

(51) International Patent Classification:
G08G 1/04 (2006.01)(21) International Application Number:
PCT/MY2011/000127(22) International Filing Date:
22 June 2011 (22.06.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
PI2010005907 10 December 2010 (10.12.2010) MY(71) Applicant (for all designated States except US): **MIMOS
BERHAD** [MY/MY]; Technology Park Malaysia, 57000
Kuala Lumpur (MY).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **HON, Hock Woon**
[MY/MY]; C/o Mimos Berhad, Technology Park Malaysia,
57000 Kuala Lumpur (MY). **THEN, Siu Jing** [MY/MY];
C/o Mimos Berhad, Technology Park Malaysia, 57000 Ku-
ala Lumpur (MY).(74) Agent: **YAP, Kah, Hong**; Pyprus Sdn Bhd, Suite 8.02, 8th
Floor, Plaza First Nationwide 161, Jalan Tun H.S. Lee,
50000 Kuala Lumpur (MY).(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, TH, TJ, TM, TN, TR, TT, TZ,
UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

[Continued on next page]

(54) Title: AN APPARATUS AND METHOD FOR ROAD ACCIDENT RISK REDUCTION

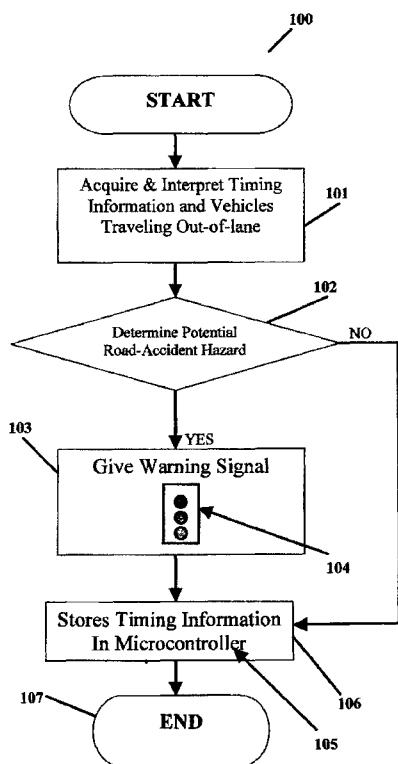


FIG. 1

(57) Abstract: The present invention provides a method for monitoring and detecting vehicles at risk of a car accident in a high-risk accident area. The method comprises fusing a motion sensing device on the surface of a road in one moving direction at the high risk- area, wherein the motion sensing device comprising four detection bars operable to detect a passing vehicle based light intensity change detected through the detection bars; acquiring timing information of the passing vehicle passing through each of the four detection bar of the motion-sensing device to interpret velocities and accelerations of the passing vehicle; determining a potential road-accident hazard based on the interpreted velocities and accelerations of the moving vehicle; providing a warning signal for an opposing moving direction when the potential road-accident hazard is determined; and storing the timing information acquired and interpreted in a database of a microcontroller of the motion sensing device.



(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, 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, RS, SE, SI, SK,

SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

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

An Apparatus And Method For Road Accident Risk Reduction

Field of the Invention

[0001] The present invention relates to an apparatus and method for detecting vehicles so that the risk-level of car accident can be reduced. In particular, the vehicles
5 can be detected when low visibility on the road is encountered or provide warnings when vehicles are traveling out-of-lane.

Background

[0002] Accidents often occur on the roads when vehicles are speeding. However, there are situations in countries with road conditions that are not optimal
10 for the safety of its users. Accidents may also occur in areas where the roads are winding or on the steep roads, common in the countryside. Such high accident rates in these areas arise as visibility tends to be blocked by the natural terrains (on sloppy roads), or the topology of the roads. These areas may be commonly regarded as high-risk accident areas.

15 **[0003]** One such situation may occur in an area with an uphill and downhill road. A vehicle travelling uphill may not be able to see another vehicle travelling on the opposite direction, on the other side of the hill. Vehicles from each opposing side of the road are given very little time when they see each other, increasing risk for accidents to occur. This is especially so at times when either or both vehicles are
20 travelling at high speeds.

[0004] There are also situations on the roads when vehicles tend to travel out of their designated lane. One such scenario could occur on roads with only two lanes, one lane for each direction designated for the vehicles to travel. A vehicle may travel out of its designated lane, into the lane designated for vehicles travelling in the opposite direction. The vehicle that travels out of its designated lane, unknown about the possible incoming vehicle travelling in the opposite direction, increases the risk of causing an accident to occur.

[0005] Therefore, high accident rates increase the need for early detection or preventions for such situations or scenarios to occur, some of which that has been given above are only for exemplary purposes. Early detection or preventions allow ample reaction time for vehicle users traveling in such high-risk accident areas. Current method commonly used in such areas, provides a mirror placed strategically on the roadsides of the high-risk accident area tend to serve little purpose as drivers of the vehicles tend to receive warnings at short distances from the mirror. As such, drivers may not have ample reaction time to avoid possible accidents from occurring.

Summary

[0006] In one aspect of the present invention, there is provided a method for monitoring and detecting vehicles at risk of a car accident in a high-risk accident area. The method comprises fusing a motion-sensing device on the surface of a road in one moving direction at the high risk-area, wherein the motion-sensing device comprising four detection bars operable to detect a passing vehicle based on the light intensity change detected through the detection bars; acquiring timing information of the passing vehicle passing through each of the four detection bar of the motion-sensing device to

interpret velocities and accelerations of the passing vehicle; determining a potential road-accident hazard based on the interpreted velocities and accelerations of the moving vehicle; and providing a warning signal for an opposing moving direction when the potential road-accident hazard is determined; and storing the timing
5 information acquired and interpreted in a database of a microcontroller of the motion sensing device.

[0007] In one embodiment, the method further comprises setting a reference reading for each of the four detection bars, wherein each of the reference reading corresponding to each of the four detection bars is changed dynamically accordingly
10 according to luminance condition surrounding the motion-sensing device. The reference reading maybe compared against a light intensity digital reading of each of the detection elements arranged in line of each of the corresponding detection bars, when the each of the light intensity digital reading is lower than the reference reading of the corresponding detection bar, an instant timing is recorded as the timing
15 information of the corresponding detection bar.

[0008] In another embodiment, the four detection bars are each fused separately at a known distance apart on the surface of the road.

[0009] Possibly, the method may further comprises determining a width of the passing vehicle through an array of detection elements forming each of the detection
20 bar, wherein the width is determined based on the number of detection elements experiencing the change of light intensity. The method may further comprise determining if the passing vehicle is moving out-of-lane, wherein when the number of

detection elements is experiencing the change in light intensity decreases or increases when compared to the other detection bars.

[0010] Further, the motion-sensing device maybe installed on the road surface leading the respective warning signal provided for an approaching moving vehicle.

5 [0011] Yet, the warning signal may also be provided faces the approaching moving vehicle, allowing ample time for the approaching vehicle to react.

Brief Description of the Drawings

[0012] This invention will be described by way of non-limiting embodiments of the present invention, with reference to the accompanying drawings, in which:

10 [0013] FIG. 1 illustrates the process flow of a Road Accident Risk Reduction (RARR) method according to one embodiment of the present invention;

[0014] FIG. 2A illustrates an operation flow of a motion-sensing device adapted for the RARR method of FIG. 1 according to one embodiment of the present invention;

15 [0015] FIG. 2B illustrates a flow chart of a derivation process in the microcontroller of the motion-sensing device;

[0016] FIG. 3B illustrates one possible scenario of a vehicle detected traveling at constant velocity;

[0017] FIG. 3C illustrates one possible scenario of a vehicle detected traveling
20 at increasing velocity (acceleration);

[0018] FIG. 3D illustrates one possible scenario of a vehicle detected traveling at decreasing velocity (deceleration);

[0019] FIG. 3E illustrates a histogram of the velocity and acceleration information tabulated based on the timing information attained as shown in FIG. 3B-

5 3D;

[0020] FIG. 4A illustrates an example of a scenario with the apparatus installed in one high-risk accident area; and

[0021] FIG. 4B illustrates an example of a scenario with the apparatus installed in another high-risk accident area.

10

Detailed Description

[0022] The following descriptions of a number of specific and alternative embodiments are provided to understand the inventive features of the present invention. It shall be apparent to one skilled in the art, however that this invention may be practiced without such specific details. Some of the details may not be described in length so as to not obscure the invention. For ease of reference, common reference numerals will be used throughout the figures when referring to same or similar features common to the figures.

