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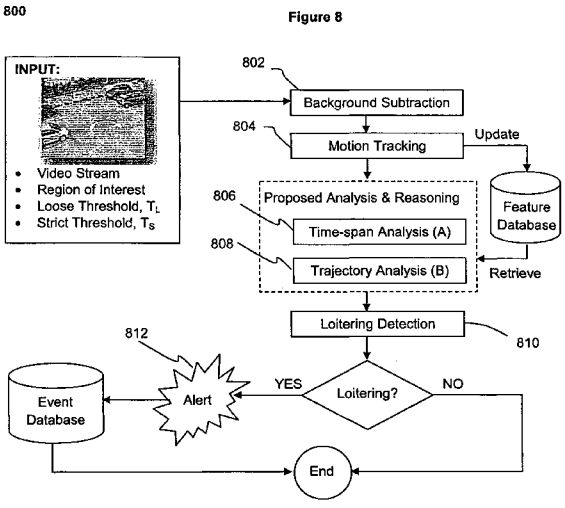


(57) Abstract: The present invention provides a method for detecting loitering event in a region of interest. The method comprises the steps of determining presence of at least one object in region of interest, tagging each object of interest with identity, computing total time stamp for each object of interest, determining time span of each object of interest based on trajectory information and speed profile, detecting loitering event based on combination of plurality of the determined features and triggering alert when loitering event is detected.

WO 2012/074370 A1

A SYSTEM AND METHOD TO DETECT HUMAN LOITERING ACTIVITY USING TRAJECTORY INFORMATION

FIELD OF INVENTION

The present invention relates to a system and method to detect human loitering activity using trajectory information.

BACKGROUND ART

Loitering refers to the act of standing idly about or lingering aimlessly around a specific area. The present invention is based on measurement of the duration of loitering by human subjects in specific area, known as region-of-interest.

Presently, video surveillance systems are used in public areas for security or surveillance. The cameras are typically monitored by humans with the intent that the operators can recognize a suspicious event when it happens. However, as number of cameras increases, it becomes more challenging to monitor individual video streams. Further, research studies have shown that attention time of a human is limited to an average duration of 20 minutes, which further supports the ineffectiveness of human monitoring.

The present invention establishes a method and system for determining loitering event using variety of loitering thresholds. The present invention is directed to recording motion of object, deleting background scenes and triggers alert when loitering event is detected.

The subject matter claimed herein is not limited to embodiments that solve any disadvantages or that operate only in environments such as those described above. Rather, this background is only provided to illustrate one exemplary technology area where some embodiments described herein may be practice.

SUMMARY OF INVENTION

The present invention provides a system (800) for detecting loitering event in region of interest. The system comprises at least one background subtraction module (802), at least one motion tracking module (804), at least one time-span analysis module (806), at least one trajectory analysis module (808), at least one loitering detection module (810) and at least one decision making module (812). The said background subtraction module (802) determines presence of at least one object in region of interest by grouping motion pixels having similar properties and eliminating noise generated by motion pixels. The said motion tracking module (804) tags each object of interest with identity by comparing each object to at least one predetermined property including colours, spatial or geometric information and identifying each object based upon at least one predetermined property. The said time-span analysis module (806) computes total timestamp for each object of interest by classifying each object as normal or suspicious using a plurality of loitering thresholds, establishing first threshold value T_S to determine loitering event depending on speed and trajectory of each object, determining loitering event when total time span for object t_i in region of interest is greater than first threshold value T_S, establishing second threshold value T_L to determine loitering event depending on speed and trajectory status of each object and determining loitering event when a total time span for object t_i in region of interest is greater than second threshold value T_L.

Further, the said trajectory analysis module (808) determines time span of each object of interest based on trajectory information and speed profile by classifying each object as normal or suspicious using historical and/or current trajectory pattern. The said loitering detection module (810) detects loitering event based on combination of plurality of determining features and the said decision making module (812) triggers alert when loitering event is detected.

Another aspect of the present invention provides a method (900) for detecting loitering event in region of interest. The method comprising steps of determining presence of at least one object in region of interest (902), tagging each object of interest with identity (904), computing total time stamp for each object of interest (906), determining trajectory pattern and speed of each object of interest based on trajectory information and speed

profile (908), detecting loitering event based on combination of plurality of determining features (910) and triggering alert when loitering event is detected (912).

Preferably, a method for determining presence of at least one object in region of interest further comprises grouping motion pixels having similar properties (1002) and eliminating noise generated by motion pixels (1004). A method for tagging each object of interest with identity further comprises comparing each object to at least one predetermined property including colours, spatial, or geometric information (1102) and identifying each object based upon at least one predetermined property (1104).

Further, a method for applying plurality of loitering thresholds further comprises establishing first threshold value T_S to determine loitering event depending on time span of each object (1202), determining loitering event when total time span for object t_i in region of interest is greater than first threshold value T_S (1204), establishing second threshold value T_L to determine loitering event depending on time span of each object (1206) and determining loitering event when a total time span for object t_i in region of interest is greater than second threshold value T_L and its trajectory status is abnormal (1208).

The present invention consists of features and a combination of parts hereinafter fully described and illustrated in the accompanying drawings, it being understood that various changes in the details may be made without departing from the scope of the invention or sacrificing any of the advantages of the present invention.

BRIEF DESCRIPTION OF ACCOMPANYING DRAWINGS

To further clarify various aspects of some embodiments of the present invention, a more particular description of the invention will be rendered by references to specific embodiments thereof, which are illustrated in the appended drawings. It is appreciated that these drawings depict only typical embodiments of the invention and are therefore not to be considered limiting of its scope. The invention will be described and explained with additional specificity and detail through the accompanying drawings in which:

Figure 1 illustrates sample region of interest in the present invention.

Figure 2 illustrates normal trajectory.

Figure 3 illustrates an example of detection of loitering event of a false positive event.

Figure 4 illustrates another example of detection of loitering event of false positive event.

Figure 5 illustrates example where a person is able to walk out of the region in a reasonable amount of time without detection.

Figure 6 illustrates an example of abnormal trajectory.

Figure 7 illustrates an example of false alarm.

Figure 8 illustrates architecture of a vision-based system to detect human loitering activity using trajectory information.

Figure 9 is a flowchart illustrating a method for detecting loitering event in region of interest.

Figure 10 is a flowchart illustrating a method for determining presence of at least one object in region of interest.

Figure 11 is a flowchart illustrating a method for tagging each object of interest with identity.

Figure 12 is a flowchart illustrating a method for applying plurality of loitering thresholds.

Figure 13 is a flowchart illustrating a method for classifying each object as normal or suspicious using plurality of loitering thresholds.

Figure 14 is a flowchart illustrating a method for classifying each objet as normal or suspicious using historical and/or current trajectory information pattern.

Figure 15 illustrates time-span analysis module.

Figure 16 illustrates trajectory patterns.

Figure 17 illustrates speed profiles.

Figure 18 illustrates combination of trajectory and speed profile information.

Figure 19 is a flowchart illustrating process flow of speed analysis in trajectory analysis module.

Figure 20 is a flowchart illustrating detection of trajectory pattern analysis in trajectory analysis module.

Figure 21 is a flowchart illustrates process flow of loitering detection module.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention provides a system and method to detect human loitering activity using trajectory information. Hereinafter, this specification will describe the present invention according to the preferred embodiments. It is to be understood that limiting the description to the preferred embodiments of the invention is merely to facilitate discussion of the present invention and it is envisioned without departing from the scope of the appended claims.

Reference is first being made to Figure 1 and Figure 2 respectively. Figure 1 illustrates sample region of interest in the present invention. Figure 2 illustrates normal trajectory pattern in Figure 2a wherein the person was able to walk out of the region of interest within predefined threshold time for loitering, T_L. For all of the examples, t_i represents total time span for object of interest or person that is spent within the region of interest. In Figure 2b, $t_i \leq T_L$. Hence, no loitering was detected, resulting in true negative and normal trajectory.

Reference is now being made to Figures 3 and 4 respectively. Figure 3 illustrates detection of loitering wherein $t_i > T_L$, resulting in false positive event detection. Loitering is detected because the person was unable to clear or exit the region of interest within the allocated or predetermined time. This may because he was pushing something heavy across the space due to slower walking speed or that he stopped to tie his shoe laces.

Reference is now being made to Figure 5 and 6 respectively. Figure 5 illustrates an example where a person was able to walk out of the region in a reasonable amount of time. However, from its trajectory pattern, it is clear that he had spent a considerable amount of time loitering in the region. However, the loitering alarm was not raised as $T_L > t_i$. An example of an abnormal trajectory is shown in Figure 6 wherein loitering was detected as total time spent within the region was greater than T_L.

