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CAWSE(10) **Pub. No.: US 2015/0012211 A1**(43) **Pub. Date: Jan. 8, 2015**(54) **APPARATUS AND METHOD FOR
OPTIMALLY RECORDING GEOGRAPHICAL
POSITION DATA****Publication Classification**(71) Applicant: **GEOTAB INC**, Oakville (CA)(72) Inventor: **Neil Charles CAWSE**, Oakville (CA)(73) Assignee: **GEOTAB INC**, Oakville (CA)(21) Appl. No.: **14/174,447**(22) Filed: **Feb. 6, 2014**(51) **Int. Cl.****G01C 21/26** (2006.01)**G07C 5/08** (2006.01)**G07C 5/00** (2006.01)**G01S 19/42** (2006.01)(52) **U.S. Cl.**CPC **G01C 21/26** (2013.01); **G01S 19/42**(2013.01); **G07C 5/0858** (2013.01); **G07C****5/008** (2013.01)USPC **701/412****Related U.S. Application Data**

(63) Continuation of application No. 13/241,202, filed on Sep. 22, 2011, now Pat. No. 8,670,928, which is a continuation of application No. 11/252,747, filed on Oct. 19, 2005, now Pat. No. 8,032,276.

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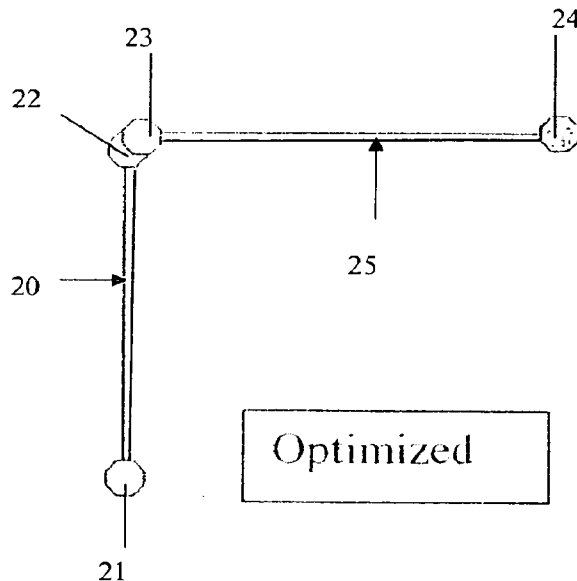
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ABSTRACT

The present invention relates to an apparatus and method for optimally recording or transmitting positional data and events of an object, said apparatus including input means to continuously provide positional data to a microprocessor and a memory device to store selected positional data wherein the microprocessor is programmed to compares new positional data from said input means to previously recorded log of positional data and creates a new log if the new positional data differs from the previously recorded log in accordance with pre-determined parameters.



