the disadvantage of such precision and sophistication is two-fold. Such sophistication implies substantial computer processing and memory storage leading both to increased time for production of results and increased cost associated with the processor 48 and memory device 46.

It is generally true that criminals act in a local area. Furthermore criminals do not tend to wear exotic shoes, but usually shoes that are commonly available in the geographical area in question. Consequently, the present invention seeks to limit the database through which the comparisons are made so that fewer “hits” are reported, even with less sophisticated software. This has the further advantage that the software can run faster with less processing power and less requirement for memory storage.

Thus the database 46b of known shoe types is restricted only to known shoe types of shoes which left imprints at local crime scenes. Indeed, it is no advantage to a police officer to know the make of a suspect’s shoe if that make has not been employed in a local crime, and in the recent past (ie the last two or three years). The largest database of shoe-types currently existing in the United Kingdom has some 15,000 different shoe types. Some popular brands of shoe, particularly trainers, are used frequently in the course crimes. However, it is a convenient fact of modern fashion that even the sole design of shoes changes rapidly, so that the number of crimes associated with even the most common shoe type recorded at different crime scenes is limited. Moreover, it changes with time as shoes wax and wane in fashion, and hence frequency of use.

Consequently, with reference to Figure 1, the database 46b of custody suite identification units 18a and b will only have shoe type data for shoes identified as employed at crimes committed in the geographical area 20a. Likewise, the database of unit 18c will only have data in respect of geographical area 20b. There is, of course, the possibility of including adjoining areas within the area of coverage of one police department or authority, but the essential point is that databases 46b and 46c will differ from one geographical area 20a to another area 20b.

However, when a suspect's shoe imprint 42a is recorded and the key data associated therewith is determined, the data is transmitted to central police computer 12. This occurs whether or not there is a match with known shoe types on the local database 18. The reason for this is that more sophisticated analysis of the imprint can be conducted in order to match not just the suspect's shoe with a known shoe type employed at certain crimes, but perhaps also to match the shoe precisely with a crime scene shoe imprint. Establishing that a particular shoe (worn some time later by a suspect arrested for some possibly unconnected reason) was worn at a crime scene is strong circumstantial evidence of involvement in a crime. While ideally such information would be useful immediately after arrest and while the suspect is in the custody suite being interrogated, present technology, not to mention cost restraints, do not permit such analysis to be conducted in a useful timeframe. On the other hand, in respect of local crimes almost as useful information (a list of local crimes at which a particular shoe type was worn) is provided employing the measures suggested by the present invention.

Furthermore, the identification unit 18 further comprises a secure door 60, by means of which access may be had to the interior of the casing for service thereof. The casing also has a lockable tray 62, for example using a padlock 64, whereby the sheet 36 can safely be stored until it is removed by authorised personnel who can protect its evidential value. The sheet is automatically deposited in the tray 62 after scanning. Any form of lock may be employed. The processor 48 preferably adds an electronic date stamp to the electronic image 42 whereby correspondence with the written information on the image can be confirmed.

Finally, the casing is provided with communication ports 64 to enable power and communication cables to be connected.

Throughout the description and claims of this specification, the words “comprise” and “contain” and variations of the words, for example “comprising” and “comprises”, means “including but not limited to”, and is not intended to (and does not) exclude other moieties, additives, components, integers or steps.

Throughout the description and claims of this specification, the singular encompasses the plural unless the context otherwise requires. In particular, where the indefinite article is used, the specification is to be understood as contemplating plurality as well as singularity, unless the context requires otherwise.

Features, integers, characteristics, compounds, chemical moieties or groups described in conjunction with a particular aspect, embodiment or example of the invention are to be understood to be applicable to any other aspect, embodiment or example described herein unless incompatible therewith.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of any foregoing embodiments. The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

CLAIMS

1. A shoeprint identification system comprising a custody suite identification unit comprising:

a) a scanner to scan a suspect's shoeprint image;

b) a processor to process the image according to an algorithm to provide key data in respect of the image;

c) a database of known shoe types and key data applying to said shoe types;

d) a database of crimes at which imprints of known shoe types existed;

e) a comparator to compare the image key data against the key data in said data base to provide one of three results:

i) no match;

ii) exact match; or

iii) a number of possible matches,

between said suspects' shoeprint image and said known shoe types

characterised in that

said database is limited in the shoe types contained therein to a set of the shoe types typically worn by criminals in the area of the custody suite and/or identified at local crime scenes.

