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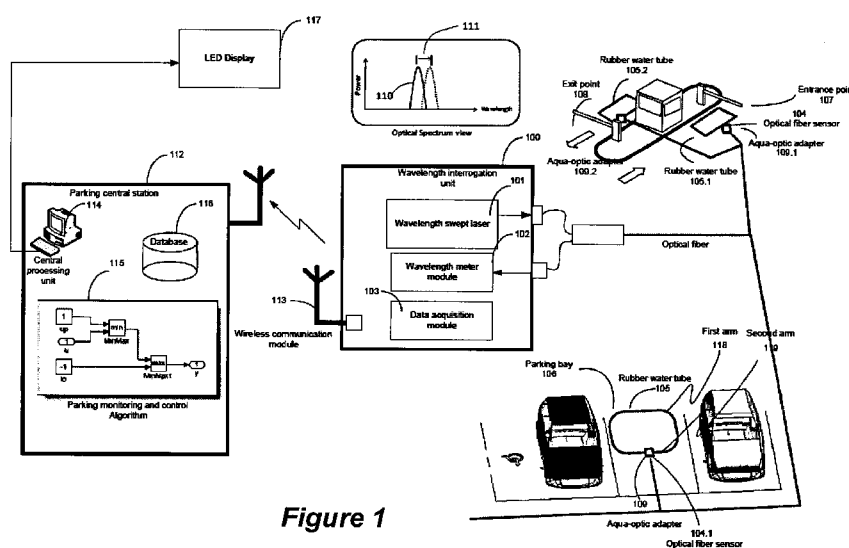


Figure 1

(57) Abstract: The present invention relates to a parking management system and a method of identifying and allocating a parking space for a vehicle. One of the advantages of the present invention is that the passive sensing device in this present invention uses optical fiber technology in combination with simple water pipe construction that laid without a need to cut the tarmac on the surface of the parking lot during installation of inductive loop detectors. The elimination of active devices in the parking system of the present invention increases the cost effectiveness of deploying such system as compared to all the deployment using active sensing devices such as ultrasonic sensor, video imaging and inductive loop sensor.

A PARKING MANAGEMENT SYSTEM**FIELD OF THE INVENTION**

- 5 The present invention relates to a parking management system and a method of identifying and allocating a parking space for a vehicle.

BACKGROUND OF THE INVENTION

- 10 Among the important issue at urban township is the high volume of private cars concentrated in small areas. Inefficient public transportation services further contribute to this problem with people tend to travel in private cars rather than taking public transportation to commute from one point to other destinations. The same mode of transportation is being chosen for business or leisure. For example, during week days, one can find administrative and office
15 complexes are flooded with cars visiting the complexes for services, attending meetings or submitting documents. When reach to weekends, cars flooded commercial complexes for entertainment and for weekly groceries or leisure. The condition getting worst with limited area gazetted or allocated for parking spaces surrounding administrative or commercial complexes as compared to the rapid expansion of newly development areas. Consequently,
20 people wasted more time looking for parking spaces and lose productive time for the intended purpose.

- To ease the problem of locating an empty parking space at these areas, technologies are being deployed to identify and inform visitors of available parking spaces. Deployment of
25 such technology is feasible in a controlled environment such as roofed indoor multistory parking complexes where devices can be easily installed at a much lower cost compared to outdoor parking complexes where physical structures need to be erected to install sensors and electrical cables need to be pulled from a source far away from electrical main supply. Threats from outdoor environments such as rain and heat also decide on what and which
30 technology is suitable to be deployed. Technology such as ultrasonic waves is used to detect presence and absence of a vehicle which can be translated into information regarding the availability of free parking spaces. Imaging technology is also be deployed for the same purpose with both falls into active devices which require dedicated electrical supply to power up the devices.

However, none of these technologies can withstand outdoor harsh environment when deployed and furthermore electrical supply is needed at the sensing point. Therefore, there is a need for an improved parking system with passive devices to remove the necessity of having electrical supply and against the harsh outdoor environment. The present invention further provides a considerable reduction of materials with even greater efficiency and economically during operation.

SUMMARY OF THE INVENTION

The present invention provides a parking management system comprising a sensing unit for detecting an availability status of a vehicle parking space; a processing unit for processing and analysing the collected information on the availability status of a vehicle parking space; and a displaying unit for displaying the information of the availability status of a vehicle parking space.

