(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 530 183 A2

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
11.05.2005 Bulletin 2005/19

(51) Int Cl.[7]: **G08G 1/14**

(21) Application number: **04256804.8**

(22) Date of filing: **04.11.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL HR LT LV MK YU

(30) Priority: **08.11.2003 GB 0326135**

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(54) **Parking indicator and control system**

(57) A vehicle park has potentially available parking bays for vehicles arranged in groups of parking bays, the groups being arranged in a hierarchy such that successive groups are located further from an entrance for vehicles than preceding groups. Each group has an associated controller linked to individual sensors associated with individual parking bays of its group. Each sensor is adapted to detect the presence or absence of a vehicle in the respective bay and to communicate such presence or absence to its controller. Each controller is linked to a respective indicator adapted to give an indication of the number of vacant bays at any time in the group to which its controller belongs.

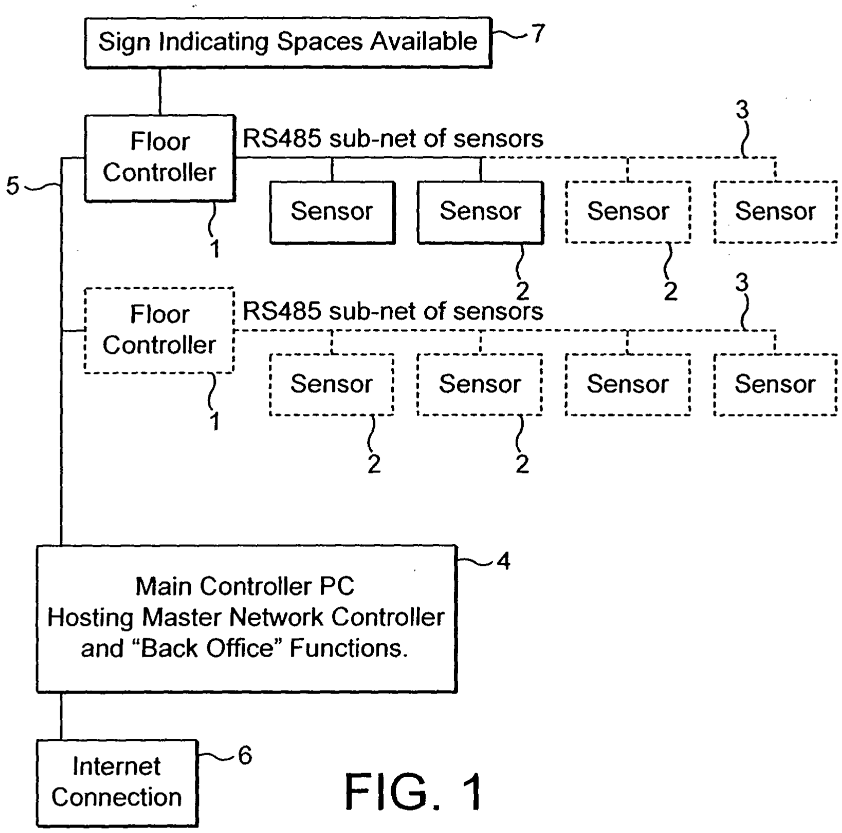

FIG. 1

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Description

[0001] This invention relates to electronic systems adapted for use as indicator systems and/or as control systems for vehicle parks.

[0002] Whether any particular vehicle park takes the form of an extended parking lot with individual marked bays for vehicles arranged in groups or rows or of a multi-storey vehicle park with marked bays for vehicles located on different floors, a driver entering the park with his vehicle will generally have little idea where vacant bays are located, particularly when, as often happens, the vehicle park is generally quite full. Drivers are often reduced to circulating through the vehicle park in the hope of locating a vacant bay. In the case of a parking lot, bays adjacent the entrance and exit and bays adjacent the facility (for example a supermarket) for which the parking lot may be dedicated, tend to be filled first and drivers only approach more remote locations of the parking lot once they have exhausted every available vacant bay in the preferred locations. Similarly, in the case of a multi-storey vehicle park bays located on floors close to the entrance or on floors adjacent an exit from the vehicle park for pedestrians tend to be filled first, while more remote bays on more remote floors tend to be filled last. Drivers may circulate on the most popular floors for some while without appreciating that there may be vacant bays on an adjacent floor.

[0003] Accordingly, conventional parking lots and conventional multi-storey vehicle parks are characterised by considerable inefficiency giving rise to wastage of time and fuel on behalf of customers, and even leading to potential customers leaving the vehicle park without parking their vehicle and making a payment to the vehicle park owner because they thought there were no bays available when there may, after all, have been vacant bays in a part of the vehicle park that they failed to find or failed to visit when circulating.

[0004] It is clear from the patent literature that these problems have exercised inventors for some while, as there appear to be numerous paper proposals intended to overcome these problems. However, to the best of the present knowledge of the Applicant, practical systems that succeed in solving these well understood problems do not appear to have been reduced to practice and made available on the market.

[0005] Thus Salas Escrina in ES2070057 proposes a system for locating unoccupied spaces in public vehicle parks by means of indicators which appear general as the user enters the vehicle park but become more specific as the user penetrates further into the car park. The use of ultrasonic emitters/receivers is proposed in a general manner for detecting the presence of a vehicle by time elapsed for waves to return to the emitter/receiver. Gonzalez in WO00/00942 proposes various alternative sensors that may be used to detect the presence of a motor vehicle in a parking bay and signalling devices distributed throughout the parking space to indicate the status and location of parking places. Siemens AG in WO98/19286 propose a system in which a multi-storey vehicle park is fitted with a control system using ultrasonic proximity switches and in which the signal and energy bus system for the ultrasonic detectors is also used for carrying out monitoring functions such as smoke, temperature, movement and CO_2 gas using parallel systems of dedicated sensors for these functions. Guermonprez in FR2756959 proposes an ultrasonic system in which the time between transmission and reception of a reflected signal is measured, thereby determining the distance from which the reflection occurs. If this distance is less than the reference a parking space is assumed to be occupied. Su in EP1262613A discloses a parking system in which detectors are located in each parking space, providing information as to whether a specifically numbered parking space is occupied or not, information concerning all these individual numbered parking spaces being collected and displayed for the benefit of parking system controllers and/or drivers. Muraki in US2002/0171562A discloses a parking lot guidance system in which vehicle detection units are located in each parking bay, data as to which bays are occupied and which are not being collated and translated into a system of optical beacons guiding drivers to unoccupied parking spaces.