2. A system as claimed in claim 1, wherein the database includes images of the shoe types for which it has key data and the identification unit further includes a display device whereby shoeprint images of possible matches can be displayed.

3. A system as claimed in claim 2, wherein the unit also includes means to display the suspect's shoeprint image simultaneously with display of the images of possible matches whereby a manual visual comparison can be made.

4. A system as claimed in claim 1, 2 or 3, wherein said database includes details of crimes at which shoeprint evidence has been identified and matched to specific shoe types, and said unit provides a list of crime identification information, at least in respect of a shoe type corresponding with said exact match.

5. A system as claimed in claim 4, wherein said crime identification information includes images of shoe imprints obtained from the respective crime scenes, whereby a comparison with the suspect's shoeprint image may be made.

6. A system as claimed in any preceding claim, wherein said identification unit includes user input means to enable operation of the system comprising a touch sensitive screen.

7. A system as claimed in claim 6, wherein said processor displays a menu of user options on said touch screen.

8. A system as claimed in any preceding claim, wherein said identification unit comprises a secure casing resistant to manual abuse by a violent but unarmed assailant.

9. A system as claimed in claim 8, wherein means enable said identification unit to be secured in place, so that it is not capable of itself being employed as a weapon.

10. A system as claimed in claim 9, wherein said means comprise holes in a base of the unit through which fasteners can pass to connect the unit to a fixed surface.

11. A system as claimed in any preceding claim, wherein said scanner is a double-sided scanner to scan simultaneously both sides of a sheet bearing said suspect's shoeprint image.

12. A system as claimed in any preceding claim, wherein, the identification unit includes electronic security features hampering electronic tampering of the scanned image.

13. A system as claimed in claim 12, wherein said security feature includes an electronic time and date stamp of the time and date at which the scan was taken and integrated with said image.

14. A system as claimed in any preceding claim, wherein said unit includes communication ports, whereby data may be transferred between said unit and another computer at a remote location that comprises a fuller database of shoe type images and key data.

15. A system as claimed in claim 14, wherein the scanned image may be transferred to said remote computer for comparison against a fuller database of shoe type images and key data.

16. A system as claimed in claim 15, wherein said remote computer is capable of being employed both to analyse the suspect's shoeprint image and to produce further key data.

17. A system as claimed in claim 16, wherein said remote computer is capable of being employed to compare said key data and said further key data with a database containing substantially all known shoe types.

18. A system as claimed in 14, wherein said data comprises shoe type images and key data relating to shoe types not on said database of known shoe types and transferred from said remote computer.

19. A system as claimed in 14, wherein said data comprises instructions from said remote computer to delete or amend existing shoe type images and key data on said database.

20. A system as claimed in any preceding claim, wherein said scanner has an opening accessible to the outside and through which the sheet on which said shoe imprint image is formed is fed, the sheet dropping into a lockable compartment after scanning for secure retention.

21. A shoeprint identification system comprising:

a central computer including a central database of

1. known shoe types and key data applying to said shoe types, and

2. crimes at which shoe imprints existed and key data applying to said shoe imprints; and

a plurality of remote identification units, one each located in geographically spaced custody suites, each custody suite identification unit comprising:

a) a scanner to scan a suspect's shoeprint image to produce a scanned image;

b) a processor to process the scanned image according to an algorithm to provide key data in respect of the scanned image;

c) a custody unit database of known shoe types and key data applying to said shoe types;

d) a custody unit database of crimes at which imprints of known shoe types existed;

e) a comparator to compare the image key data against the key data in said custody unit database to provide one of three results:

i) no match;

ii) exact match; or

iii) a number of possible matches,

between said suspects' shoeprint image and said known shoe types,

characterised in that

the custody suite databases are limited in the shoe types contained therein to sets of the shoe types typically worn by people in the local area of the custody suite and identified at local crime scenes, such that different custody suite databases include different data from each other and substantially less data than said central database.