*Logging happens
frequently
because heading
and velocity are
changing*

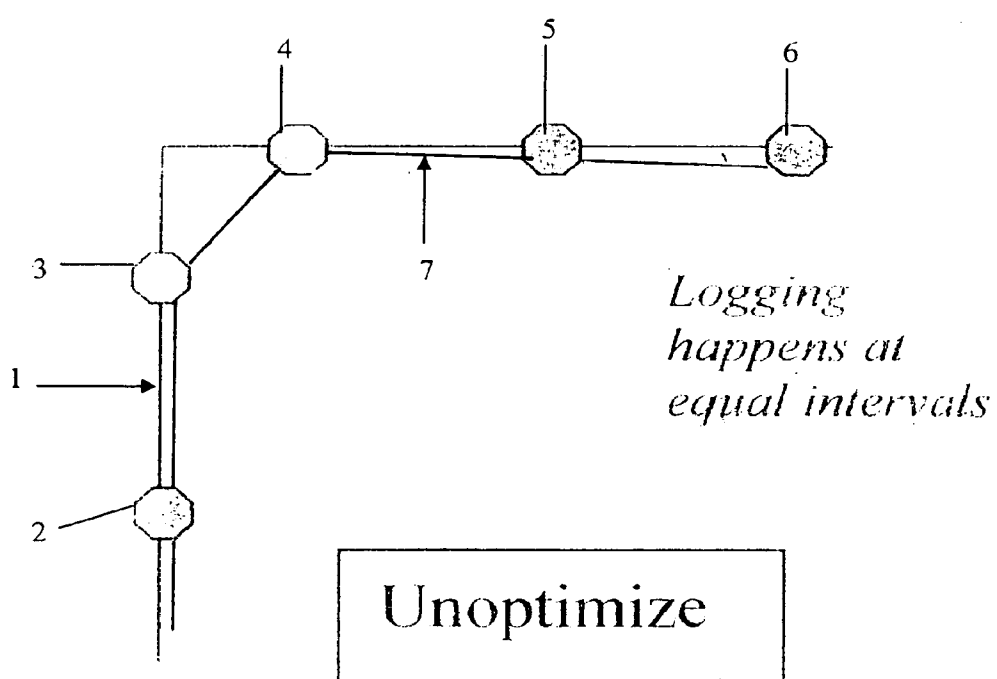
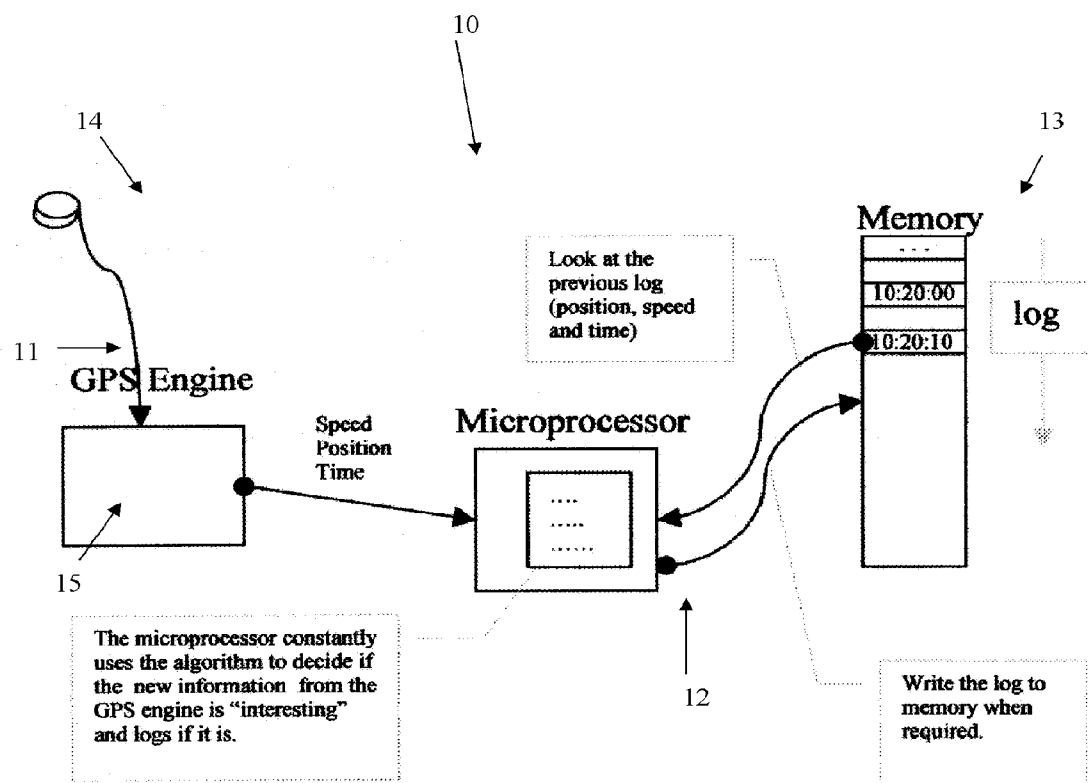