[0023] FIG. 1 illustrates the process flow of a Road Accident Risk Reduction (RARR) method 100 according to one embodiment of the present invention. The RARR method 100 comprises acquiring and interpreting timing information of a moving vehicle and detects if the vehicle is traveling out-of-lane at step 101; determining if the moving vehicle is in potential road-accident hazard at step 102;

providing a warning signal with an aid of a traffic light 104 at step 103; storing the timing information in the database of a microcontroller 105 at step 106.

[0024] Still referring to FIG. 1, the RARR 100 is typically utilized in areas with common accident occurrences, or high-risk accident areas. Such high-risk
5 accident areas may be one with low visibility on roads over a hill where vehicles from the opposing side at the either side of the hill or sharp bend and are only visible at very close distance from each vehicle, or when vehicles travel along the opposing direction lane. The RARR method 100 starts monitoring all passing vehicles as it traveling along the areas under monitored. Each vehicle traveling along the area is
10 time-tagged. The RARR method 100 acquires and interprets the timing information of the vehicle as well as detecting if the vehicle is traveling out-of-lane through a motion-sensing device. The acquiring and interpreting of the timing information of the vehicle is processed with the motion-sensing device. The timing information may include the vehicles' velocity and acceleration. The motion-sensing device is also
15 adapted to detect if the passing vehicle is traveling out-of-lane.

[0025] Based on the timing information attained at step 101, the RARR method 100 further determines if the vehicle is a potential road-accident hazard at step 102. The potential road-accident hazards may include vehicles traveling at high speeds (based on its velocity or acceleration acquired), and the vehicle is traveling
20 out-of-lane. Such low visibility may be due to the natural terrain of the road (uphill and downhill) or in areas with sharp winding roads. There have been cases where vehicles travel on the wrong lane, thereby resulting in accidents with collisions into oncoming vehicles.

[0026] When a potential road-accident hazard is determined at the step 102, a warning signal will be provided/activated at the step 103 to vehicles with an aid of the traffic light 104, for example. The traffic light 104 may provide a red light and/or triggers a sound alarm, such as a siren to warn the oncoming vehicles from the
5 opposing side if the potential road-accident hazard is determined at the step 102. If there is no potential road-accident hazard determined at the step 102, the traffic light 104 remains green. At step 106, the timing information is stored on the motion-sensing device whether a potential road-accident hazard at step 103. After storing the timing information, the RARR method 100 ends at step 111 till another vehicle
10 comes along the same area and the RARR method 100 starts again.

[0027] FIG. 2A illustrates an operation flow of a motion-sensing device 200 adapted for the RARR method 100 of FIG. 1 according to one embodiment of the present invention. The motion-sensing device 200 comprises a detector 201 and a microcontroller 202. It is desired that the detector 201 is fused on the road on-site for
15 the necessary detection and is able to derive at least the speed, the acceleration and the width of the vehicle. It is also desired that the motion-sensing device 200 is able to detect when the vehicle is travelling out-of-lane.

[0028] Still referring to FIG. 2, the detector 201 comprises a plurality of detection bars 203 to detect passing vehicles. The example given in the present
20 invention comprises four detection bars 203 aligned in parallel and placed within a metal frame 204. The four detection bars 203 are arranged separately at a known distant apart. Each of the detection bar 203 is further made up of a plurality of detection elements 205 arranged in line. The detection elements 205 may be any type of sensing

elements that may be light sensitive, pressure sensitive or proximity sensitive. The type of sensing element desired might be light sensitive elements, which detects a change in light intensity. The change in light intensity may occur as an object is passing through, causing a change in the intensity level of light detected from the detection elements

5 205. The detector 201 is designed to fuse on the surface of the roads to be monitored, detecting vehicles once it passes through the detector 201. It is desired that the detection bar 203, which comprises the plurality of detection elements 205, be made up of a flexible material. It allows modification in its shape to accord to the conditions of the road. The conditions of the road includes roads that are curvature or uneven, just to

10 name a few.

[0029] Still referring to FIG. 2A, as a vehicle passes through the detector 201 fused on the road, each of the detection element 205 functions independently and experiences a change in light intensity as the vehicle shades the area above the detection element 205. From each of the detection bar 203 in the detector 201, the

15 change in the light intensity of each detection element 205 is converted into an electrical signal via a voltage converter at step 206. The voltage converter further quantizes the electrical signal into a series of digital readings at step 207. The digital readings from each of the detection bar 203 are stored at step 208 for further processing. The steps 206-208 are carried out for each detection bar 203, and the digital

20 readings are collectively processed at step 209 to determine the velocity, acceleration and the width of the passing vehicle.

[0030] FIG. 2B illustrates a flow chart of a derivation process 209 in the microcontroller 202 of the motion-sensing device 200. The derivation process 209

begins at stage 210 once the motion-sensing device 200 is installed onto the desired road or area. At stage 211, a valid-size detection of a vehicle travelling along the area and a time-out parameter is preset in the microcontroller 202. The valid-size detection provides the approximate width of an average vehicle. The valid-size detection eliminates the possibilities of non-vehicle objects passing through the motion-sensing device 200. The time-out parameter is provided in the derivation process 209 to ensure that each consecutively placed detector bar 203 in the motion-sensing device detects an event (or a passing vehicle) successively. The time-out parameter eliminates the possibilities of storing timing information when not all the four detection bars 203 detect a passing vehicle. Once the valid-size detection and the time-out parameter is preset, the motion-sensing device 200 is in the state of detecting passing vehicles and determines the velocity, acceleration and the width of the passing vehicles. At step 212, the light signals received by the detection elements 205 are converted to a voltage reading. At the step 213, the voltage readings are quantized to digital reading in a series of readings. At step 214, these readings are stored.

[0031] At step 212, the light signals received by detection elements 205, i.e. the light intensity, are converted to voltage readings. Such analogue readings are quantized or digitized into digital readings in order to be readable by the microcontroller 202. The digital reading refers to a digitized signal or digital representation of the light signal detected from the detection elements 205. In one example, an 8-bit digital reading may present the light intensity reading in 2^8 levels or 256 levels from 0 to 255, wherein 0 represents the darkest black and 255 represents the lightest white of the light intensity. The digital readings from the detection elements 205 of each detection bar 203 at a specific timing are averaged out and set as a

reference reading. The reference reading will be set/updated at the specific timing as the user has defined it. This allows the reference reading to be automatically set dynamically as the luminance of the environment in which the motion-sensing device 200 is fused on changes during the day. Therefore, the reference reading set/updated
5 due to the luminance of the environment throughout the day is used throughout the derivation process 209 when the detector 201 detects a passing vehicle. The reference reading does not change during the detection of the passing vehicle. The corresponding reference reading for each detection bar 203 will be compared with the digital readings attained from each of the detection elements 205 arranged in line according to each of
10 the four detection bars 203.

[0032] At stage 215, the first detector bar 203 detects an event or a passing vehicle. At stage 216, the microcontroller 202 checks if the digital reading attained from each of the detection elements 205 in the first detector bar 203 is lower than the reference reading of the first detector bar 203. When the digital readings of each of
15 the detection elements 205 are lower than the reference reading of the first detector bar 203, it signifies that an object has passed through the first detection bar 203, and accordingly a time t_1 indicating the instant time when the object passes through the first detection bar 203, is recorded and stored at stage 217. Otherwise, the derivation process 209 returns to stage 215 and for another event or motion to be detected first
20 by the first detector bar 203. After the time t_1 is set, at stage 218, the second detector bar 203 checks if the event or motion is detected within the time-out parameter that has been set in stage 211. If the event is detected within the time-out parameter by the second detector bar 203, the digital readings from each of the detection elements 205 on the second detection bar 203 is checked if it is lower than the corresponding