22. A system as claimed in claim 21, wherein said central computer communicates with said custody suite identification units to upload said scanned image of the suspect's shoeprint image and/or the key data in respect of the scanned image.

23. A system as claimed in claim 22, wherein said communication is for the purpose of providing a match with a known shoe type if the custody suite identification unit had not itself produced a match.

24. A system as claimed in claim 22 or 23, wherein said communication is for the purpose of confirming a match made by a custody suite identification unit, said particularly custody suite identification unit employing less sophisticated algorithms for making a comparison.

25. A system as claimed in claim 22, 23 or 24, wherein said communication is for the purpose of identifying crime scenes at which shoe imprints existed corresponding with said matched shoe type.

26. A system as claimed in claim 22, 23 or 24, wherein said communication is for the purpose of identifying crime scenes at which shoe imprints existed which are a specific match with said scanned image.

27. A shoeprint identification system substantially as hereinbefore described with reference to the accompanying drawings.

28. A shoeprint identification unit substantially as hereinbefore described with reference to the accompanying drawings.

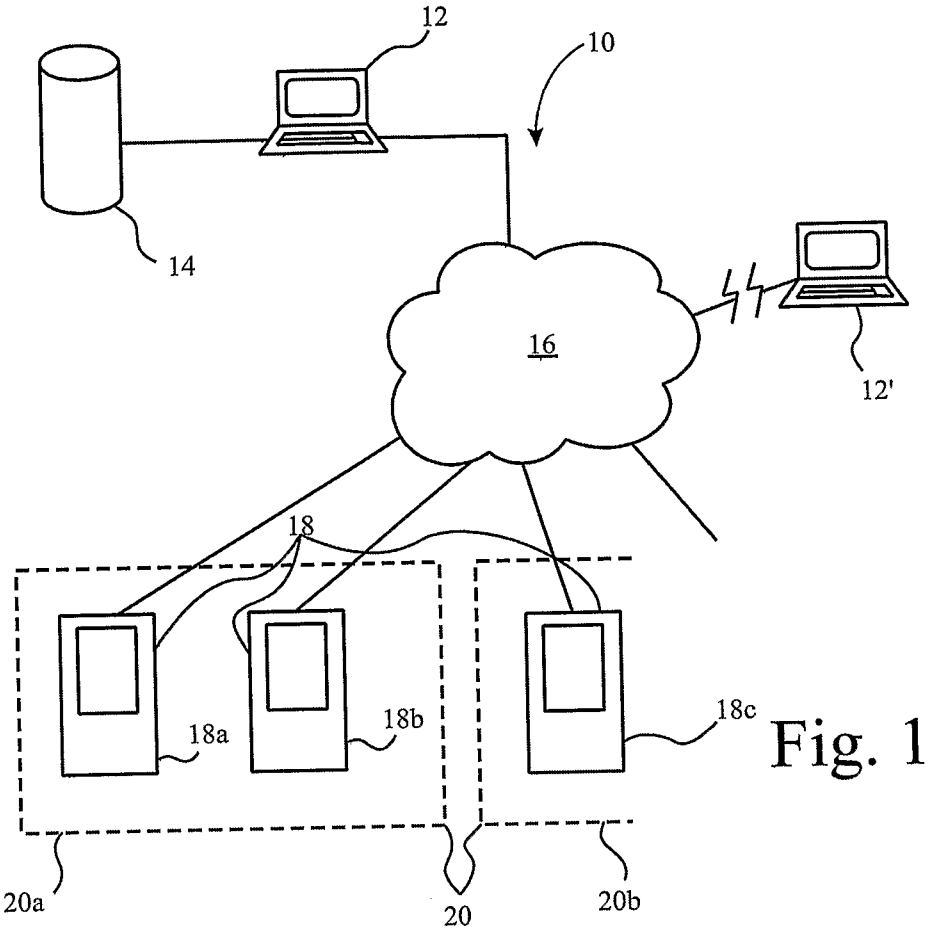

Fig. 1

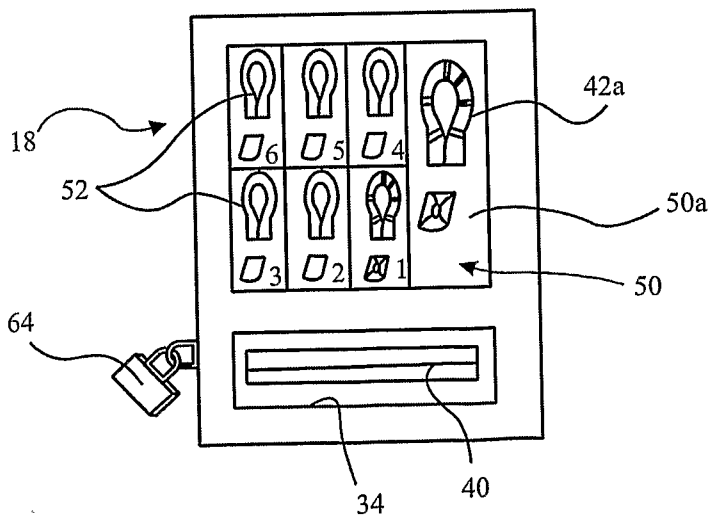

Fig. 2

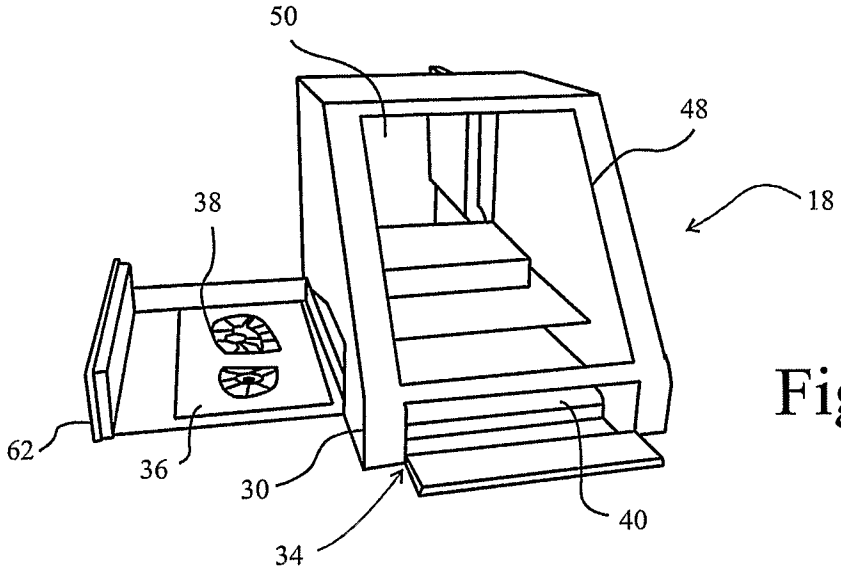

Fig. 3a

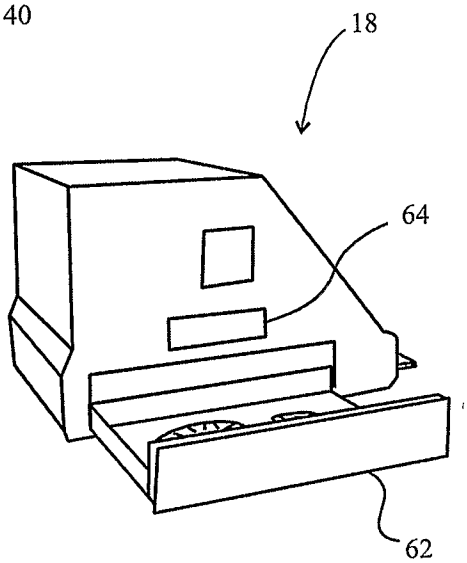

Fig. 3b

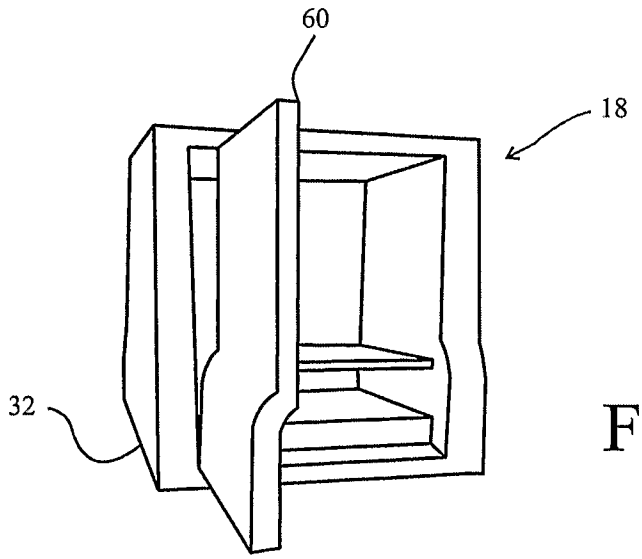

Fig. 3c

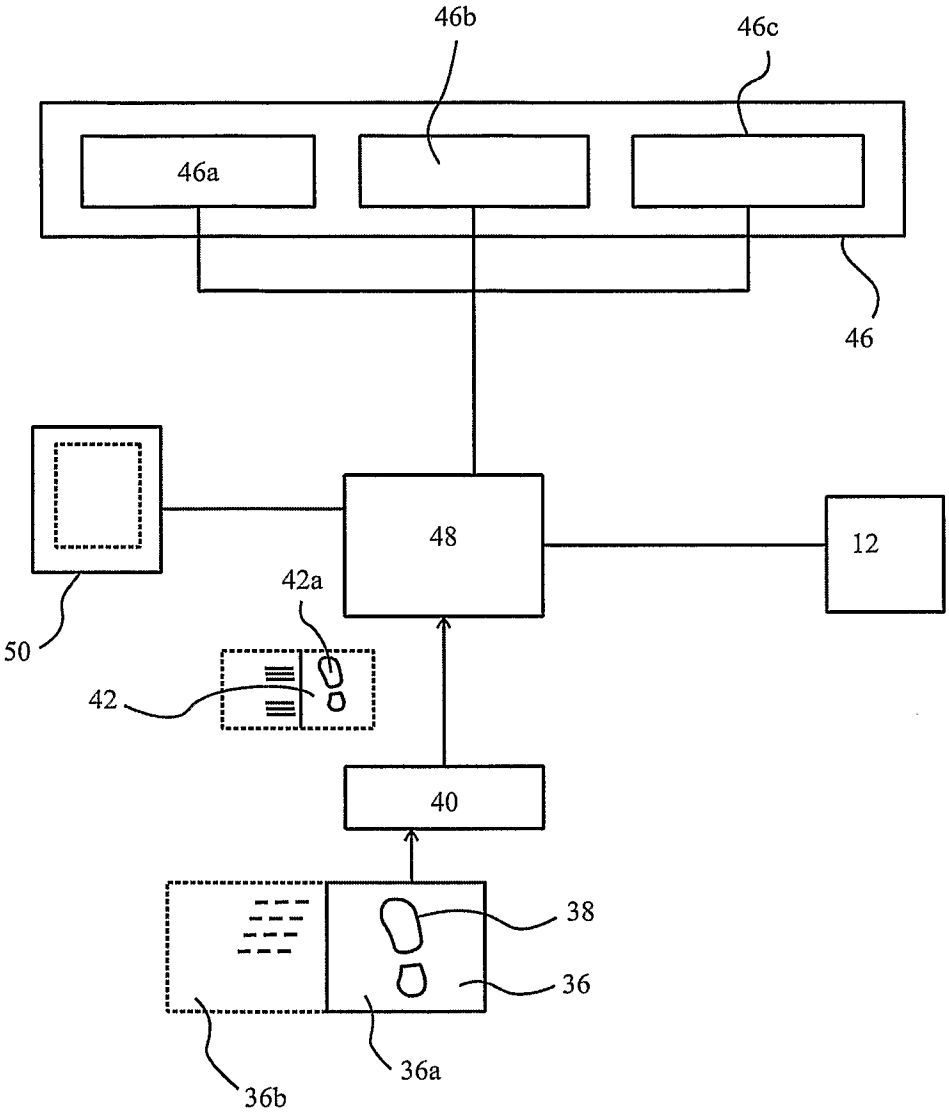

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2009/050859

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06K9/00
ADD. H04N1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06K H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	MANKEVICH A: "SICAR "Outsole Recognition" at the Maryland State Police" THE CHESAPEAKE EXAMINER, [Online] vol. 44, no. 1, 2003, XP002543954 Retrieved from the Internet: URL:http://www.cbdiai.org/Articles/mankevich_sp-03.pdf> [retrieved on 2009-09-02]	1-10, 14-19, 21-28
Y	abstract page 17, left-hand column, paragraph 1 - right-hand column, paragraph 4 page 18, left-hand column, paragraph 2 page 18, left-hand column, paragraph 6 - page 19, left-hand column, paragraph 2	11-13,20