FIGURE 1

FIGURE 2



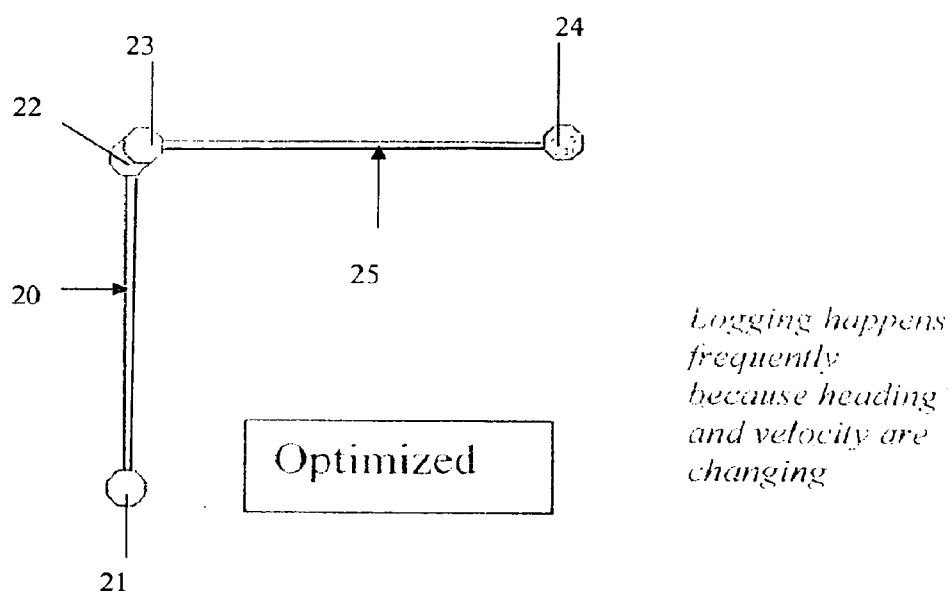


FIGURE 3

APPARATUS AND METHOD FOR OPTIMALLY RECORDING GEOGRAPHICAL POSITION DATA

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates to a method and apparatus for optimally recording or transmitting geographical position and events. In particular the present invention provides apparatus to determine position, time and speed of an object such as a vehicle and log data in accordance with changes in pre-determined parameters.

[0003] 2. Description of the Prior Art

[0004] Recording or transmitting the position (latitude, longitude and possibly altitude) and events that occur for an object is a useful exercise in many scenarios in business. There are many examples of systems that today record and or transmit positional data, but they all suffer from the same problems. They do not correctly choose the positions that are to be stored or transmitted, so as to maximize the level of useful detail on a map but at the same time minimize the number of actual positions used to do this. Many systems currently base their logging on an interval (eg. every 60 seconds) or a distance (eg. every 200 m). When looking at this data on a map, very often these points don't show any new useful additional information or, which is worse they miss out a significant event like a turn or a big drop in speed.

[0005] The present invention is used to optimize exactly when these pieces of information are recorded or transmitted. This then minimizes the memory requirements if these points are stored, or it minimizes time or cost if the information is transmitted. In addition, the usefulness of the information is maximized by making sure that any significant events are caught, like turning a corner or a large change in speed.

SUMMARY OF THE INVENTION

[0006] It is an object of the invention to provide a method to optimize exactly when positional data is recorded or transmitted to minimize the memory requirements if the data is stored, or minimize time or cost if the data is transmitted.

[0007] It is a further object of the invention to provide a method to optimize exactly when positional data is recorded or transmitted to ensure that any significant events are captured, like a change in direction arising from turning a corner or a large change in speed.

[0008] It is a further object of the invention to provide apparatus to determine positional data associated with an object, compare new positional data with existing data to determine when positional data is recorded or transmitted.

[0009] Thus in accordance with the present invention there is provided apparatus for optimally recording or transmitting positional data and events of an object, said apparatus including input means to continuously provide positional data to a microprocessor and a memory device to store selected positional data wherein the microprocessor is programmed to compare new positional data from said input means to previously recorded log of positional data and creates a new log if the new positional data differs from the previously recorded log in accordance with pre-determined parameters. In a preferred embodiment for use with a vehicle, the input means to continuously provide positional data includes a GPS antenna and GPS engine and the positional data provided to the microprocessor includes the exact time, position and speed of the

vehicle. No new information is recorded if the velocity vector of the vehicle has not changed. The velocity vector is determined by monitoring the speed and heading of the vehicle. If these do not change by more than a threshold then no logs are taken. In turn, if these elements change rapidly then the logs should be taken more frequently. Additional events that are of interest are also being monitored by other input means, then these could trigger a log even if there were no geographical reason to do so.