In one of the embodiment of the present invention, the sensing unit comprising an optical fiber sensor determine the changes of water pressure based on the weight of the vehicle coupled to a water pressure controlled chamber to amplify the changes in water pressure from a water pipe connected; a sensor interrogation unit having a wavelength-swept laser to sweep central wavelengths of the optical fiber sensor; a wavelength meter module for recording the shifting of central wavelength of the optical fiber sensor; data acquisition module for allowing wavelength shift has been pre-programmed and triggering a signal upon exceeding a threshold value wherein the signal corresponds to the wave length shift and indicates a vehicle presence in the parking space; and a wireless communication module for transferring the information of the vehicle presence in the parking space to the processing unit.

In yet another embodiment of the present invention, the processing unit receiving the information of the vehicle presence in the parking space and to cross check with the database to identify a free parking bay for the vehicle and send the information to a displaying unit.

In another embodiment of the present invention, a membrane is attached inside the water pressure controlled chamber to amplify the pressure upon receiving a low pressure from the water pipe.

A method of identifying and allocating a parking space for a vehicle comprising inducing a pressure onto a water pipe coupled with an optical fiber sensor of a sensing unit via aqua-opto adapter when a vehicle approaches an entrance point of a parking bay; providing a strain on the optical fiber Bragg sensor to shift the central wavelength of the optical fiber Bragg grating spectrum to a value; recording the wavelength shift by a wavelength meter module and providing the information to a data acquisition module; providing a threshold value for allowing maximum the wavelength shift to trigger a signal; indicating a vehicle passing over the water pipe when the signal is triggered and a vehicle is presence in the detected area; transferring the information on the presence of the vehicle to a processing unit via a wireless communication module; providing a cross check on a database to identify an empty parking space for the detected vehicle by sending the information to a display unit the predetermined location; guiding the vehicle to the empty parking space as indicated in the display unit; matching a wavelength shift of the vehicle as parked in the empty parking space in the database of the processing unit; and displaying the information from the database on the reduction of parking space in the occupied parking bay at the display unit.

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BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

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Figure 1 illustrates a diagram of a parking management system in accordance of the present invention.

Figure 2 illustrates an aqua-optic adapter and a fiber optic sensor of a parking management system in accordance of the present invention.

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DETAILED DESCRIPTIONS OF THE INVENTION

The present invention will now be described in detail in connection with specific embodiments with reference to the accompanying drawings.

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The present invention describes a parking management system and a method of identifying and allocating a parking space for a vehicle with more than 100 parking spaces scattered around an administrative or commercial complexes with high occupancy rate and with multiple entrance access to a building.

10

A parking management system of the present invention as illustrated in **Figure 1** comprises a sensing unit for detecting an availability status of a vehicle parking space, a processing unit for processing and analysing the collected information on the availability status of a vehicle parking space and a displaying unit for displaying the information of the availability status of a vehicle parking space. The sensing unit comprising an optical fiber sensor (104) determine the changes of water pressure based on the weight of the vehicle coupled to a water pressure controlled chamber to amplify the changes in water pressure from a water pipe (105) connected preferably a rubber water tube; a sensor interrogation unit having a wavelength-swept laser to sweep central wavelengths of the optical fiber sensor; a wavelength meter module for recording the shifting of central wavelength of the optical fiber sensor; data acquisition module for allowing wavelength shift has been pre-programmed and triggering a signal upon exceeding a threshold value wherein the signal corresponds to the wave length shift and indicates a vehicle presence in the parking space; and a wireless communication module for transferring the information of the vehicle presence in the parking space to the processing unit.

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The wavelength swept laser (101) emits laser signal and perform a spectral scan covering all the central wavelengths of the optical fiber sensors (104, 104.1, 104.2) that are coupled to a customized water hose (105, 105.1, 105.2) via an aqua-optic adapter (109, 109.1, 109.2) to detect the presence of vehicle at the parking bay (106), particularly in entrance point (107) and exit point (108) of the parking bay by introducing pressure within the customized water hose (105, 105.1, 105.2).