Table 1 summarizes various combinations of time span with the trajectories, as well as the resultant system output which indicates loitering or no loitering. (c), (e) and (f) are not possible while (d) illustrates some of the shortcomings of the current systems that the present invention seeks to overcome.

	Time span	Trajectory	Loitering	Status	Figure
a	$t_i \leq T_L$	Normal	No	True Negative	2
b	$t_i \leq T_L$	Abnormal	No	False Negative	5
c	$t_i \leq T_L$	Normal	Yes	Invalid	-
d	$t_i \leq T_L$	Abnormal	Yes	Error	-
e	$t_i > T_L$	Normal	No	Invalid	-
f	$t_i > T_L$	Abnormal	No	Invalid	-
g	$t_i > T_L$	Normal	Yes	False Positive	3,4
h	$t_i > T_L$	Abnormal	Yes	True Positive	6

Table 1: Loitering Detection

A threshold value, T_L must be selected carefully in order to minimize number of false alarms. Having a large T_L may allow people to spend considerable amount of time loitering whereas, a short T_L produces false alarms. This phenomenon is illustrated in Figure 7. Further, real-time behaviour of humans in each scenario varies, making it difficult to obtain optimal T_L value and eliminate false alarms completely.

Reference is now being made to Figure 8. Figure 8 illustrates the architecture of a vision-based system that monitors the activities of the object of interest in the scene to detect abnormal events. The system (800) for detecting loitering event in region of interest, comprising at least one background subtraction module (802), at least one motion tracking module (804), at least one time-span analysis module (806), at least one trajectory analysis module (808), at least one loitering detection module (810) and at least one decision making module (812). The said background subtraction module (802) determines presence of at least one object in region of interest by grouping motion pixels

having similar properties and eliminating noise generated by motion pixels while the said motion tracking module (804) tags each object of interest with identity by comparing each object to at least one predetermined property including colours, spatial, or geometric information and identifying each object based upon at least one predetermined property.

The said time-span analysis module (806) computes total timestamp for each object of interest by classifying each object as normal or suspicious using a plurality of loitering thresholds, establishing first threshold value T_S to determine loitering event depending on time span of each object, determining loitering event when total time span for object t_i in region of interest is greater than first threshold value T_S, establishing second threshold value T_L to determine loitering event depending on time span of each object and determining loitering event when a total time span for object t_i in region of interest is greater than second threshold value T_L and its trajectory status is abnormal.

The said trajectory analysis module (808) determines time span of each object of interest based on trajectory information and speed profile by classifying each object as normal or suspicious using historical and/or current trajectory pattern. The said loitering detection module (810) detects loitering event based on combination of plurality of determining features while the said decision making module (812) triggers alert when loitering event is detected.

Reference is now being made to Figure 9, Figure 10 and Figure 11 respectively. Figure 9 is a flowchart illustrating a method for detecting loitering event in region of interest while Figure 10 is a flowchart illustrating a method for determining presence of at least one object in region of interest and Figure 11 is a flowchart illustrating a method for tagging each object of interest with identity.

As illustrated in Figure 9, the presence of at least one object in region of interest is determined (902). As illustrated in Figure 10, the method for determining presence of at least one object in region of interest further comprises grouping motion pixels having similar properties (1002) and eliminating noise generated by motion pixels (1004).

Thereafter, each object of interest is tagged with identity (904) and total time stamp for each object of interest is computed accordingly (906). As illustrated in Figure 11, the method for tagging each object of interest with identity further comprises comparing each object to at least one predetermined property including colours, spatial, or geometric information (1102) and identifying each object based upon at least one predetermined property (1104).

Time span of each object of interest is determined based on trajectory information and speed profile (908). Determining time span of each object of interest based on trajectory information and speed profile further comprises classifying each object as normal or suspicious using historical and/or current trajectory pattern.

Subsequently, loitering event is detected based on combination of plurality of determining features (910) and alert is triggered when loitering event is detected (912). Detecting loitering event based on combination of plurality of determining features further comprises classifying each object as normal or suspicious using historical and/or current speed. Further, detecting loitering event comprises combination of responses of time stamp of each object, trajectory pattern and speed or velocity of each object.

Detecting loitering event based on combination of plurality of determining features further comprises applying plurality of loitering thresholds.

Reference is now being made to Figure 12 and Figure 13 respectively. Figure 12 is a flowchart illustrating a method for applying plurality of loitering thresholds while Figure 13 is a flowchart illustrating a method for classifying each object as normal or suspicious using plurality of loitering thresholds. Computing total timestamp for each object of interest further comprises classifying each object as normal or suspicious by applying plurality of loitering thresholds. As illustrated in Figure 12, the method for applying plurality of loitering thresholds further comprises establishing first threshold value T_S to determine loitering event depending on time span of each object (1202), determining loitering event when total time span for object t_i in region of interest is greater than first threshold value T_S (1204), establishing second threshold value T_L to determine loitering event depending on time span of each object (1206) and determining loitering event when a total time span for object t_i in region of interest is greater than second threshold

value T_L and its trajectory status is abnormal(1208). The first threshold value T_s and the second threshold value T_L are different wherein the first threshold value T_s is larger than the second threshold value T_L.

As illustrated in Figure 13, the method for classifying each object as normal or suspicious using plurality of loitering thresholds further comprises validating each labeled motion pixel with region of interest wherein object having validated pixel will be tagged with time information known as total time span for the object t_i (1302). Thereafter, total time span for object t_i of validated motion pixel with first threshold value T_S and second threshold value T_L is compared (1304). Subsequently, occurrence of loitering event when total time span for object t_i in region of interest is greater than first threshold value T_S is determined (1306) and occurrence of loitering event when total time span for object t_i in region of interest is greater than second threshold value T_L wherein if total time span for the object t_i is not greater than first threshold value T_S and when its trajectory status is abnormal is determined (1308).

Reference is now being made to Figure 14. Figure 14 is a flowchart illustrating a method for classifying each objet as normal or suspicious using historical and/or current trajectory information pattern. As illustrated in Figure 14, upon analyzing trajectory pattern of object (1402), trajectory pattern of object with plurality of normal pattern is compared with abnormal trajectory patterns (1404). Thereafter, occurrence of loitering event is determined when trajectory pattern of object matches at least one abnormal trajectory pattern (1406).

As illustrated in Figure 15, time information or stamp that is associated with each object is compared with two predefined loitering thresholds. Firstly, if the time information of object-of-interest exceeds predefined strict loitering threshold, T_s, object will directly considered as exhibiting loitering threshold. Otherwise, time information will go through second layer of time-span analysis; compared to loose threshold, T_L which is the second threshold value. Only object-of-interest with time-span that exceeds predefined loose loitering threshold will be fed into subsequent module which is trajectory analysis module. Strict loitering threshold is introduced as cut-off factor to directly determine loitering event regardless of time span information.

Trajectory patterns, such as, normal and abnormal are illustrated in Figure 16. Similarly, speed profiles are illustrated in Figure 17. Figure 18 illustrates combination of trajectory and speed profile information.

Figure 19 illustrates process flow of speed analysis in trajectory analysis module. Similarly, process flow of trajectory pattern analysis in trajectory analysis module is illustrated in Figure 20. As illustrated in Figure 20, length of moving window may vary according to criticality of the applications. Object-of-interest will be considered suspicious if speed is inconsistent and counter to keep track of level of suspiciousness of object-of-interest will be increased. A plurality of defined rules (rule-based) can be applied to speed feature to determine if speed is suspicious. Otherwise, classification method with speed feature as the input can be applied. Accumulated level of suspiciousness will then be compared against defined speed threshold, T_{speed}. If suspicious level exceeds speed threshold, T_{speed}, object is tagged as exhibiting suspicious speed (Status of object i, $Speed_i$ is suspicious).

Thereafter, trajectory pattern is analyzed. Trajectory pattern analysis is similar to the aforementioned speed analysis and is illustrated in Figure 21 wherein Figure 21 illustrates loitering detection module. If trajectory pattern is deemed suspicious according to set of defined rules, object-of-interest is given suspicious status (Status of object I, $Trajectory_i$ is suspicious) and vice versa. If any of the speed status, $Speed_i$ or trajectory status, $Trajectory_i$ is tagged suspicious; object-of-interest will have suspicious status, $Status_i$. The said status is important as it will be analyzed in loitering detection module to infer an outcome.

In the present invention, an object of interested will not be deemed to be loitering event if the associated time stamp exceeds the predetermined threshold unless its trajectory pattern is abnormal. The final module is the decision making module which stores loitering event in database. This allows for post-event analysis on video to further assist with investigations.

The uniqueness of the present invention lies in a system and method for detecting loitering event in a region of interest which includes providing timestamp t_i of each tracked subject in a predefined region of interest. The present invention determines

trajectory pattern for each object. The present invention includes classifying each object as normal or suspicious based upon predetermined loitering threshold time T_L. Loitering event is determined by trajectory pattern, timestamp t_i, and predetermined loitering thresholds T_L.