reference reading of the second detection bar 203 at stage 219. Otherwise, the derivation process returns to stage 215 and for another event to be detected by the first detector bar 203. Similarly, at stage 219, if the digital reading is lower than the reference reading of the corresponding second detector bar 203, a time t_2 is recorded and stored at stage 220, else the derivation process 209 returns to the stage 215 and begins when the first detector bar 203 detects an event. At stage 221, the third detector bar 203 check if the event or motion is detected within the time-out parameter that has been set in stage 211. If the event is detected within the time-out parameter in the third detector bar 203, the digital readings from each of the detection elements 205 on the third detection bar 203 is checked if it is lower than the reference reading of the corresponding reference reading of the third detector bar 203 at stage 222. Otherwise, the derivation process returns to stage 215 and for another event to be detected by the first detector bar 203. Similarly, at stage 222, if the digital readings from each of the detection elements 205 on the third detection bar 203 is lower than the reference reading, a time t_3 is recorded and stored at stage 223, else the derivation process 209 returns to the stage 215 and for another event to be detected. The derivation process 209 continues consecutively from stage 215 to stage 223 accordingly. At stage 224, the forth detector bar 203 checks if the event or motion is detected within the time-out parameter that has been set in stage 211. If the event is detected within the time-out parameter in the forth detector bar 203, the digital readings from each of the detection elements 205 on the forth detection bar 203 is checked if it is lower than the reference reading off the corresponding forth detection bar 203 at stage 225. Otherwise, the derivation process returns to stage 215. Similarly, if the digital readings from each of the detection elements 205 on the forth

detection bar 203 is lower than the reference reading of the corresponding forth detection bar 203, a time as t_4 is recorded and stored at stage 226. else the derivation process 209 returns to the stage. The derivation process 209 continues consecutively from stage 215 to stage 226 accordingly. As mentioned in FIG. 2A, only four of the
5 detection bars 203 are utilized in the detector 201. Therefore, after stage 226, the recorded and stored readings for each detector bars 203 detecting the passing vehicle are t_1 , t_2 , t_3 , and t_4 .

[0033] Still referring to the FIG. 2B, at stage 227, the size of the vehicle detected is validated and checked against the valid-size detection that have been
10 preset in stage 211. For an example, when the preset valid-size detection requires at least 25%-30%, for example, of the detection elements 205 on each of the detection bar 203 to experience a change in light intensity, the passing objects that triggered lesser (than 25%-30%) of the detection elements 205 will be disregarded. When the number of detection elements 205 experiencing the change in the light intensity
15 decreases or increases drastically when compared to the other detection bar 203, the derivation process 209 may also derive that the vehicle is potentially traveling out of its lane. At stage 228, determines if the vehicle is traveling out of its lane, and acquires time readings as detected from each detection bar 203.

[0034] FIG. 3A-3F illustrates a velocity derivation process 300 based on the
20 time readings attained and stored in the microcontroller 202 as shown in FIG. 2B. The time readings (t_1 , t_2 , t_3 , and t_4) acquired and stored on the microcontroller 202 is plotted as a pulse 301 detected from each detection bar 203 on a graph 302 The pulse 301 detected aids in representing the time readings that may be used to derive the

timing information. The timing information comprises velocity and acceleration information. The derivation of the velocity and acceleration information relies on the time readings attained and the known distances between each of the consecutive detection bars 203.

5 **[0035]** When the vehicle passes through the detection bar 203, the graph 302 shows the pulse 301 of the time reading, of the time tagged with the vehicle. The pulse 301 is only detected and plotted on the graph 302 when the detection bar 203 of the detector 201 detects a change in the light level intensity. The pulse 301 detected will be subjected to the plurality of detection bar 203 attached in the metal
10 frame 204 of the detector 201. In the present invention, only four detection bars 203 are utilized, hence only four pulses 301 will be detected and plotted.

[0036] Still referring to FIG. 3A, the four different time readings taken, t_1 , t_2 , t_3 and t_4 derived in FIG. 2B is represented along four individual lines. The pulse 301 is alike the shape of a square-wave. Prior to deriving the timing information, the time
15 interval between two consecutive time readings has to be computed. The 1st time interval is computed by taking the difference of t_1 and t_2 as shown by an arrow 303, the 2nd time interval is computed by taking the difference of t_2 and t_3 as shown by an arrow 304 and lastly, the 3rd time interval is computed by taking the difference of t_3 and t_4 as shown by an arrow 305. Similarly, the difference between the 1st time
20 interval and 2nd time interval is first computed as shown by an arrow 306, and the difference between the 2nd time interval and 3rd time interval is computed as shown by an arrow 307. The derivation of the various time intervals and differences as shown by the arrows 303-307 will be used to derive the timing information required.

[0037] FIG. 3B illustrates one possible scenario of a vehicle detected traveling at constant velocity. The timing information is tabulated based on the time readings attained accordingly. The graph 302 of the vehicle traveling in constant velocity will have equal 1st time interval (arrow 303), as with the 2nd time interval (arrow 304) and 3rd time interval (arrow 305). This means that arrows 303-305 represented will have equal lengths. Similarly, the arrows 306-307 representing the difference between the 1st time interval and 2nd time, and the difference between the 2nd time interval and 3rd time interval, will have equal lengths.

[0038] FIG. 3C illustrates one possible scenario of a vehicle detected traveling at increasing velocity (acceleration). Similarly, the timing information is tabulated based on the time readings attained. The graph 302 of the vehicle traveling in increasing velocity with arrows 303-305 representing the 1st time interval, the 2nd time interval and the 3rd time interval shows consecutively decreasing lengths in the arrows. This means that the time taken for the vehicle to pass through two consecutive detection bars 203 decreases accordingly, or rather, the vehicle takes an increasingly shorter time to pass through each detection bar 203. Similarly, the arrows 306-307 representing the difference between the 1st time interval and 2nd time, and the difference between the 2nd time interval and 3rd time interval, will also be decreasing consecutively in the lengths.

[0039] FIG. 3D illustrates one possible scenario of a vehicle detected traveling at decreasing velocity (deceleration). The timing information is tabulated based on the time readings attained. The graph 302 of the vehicle traveling in decreasing velocity with arrows 303-305 representing the 1st time interval, the 2nd

time interval and the 3rd time interval shows consecutively increasing lengths in the arrows. This means that the time taken for the vehicle to pass through two consecutive detection bars 203 increases accordingly, or rather, the vehicle takes an increasingly longer time to pass through each detection bar 203. Similarly, the
5 arrows 303-307 representing the difference between the 1st time interval and 2nd time, and the difference between the 2nd time interval and 3rd time interval, will also be increasing consecutively in the lengths.

[0040] FIG. 3E illustrates a histogram of the velocity and acceleration information tabulated based on the timing information attained as shown in FIG. 3B-
10 3D. The corresponding reciprocal of the time intervals calculated as shown by arrows 303-305 in FIG. 3B-3D are calculated and then plotted on the histogram at stage 308. The corresponding reciprocal of the difference in time intervals calculated as shown by the arrows 306-307 are calculated and plotted on the histogram at stage 309. Stages 308-309 provides the histogram to show the velocity and acceleration
15 information.

[0041] Still referring to FIG. 3E, based on the corresponding reciprocal of the timing information attained at stage 308 and stage 309, a graph A 310 is a graph based on the timing information attained in FIG. 3B, with a vehicle traveling across the detector 201 with constant time intervals or constant velocity. The histogram
20 plots the reciprocals of the 1st time interval, the 2nd time interval and the 3rd time interval as shown by the three bar graphs (arrow 303-305 as shown in FIG. 3B). At stage 309, the histogram plots the reciprocals of the difference between the 1st and 2nd time interval, and the difference between the 2nd and 3rd time interval as shown by

the two bar graphs (arrow 306-307 as shown in FIG. 3B). Similarly, a graph B 311 is a graph based on the timing information attained in FIG. 3C, with a vehicle traveling across the detector 201 with decreasing time intervals or increasing velocity (acceleration). The reciprocals of the following decreasing time intervals are then
5 calculated and shown as increasing in the corresponding stage 308 and stage 309. A graph C 312 is a graph based on the timing information attained in FIG. 3D, with a vehicle traveling across the detector 201 with increasing time intervals or decreasing velocity (deceleration). Accordingly, the corresponding reciprocals of the increasing time intervals will be calculated and shown as decreasing during the stage 308 and
10 stage 309.

[0042] Still referring to FIG. 3E, the plotted histogram is purely based on the time readings attained from each of the detection bar 203. The velocities and accelerations are not deduced from the histogram, as it is determined in the microcontroller 105 with the timing information tabulated and acquired. The timing
15 information 101 is required in the RARR method 100 prior to determining the potential road-accident hazard 103. The Graph A 310, graph B 311 and graph C 312 are three such examples of three possible scenarios that the detector 201 can detect from the varying speeds of a vehicle and of the timing information that can be obtained.