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When no vehicles presence at the parking bay, no water pressure is introduced into the customized water hose (105,105.1). Hence, no change in the central wavelength position of

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the optical fiber sensor residing in Aqua-optic adapter (109) and (109.1). The wavelength swept laser (101) sweeps across all the central wavelengths of the optical fiber sensor (104, 104.1). During this period the spectrum of all optical fiber sensors (104, 104.1, 104.2) maintains at their respective central wavelength which is unique to each sensor

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When a vehicle approaches the entrance point (107), the weight of the vehicle induces pressure onto the customized water hose (105.1) which is coupled to the optical fiber sensor via an aqua-opto adapter (109.1) and causes a strain to the optical fiber sensor (104) as illustrated in **Figure 2**. During this period, the strain from the water pressure shifts
10 the central wavelength of the optical fiber spectrum (110) to a different wavelength.

The shifted wavelength (111) is recorded by wavelength meter module (102) which feed this information to the data acquisition module (103). In the data acquisition module (103), a threshold value for the maximum allowed shifted wavelength is pre-programmed. Upon
15 exceeding this threshold value, this triggers a signal. This signal corresponds to the shifted wavelength (111) to indicate that an object has crossed over the customized water hose (105) which corresponds to a presence of a vehicle in the defined parking space.

Such information is then transferred wirelessly to a parking central station (112) via a
20 wireless communication module (113) that is also built inside the sensor interrogation unit (100). At the parking central station (112), the information is processed and stored in a computer (114). An algorithm (115) stored in the computer is then validated with the computer data base (116) to identify a free parking space for the vehicle. Information which comprises the location of the parking bay to an LED display (117) is installed at the entrance
25 of the parking bay.

A method of identifying and allocating a parking space for a vehicle begins when the vehicle proceed to the designated parking zone indicated at the LED display (117) and approaches an empty parking bay. Upon entering the empty parking bay, the vehicle drives over the first
30 arm (118) of the customized water hose (105) and induces a pressure on the water hose (105). Consequently, such action introduces strain on the optical fiber sensor (104.1) and executes the same process as previous except the program in the algorithm (114) stores this information in the computer database while waiting for the next information from the sensor interrogation unit (100) arrives. Shifted wavelength signal introduced by the vehicle upon
35 crossing the second arm (119) as described in the following paragraph.

When the vehicle moves forward, it crosses on the second arm (119) of the customized water hose (105) and triggers the optical fiber sensor (104.1) to send a signal to the sensor interrogation unit (100) with information regarding the shifted wavelength again. At the central parking station (112), a computer searches in the data base (116) to match the shifted wavelength identical to the one received from the sensor interrogation unit (100). Once the information is matched, a program from algorithm (114) provides an instruction to the computer to display a parking space reduction in parking bay at the specific area. With the information from the database (116), the algorithm further provides number of vehicles queuing to pay parking ticket at the exit point of the parking bay. With this functionality, a driver of a vehicle can be alerted and decided at which exit point to exit having less number of vehicles. Thus, this reduces and avoids traffic congestion in the parking bay.

Another additional feature for the parking management system of the present invention is that it utilizes information from the database (116) to designate a specific parking bay to a monthly parking pass subscriber via mobile device such as cellphone upon entering the parking bay. This provides a guarantee to a driver to have a parking bay to the subscriber and reduces time to navigate to the free parking zones which is indicated by the LED display (117).

A parking management system of the present invention counts the number of cars entering (or leaving) parking complex and an algorithm determines whether a vehicle is redirected to other parking zone or restricted from entering parking zone when it is fully occupied. An algorithm is used to optimize the parking zone utilization integrated into the system which allows users to be directed to specific parking zone which eventually provides a traffic control mechanism for better traffic flow in the parking bay. For parking complexes without unmanned payment machines (i.e using Pay-on-Exit system), the algorithm is deployed to re-direct vehicles to various payment booth at the exit gate of the parking complex to avoid traffic congestion during peak hours. The decision from the algorithm process is sent to various LED displays located at the multiple parking entrances or event roads leading to the parking complex to give an early indication of parking space availability (in term of numbers and location).

Monthly parking pass subscribers are notified through short message service (via mobile devices) of the parking space allocated to them upon entering the parking complex entrance.

By having such privilege, users with monthly pass are guaranteed of a parking space over other vehicles without monthly passes. Added features such as voice turn by turn navigation can be activated upon entering the parking complex where the users (subscribing to the monthly pass) are directed to the allocated parking space via their mobile device. The parking system of the present invention can be connected to a local data collection terminal and conveyed to a central monitoring and controlling a premise via wireless. The information provided at the central premise is then used to identify and inform users of parking space availability using electronic display or through text messages pushed over their mobile phone upon entering the parking complex.