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 September 2009	16/09/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Fax: (+31–70) 340–3016	Müller, Martin

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2009/050859

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DRISCOLL E C ET AL: "A comparison of centralized versus distributed architectures in biometric access control systems" PROCEEDINGS OF THE INTERNATIONAL CARNAHAN CONFERENCE ON SECURITY TECHNOLOGY. ZURICH, OCT. 3 - 5, 1989, ZURICH : ETH ZENTRUM-KT, CH, 3 October 1989 (1989-10-03), pages 193-198, XP010324640 abstract page 194, right-hand column, paragraph 6 - page 195, left-hand column, paragraph 1 page 195, right-hand column, paragraph 1 page 196, left-hand column, paragraph 2 page 198, left-hand column, paragraph 2	1-28
A	SAWYER N E ET AL: "Shoe-fit-a computerised shoe print database" SECURITY AND DETECTION, 1995., EUROPEAN CONVENTION ON BRIGHTON, UK, LONDON, UK,IEE, UK, 1 January 1995 (1995-01-01), pages 86-89, XP006529747 ISBN: 978-0-85296-640-2 page 86, left-hand column, paragraph 3 page 86, right-hand column, paragraph 2 - page 87, left-hand column, paragraph 1 page 88, left-hand column, paragraph 2 - paragraph 5 page 89, left-hand column, paragraph 2 - paragraph 3	1-28
A	ZHANG ET AL.: "Automatic Shoeprint Retrieval System for use in Forensic Investigations" PROC. 2005 UK WORKSHOP ON COMPUTATIONAL INTELLIGENCE, [Online] 5 September 2005 (2005-09-05), - 7 September 2005 (2005-09-07) pages 137-142, XP002543955 London, UK Retrieved from the Internet: URL:http://www.dcs.bbk.ac.uk/ukci05/ukci05 proceedings.pdf> [retrieved on 2009-09-02] abstract; figure 1 page 137, left-hand column, paragraph 1 page 138, left-hand column, paragraph 3	1-28
Y	ANONYMOUS: "Photo feeder with backside scanner" RESEARCH DISCLOSURE, MASON PUBLICATIONS, HAMPSHIRE, GB, vol. 494, no. 13, 1 June 2005 (2005-06-01), XP007135157 ISSN: 0374-4353 the whole document	11

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INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2009/050859

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 642 199 A (UKAI TAKESHI [JP] ET AL) 24 June 1997 (1997-06-24) figure 1	12,13
Y	WO 90/06651 A (WULFORST HOWARD E [US]) 14 June 1990 (1990-06-14) abstract	20

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2009/050859

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		JP 7212602 A	11-08-1995
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