[0006] It is the Applicant's belief that these numerous prior proposed systems may have failed to achieve widespread acceptability for a number of reasons. In some cases, it is noted that the proposals are quite vague. The inventor was able to suggest a system only in quite general terms but without carrying through his development into practical working arrangements.

[0007] In contrast to the above papers proposals, the Applicant is aware of more practical systems that have been put into effect, and which count the number of vacant spaces within an entire vehicle park by means of induction loops located at the vehicle entrance and at the vehicle exit, the system counting the number of vehicles entering and the number of vehicles leaving and producing a difference, being the number of vacant bays, which is then electronically displayed. Whilst such simple counting systems are certainly an improvement over previous vehicle parks without any form of indication or guidance to drivers whatever, the indication they give is quite crude, and should be taken as no more than a general indication, because it makes no allowance for vehicles which may be badly parked so as to occupy more than one bay or may be over size and thus occupy more than one bay, or vehicles which, conversely, may be parked in an improper position which does not constitute a proper bay. In such systems, when an indication is given that there are parking bays available, a driver entering such a vehicle park still has no idea where those vacant bays may be located.

[0008] The present invention seeks to provide an improved indicator and/or control system for vehicle parks in which practical embodiments, described in detail hereinbelow, address, among others, the several problems discussed above.

[0009] According to one aspect of the present invention, there is provided a parking indicator/control system in which potentially available parking bays for vehicles are arranged in groups of parking bays, the groups being arranged in a hierarchy such that successive groups are located further from an entrance for vehicles than preceding groups; the system comprising a controller for each said group, each controller being linked to individual sensors associated with individual parking bays of its group, each of which sensors is adapted to detect the presence or absence of a vehicle in the respective said bay and to communicate such presence or absence to its controller, and each controller being linked to a respective indicator adapted to give an indication of the number of vacant bays at any time in the group to which its controller belongs.

[0010] In this way, a driver approaching a particular group may be advised that all bays in that group are filled, and so will make directly for the next successive group in the hierarchy in the hope of finding a vacant bay there, rather than vainly circulating in the first group.

[0011] Preferably the controllers are linked so that each indicator is adapted both to give an indication of the number of vacant bays at any time in the group to which its controller belongs and to give an indication of the total number of vacant bays in groups beyond the said group in the hierarchy.

[0012] This is particularly useful in the case of a multi-storey vehicle park in which the indication system could, for example, be arranged so as to give an indication of the number of vacant bays on a particular floor, the number of vacant bays on the next higher floor and the number of vacant bays on all higher floors. In this way, a driver may be efficiently guided to an appropriate floor in which he or she can readily manoeuvre their vehicle into a vacant bay.

[0013] The indicators are suitably linked to a master control. The master control may be provided with an indicator over-ride, enabling more even distribution of vehicles within the vehicle park by over-riding indicators in the most popular groups to cause such indicators to show no vacancies even when one might be present, thereby directing vehicles to less popular parts of the vehicle park. In this way, for example, vehicles can be directed away from the most popular floors of a multi-storey vehicle park (usually adjacent the exit for pedestrians to a shopping centre) if those floors become congested, for example by people loading their vehicles with shopping.

[0014] We have found that the most suitable presence/absence sensors are ultrasonic transducers adapted to send an ultrasonic pulse train, preferably a single ultrasonic ping, and to detect the echo from that ping after a time interval depending upon the distance from which the ping is reflected.

[0015] A second reason why we believe the numerous prior paper proposals may not have achieved commercial success is that they fail to address the question of reliability. Problems may arise in achieving acceptability unless a system can effectively guarantee that it will not create false positives indicating that bays are occupied when they are not and equally well will not create false negatives indicating that bays are empty when all are full.

[0016] As explained below with reference to specific embodiments, in our ultrasonics-based systems, best results, which avoid both false positives and false negatives, are achieved when steps are taken to avoid interference between adjacent sensors, when the sensors associated with an individual controller are synchronised and when a sensing protocol is followed in which a change between presence and absence of a vehicle in a respective parking bay is recognised only after a predetermined number of repeated sensings.

[0017] The invention is hereinafter more particularly described by way of example only with reference to the accompanying drawings, in which:-

Fig. 1 is a schematic diagram illustrating the overall network topology for an embodiment of system constructed in accordance with the present invention;

Fig. 2 is a schematic diagram mapping sensor timing to individual parking bays in a typical parking bay group;

Fig. 3 is a logic flow diagram illustrating how synchronisation is achieved in a typical system according to Figs. 1 to 3;

Fig. 4 schematically illustrates the electronic system associated with a single sensor of the group;

Figs. 5a, 5b and 5c illustrate a typical transducer in front, side and rear elevational views, respectfully; and

Figs. 6 and 7 are logic flow diagrams illustrating typical operation of a system according to Figs. 1 to 5; and

Fig. 8 schematically illustrates a variation to the system of Fig. 4.

[0018] Reference should first be made to Fig. 1 which schematically illustrates the network topology for an embodiment of parking system in accordance with the present invention. The potentially available parking bays for vehicles in a vehicle park, for example a multi-storey vehicle park are divided into groups of parking bays. Suitably, in the case of a multi-storey vehicle park, each group may comprise all the parking bays on a particular floor or sub-floor. In a more complex system each floor may be divided into a number of separate groups. Associated with each group of parking bays is a controller 1, each controller being linked to a number of sensors 2 arranged in a sub-net 3, suitably an RS485 network. The number of sensors 2 that theoretically could be connected in a sub-net 3 to a controller 1 is limited only by the type of network employed for the sub-net. In practice a more practical limitation is posed by the number of parking bays that may conveniently form a group.

[0019] The respective floor controllers 1 are connected to a main controller 4 which serves both as a master network controller and, if a personal computer, may also provide so-called "Back Office" functions. Connection between the floor controllers and the main controller 4 is suitably by a separate RS485 network 5 or by an Ethernet network. The main controller 4 may be provided with an Internet connection 6 enabling the parking system as a whole to be controlled from or report to a remote location.

[0020] Each floor controller is coupled to an indicator, for example by using an RS232 interface. Only one such indicator 7 is shown in Fig. 1 but it is to be understood that each floor controller is suitably provided with such an indicator.