[0010] In another embodiment the present invention provides a system for optimally recording or transmitting positional data and events of an object, said system having a processing unit on the object, said processing unit including input means to continuously provide positional data to a microprocessor and a memory device to store selected positional data wherein the microprocessor is programmed to compare new positional data from said input means to previously recorded log of positional data and creates a new log if the new positional data differs from the previously recorded log in accordance with pre-determined parameters and a base station programmed with software to extract, display, process and analyze the recorded data.

[0011] A further aspect of the present invention provides a method for optimally recording or transmitting positional data and events of an object to optimize exactly when positional data is recorded or transmitted to minimize the memory requirements if the data is stored, or minimize time or cost if the data is transmitted and to ensure that any significant events are captured by continuously providing positional data to a microprocessor from input means, said microprocessor compares new positional data from said input means to previously recorded log of positional data and creates a new log if the new positional data differs from the previously recorded log in accordance with pre-determined parameters.

[0012] Further features of the invention will be described or will become apparent in the course of the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] In order that the invention may be more clearly understood, the preferred embodiment thereof will now be described in detail by way of example, with reference to the accompanying drawings, in which:

[0014] FIG. 1 is a schematic illustration of a positional chart of a prior art system that logs at positional data for an object at regular time or distance intervals (prior art).

[0015] FIG. 2 is a schematic illustration of one embodiment of apparatus according to the present invention for optimally recording or transmitting geographical position and events.

[0016] FIG. 3 is a schematic illustration of a positional chart using the apparatus of FIG. 2 where the positional data for an object has been optimally recorded.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0017] Referring to FIG. 1 a schematic illustration of a positional chart of a prior art system that logs at positional data for an object at regular time or distance intervals is shown. The actual trip for the object is designated by line 1. The system logs positional data at regular intervals 3, 4, 5 from starting point 2 to end point 6. Connecting points 2-6, as shown by line 7, shows the apparent route of the object. The apparent route 7 does not accurately reflect the actual trip 1.

[0018] One embodiment of apparatus for optimally recording or transmitting positional data and events of an object, preferably a vehicle, according to the present invention is generally indicated at **10**. The apparatus **10** consists of input means **11** to continuously provide positional data to a microprocessor **12** and memory device **13** to store selected positional data. The input means **11** to continuously provide positional data preferably includes a GPS antenna **14** and conventional GPS engine **15**. The GPS engine **15** delivers the positional data preferably the exact time, position and speed of the object, to microprocessor **12**. Microprocessor **12** compares the new positional data to the previously recorded log of positional data to determine the time that has elapsed since that previous log, the change in speed and heading or other input triggers and creates a new log if the information is deemed to be “new and interesting” in accordance with pre-determined parameters. The pre-determined parameters preferably include harsh braking, excessive speed, change in heading at high speed, change in heading at low speed, change in speed, and time since last log. If the differences in positional data are greater than a pre-determined minimum, microprocessor **12** stores the positional data on memory device **13** for subsequent download or transmittal. If the dif-

ferences in positional data are not greater than the pre-determined minimum, microprocessor **12** does not store the new positional data on memory device **13** thereby optimizing exactly when positional data is recorded to minimize the memory requirements if the data is stored, to minimize the time or cost when the data is transmitted and/or to ensure that any significant events are captured, like a change in direction arising from turning a corner or a large change in speed.

[0019] FIG. 3 illustrates a schematic of a positional chart using the embodiment of apparatus for optimally recording or transmitting positional data and events of an object **1** where the positional data for the object has been optimally recorded. In this case the actual trip for the object is designated by line **20**. The system logs positional data at starting point **21**, at point **22** where a change in speed is determined, point **13** where a change of direction is determined and end point **14**. Connecting points **21-24**, as shown by line **25**, shows the apparent route of the object which reflects more accurately the actual trip **20** than the prior art system illustrated in FIG. 1 even though positional data is logged at fewer points.

[0020] Microprocessor **12**, in an embodiment, is programmed to compare and select position data to be recorded as follows:

```

// check valid GPS data against logging criteria
void ValidGPS(void)
{
    unsigned long lTemp;
    unsigned char bDiff;
    bInvalidCount = 0;
    GPS.GPSData.bAux.gps valid = 1;           // reset invalid count
    GPS.GPSData.bRecordType = GPS_RECORD;     // valid flag
    // store valid vars                         // log record type
    lValidDate = GPS.GPSData.lDateTime;
    lValidLat.full = GPS.GPSData.lLat.full;
    lValidLong.full = GPS.GPSData.lLong.full;
    // accident data check
    if (GPS.GPSData.bSpeed > bMinAccSpeed)
    {
        bMemFlags.save_acc = 1;
        if (bFlags3.valid_gps_restart)
        {
            if (bHarshBrake != 0)
            {
                if (bValidSpeed > GPS.GPSData.bSpeed)
                {
                    bDiff = bValidSpeed - GPS.GPSData.bSpeed;
                    if (bDiff > bHarshBrake)
                    {
                        GPS.GPSData.bLogReason =
LOG_HARSH_BRAKE; // speeding start
                        bMemFlags.save_log = 1;
                    }
                }
            }
        }
    }
    bValidSpeed = GPS.GPSData.bSpeed;
    bFlags3.valid_gps_restart = 1;
    // check log next valid flag - set on ign
    if (bFlags3.log_next_valid)
    {
        if (bOptions0.beep_on_log || bFlags3.debug)
        {
            BUZZER_ON;
            Delay10KTCYx(250);
            Delay10KTCYx(250);
        }
        bFlags3.log_next_valid = 0;
        GPS.GPSData.bLogReason = LOG_NEXT; // log first valid after
    }
    ign
    bMemFlags.save_log = 1;
    return;
}

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// if harsh braking occurred above then exit
if (bMemFlags.save_log)
    return;
if (bOptions0.speeding)
{
    // if not speeding
    if (!bFlags2.speeding)
    {
        // and speeding occurs
        if (GPS.GPSData.bSpeed > bSpeedingSpeed)
        {
            // start indicator and log
            bFlags2.speeding = 1;
            GPS.GPSData.bLogReason =
LOG_SPEEDING_START; // speeding start
            bMemFlags.save_log = 1;
            return;
        }
    }
    // else if speeding
    else
    {
        // and get to reset speed
        if (GPS.GPSData.bSpeed <= bResetSpeed)
        {
            BUZZER_OFF; // just in case
            // stop indicator and log
            bFlags2.speeding = 0;
            GPS.GPSData.bLogReason =
LOG_SPEEDING_STOP; // speeding stopped
            bMemFlags.save_log = 1;
            return;
        }
    }
}
// change in heading at hi speed
if (GPS.GPSData.bSpeed > bHiDeltaHeadMinSpeed)
{
    if ((GPS.GPSData.bHeading < 37) && (bLastHeading > 113))
    {
        bDiff = GPS.GPSData.bHeading + (150 - bLastHeading);
    }
    else if ((bLastHeading < 37) && (GPS.GPSData.bHeading > 113))
    {
        bDiff = bLastHeading + (150 - GPS.GPSData.bHeading);
    }
    else if (GPS.GPSData.bHeading > bLastHeading)
    {
        bDiff = GPS.GPSData.bHeading - bLastHeading;
    }
    else
    {
        bDiff = bLastHeading - GPS.GPSData.bHeading;
    }
    if (bDiff > bHiDeltaHead)
    {
        GPS.GPSData.bLogReason = LOG_HEADING; //
change in heading
        bMemFlags.save_log = 1;
        return;
    }
}
// change in heading at low speed
else if (GPS.GPSData.bSpeed > bDeltaHeadingMinSpeed)
{
    if ((GPS.GPSData.bHeading < 37) && (bLastHeading > 113))
    {
        bDiff = GPS.GPSData.bHeading + (150 - bLastHeading);
    }
    else if ((bLastHeading < 37) && (GPS.GPSData.bHeading > 113))
    {
        bDiff = bLastHeading + (150 - GP S.GPSData.bHeading);
    }
    else if (GPS.GPSData.bHeading > bLastHeading)
    {
        bDiff = GPS.GPSData.bHeading - bLastHeading;
    }
}