The present invention may be embodied in other specific forms without departing from its essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore indicated by the appended claims rather than by the foregoing description. All changes, which come within the meaning and range of equivalency of the claims, are to be embraced within their scope.

CLAIMS

1. A system (800) for detecting loitering event in region of interest, comprising:
   at least one background subtraction module (802);
   at least one motion tracking module (804);
   at least one time-span analysis module (806);
   at least one trajectory analysis module (808);
   at least one loitering detection module (810); and
   at least one decision making module (812).

2. A system according to Claim 1, wherein the said background subtraction module (802) determines presence of at least one object in region of interest by grouping motion pixels having similar properties and eliminating noise generated by motion pixels.

3. A system according to Claim 1, wherein the said motion tracking module (804) tags each object of interest with identity by comparing each object to at least one predetermined property including colours, spatial, or geometric information and identifying each object based upon at least one predetermined property.

4. A system according to Claim 1, wherein the said time-span analysis module (806) computes total timestamp for each object of interest by:
   classifying each object as normal or suspicious using a plurality of loitering thresholds;
   establishing first threshold value T_S to determine loitering event depending on time span of each object;
   determining loitering event when total time span for object t_i in region of interest is greater than first threshold value T_S;
   establishing second threshold value T_L to determine loitering event depending on time span of each object; and
   determining loitering event when a total time span for object t_i in region of interest is greater than second threshold value T_L and its trajectory status is abnormal.

5. A system according to Claim 1, wherein the said trajectory analysis module (808) determines time span of each object of interest based on trajectory information and speed profile by classifying each object as normal or suspicious using historical and/or current trajectory pattern.

6. A system according to Claim 1, wherein the said loitering detection module (810) detects loitering event based on combination of plurality of determining features.

7. A system according to Claim 1, wherein the said decision making module (812) triggers alert when loitering event is detected.

8. A method (900) for detecting loitering event in region of interest, comprising the steps of:

determining presence of at least one object in region of interest (902);
tagging each object of interest with identity (904);
computing total time stamp for each object of interest (906);
determining time span of each object of interest based on trajectory information and speed profile (908);
detecting loitering event based on combination of plurality of determining features (910); and
triggering alert when loitering event is detected (912).

9. A method according to Claim 8, wherein determining presence of at least one object in region of interest further comprises:

grouping motion pixels having similar properties (1002); and
eliminating noise generated by motion pixels (1004).

10. A method according to Claim 8, wherein tagging each object of interest with identity further comprises:

comparing each object to at least one predetermined property including colours, spatial, or geometric information (1102); and
identifying each object based upon at least one predetermined property (1104).

11. A method according to Claim 8, wherein computing total timestamp for each object of interest further comprises classifying each object as normal or suspicious by applying plurality of loitering thresholds.

12. A method according to Claim 8, wherein determining time span of each object of interest based on trajectory information and speed profile further comprises classifying each object as normal or suspicious using historical and/or current trajectory pattern.

13. A method according to Claim 8, wherein detecting loitering event based on combination of plurality of determining features further comprises classifying each object as normal or suspicious using historical and/or current speed.

14. A method according to Claim 8, wherein detecting loitering event comprises combination of responses of time stamp of each object, trajectory pattern and speed or velocity of each object.

15. A method according to Claim 8, wherein detecting loitering event based on combination of plurality of determining features further comprises applying plurality of loitering thresholds.

16. A method according to Claim 11, wherein applying plurality of loitering thresholds further comprises:

establishing first threshold value T_S to determine loitering event depending on time span of each object (1202);

determining loitering event when total time span for object t_i in region of interest is greater than first threshold value T_S (1204);

establishing second threshold value T_L to determine loitering event depending on time span status of each object (1206); and

determining loitering event when a total time span for object t_i in region of interest is greater than second threshold value T_L and its trajectory status is abnormal (1208).

17. A method according to Claim 16, wherein first threshold value T_S and second threshold value T_L are different.

18. A method according to Claim 11, wherein classifying each object as normal or suspicious using plurality of loitering thresholds further comprises:

validating each labelled motion pixel with region of interest wherein object having validated pixel will be tagged with time information known as total time span for the object t_i (1302),

comparing total time span for object t_i of validated motion pixel with first threshold value T_S and second threshold value T_L(1304);

determining occurrence of loitering event when total time span for object t_i in region of interest is greater than first threshold value T_S (1306);

determining occurrence of loitering event when total time span for object t_i in region of interest is greater than second threshold value T_L wherein if total time span for the object t_i is not greater than first threshold value T_S and when its trajectory status is abnormal (1308).

19. A method according to Claim 12, wherein classifying each object as normal or suspicious using historical and/or current trajectory pattern further comprises:

analyzing trajectory pattern of object (1402);

comparing trajectory pattern of object with plurality of normal and abnormal trajectory patterns (1404); and

determining occurrence of loitering event when trajectory pattern of object matches at least one abnormal trajectory patterns (1406).

100

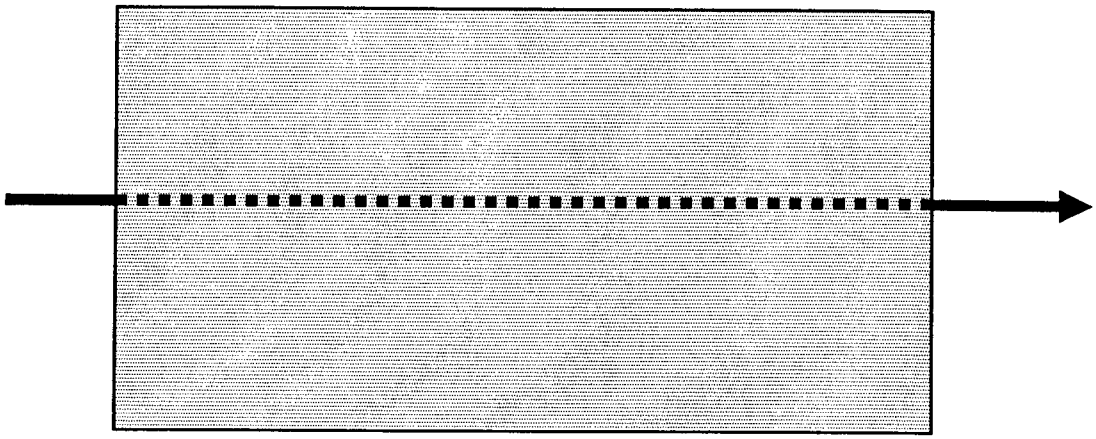
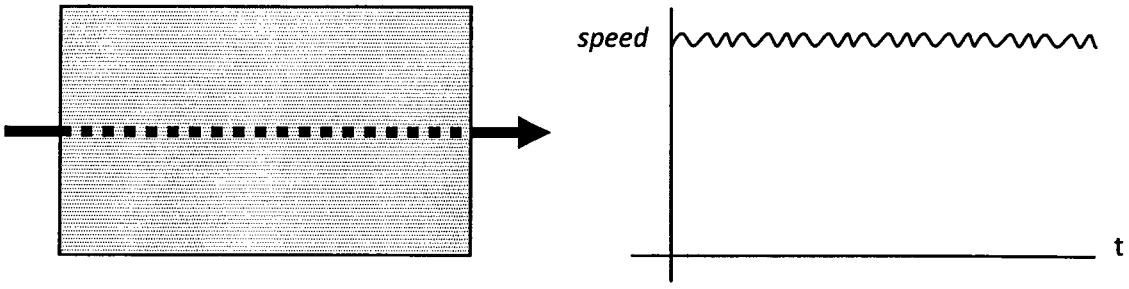