One of the advantages of the present invention is that the passive sensing device in this present invention uses optical fiber technology in combination with simple water pipe construction that laid without a need to cut the tarmac on the surface of the parking lot during installation of inductive loop detectors. The elimination of active devices in the parking system of the present invention increases the cost effectiveness of deploying such system as compared to all the deployment using active sensing devices such as ultrasonic sensor, video imaging and inductive loop sensor.

The foregoing embodiment and advantages are merely exemplary and are not to be construed as limiting the present invention. The description of the embodiments of the present invention is intended to be illustrative and not to limit the scope of the claims and many alternatives, modifications and variations will be apparent to those skilled in the art.

CLAIMS

1. A parking management system comprising

5 a sensing unit for detecting an availability status of a vehicle parking space;
a processing unit for processing and analysing the collected information on the
availability status of a vehicle parking space; and
a displaying unit for displaying the information of the availability status of a vehicle
parking space.

2. The parking management system as claimed in Claim 1 wherein the sensing unit
comprising

an optical fiber sensor determine the changes of water pressure based on the
weight of the vehicle coupled to a water pressure controlled chamber to amplify

15 the changes in water pressure from a water pipe connected;

a sensor interrogation unit having a wavelength-swept laser to sweep central
wavelengths of the optical fiber sensor;

a wavelength meter module for recording the shifting of central wavelength of the
optical fiber sensor;

20 data acquisition module for allowing wavelength shift has been pre-programmed and
triggering a signal upon exceeding a threshold value wherein the signal corresponds
to the wave length shift and indicates a vehicle presence in the parking space; and

a wireless communication module for transferring the information of the vehicle
presence in the parking space to the processing unit.

3. The parking management system as claimed in Claim 1 wherein the processing unit
receiving the information of the vehicle presence in the parking space and to cross check
with the database to identify a free parking bay for the vehicle and send the information
to a displaying unit.4. The parking management system as claimed in Claim 2 wherein a membrane is
attached inside the water pressure controlled chamber to amplify the pressure upon
receiving a low pressure from the water pipe.

5. A method of identifying and allocating a parking space for a vehicle comprising

inducing a pressure onto a water pipe coupled with an optical fiber sensor of a sensing unit via aqua-opto adapter when a vehicle approaches an entrance point of a parking bay;

providing a strain on the optical fiber Bragg sensor to shift the central wavelength of the optical fiber sensor spectrum to a value;

recording the wavelength shift by a wavelength meter module and providing the information to a data acquisition module;

providing a threshold value for allowing maximum the wavelength shift to trigger a signal;

indicating a vehicle passing over the water pipe when the signal is triggered and a vehicle is presence in the detected area;

transferring the information on the presence of the vehicle to a processing unit via a wireless communication module;

providing a cross check on a database to identify an empty parking space for the detected vehicle by sending the information to a display unit the predetermined location;

guiding the vehicle to the empty parking space as indicated in the display unit;

matching a wavelength shift of the vehicle as parked in the empty parking space in the database of the processing unit; and

displaying the information from the database on the reduction of parking space in the occupied parking bay at the display unit.