20 [0043] FIG. 4A and FIG. 4B illustrates examples of the RARR method 100 that is used on two different topology of roads. The traffic lights 104 systems are situated strategically at locations, warning drivers of vehicles traveling along the road on potential road-accident hazard 103. The traffic lights 104 are also placed

strategically where it allows ample time for the drivers to react (if they need to brake) accordingly. As the microcontroller 105 is connected to the traffic light 104, the type of velocity (constant, increasing or decreasing) determined in FIG. 3E is helpful in determining the potential road-accident hazard 103, therefore providing
5 the warning signal with the traffic light 104.

[0044] FIG. 4A shows an example of a scenario with the apparatus 200 installed in one high-risk accident area. The example as shown is an area with an uphill and downhill road. The detector 201 is placed on the lower terrain of a hill with the traffic light 104 located along the middle terrain of the hill. The detector 201
10 has the detection bars 203 oriented in a known distance from the adjacent bar. Each detector 201 is installed on the road surface leading the respective traffic light 104. As shown in FIG. 4A, a car A is travelling up on the right side of the hill on one lane. Another car B is traveling up on the left side of the hill, on another lane. For explanatory purposes in such a scenario, one lane for each direction is used to
15 describe the example as shown in FIG. 4A. The method is not subjected only to a hill with two opposing lanes and may have more than one lane provided for each direction. Accordingly, as car A passes through the detector 201 at a high speed with increasing velocity, the RARR method 100 may determine that car A is a potential road-accident hazard 103 to car B. The traffic light 104 facing the car B therefore
20 operates to give a warning signal to car B that a vehicle approaching from the other side of the hill is a potential road-accident hazard 103. Similarly, if car B passes through the detector 201 on its lane, the traffic light 104 facing the car A operates to give a warning signal to car A that a vehicle is approaching from the other side of the hill. If either car A or car B travels out of its stipulated lane (towards the car

traveling out-of-lane 102 in the opposing direction), the RARR method 100 determines the car is a potential road-accident hazard 103 and the traffic light 104 gives the same warning signal to the approaching car. If the car A and car B are not determined as a potential road-accident hazard 103 by the RARR method 100, the
5 time readings as detected from each of the detection bar 205 will be stored accordingly in the microcontroller 105.

[0045] Still referring to FIG. 4A, due to the flexible material used for the detection bars 203 in the detector 201, the detector 201 may still be fused accordingly onto the roads, regardless of the irregularities of the roads (e.g. the roads
10 may be sandy, filled with gravels or curvaceous).

[0046] FIG. 4B illustrates an example of a scenario with the apparatus 200 installed in another high-risk accident area. The example as shown is an area with a winding road (curvaceous road). The detector 201 is placed on each lane of the road and the traffic light 104 gives warning signals to vehicles traveling on the roads
15 when the RARR method 100 determines a potential road-accident hazard 103. The derivation process 209, which is part of the RARR method 100, has a predetermined valid-detection 212, which presets the least number of detection elements 205 in each of the detection bars 203 needed to have a change in the light intensity.

[0047] Still referring to FIG. 4B, a car A and car B are traveling along a
20 winding road, each on one lane in the opposite direction. The traffic light 104 is located on the side of the road along each lane, to give the warning signal for the vehicle traveling on the road. If car A travels out-of-lane 102, the number of detection elements 205 detecting the change in the light intensity shows a gradual

change (decreasing number of detection elements 205 detecting the vehicle) with the consecutive detection bars 203. Accordingly, the RARR method 100 interprets a vehicle traveling out-of-lane 102 and therefore determines the vehicle as a potential road-accident hazard 103. The traffic light 104 gives the warning signal accordingly to car B. likewise, as when car B travels out-of-lane 102, the traffic light 104 gives the warning signal to the approaching car A.

[0048] The RARR method 100 only monitors the vehicles traveling along the area and gives the warning signal to the vehicles if a potential road-accident hazard 103 is determined. It does not provide a method that prevents an accident from occurring, as the drivers of the vehicles may not heed the warning signals given.

[0049] The above description illustrates various embodiments of the present invention along with examples of how aspects of the present invention may be implemented. While specific embodiments have been described and illustrated it is understood that many changes, modifications, variations and combinations thereof could be made to the present invention without departing from the scope of the present invention. The above examples, embodiments, instructions semantics, and drawings should not be deemed to be the only embodiments, and are presented to illustrate the flexibility and advantages of the present invention as defined by the following claims:

Claims

1. A method for monitoring and detecting vehicles at risk of a car accident in a high-risk accident area, the method comprising:
 - fusing a motion-sensing device on the surface of a road in one moving direction
 - 5 at the high risk-area, wherein the motion sensing device comprising four detection bars operable to detect a passing vehicle based light intensity change detected through the detection bars;
 - acquiring timing information of the passing vehicle passing through each of the four detection bar of the motion-sensing device to interpret velocities and accelerations
 - 10 of the passing vehicle;
 - determining a potential road-accident hazard based on the interpreted velocities and accelerations of the moving vehicle;
 - providing a warning signal for an opposing moving direction when the potential road-accident hazard is determined; and
 - 15 storing the timing information acquired and interpreted in a database of a microcontroller of the motion-sensing device.
2. The method according to claim 1, further comprising setting a reference reading for each of the four detection bars, wherein each of the reference reading corresponding to each of the four detection bars is changed dynamically accordingly according to
- 20 luminance condition surrounding the motion-sensing device.
3. The method according to claim 2, wherein the reference reading maybe compared against a light intensity digital reading of each of the detection elements arranged in line of each of the corresponding detection bars, when each of the light intensity digital reading is lower than the reference reading of the corresponding

detection bar, an instant timing is recorded as the timing information of the corresponding detection bar.

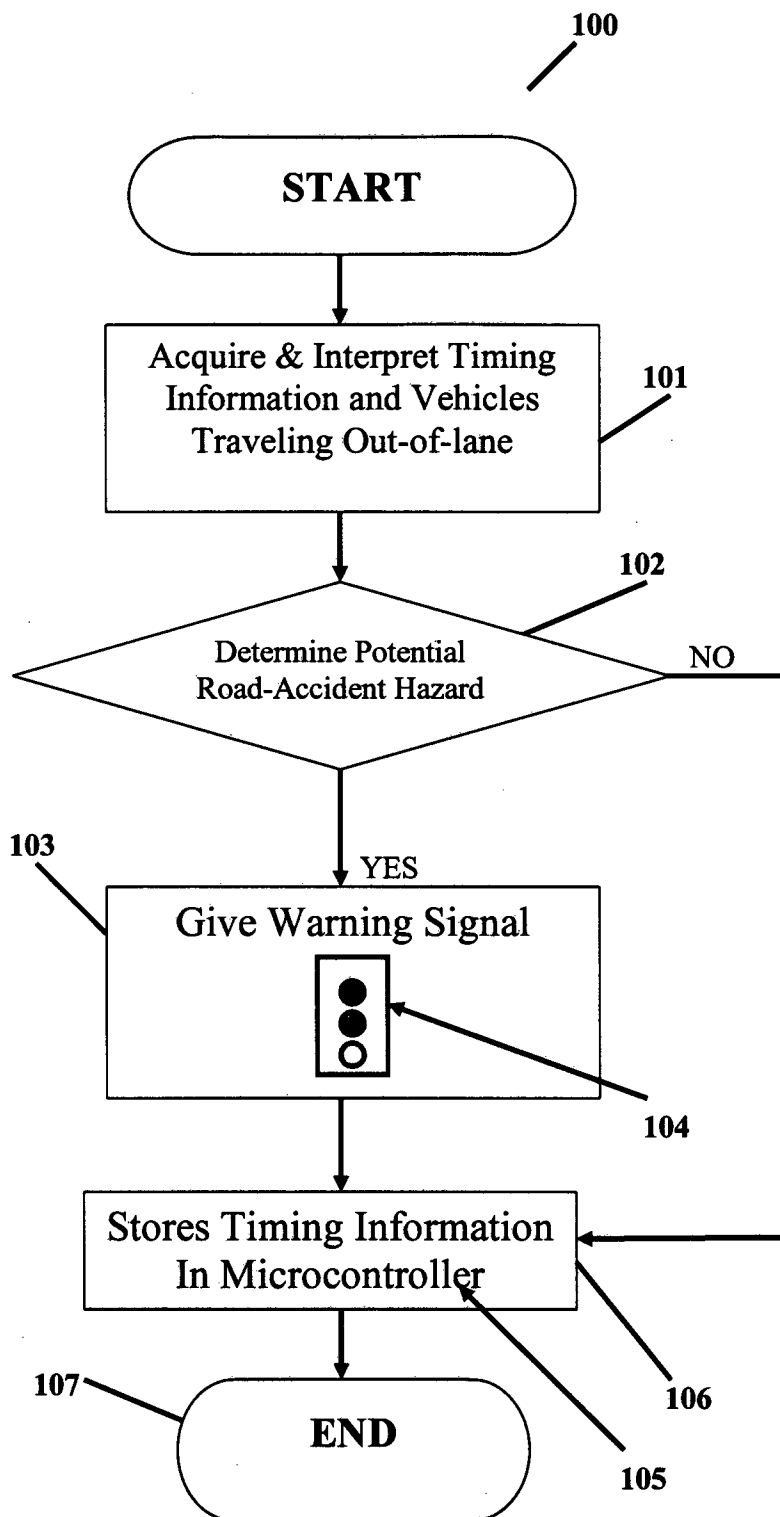
4. The method according to claim 1, wherein the four detection bars are each fused separately at a known distance apart on the surface of the road.

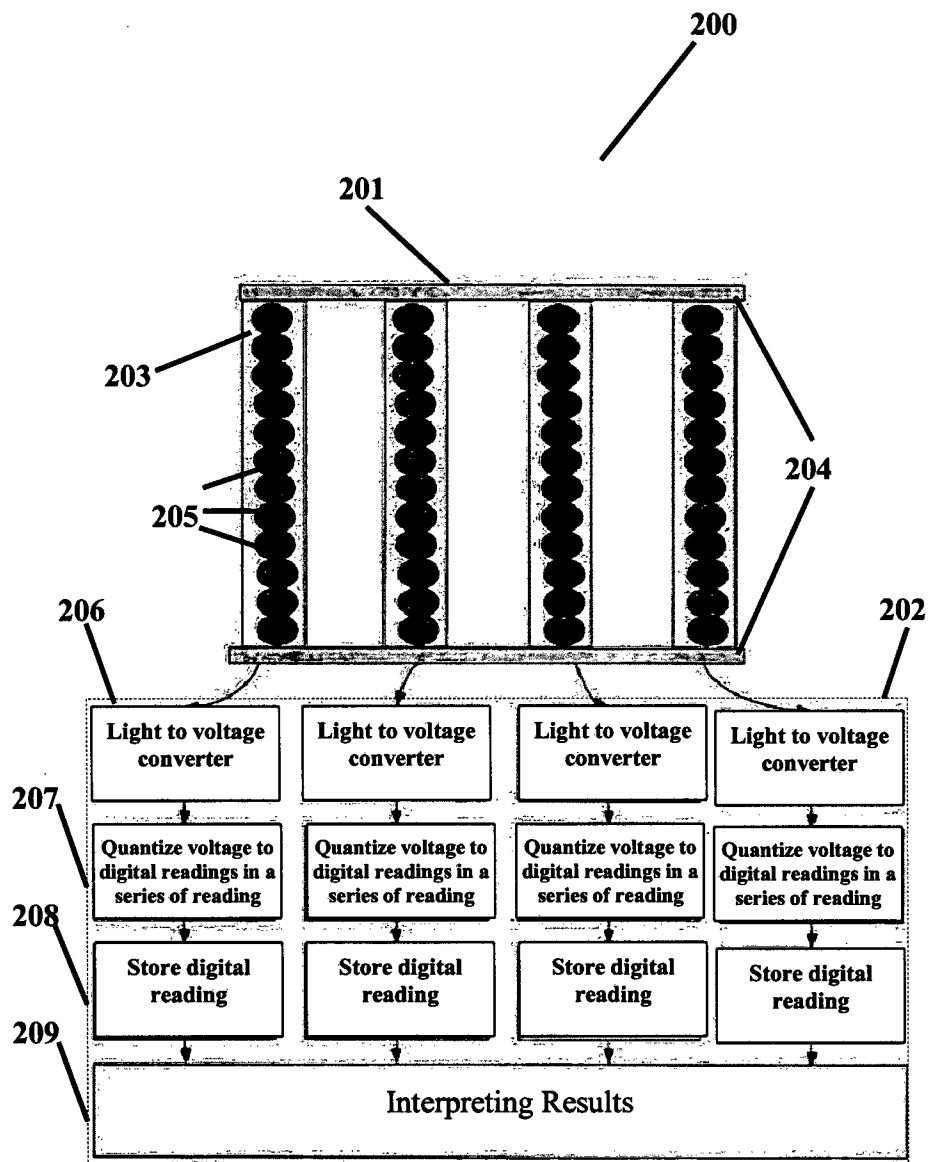
5 5. The method according to claim 1, further comprising determining a width of the passing vehicle through an array of detection elements forming each of the detection bar, wherein the width is determined based on the number of detection elements experiencing the change of light intensity.

6. The method according to claim 6, further comprising determining if the passing
10 vehicle is moving out-of-lane, wherein when the number of detection elements is experiencing the change in light intensity decreases or increases when compared to the other detection bars.

7. The method according to claim 1, whereby the motion-sensing device is installed on the road surface leading the respective warning signal provided for an
15 approaching moving vehicle.

8. The method according to claim 1, whereby the warning signal provided faces the approaching moving vehicle, allowing ample time for the approaching vehicle to react.

**FIG. 1**

**FIG. 2A**

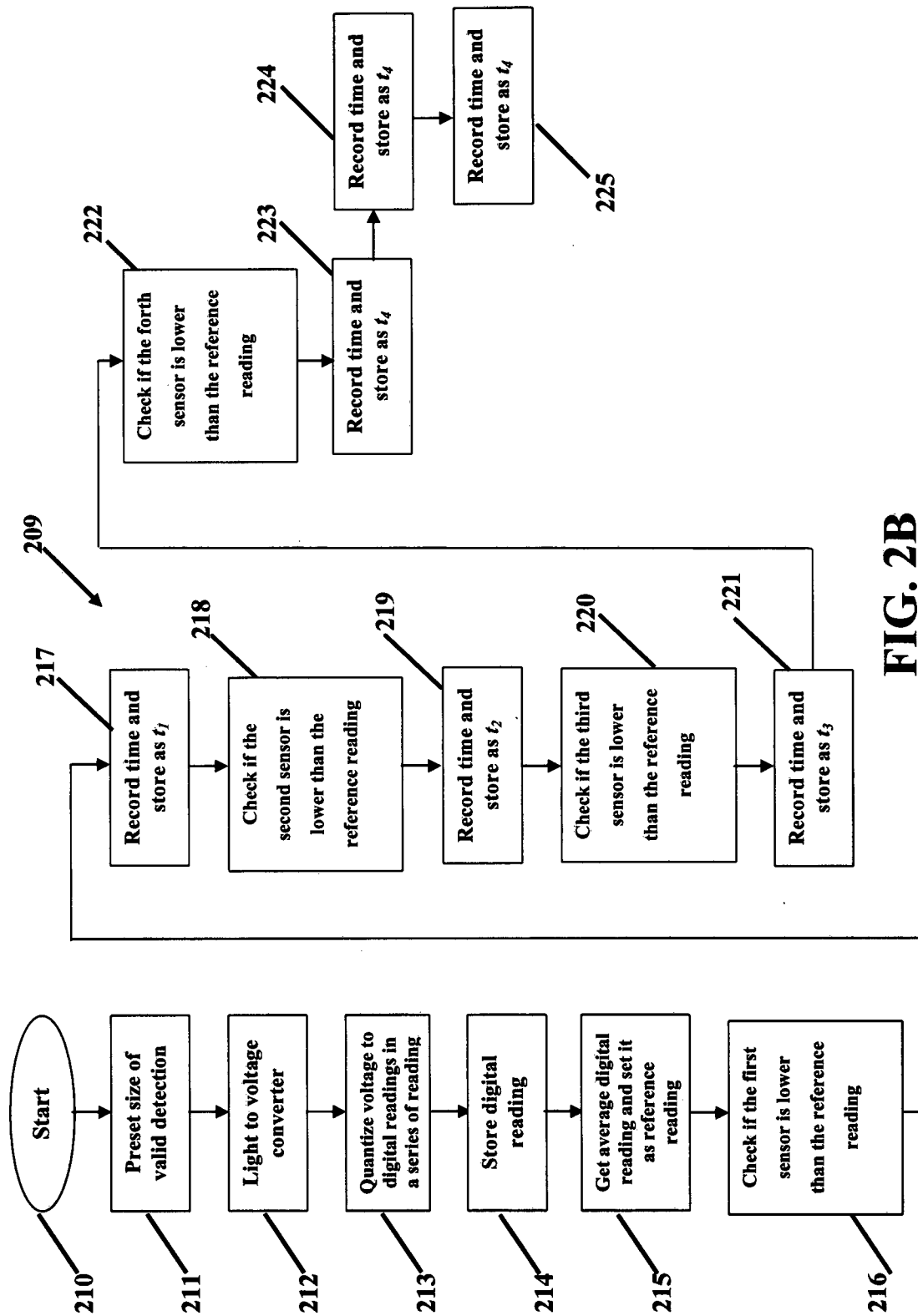
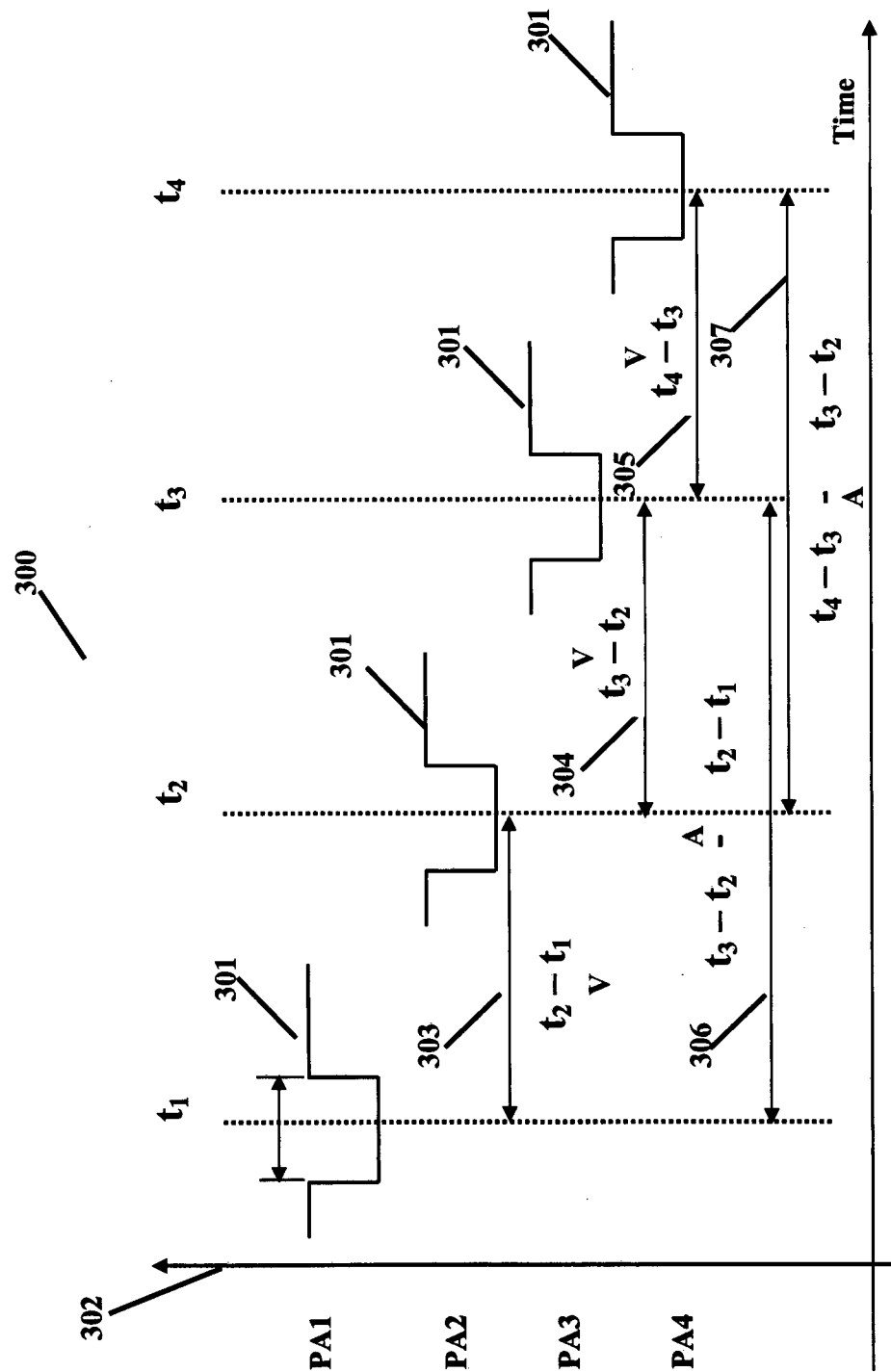


FIG. 2B



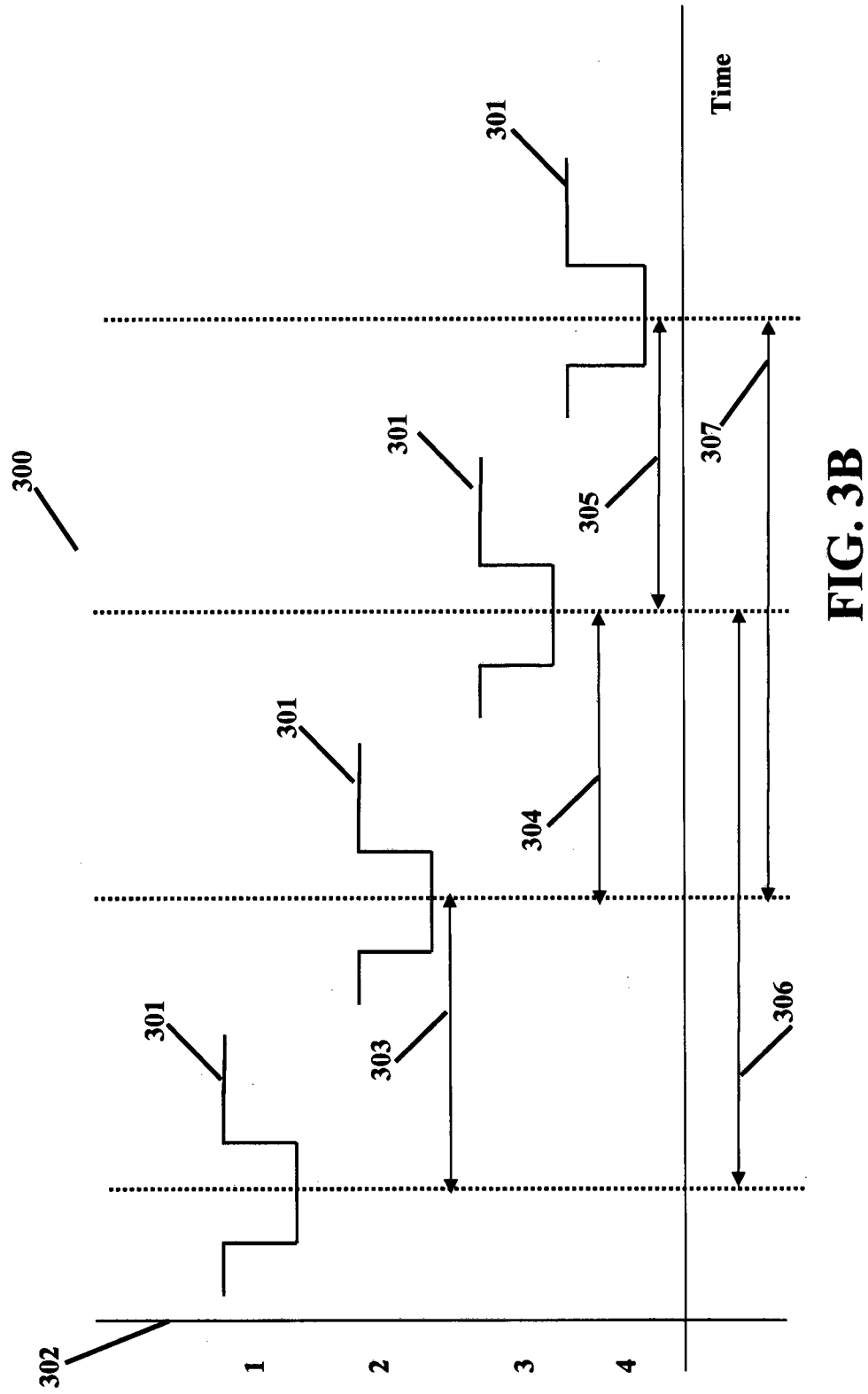


FIG. 3B

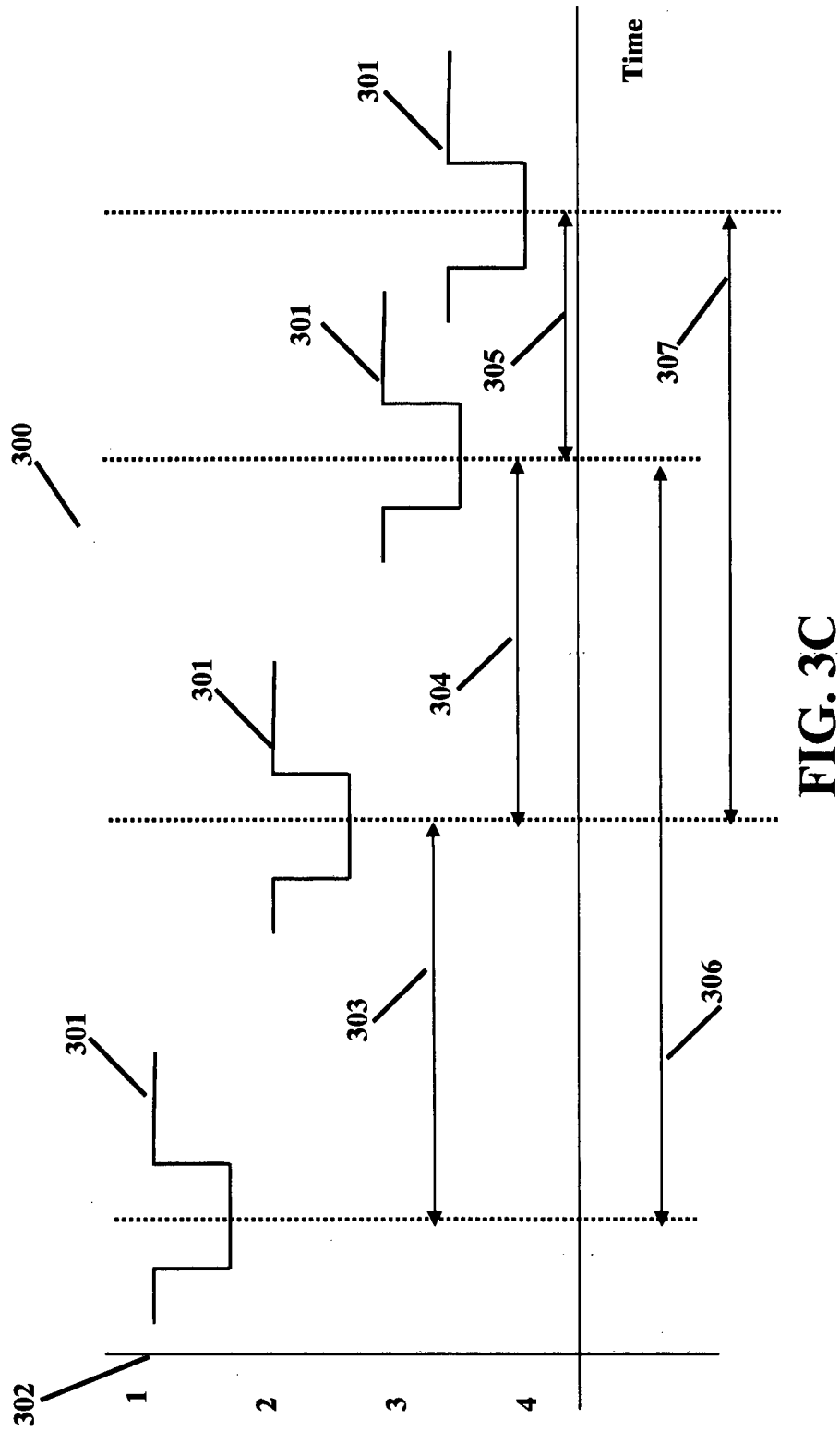
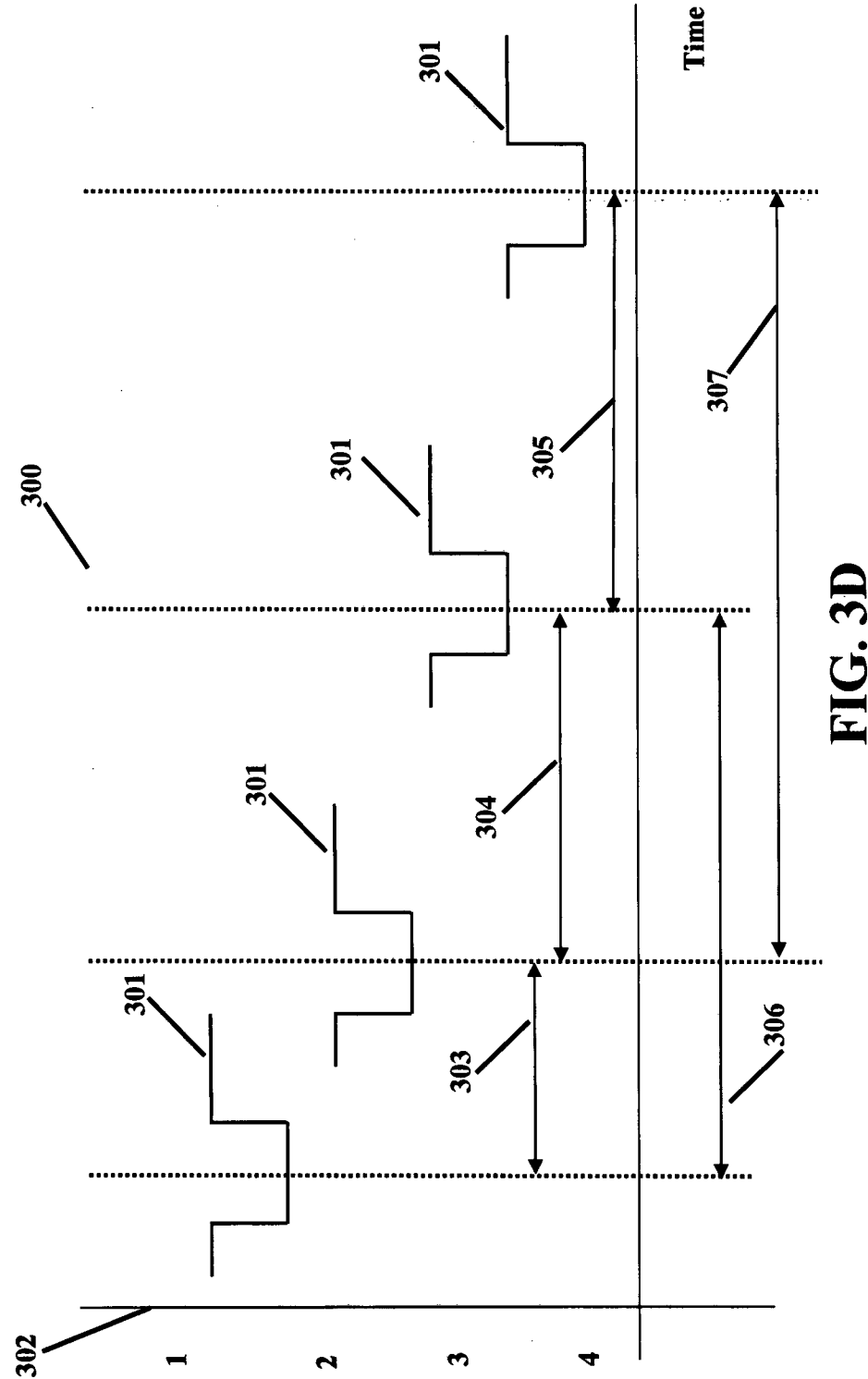


FIG. 3C



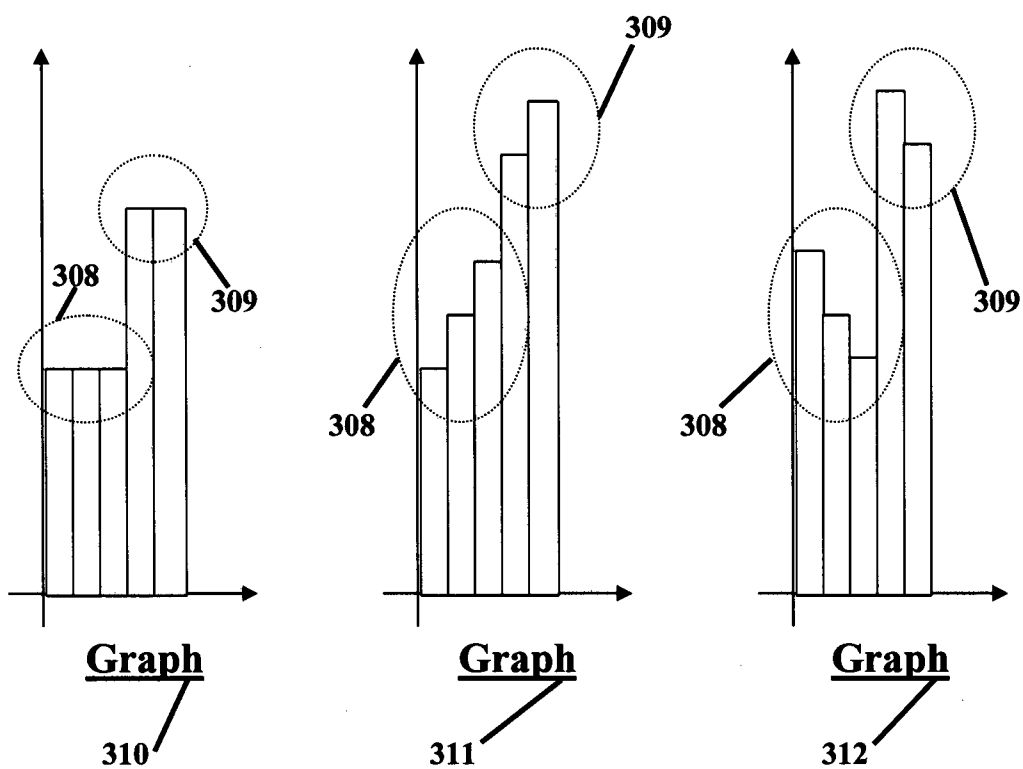
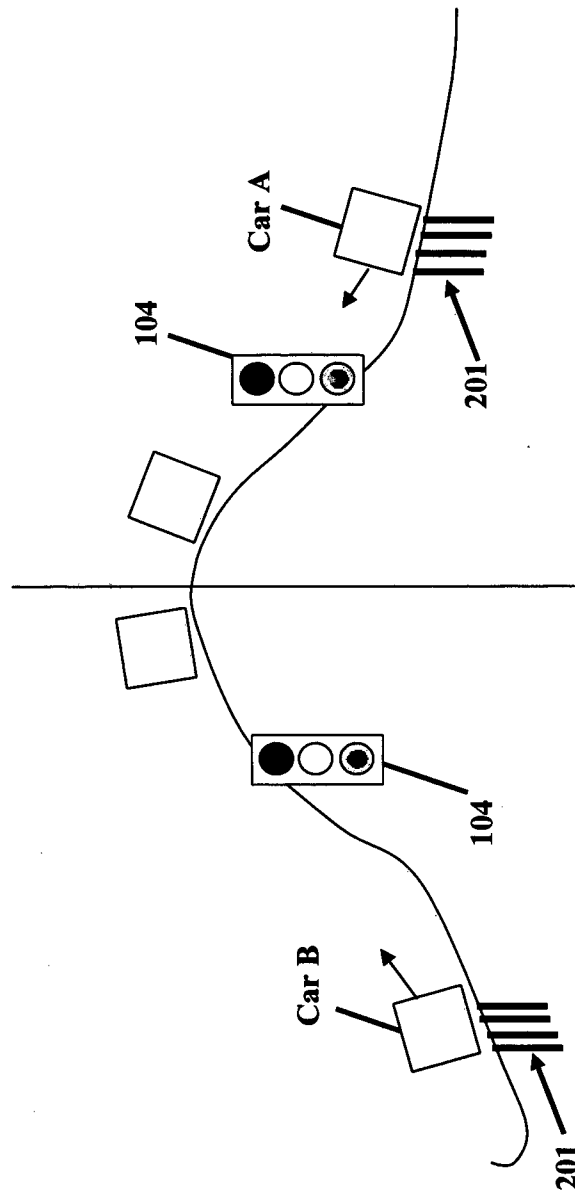


FIG. 3E

Scenario 1



Scenario 2

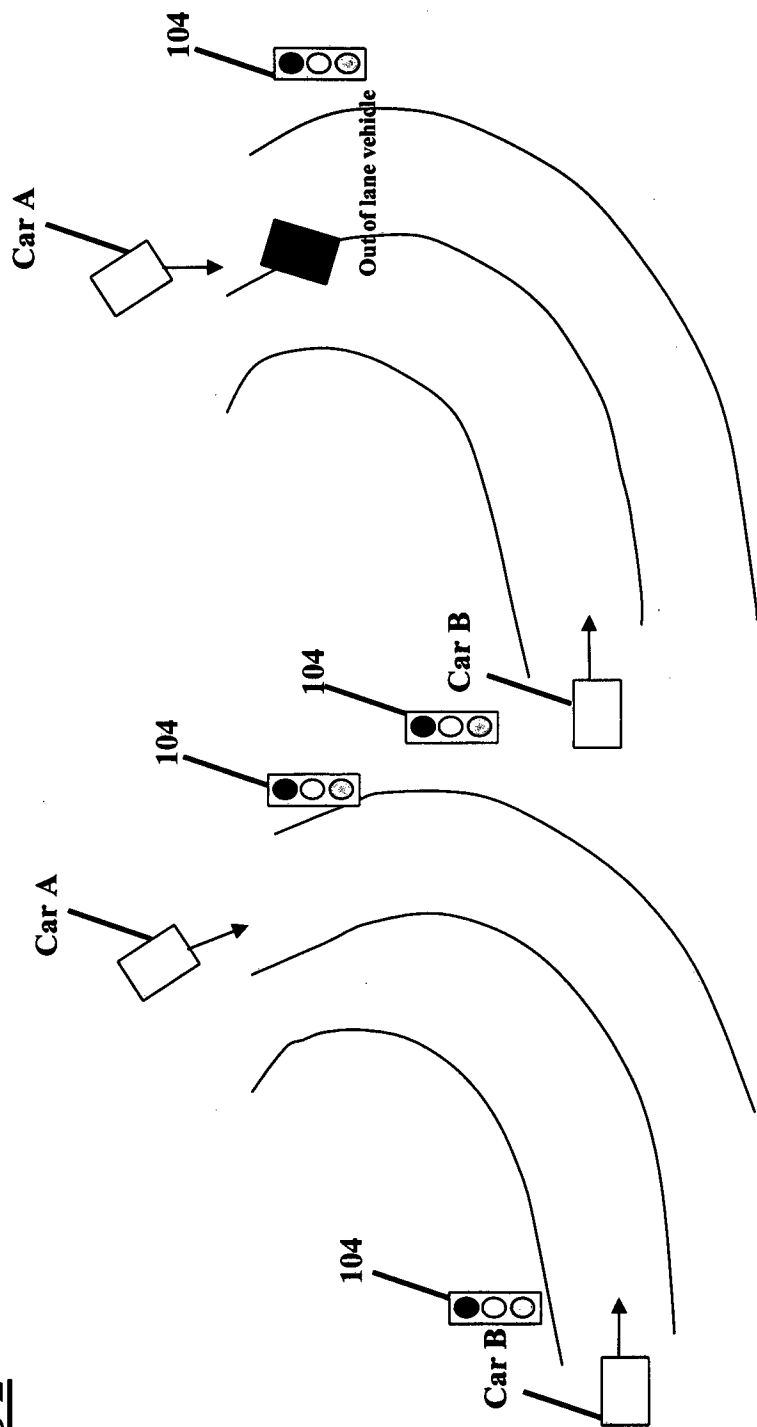


FIG. 4B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/MY2011/000127

A. CLASSIFICATION OF SUBJECT MATTER Int. Cl. G08G 1/04 (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) EPODOC, WPI, GOOGLE PATENTS: keywords (vehicle, fusing, optical sensor, timing, hazard, warning and similar terms)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 100946806 B1 (SAMDO CO LTD) 11 March 2010 Abstract	1-8
A	Patent Abstracts of Japan, JP 2008-165604 A (NOMURA RESEARCH INSTITUTE LTD) 17 July 2008 Abstract	1-8
A	Patent Abstracts of Japan, JP 2008-216231 A (SUMITOMO ELECTRIC IND LTD) 18 September 2008 Abstract	1-8
☐ 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 19 September 2011	Date of mailing of the international search report 23/09/2011	
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/MY2011/000127

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
KR	100946806	NONE
JP	2008165604	NONE
JP	2008216231	NONE
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.		
END OF ANNEX		