Figure 1

200

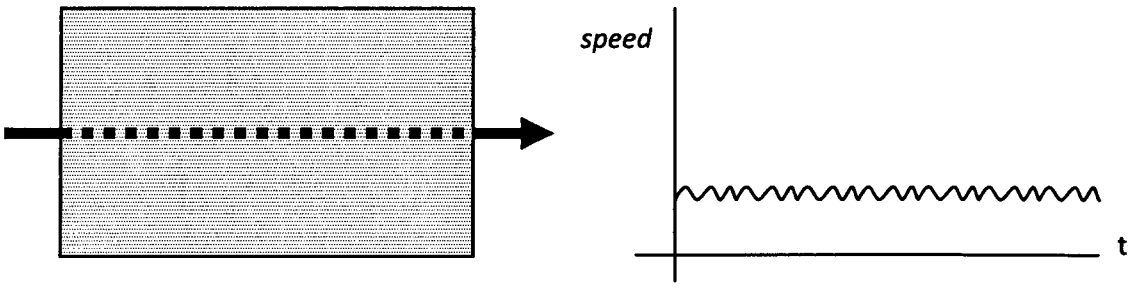


(a) Trajectory : Normal (b) Speed graph

$t_i \leq T_L$

Figure 2

300

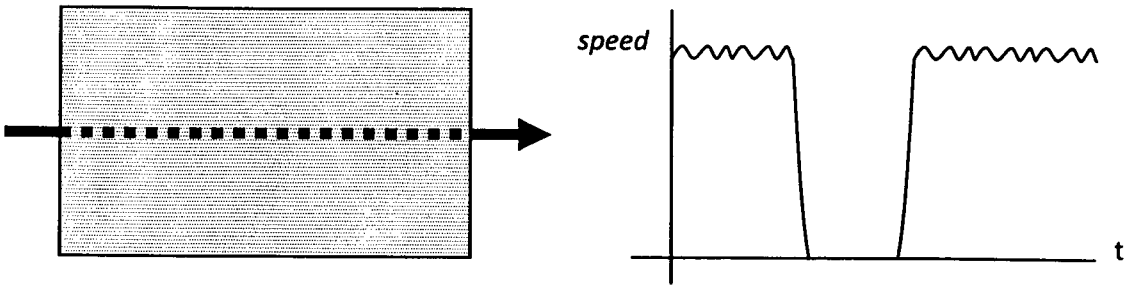


(a) Trajectory : Normal (b) Speed graph

$t_i > T_L$

Figure 3

400

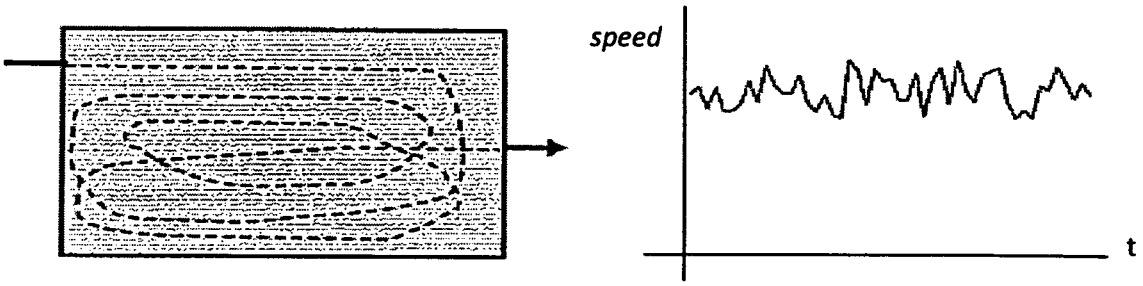


(a) Trajectory : Normal (b) Speed graph

$t_i > T_L$

Figure 4

500

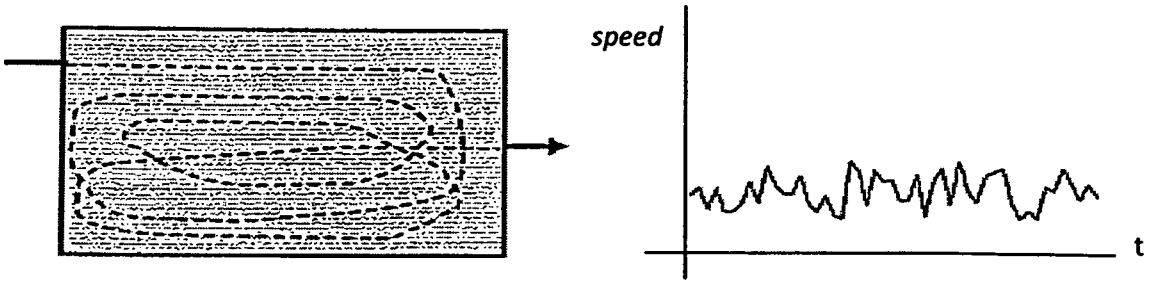


(a) Trajectory : Abnormal (b) Speed graph

$t_i \leq T_L$

Figure 5

600

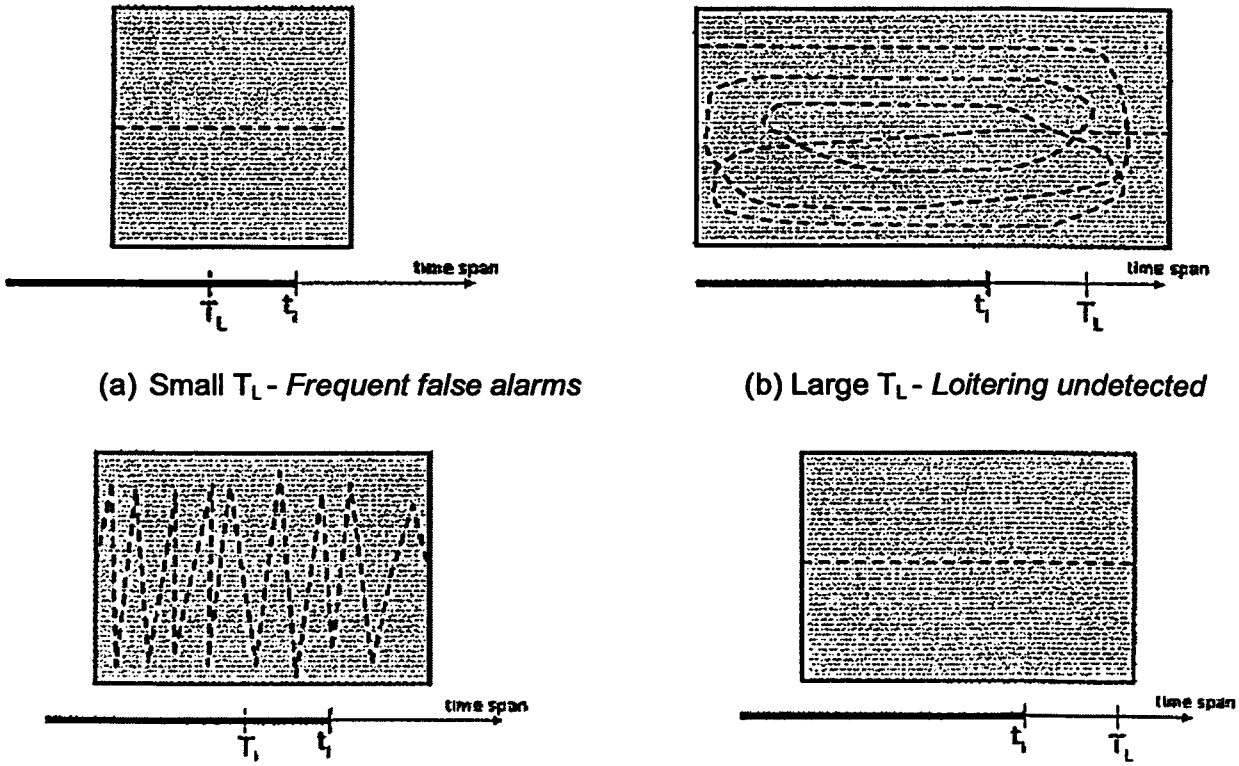


(a) Trajectory : Abnormal (b) Speed graph

$t_i > T_L$

Figure 6

700



(a) Small T_L - *Frequent false alarms* (b) Large T_L - *Loitering undetected*

(c)Optimum TL

Figure 7

800

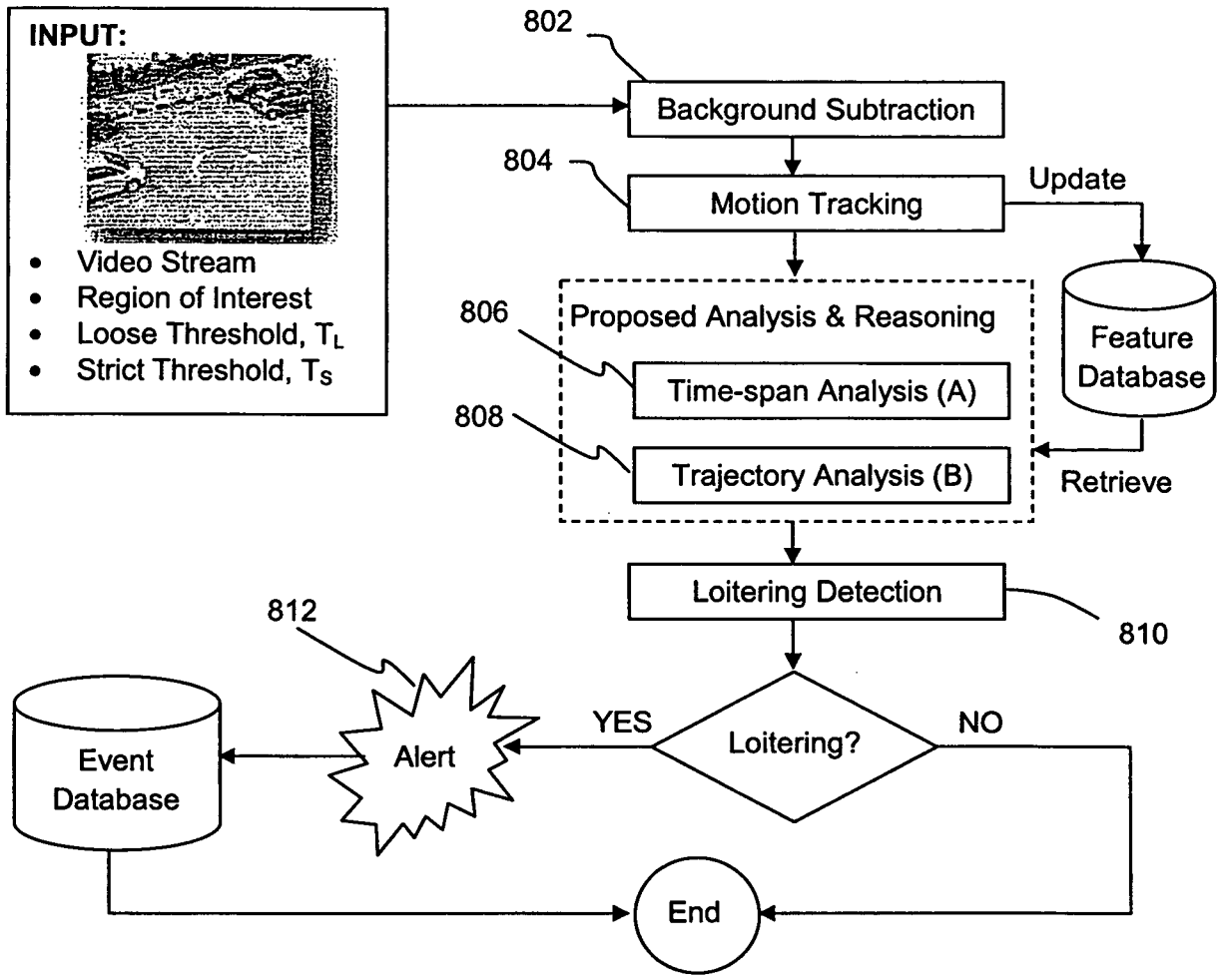

INPUT:
Video Stream
Region of Interest