[0021] As well as serving to couple the sensors of its group and to communicate the information provided by those sensors both to the main controller 4 and to the respective indicator 7, the controller 1 operates to synchronise the respective sensors. As explained in more detail below, each sensor suitably comprises an ultrasonic transducer adapted to transmit trains of ultrasonic pulses, preferably a single ping, and to detect the echo from that ping. In a practical embodiment (see Fig. 2), the short duration of each ping is time-domain-multiplexed into 8 x 100mS intervals. The start of each interval (S) is individually set for each parking bay by the controller. The relationship between the timing of respective pings is mapped to the physical layout of the parking bays. A typical such arrangement is illustrated in Fig. 2 for a group of 16 sensors 2 and parking bays arranged in two lines of 8 bays on opposite sides of a roadway, for example comprising the parking bays on a single floor of a multi-storey vehicle park. In this arrangement each bank of 8 sensors can measure the distance to an object (in practice the floor or a vehicle occupying the parking bay, the sensor being mounted in or from the roof above its parking bay) without interfering with neighbouring sensors because of the way in which the sensors are offset from each other.

[0022] Synchronisation of sensors in such a sub-net is achieved as explained in the logic flow diagram of Fig. 3 by first sending a broadcast message from the controller to the sensor network as a whole (7). If a particular sensor receives the broadcast message, it sets a flag, which is read during the next polling of sensors. If the controller does not receive notification that all sensors in its group have received the synchronisation message (8), it disables the appropriate sensor and re-initiates the synchronisation cycle by resetting the timing for all sensors (9) and resuming from the beginning. If all sensors in the sub-net have received the controller sync signal, each sensor is polled in sequence, when its time domain is reached (10), as explained below in a specific arrangement with reference to Figs. 6 and 7. After a time interval (11), suitably between 1 second and 1 minute, the synchronisation sequence of Fig. 3 is repeated.

[0023] In the complete network of Fig. 1, the respective controllers can be polled by the main controller 4 to retrieve the status of each sensor 2 in its respective sub-net 3. Associated with each sensor in each parking bay is a light indicating parking bay vacancy. The controllers are arranged to send each sensor in their respective group or sub-net set-up data determining when the sensor will illuminate the light indicating a parking bay vacancy. The settings can be adjusted to suit the particular environment of a particular sensor, as explained further below. Equally well, options can be provided in the system to allow the sensor to assume the presence of a vehicle when either no echo whatever is received or the echo indicates a multiple path indicating a complex reflection, for example when a vehicle present in the parking bay does not have a surface perpendicular to the axis of the sensor which serves to reflect the sensor signal.

[0024] Turning now to Fig. 4, which shows, generally schematically, the electronic system associated with an individual sensor, it will be seen that each sensor is effectively an ultrasonic transducer comprising both an ultrasonic transmitter 12 and an ultrasonic receiver 13. The ultrasonic transducer is controlled by an integral microcontroller 14, which communicates with the transmitter 12 via a MOSFET switch 15 to cause the transmitter to issue a ping. Receiver 13 will sense any echo, the echo producing a signal in the receiver which passes via bandpass filter 16, programmable gain amplifier 17 and peak detector 18 back to the microcontroller 14. The microcontroller 14 is also linked by a further MOSFET switch 19 to a light 20 which, when lit, indicates that the parking bay is vacant. Microcontroller 14 is coupled into the RS485 sub-net 3 of its respective sensor group by means of an RS485 communications interface 21. Suitable transducers are readily available commercially, for example from Ceramic Transducer Design Co. Ltd, Taiwan. A typical such transducer is illustrated in Figs. 5a, 5b and 5c in front elevation, side elevation and rear elevation, respectively. Such transducers are quite small typically having a diameter of around 16.1mm providing a sound pressure level of around 120dB over an angle of 55° with a centre frequency of around 40kHz. The microcontroller 10 incorporated in the transducer, in one embodiment has a crystal driven clock frequency of 7.3728MHz, and a memory granularity of 8-bit bytes, with an internal FLASH ROM of 8K and an internal RAM of 368 bytes with a further internal EEPROM data memory of 256 bytes. The microcontroller should also be capable of controlling the lamp driver operating at 24V and 1A.

[0025] Thus, the sensor is effective to measure physical distance by means of the ultrasonic transmitter/receiver pair, is also capable of switching the parking bay "vacant" indicator lamp, based on distance calibration received from the controller or under remote control, and is also capable of communicating measurement data and system status to the controller. Synchronisation of the ultrasonic pings to avoid unwanted interaction and disruption of measurements with other sensors in the network is arranged as described previously. Suitably the controller 1 is arranged to set operational parameters for the sensor including in particular ultrasonic receiver sensitivity, ultrasonic power level and input filter characteristics as explained in more detail below.

[0026] Figs. 6 and 7 schematically illustrate how occupancy of a parking bay or vacancy of a parking bay is detected in a preferred protocol. In these Figures:

S = the particular time domain slot (see Fig. 2)
X = the distance to the floor minus half the minimum detectable vehicle height
E = the number of "no-echo" samples in successive polls, and
N = a predetermined number of measurement samples or polls before a change of status is accepted by the system.

[0027] At the start of polling each sensor checks (22) whether its time domain slot S has been reached. When it has, the particular sensor will cause an electronic ping to be sent (23) by its ultrasonic transmitter and timeout will be set to "0" in the sensor. If an echo (24) is detected by the receiver in the sensor, then E is set to "0" (25) and the distance measurement determined by the time lapse between the ping and its echo is stored. If no echo is received, then E is set to E+1 (26). In either event, the microcontroller checks whether E is then greater than or equal to N (27). If it is, the vacancy light 20 is switched off or maintained off (28), a 100mS timeout 29 occurs and the routine repeats. Alternatively, if E is not greater than or equal to N, there is no change in the light 20, the timeout occurs and the routine is repeated.

[0028] What this means is that if the system was showing a vacancy in the particular parking bay, that situation is maintained, when no echo is received, until no echo has been received N times in successive polls. Preferably the programme controlling the system as a whole or individual microprocessors can select the value of N. Suitably N is between 3 and 10. By selecting N to be different for different sensors, account may be taken of the particular environment of individual sensors. Any sensor that appears to be giving false results can have its value of N increased. Taking the system illustrated in Fig. 2 as being typical of a group controlled by a single controller, it will be seen that even with N set to 10 for all the sensors, the time taken for the repeated non-echoes to cause a change of vacancy status is only around 1 second.