```

-continued

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    }
    else
    {
        bDiff = bLastHeading - GPS.GPSData.bHeading;
    }
    if (bDiff > bDeltaHeading)
    {
        GPS.GPSData.bLogReason = LOG_HEADING;           //
change in heading
        bMemFlags.save_log = 1;
        return;
    }
    // change in speed
    if (GPS.GPSData.bSpeed > bDeltaSpeedMinSpeed)
    {
        if (GPS.GPSData.bSpeed > bLastSpeed)
            bDiff=GPS.GPSData.bSpeed - bLastSpeed;
        else
            bDiff=bLastSpeed - GPS.GPSData.bSpeed;
        if (bDiff > bDeltaSpeed)
        {
            GPS.GPSData.bLogReason = LOG_SPEED;         // change in
speed
            bMemFlags.save_log = 1;
            return;
        }
    }
    // time since last log
    if (GPS.GPSData.lDateTime - lLastDate > iMinLogTime.full)
    {
        GPS.GPSData.bLogReason = LOG_TIME;             // time elapsed
        bMemFlags.save_log = 1;
        return;
    }
    if (bOptions0.log_valid)
    {
        GPS.GPSData.bLogReason = LOG_ALL;              // log all valid
option set
        bMemFlags.save_log = 1;
        return;
    }

```

[0021] In an embodiment the microprocessor **12**, GPS engine **15** and optionally the memory device **13** to store selected positional data are provided in an in-vehicle processing unit which is in a sealed housing. In lieu of the memory device **13** being included in the vehicle processing unit, a separate portable memory device (such as memory stick, disc or key can be provided). Appropriate wiring harness would be provided to easily connect the in-vehicle processing unit containing the microprocessor **12**, and GPS engine **15** to the vehicle electrics, GPS antenna **14** and other inputs or outputs including memory device **13**.

[0022] In another embodiment, the present invention provides a system which includes a base station piece programmed with software to extract, display, process and analyze the recorded vehicle data. Where a portable memory device **13** is used in conjunction with the in-vehicle processing unit, data maybe “extracted” from the portable memory device or directly from the vehicle via a wireless connection such as 900 MHz radio or through a GSM/GPRS/Internet communication medium or other like method and transmitted to the base station.

[0023] The additional inputs can include an identification key to identify individual drivers or vehicles or permit updating or modification of the software in the microprocessor unit **12** to set parameters on which the system is customized to compare and log data.

[0024] The base station and its software can be used as noted above to view trip data on a map, produce activity reports including list of trips, speed profile, auxiliary usage and the like. In addition the software can be customized to set rules for determining when a log point should be recorded by monitoring data such as speed, stop time, auxiliary useage or vehicle position relative to prescribed zones such as customer locations.

[0025] Having illustrated and described a preferred embodiment of the invention and certain possible modifications thereto, it should be apparent to those of ordinary skill in the art that the invention permits of further modification in arrangement and detail. All such modifications are covered by the scope of the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. Apparatus for optimally recording or transmitting positional data and events of an object, said apparatus including input means to continuously provide positional data to a microprocessor and a memory device to store selected positional data wherein the microprocessor is programmed to compares new positional data from said input means to previously recorded log of positional data and creates a new log if the new positional data differs from the previously recorded log in accordance with pre-determined parameters.

2. Apparatus according to claim 1 wherein said input means to continuously provide positional data includes a GPS

antenna and GPS engine and the positional data provided to the microprocessor includes the exact time, position and speed of the object.

3. A system for optimally recording or transmitting positional data and events of an object, said system having a processing unit on the object, said processing unit including input means to continuously provide positional data to a microprocessor and a memory device to store selected positional data wherein the microprocessor is programmed to compares new positional data from said input means to previously recorded log of positional data and creates a new log if the new positional data differs from the previously recorded log in accordance with pre-determined parameters and a base station programmed with software to extract, display, process and analyze the recorded data.

4. A system according to claim **3** wherein data is transmitted from the processing unit to the base station by extracting data from the memory device by downloading data from a

portable memory device or directly from the processing unit via a wireless connection to the base station.

5. A method for optimally recording or transmitting positional data and events of an object to optimize exactly when positional data is recorded or transmitted to minimize the memory requirements if the data is stored, or minimize time or cost if the data is transmitted and to ensure that any significant events are captured by continuously providing positional data to a microprocessor from input means, said microprocessor compares new positional data from said input means to previously recorded log of positional data and creates a new log if the new positional data differs from the previously recorded log in accordance with pre-determined parameters.

6. A method according to claim **5** wherein said wherein said input means to continuously provide positional data includes a GPS antenna and GPS engine and the positional data provided to the microprocessor includes the exact time, position and speed of the object

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