Loose Threshold, T_L
Strict Threshold, T_S
802
Background Subtraction
804
Motion Tracking
Update
Feature Database
806
Proposed Analysis & Reasoning
Time-span Analysis (A)
808
Trajectory Analysis (B)
Retrieve
Loitering Detection
810
812
Alert
YES
Loitering?
NO
Event Database
End

Figure 8

900

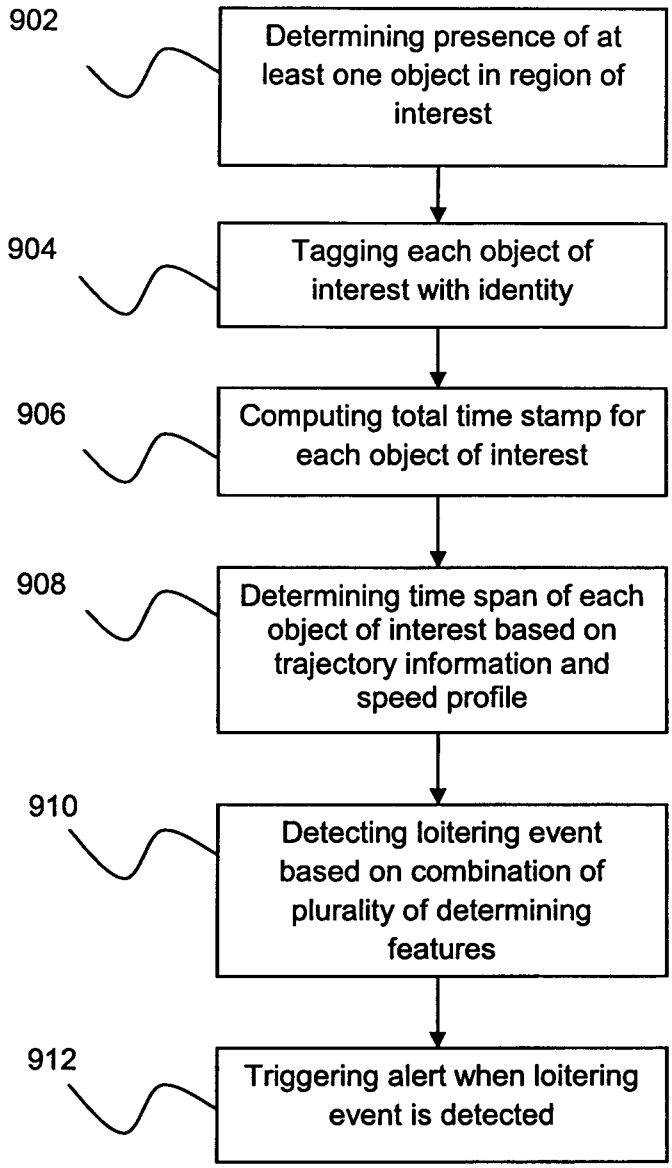

902
Determining presence of at least one object in region of interest
904
Tagging each object of interest with identity
906
Computing total time stamp for each object of interest
908
Determining time span of each object of interest based on trajectory information and speed profile
910
Detecting loitering event based on combination of plurality of determining features
912
Triggering alert when loitering event is detected