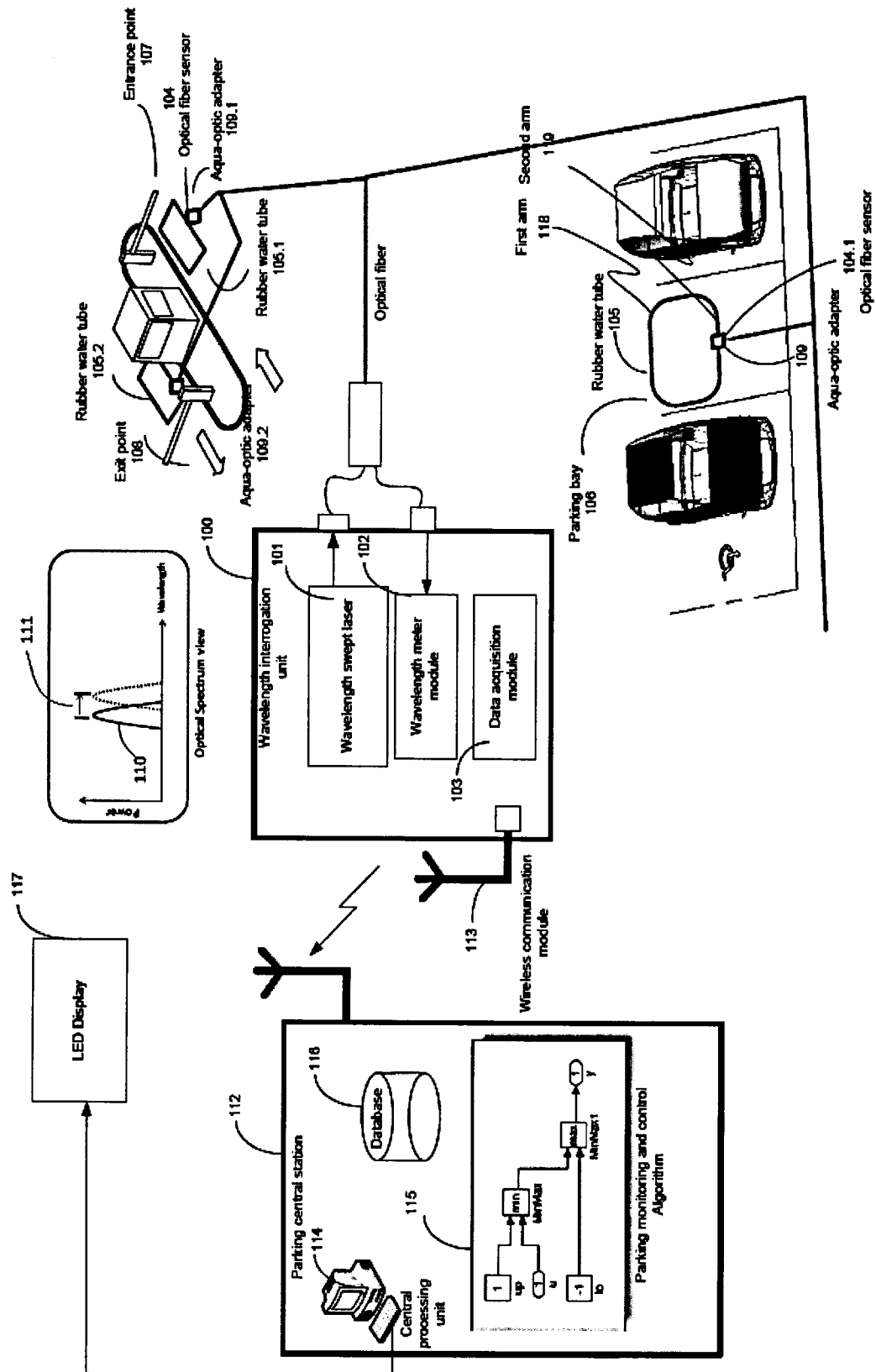


Figure 1

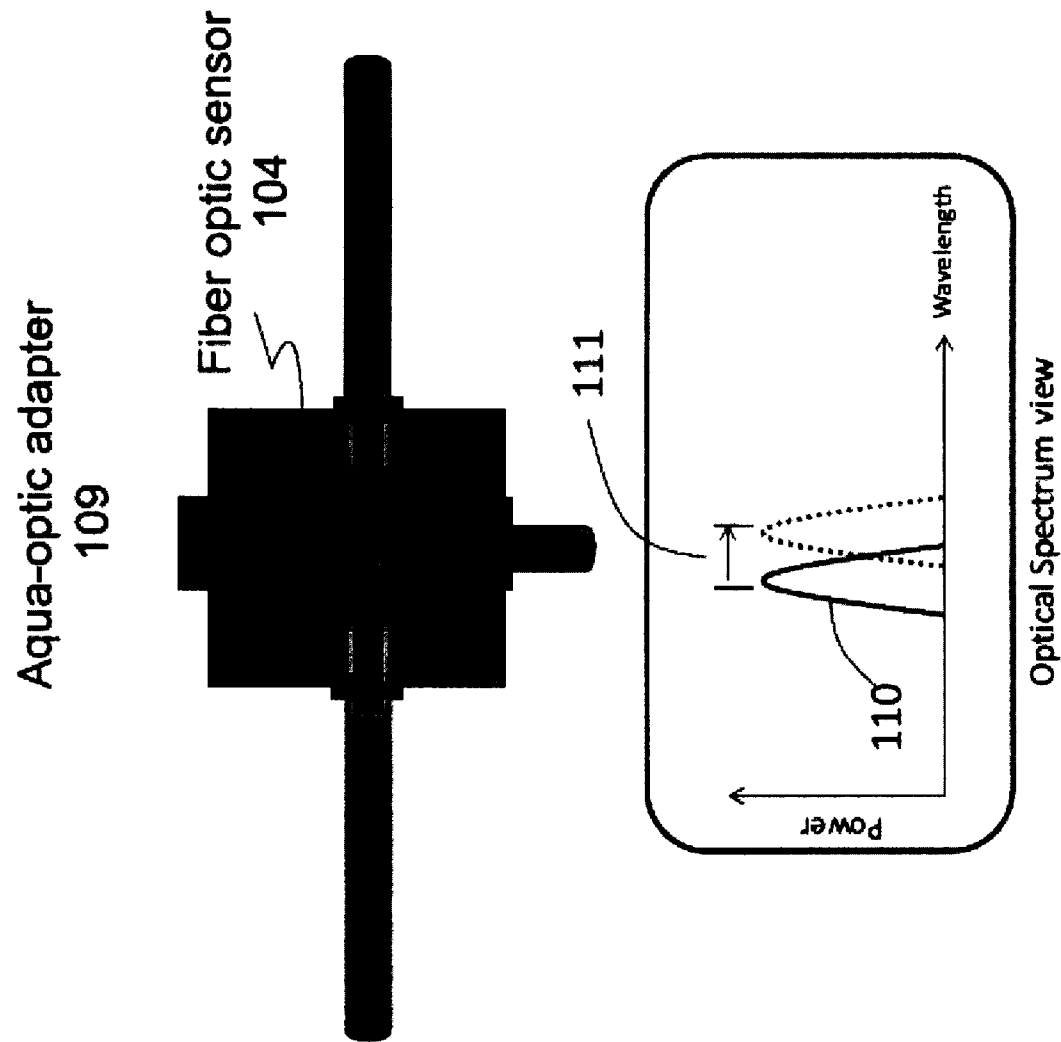


Figure 2

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER

INV. G08G1/14 G08G1/04 G08G1/02 G01L1/24 E01F11/00
G01L11/02

ADD.

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)

G08G G01L E01F

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)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/007525 A1 (SHANBHAG AMIT UMESH [US] ET AL) 14 January 2010 (2010-01-14)	1,3
A	paragraphs [0030] - [0039], [0066]; figures 1-4	2,4,5
X	JP 2006 284494 A (MITSUBISHI ELECTRIC CORP) 19 October 2006 (2006-10-19)	1,3
A	abstract; figures 1-12	2,4,5
X	US 5 163 000 A (ROGERS JOHN N [US] ET AL) 10 November 1992 (1992-11-10)	1,3
A	column 2, lines 17-59; figure 1	2,4,5
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Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

International application No
PCT/MY2014/000146

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GURU PRASAD A S ET AL: "Fiber Bragg Grating sensor instrumentation for parking space occupancy management", OPTICAL ENGINEERING (ICOE), 2012 INTERNATIONAL CONFERENCE ON, IEEE, 26 July 2012 (2012-07-26), pages 1-4, XP032307886, DOI: 10.1109/ICOE.2012.6409571 ISBN: 978-1-4673-2461-8 the whole document -----	1-5
A	US 2007/031084 A1 (WANG DAVID W [US] ET AL) 8 February 2007 (2007-02-08) paragraphs [0011] - [0013], [0025] - [0026] -----	1-5
A	EP 2 485 202 A1 (TOSHIBA KK [JP]) 8 August 2012 (2012-08-08) paragraph 16-19 - pages 1-3 -----	1-5
A	US 2008/317401 A1 (HUANG AN-BIN [TW] ET AL) 25 December 2008 (2008-12-25) paragraphs [0002], [0019] - [0023]; figures 1a-2 -----	1-5

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/MY2014/000146

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010007525 A1	14-01-2010	NONE	
JP 2006284494 A	19-10-2006	JP 4451343 B2 JP 2006284494 A	14-04-2010 19-10-2006
US 5163000 A	10-11-1992	NONE	
US 2007031084 A1	08-02-2007	NONE	
EP 2485202 A1	08-08-2012	CN 102473348 A EP 2485202 A1 JP 2011070469 A KR 20120027520 A US 2012160574 A1 WO 2011037228 A1	23-05-2012 08-08-2012 07-04-2011 21-03-2012 28-06-2012 31-03-2011
US 2008317401 A1	25-12-2008	TW 200900671 A US 2008317401 A1	01-01-2009 25-12-2008