[0029] Referring now to Fig. 7, this routine shows what happens when there is an echo and a distance measurement is possible based on the time elapsed from the ping being sent to the echo being detected. Where this distance is greater than X for N successive polls (30) then the vacancy light 20 is switched on or maintained on (31). If the measurement is not greater than X for N successive polls, the system checks whether the measurement was less than X for N successive polls (32). If it was, this indicates that the parking bay is occupied and the light is switched off or maintained off (33) if, having first checked at 30 that the measurement was not greater than X for N successive polls and then at 32 that it was not less than X for N successive polls, there is no change in status and no change in the parking bay light 20, whether on or off.

[0030] Referring again to Fig. 1, the main controller 4 is preferably provided with an over-ride program that enables main controller 4 to over-ride individual controllers 1 so that they control their respective indicator 7 to show "no vacancies" even when one or more spaces may actually be present in their associated group. This enables those in control of a vehicle park to direct vehicles away from congested groups of parking bays, even if there may be the odd vacancy in those groups, to less congested groups, merely by suggesting to drivers reading the indicators that a particular group has no vacancies but that groups further on in the hierarchy do have vacancies.

[0031] The described system has additional utility when combined with a security system for the vehicle park, for example a CCTV system. There is a recurrent problem in vehicle parks, particularly multi-storey vehicle parks in inner city locations late at night, of vehicle theft or so-called "joy-riding" in which vehicles are broken into and driven around, often without actually leaving the vehicle park, frequently causing damage to the vehicle itself, other parked vehicles and the infrastructure of the vehicle park.

[0032] Accordingly, the system preferably additionally includes a warning system (which may be directly linked into the security system, for example to switch on the appropriate CCTV camera or a video recording system linked to the appropriate CCTV camera) that is operable at times (usually late at night) when there are relatively few vehicles present in the vehicle park, the warning system coming into effect whenever a change of status is accepted for any parking bay from "occupied" to "vacant", implying that a previously parked vehicle is moving. Security personnel can then immediately check the appropriate CCTV picture to establish whether this appears to be a legitimate driver having retrieved his vehicle, or a vehicle having been broken into and/or being driven in an erratic manner, and take any action required.

[0033] Numerous variations may be made from the specific arrangements described in detail above.

[0034] Thus, in place of an ultrasonic sensor arrangement as illustrated in Fig. 4 with a separate transmitter 12 and a receiver 13, an arrangement in which a single transducer serves both as transmitter and as receiver may be employed. The revised schematic electronic system is illustrated in Fig. 8. It will be seen that while first MOSFET switch 15 is poled to provide a signal to single ultrasonic sensor transducer 34 to cause it to transmit, a second MOSFET switch 35 is also coupled to sensor 34 and poled to pass a received signal from sensor 34 to bandpass filter 16.

[0035] Suitable single transducer sensors are available from Massa Products Corporation of Hingham, Massachusetts, USA, and comprise multilobe transducers within a one piece waterproof housing with an integral diaphragm. The transducers operate at resonance and detect the first harmonic overtone of the transmitted signal.

[0036] Some high value vehicles are fitted with ultrasonic vehicle reversing proximity detectors giving a warning to the driver when the vehicle is getting close to an obstacle; and potentially such ultrasonic devices could interfere with an ultrasonic sensor system employed in a system of the kind disclosed herein. This may cause a false result in the sensor system and may interfere with the reversing system so that the driver fails to receive the correct response and so might hit an obstacle. However, this possibility can easily be overcome by including an additional step in the routines described herein requiring the sensors to "listen" (that is: be empowered to receive a signal) for ultrasonic signals ahead of their time slot for transmitting an ultrasonic ping. Should an ultrasonic signal be detected, the sensor concerned simply vacates its time slot.

[0037] While we have found that the most suitable prescence/absence detectors are ultrasonic transducers, other forms of detectors are can be employed for some or all of the detectors in the system, depending on the operating circumstances. Thus infra-red detectors may be employed. They are less reliable, as the much higher speed of transmission makes distance measurement unfeasible. However, a reflection or alternatively no reflection can be detected and used to discriminate between occupied and vacant parking spaces, especially if the floor is roughened to reduce any reflection back to the transmitter from the floor. In another alternative arrangement, a pixelated optical recognition system may be employed. Vehicles have a generally oblong shape with sharp boundaries, whereas the floor, which will be visible when no vehicle is present in a parking space, has an absence of sharp boundaries. This difference may be employed in an object recognition system to discriminate between occupied and vacant parking spaces using an optical system employing relatively few pixels at each parking space, and thus having a relatively low band-width.

[0038] Particularly when the vehicle park is being managed from a remote site it may be important for the managers to know that there is congestion in the exit route from the vehicle park. Many such exit routes employ ticket or token operated barriers. Should there be a barrier failure or a vehicle with a driver that has lost his ticket or token or failed to authorise it for exit, a back-up of vehicles seeking to exit the vehicle park may occur. Provision of sensors in the exit route may be employed to signal any such occurrence to management.

[0039] Indicator signs indicating the number of vacant spaces in a group of parking bays may also be used for other purposes, for example by displaying advertising or public service messages in alternation with the indication of numbers of vacant parking bays.

[0040] The system may incorporate an over-ride remote check for individual sensors.

Claims

1. A parking indicator/control system for a vehicle park in which potentially available parking bays for vehicles are arranged in groups of parking bays, the groups being arranged in a hierarchy such that successive groups are located further from an entrance for vehicles than preceding groups; the system being **characterised in** comprising a controller for each said group, each controller being linked to individual sensors associated with individual parking bays of its group, each of which sensors is adapted to detect the presence or absence of a vehicle in the respective said bay and to communicate such presence or absence to its controller, and each controller being linked to a respective indicator adapted to give an indication of the number of vacant bays at any time in the group to which its controller belongs.

2. A system according to Claim 1, further **characterised in that** the presence/absence sensors linked to a particular indicator are polled in a predetermined sequence to sense the presence or absence of a vehicle in their associated parking bay, thereby avoiding interference between sensors in adjacent parking bays.

3. A system according to Claim 2, further **characterised in that** the presence/absence sensors linked to a particular indicator are periodically synchronised by transmittal of a synchronisation signal from the controller to all sensors associated with that controller.

4. A system according to any preceding Claim, further **characterised in that** said presence/absence sensors comprise ultrasonic transducers adapted to send an ultrasonic pulse train, preferably a single ultrasonic ping, and to detect an echo from that pulse train (ping) resulting from reflection.

5. A system according to Claim 3, further **characterised in that** each presence/absence sensor comprises a single ultrasonic transducer adapted both to transmit an ultrasonic pulse train, preferably a single ultrasonic ping, and to detect the echo from that pulse train (ping) resulting from reflection.

6. A system according to any preceding Claim, further **characterised in that** the several controllers are linked so that each indicator is adapted both to give an indication of the number of vacant bays at any time in the group to which its controller belongs and to give an indication of the total number of vacant bays in groups beyond the said group in the hierarchy.

7. A system according to any of Claims 1 to 4, further **characterised in that** the indicators are linked to a master control provided with an indicator over-ride, enabling more even distribution of vehicles within the vehicle park by over-riding indicators in the most popular groups to cause such indicators to show no vacancies even when one might be present, thereby directing vehicles to less popular parts of the vehicle park.

8. A multi-storey vehicle park **characterised in** being provided with a parking indicator/control system according to any of Claims 1 to 4, wherein each indicator associated with a floor other than the highest floor is arranged to display the number of vacant bays on the particular floor associated with the said indicator, and also at least one of the number of vacant bays on the next higher floor and the total number of vacant bays on all higher floors.

9. A multi-level underground vehicle park **characterised in** being provided with a parking indicator/control system according to any of Claims 1 to 4, wherein each indicator associated with a level other than the lowest level is arranged to display the number of vacant bays on the particular level associated with the said indicator, and also at least one of the number of vacant bays on the next lower level and the total number of vacant bays on all lower levels.

10. A vehicle park **characterised in** being provided with a parking indicator/control system according to Claim 3 or Claim 4, and selected from vehicle parks located in buildings and underground vehicle parks, in which vehicle parks each parking bay has both an associated ceiling and floor, wherein the presence/absence sensors are mounted in the ceiling above respective parking bays and adapted to time the interval between a transmitted pulse train (ping) and its echo resulting from reflection by a vehicle in the said bay or by the floor of the bay, thereby providing an indication whether the said bay is "vacant" or "occupied".

11. A vehicle park according to Claim 9 **characterised in** being provided with a parking indicator/control system according to Claim 2, wherein an existing status, namely one of "vacant" and "occupied", for a particular parking bay, as recognised by the controller associated with that bay, is changed to the other said status only after that other status has been indicated by a predetermined number N of successive polls of the associated sensor.

12. A vehicle park according to Claim 11, further **characterised in that** N is selectable, and optionally is different for different sensors in the system.

13. A vehicle park according to Claims 10, 11 or 12, further **characterised in that** a situation where no echo is detected on polling a particular sensor is treated as an indication that the associated bay is "occupied".

14. A vehicle park according to Claims 10, 11 or 12, further **characterised in that** a situation where a complex multipath signal is detected on polling a particular sensor is treated as an indication that the associated bay is "occupied".

15. A vehicle park according to any of Claims 8 to 14, further **characterised in that** each parking bay has an associated ceiling mounting a vacant lamp, the vacant lamps of parking bays recognised as having a "vacant" status by the associated controller being lit.

16. A vehicle park according to any of Claims 8 to 15, further **characterised in that** a CCTV security system is selectively linked to the parking indicator/control system, whereby an appropriate CCTV camera and/or video recording system is actuated whenever a change of status for a particular parking bay is recognised.

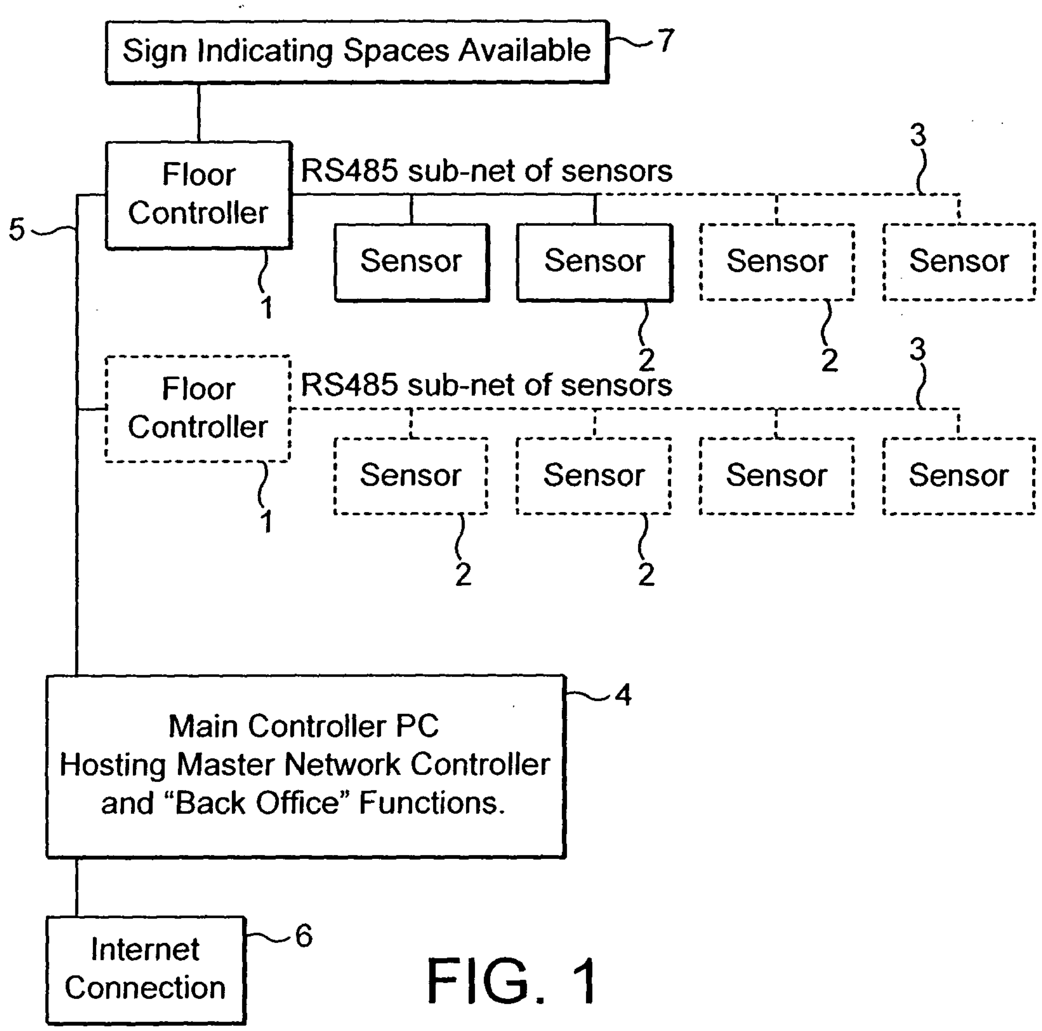

Sign Indicating Spaces Available
7
Floor Controller
RS485 sub-net of sensors
3
5
Sensor
Sensor
Sensor
Sensor
1
2
2
Floor Controller
RS485 sub-net of sensors
3
Sensor
Sensor
Sensor
Sensor
1
2
2
Main Controller PC
Hosting Master Network Controller
and "Back Office" Functions.
4
Internet Connection
6

FIG. 1

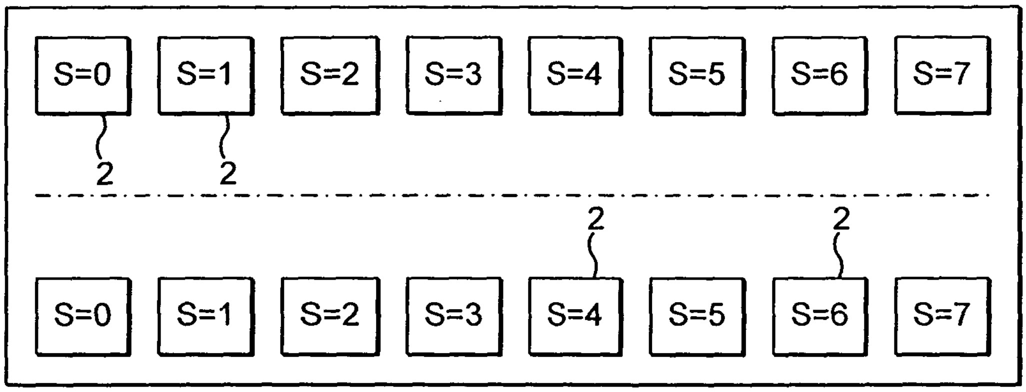

S=0
S=1
S=2
S=3
S=4
S=5
S=6
S=7
2
2
2
2
S=0
S=1
S=2
S=3
S=4
S=5
S=6
S=7

FIG. 2

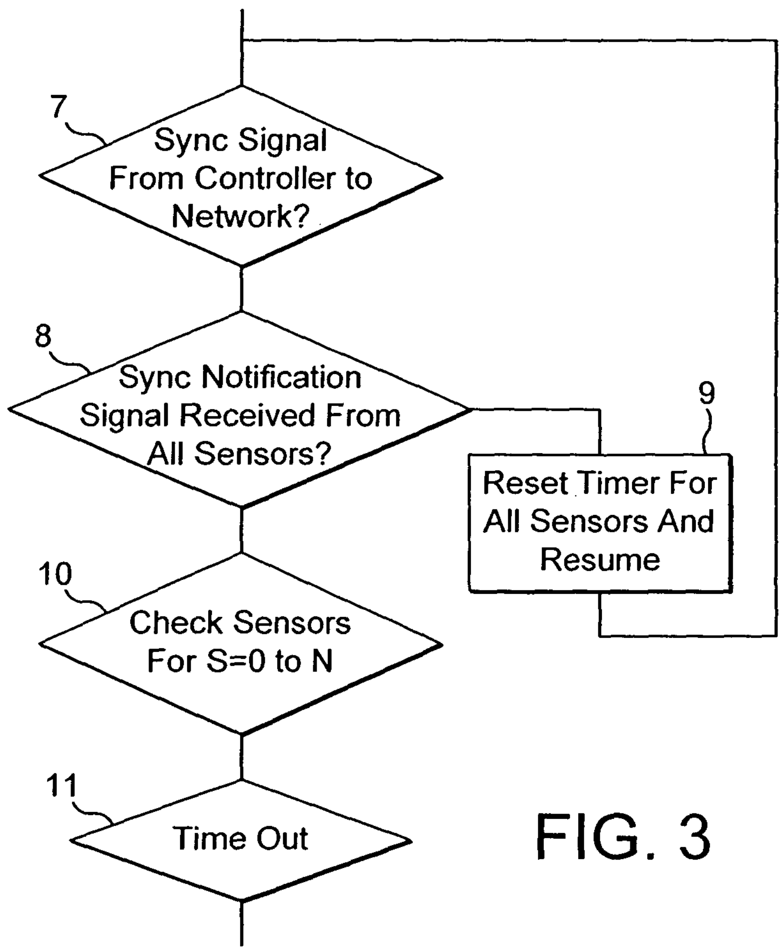

7
Sync Signal From Controller to Network?
8
Sync Notification Signal Received From All Sensors?
9
Reset Timer For All Sensors And Resume
10
Check Sensors For S=0 to N
11
Time Out

FIG. 3

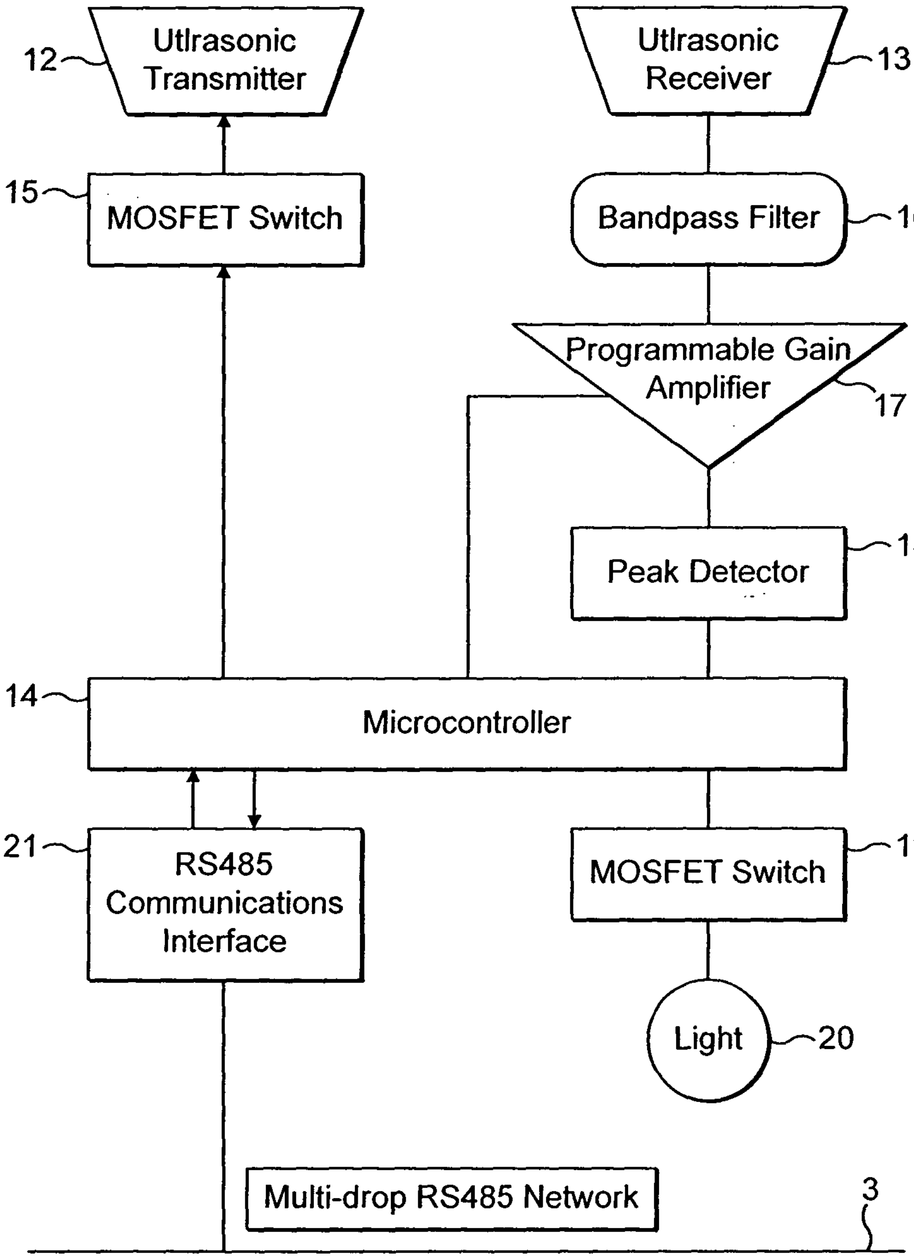

Utlrasonic Transmitter
12
Utlrasonic Receiver
13
15
MOSFET Switch
Bandpass Filter
16
Programmable Gain Amplifier
17
Peak Detector
18
14
Microcontroller
21
RS485 Communications Interface
MOSFET Switch
19
Light
20
Multi-drop RS485 Network
3

FIG. 4


FIG. 5a

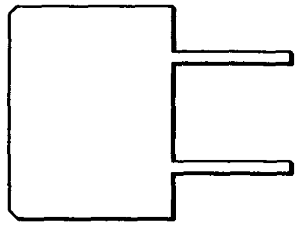


FIG. 5b

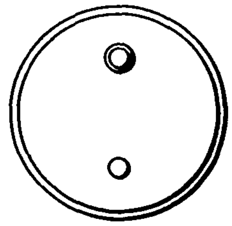


FIG. 5c

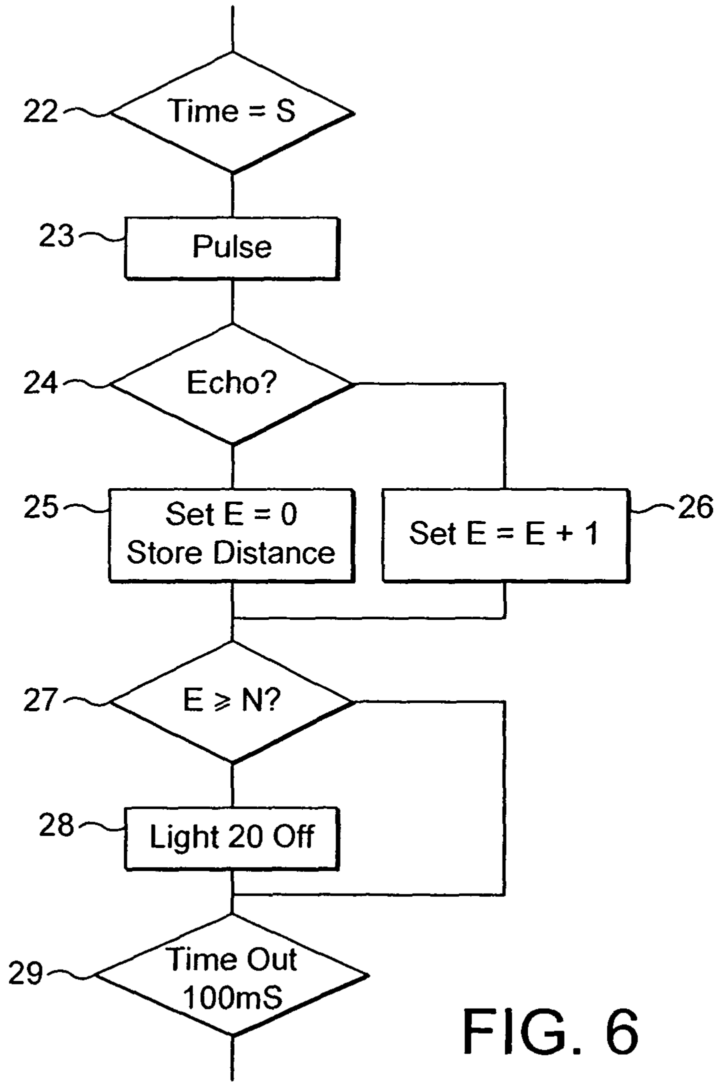


FIG. 6

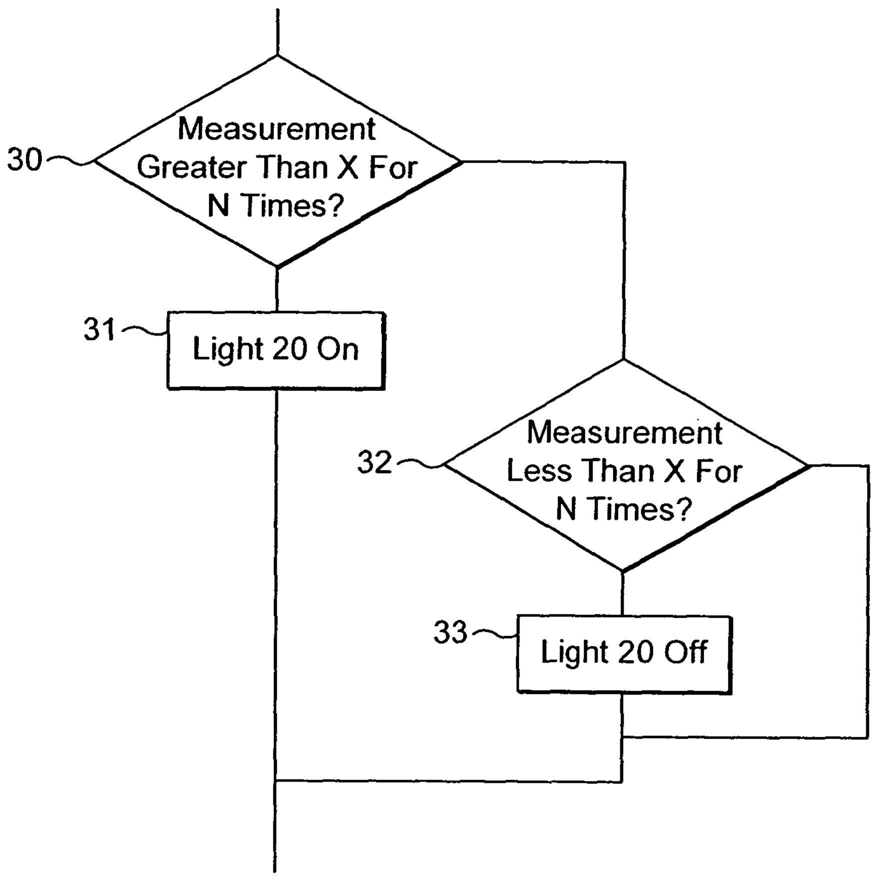
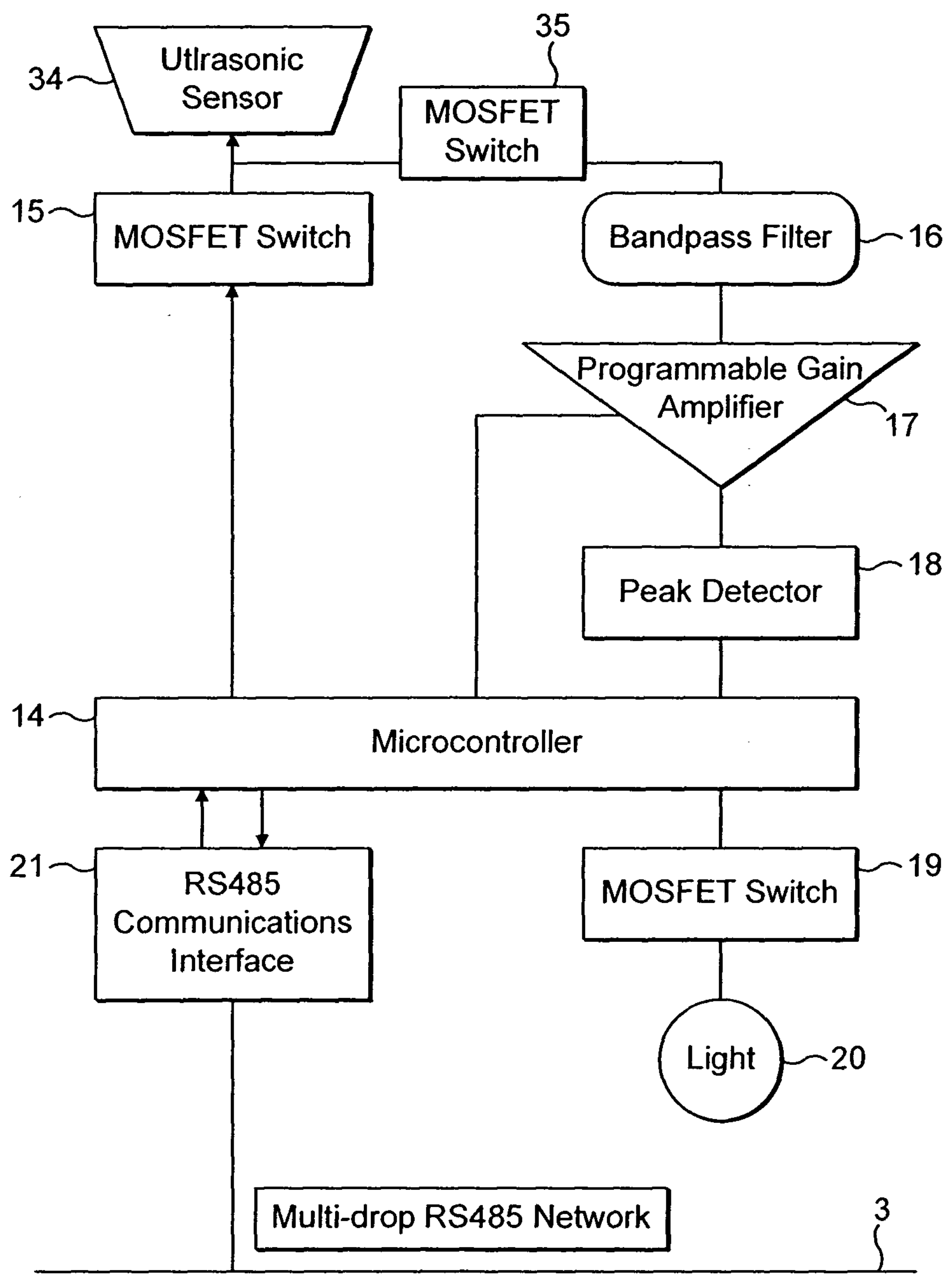

30
Measurement Greater Than X For N Times?
31
Light 20 On
32
Measurement Less Than X For N Times?
33
Light 20 Off

FIG. 7



Utlrasonic Sensor
34
35
MOSFET Switch
15
MOSFET Switch
Bandpass Filter
16
Programmable Gain Amplifier
17
Peak Detector
18
14
Microcontroller
21
RS485 Communications Interface
MOSFET Switch
19
Light
20
Multi-drop RS485 Network
3

FIG. 8