Figure 9

1000

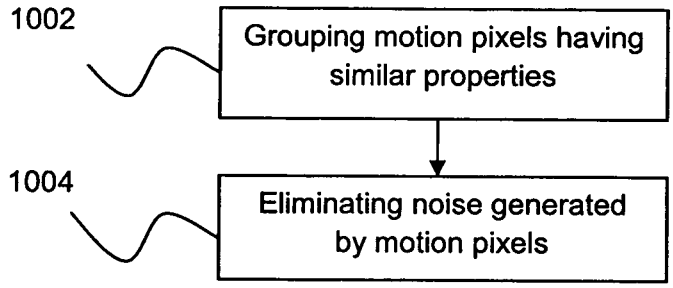


Figure 10

1100

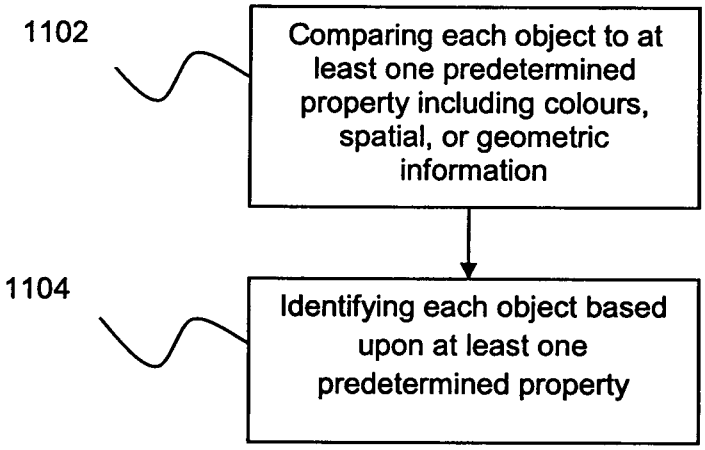


Figure 11

1200

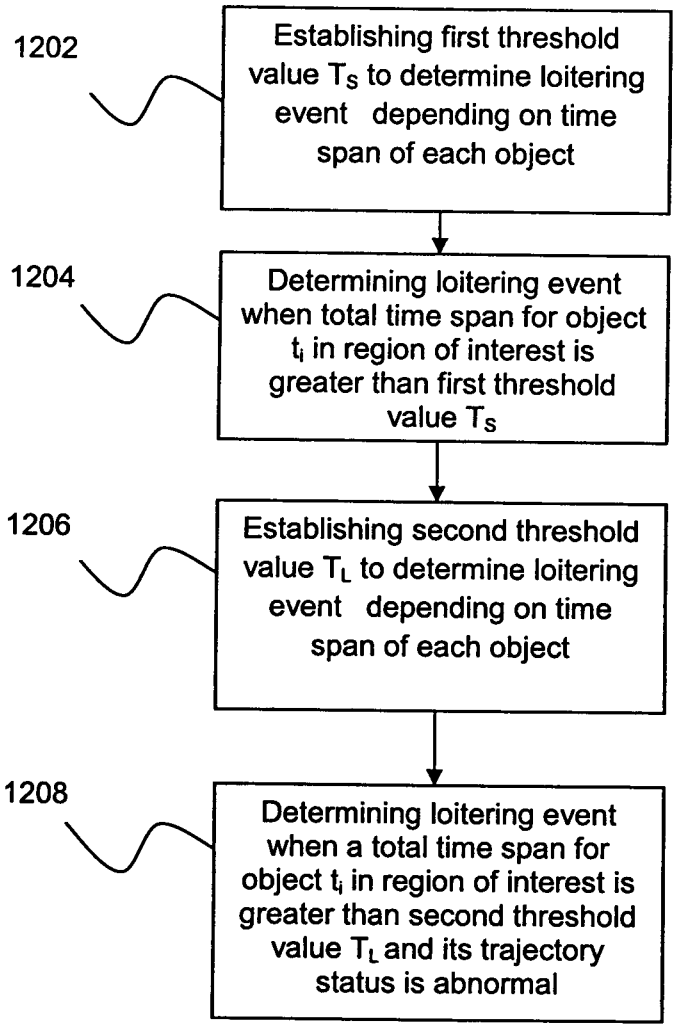


Figure 12

1300

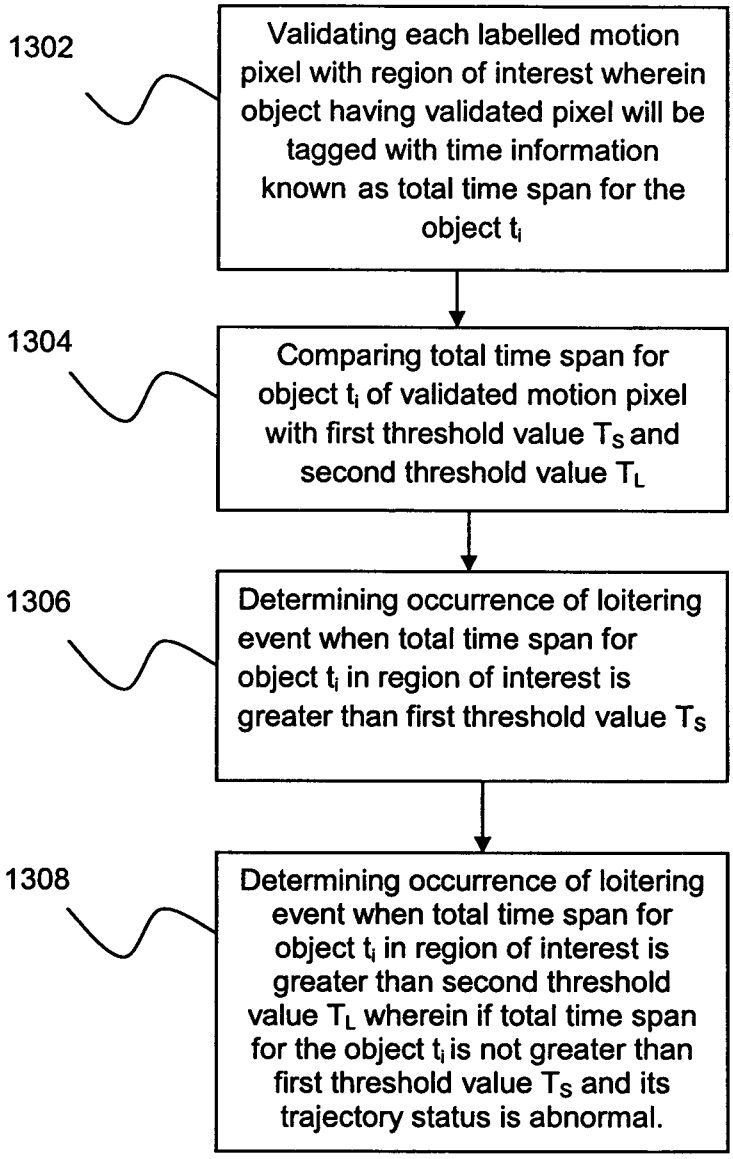


Figure 13

1400

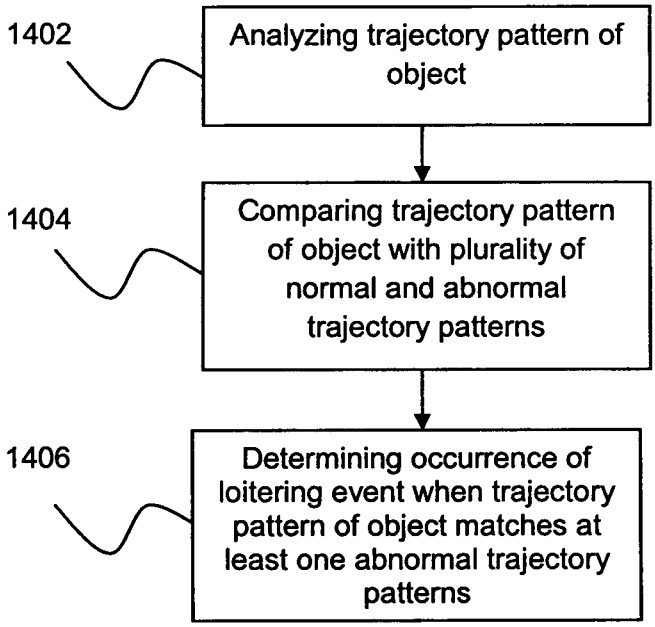


Figure 14

1500

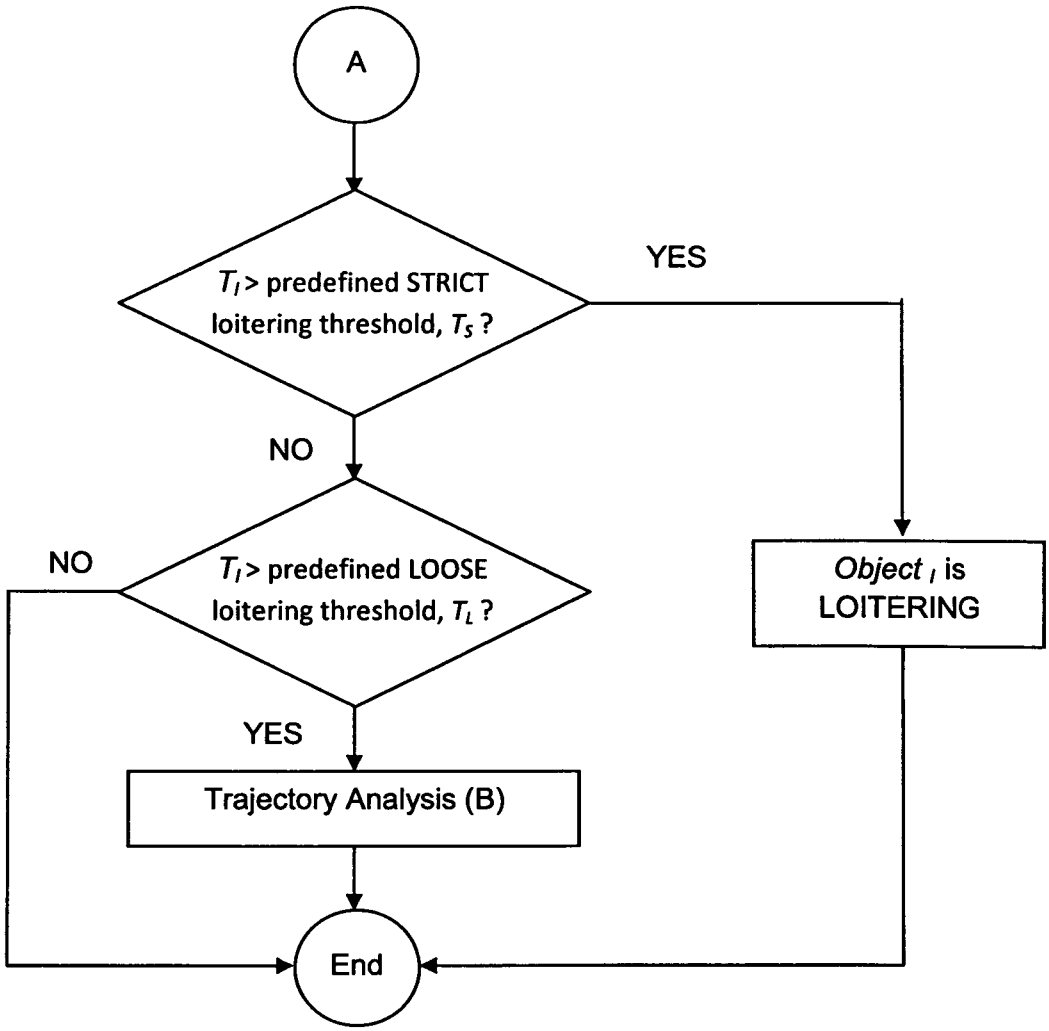
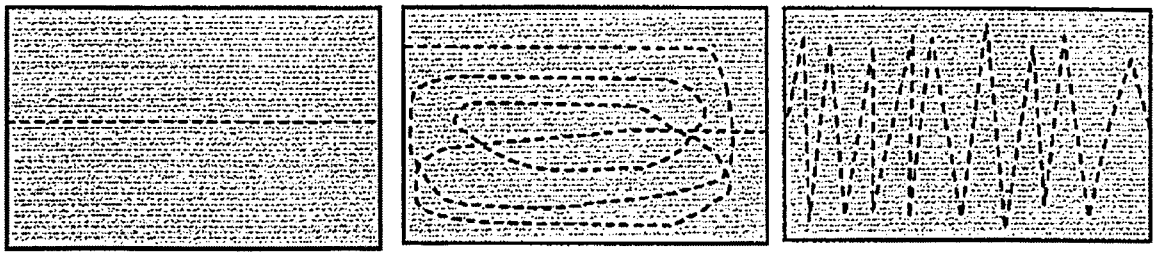


Figure 15

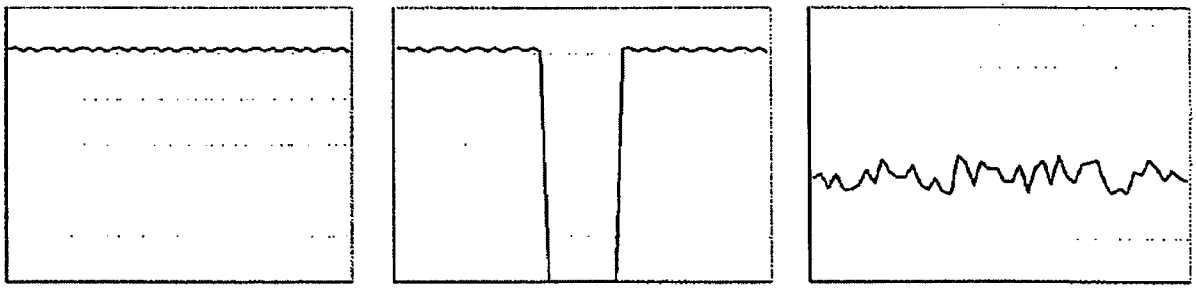
1600



(a) Normal (b) Abnormal (c) Abnormal

Figure 16

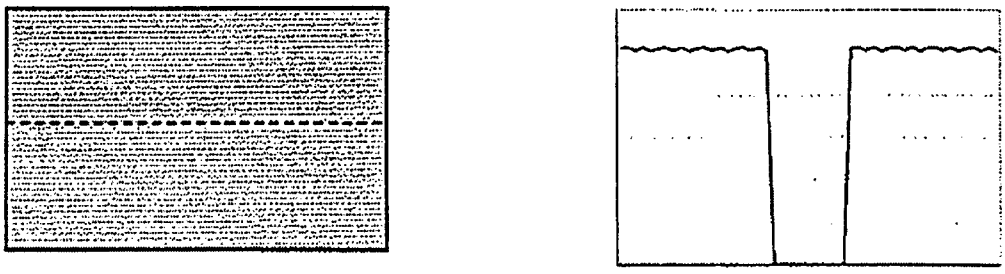
1700



(a) Profile A (b) Profile B (c) Profile C

Figure 17

1800



(a) Trajectory (b) Associated seed profile

Figure 18

1900

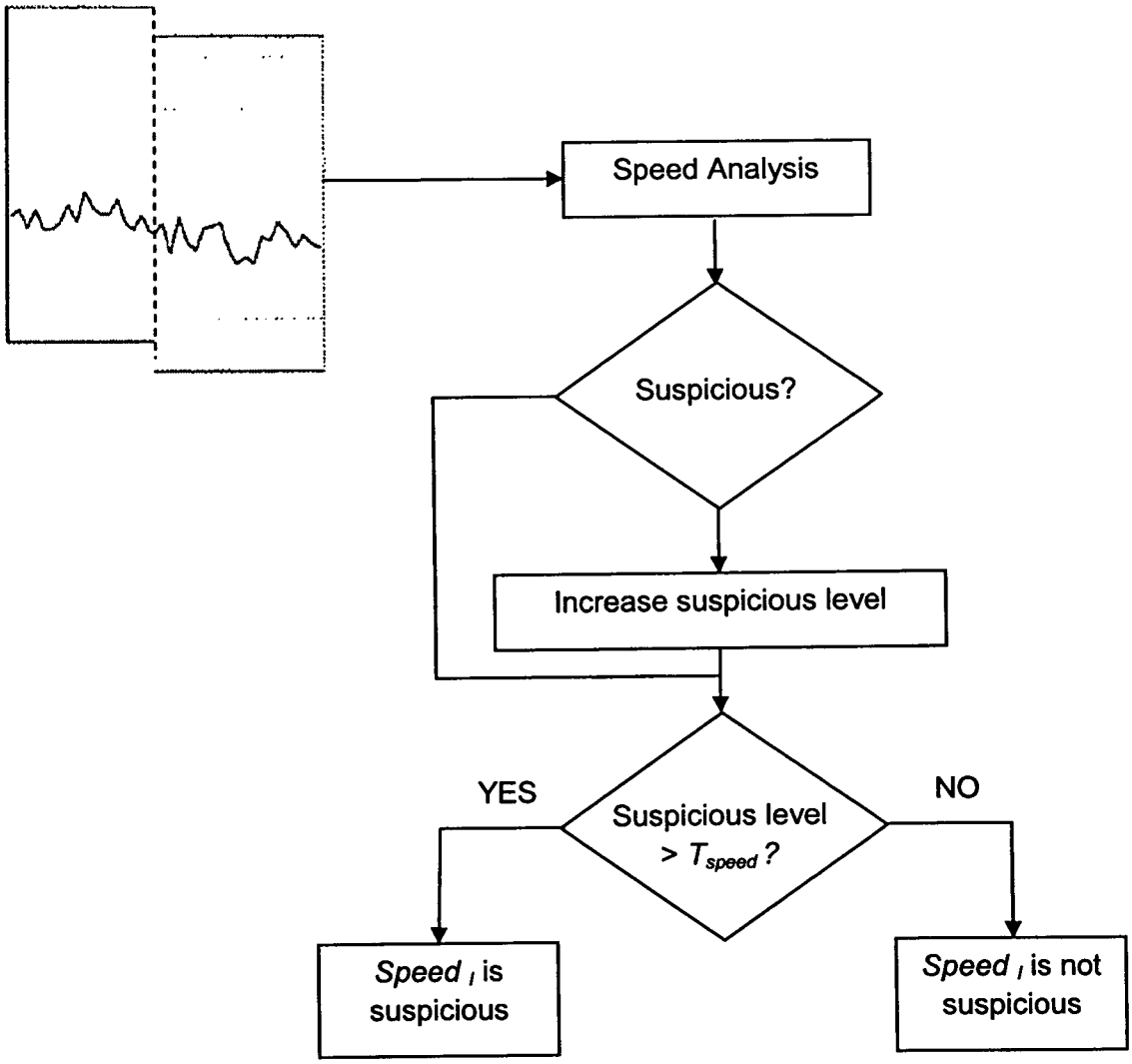


Figure 19

2000

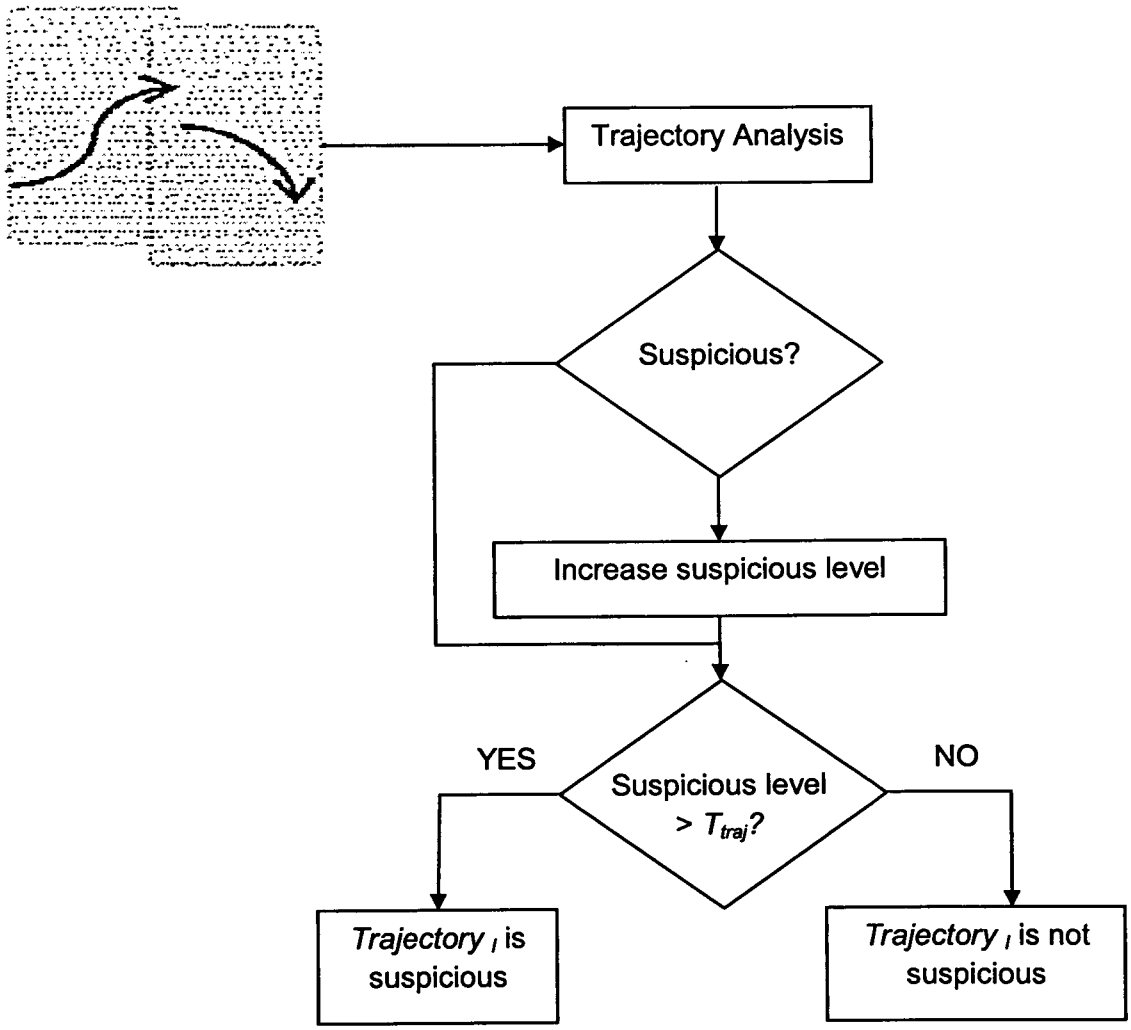


Figure 20

2100

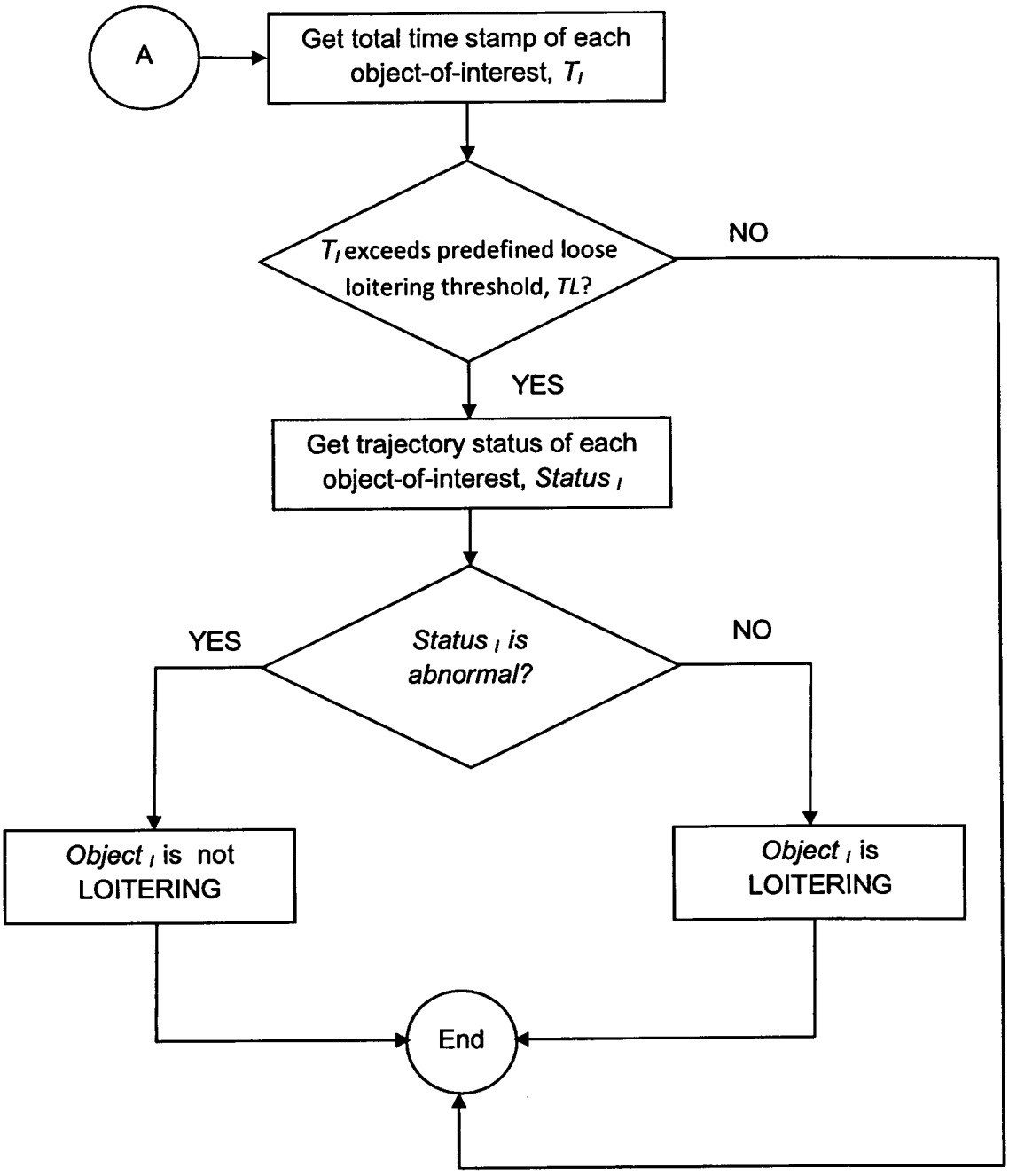


Figure 21

INTERNATIONAL SEARCH REPORT

International application No.
PCT/MY2011/000162

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

G06K 9/00 (2006.01) ***G08B 21/00*** (2006.01) ***H04N 7/18*** (2006.01)

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)

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 practicable, search terms used)
WPI, Google Scholar, Patent Lens: Keywords (loiter, wander, linger, loaf, aimless, suspicious, abnormal, detect, classify, recognise, identify, monitor, record, speed, velocity, rate, pace, time, duration, period, threshold, multiple, plural, second, additional, supplementary, auxiliary, likelihood, hypothesis, rule, trajectory, path, course, route, direction, tag, track, label, combine, merge, fuse, fusion, object, person, human, video or security surveillance) + similar keywords

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	US 7499571 B1 (HAN ET AL) 3 March 2009	
Y	See whole document; in particular abstract, col. 1 line 59 – col. 2 lines 3,19-28,61-65, col. 4 lines 28-41, col. 5 lines 7-10, col. 6 line 63- col. 7 line 36, col. 8 lines 1-29,56 – col. 9 line 10	8-19
	US 2010/0208063 A1 (LEE ET AL) 19 August 2010	
Y	See whole document; in particular abstract, paragraphs [0002],[0006]-[0008], [0011], [0069],[0120]	8-19
	US 2006/0045185 A1 (KIRYATI ET AL) 2 March 2006	
Y	See whole document; in particular abstract, paragraph [0062], fig. 6	11,15,16,18

☐ Further documents are listed in the continuation of Box C ☒ 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
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"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
02 November 2011	4 NOVEMBER 2011
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. +61 2 6283 7999	Authorized officer **OLUTOPE OMOGBENIGUN** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6283 2876

INTERNATIONAL SEARCH REPORT

International application No.
PCT/MY2011/000162

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [X] Claims Nos.: **1-7**

Note: **Claims 1-7** relate to the following excluded subject matter under Rule 39:

v. Computer programs to the extent that the International Preliminary Examining Authority is not equipped to search prior art concerning such programs. The invention presented in claims 1-7 is directed to a mere computer program comprising several modules for detecting loitering event and is therefore excluded subject matter.

2. [ ] Claims Nos.:

because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. [ ] Claims Nos.:

because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. [ ] As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[ ] No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/MY2011/000162

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	7499571	US	2005104727	US	7088846	US	2005105765
		US	7127083	US	2005104962	US	7136507
		US	2005104961	US	7148912	US	2005104959
		US	2005104960	US	2005105764	WO	2005050581
US	2010208063	WO	2010141116				
US	2006045185	EP	1631073				

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX