

PARKING DISPLAY ASSEMBLY FOR USE IN AN ELECTRONIC VEHICLE PARKING MANAGEMENT SYSTEM

Field

The present invention generally relates to electronic vehicle parking management systems, and in particular to a parking display assembly for use in such systems.

Background

[0001] The following discussion of the background to the invention is intended to facilitate an understanding of the present invention only. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or part of the common general knowledge of the person skilled in the art in any jurisdiction as at the priority date of the invention.

[0002] Electronics based vehicle parking management systems are being developed because they can improve the management of parking within car parks. These systems can eliminate the need for manned parking toll barriers, and can lead to barrierless car parks with automated payment of parking for vehicles using that car park. This will lead to improved traffic flow and minimize waiting times within the car park. Such systems may employ license plate reader (LPR) cameras to read the registration number of vehicles entering and departing the car park. These systems may also use video-based parking guidance systems (VPGS) to both monitor and provide guidance for vehicles when within the car park so that they can be directed to an appropriate parking lot. As these systems are based on determining the licence plate number of the vehicle parking at the car park, this can make it easy to charge different parking rates for different vehicles.

[0003] Car parks can have parking lots reserved for specific vehicles, for example where the vehicle owner has a long-term lease on that parking lot. It is however not always possible to prevent an unauthorized vehicle from parking in such a reserved parking lot if there is otherwise no indication in that parking lot that it is reserved. Various attempts have been made to address this issue. The simplest option is to have a message board at the parking lot indicating the reserved status of that lot. This can however be difficult to manage where there are a large number of reserved

lots that need to be managed, where the vehicles authorized to park in these lots regularly change thereby requiring updates in the signs, or where the reserved status of a parking lot changes over the day. For example, in the case of residential carpark managed by the HDB in Singapore, certain parking lots may be only reserved for residents during the evening, with the parking lot otherwise being available to the public during the day. Carparks have therefore sought to better manage their parking lots by for example locating LED matrix displays or LCD screens over each parking lot showing their current status (i.e. reserved or open to the public), and/or including the registration number of the vehicle authorized to park in that lot. The setup costs for purchasing LED matrix displays or LCD screens for each parking lot will however be high. Furthermore, the installation and cabling costs will be high because of the need to install appropriate power and data cables to each display, and the need to provide support brackets to support the weight of each display (typically around 5 kg for an LED matrix display or LCD screen). In addition, the ongoing electricity charges and maintenance costs, and the extra heat generated within the carpark makes this a less than satisfactory financial and environmental option.

[0004] Electronic vehicle parking vehicle systems can also provide ways to warn vehicles that attempt to park in a reserved parking lot. The warning that is typically used is a flashing red or other light mounted on the ceiling next to the parking lot. However, the ceiling location of such warning lights can make it difficult for the driver to see while sitting in the vehicle, and they may therefore not be aware that they are not authorized to park there. It is of course also possible that the driver may not understand the meaning of the warning light, or may simply ignore the warning light. Furthermore, vehicle parking management systems may be unable to collect sufficient evidence of unauthorized parking to allow for the issuance of a parking infringement notice. While it may also be possible to message a driver to provide them with an early warning that may prevent them incorrectly parking in the wrong lot, it is difficult to police this as it may be difficult to locate the vehicle once it has entered the carpark.

[0005] An object of the invention is to ameliorate one or more of the above-mentioned difficulties.

Summary

[0006] According to one aspect of the disclosure, there is provided a parking display assembly for use in a carpark including; a housing including at least one display panel; and at least one e-paper screen mounted on a said display panel, the e-paper screen displaying parking information provided by an electronic vehicle parking management system of the carpark; wherein the display assembly is mountable at or adjacent a parking lot of the carpark, and the e-paper screen is adapted to display parking information relevant to that parking lot.

[0007] In some embodiments, the parking display assembly may further include a licence plate reader (LPR) camera for reading a licence plate of a vehicle located in the parking lot. The LPR camera may be located within the housing. Alternatively, the LPR camera may be located in a separate camera housing.

[0008] In some embodiments, the parking display assembly may include a camera processing module built into the housing for processing the visual data provided by the LPR camera. The camera processing module may include a deep learning module for improving licence plate reading performance. Alternatively, or in addition, the camera processing module may include a checksum filter for comparing multiple LPR images to thereby maximise licence plate reading accuracy.

[0009] In some embodiments, the LPR camera may be further adapted to record visual information of a vehicle parked in the parking lot including vehicle colour and brand. Alternatively, a second camera may be included for recording visual information of a vehicle parked in the parking lot including vehicle colour and brand.

[0010] In some embodiments, the parking display assembly may include a front said display panel facing a driveway of the carpark, and a rear said display panel facing the parking lot when the display assembly is mounted within the carpark, wherein a front and rear said e-paper screen is respectively mounted on the front and rear display panels.

[0011] In some embodiments, the parking display assembly may include a screen light for illuminating the or each said e-paper screen in low light conditions.

[0012] In some embodiments, the parking display assembly may include a sound emitting device for providing an audio warning signal.

[0013] In some embodiments, the parking display assembly may further include an LED indicator mounted on the housing for providing additional parking information relating to the parking lot.

[0014] In some embodiments, the e-paper screen may be controlled by an electronic control system, and the electronic control system is located within the housing.

[0015] In accordance to another aspect of the disclosure, there is provided an electronic vehicle parking management system for a carpark having a plurality of parking lots, and including a plurality of parking display assemblies including a housing including at least one display panel; and at least one e-paper screen mounted on a said display panel, the e-paper screen displaying parking information provided by an electronic vehicle parking management system of the carpark; wherein the display assembly is mountable at or adjacent a parking lot of the carpark, and the e-paper screen is adapted to display parking information relevant to that parking lot.

[0016] Other aspects and features of the present invention will become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

Brief Description of the Drawings

[0017] In the figures, which illustrate, by way of example only, embodiments of the present invention, wherein

[0018] Figure 1 is an image of a display assembly according to an embodiment of the present invention;

[0019] Figure 2 is an image of modular display assemblies according to another embodiment of the present invention; and

[0020] Figure 3 is a chart showing the financial benefits of using an e-paper screen according to the present invention.

Detailed Description

[0021] Throughout this document, unless otherwise indicated to the contrary, the terms “comprising”, “consisting of”, “having” and the like, are to be construed as non-exhaustive, or in other words, as meaning “including, but not limited to”.

[0022] Furthermore, throughout the specification, unless the context requires otherwise, the word “include” or variations such as “includes” or “including” will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

[0023] Terms such as ‘upper’, ‘lower’, ‘front’, ‘back’ and ‘sides’ are used in the specification to refer to the typical in use orientation of the described embodiment. It is however to be understood that these terms are not intended to limit the scope of the present invention, and that alternative orientations are also envisaged.

[0024] Figure 1 shows an embodiment of the parking display assembly 1 according to the present disclosure. The parking display assembly 1 is mountable within a carpark at or adjacent a parking lot within the carpark. A mounting rail 17 can be installed in front of each row of parking lots upon which a number of display assembly 1 can be mounted.

[0025] The parking display assembly 1 includes a housing 3 having a display panel 5 located on one side thereof. An e-paper screen 7 is mounted on the display panel 5. A window 11 is also provided within the display panel 5 behind which is positioned a license plate reader (LPR) camera (not shown). A second display panel (not shown) can also be provided at the opposing side of the housing 3. That second display panel can also support an e-paper screen. The e-paper screen 7 may be

visible to the carpark driveway once mounted and can display information such as the reserved status or open to the public status of a parking lot, as well as the license plate number of the vehicle to which the parking lot is reserved. The other e-paper screen on the opposing display panel may be visible to the driver of the vehicle when located within the parking lot and can provide, for example, a warning message to that driver including if the parking lot is reserved.

[0026] The parking display assembly 1 may further include an LED indicator light 9 at the bottom of the housing 3 that can be lighted to provide a warning or other signal to a driver parked in a parking lot adjacent the parking display assembly 1. The LED indicator light 9 can also be lighted with different colours to provide additional parking information for the driver parked in the parking lot. The circuit boards providing the electronic control system for controlling the display of the or each e-paper screen is compact in dimensions and therefore can be fully accommodated within the housing 3. The electronic control system may also control the backlight for each e-paper screen, and can also alternatively control a front light to illuminate the e-paper screen from the front in situations when the lighting within the carpark is too low for the e-paper screen to be visible.

[0027] A sound emitting device such as a buzzer can also be controlled by the circuit board controlling the e-paper screens, or by a separate control system. The sound emitting device can provide a warning sound signal to a driver parked in a reserved lot when required.

[0028] The camera processor module controlling the LPR camera may also be located within the housing 3. This eliminates the need for any external network server to process the LPR conversion. Rather, the LPR camera of the display assembly 1 can be stand-alone workstation so that the failure of any one LPR camera will not affect the remainder of the vehicle parking management system. The camera processing module may incorporate deep learning technology for improving the license plate reading performance of the LPR camera. The camera processing module may further include a checksum filter for comparing multiple LPR images thereby maximize the accuracy of the license plate reading.

[0029] The LPR camera can also record visual information of any vehicle parked in the parking lot. This information can include vehicle colour and vehicle brand. Such information can provide evidence for any legal proceeding arising from unauthorized parking by a vehicle within that parking lot. It is however also envisaged that a second camera be provided to record such information.

[0030] Figure 2 shows alternative embodiments of the present disclosure. The previously described display assembly 1 integrates the e-paper screen 7 and LPR camera in the same housing 3. An alternative embodiment of the display assembly 1A includes the e-paper screen in one housing 19, with an LPR camera 1B being located within a second housing 21. A separate said display assembly 1A can then be mounted in front of each parking lot, with a single LPR camera 1B monitoring a number of adjacent parking lots. This then reduces the number of LPR cameras required to be used in the vehicle parking management system. It is also envisaged that a second camera 1C be located within a third housing 23 for recording the visual information of one or more parked vehicles. Each of the housing 1, 1A, 1B, 1C may also be provided with a LED indicator 9, 9A, 9B, 9C and a sound emitting device such as a warning buzzer as required.

[0031] The manufacturing costs for the parking display assemblies 1, 1A, 1B and 1C can then be further reduced by using common end caps 15 that can be used on each of the housings 3, 19, 21, 23. Furthermore, as the electronic control system of an e-paper screen is relatively compact, an LPR camera together with its camera control module can be installed within the same housing of the parking display assembly 1 as shown in Fig. 1. This is not possible with LED dot matrix displays or with LCD monitors.

[0032] Figure 3 provides a comparison of the set-up costs and on-going operational costs for different forms of displays, namely LED dot matrix displays, LCD monitor displays and e-paper screen displays. Using e-paper displays provides a number of advantages. Firstly, they consume significantly less power than LED or LCD displays, i.e. 0.1 watts as compared with 6 and 80 watts, as shown in the 'power consumption' column of the chart. This is in part due to the fact that the e-paper screens do not need to be continuously supplied with power. Once the control signal has been sent to the e-paper screen to display the required parking information, that

information will continue to be displayed even following discontinuation of the power supply to that e-paper screen. Another advantage is the lower setup costs for such e-paper screens. These screens are typically around 1.6mm in thickness, and are substantially lighter than LED or LCD screens. A display apparatus using an e-paper screen may typically weigh around 500gm. By comparison, an LED or LCD screen would weigh closer to 5kg. This means that the installation costs will be lower because the support rails do not need to support as high a load and can thereby be less expensive to fabricate and install. This, together with the lower cabling costs for e-paper screens means that the setup cost for e-paper screen display assembly is estimated to be only S\$400 as compared to S\$800 and S\$1,200 for LED and LCD displays respectively as shown in the 'setup costing' column in the chart.

[0033] The operation costings are shown in the 'operation costing' column of the chart which estimates the e-paper screen costs to be about 0.072kW/h, as compared with 4.32kW/h and 57.6 kW/h for LED and LCD displays respectively. Therefore, the monthly cost for running 1000 e-paper screen display assemblies is estimated to only be around S\$15.00 as compared with S\$950.00 and S\$12,672 for LED and LCD screen respectively. This is based on an electricity tariff of 0.22/kWh.

[0034] It should be appreciated by the person skilled in the art that the above invention is not limited to the embodiments described. In particular, modifications and improvements may be made without departing from the scope of the present invention.

It should be further appreciated by the person skilled in the art that one or more of the above modifications or improvements, not being mutually exclusive, may be further combined to form yet further embodiments of the present invention.

Claims:

- .1. A parking display assembly for use in a carpark including;
a housing including at least one display panel; and
at least one e-paper screen mounted on a said display panel, the e-paper screen displaying parking information provided by an electronic vehicle parking management system of the carpark;
wherein the display assembly is mountable at or adjacent a parking lot of the carpark with the at least one display panel facing a driveway of the carpark, such that the parking information displayed by the display panel is visible from the driveway; and
wherein the e-paper screen is adapted to continuously display parking information relevant to a reserved status of the parking lot, and
wherein the display assembly further includes a licence plate reader (LPR) camera for reading a licence plate of a vehicle located in the parking lot, and a camera processing module for processing the visual data provided by the LPR camera, the camera processing module including a checksum filter for comparing multiple LPR images to thereby maximise licence plate reading accuracy.
2. A parking display assembly according to claim 1, wherein the LPR camera is located within the housing.
3. A parking display assembly according to claim 1, wherein the LPR camera is located in a separate camera housing.
4. A parking display assembly according to claim 2 or 3, wherein the camera processing module is built into the housing.
5. A parking display assembly according to any one of the preceding claims, the camera processing module including, a deep learning module for improving licence plate reading performance.

6. A parking display assembly according to any one of the preceding claims, wherein the LPR camera is further adapted to record visual information of a vehicle parked in the parking lot including vehicle colour and brand.
7. A parking display assembly according to any one of claims 1 to 5, further including a second camera for recording visual information of a vehicle parked in the parking lot including vehicle colour and brand.
8. A parking display assembly according to any one of the preceding claims, including a front said display panel facing a driveway of the carpark, and a rear said display panel facing the parking lot when the display assembly is mounted within the carpark, wherein a front and rear said e-paper screen is respectively mounted on the front and rear display panels.
9. A parking display assembly according to any one of the preceding claims, including a screen light for illuminating the e-paper screen or each said e-paper screen in low light conditions.
10. A parking display assembly according to any one of the preceding claims, further including a sound emitting device for providing an audio warning signal.
11. A parking display assembly according to any one of the preceding claims, further including an LED indicator mounted on the housing for providing additional parking information relating to the parking lot.
12. A parking display assembly according to any one of the preceding claims, wherein the e-paper screen is controlled by an electronic control system, and the electronic control system is located within the housing.
13. An electronic vehicle parking management system for a carpark having a plurality of parking lots, and including a plurality of parking display assemblies including a housing including at least one display panel; and at least one e-paper screen mounted on a said display panel, the e-paper screen displaying parking

information provided by an electronic vehicle parking management system of the carpark;

wherein the display assembly is mountable at or adjacent a parking lot of the carpark with the at least one display panel facing a driveway of the carpark, such that the parking information displayed by the display panel is visible from the driveway, and wherein the e-paper screen is adapted to continuously display parking information relevant to a reserved status of the parking lot, and

wherein the display assembly further includes a licence plate reader (LPR) camera for reading a licence plate of a vehicle located in the parking lot, and a camera processing module for processing the visual data provided by the LPR camera, the camera processing module including a checksum filter for comparing multiple LPR images to thereby maximise licence plate reading accuracy.

14. An electronic vehicle parking management system for a carpark according to claim 13, wherein the LPR camera is located within the housing in each said parking display assembly.

15. An electronic vehicle parking management system for a carpark according to claim 13, wherein the LPR camera is located in a separate camera housing in each said parking display assembly.

16. An electronic vehicle parking management system for a carpark according to claim 14 or 15, wherein the camera processing module is built into the housing.

17. An electronic vehicle parking management system for a carpark according to any one of claims 13 to 16, the camera processing module in each said parking display assembly including a deep learning module for improving licence plate reading performance.

18. An electronic vehicle parking management system for a carpark according to any one of claims 13 to 17, wherein the LPR camera is further adapted to record visual information of a vehicle parked in the parking lot including vehicle colour and brand in each said parking display assembly.

19. An electronic vehicle parking management system for a carpark according to any one of claims 13 to 17, each said parking display assembly further including a second camera for recording visual information of a vehicle parked in the parking lot including vehicle colour and brand.
20. An electronic vehicle parking management system for a carpark according to any one of claims 13 to 19, including a front said display panel facing a driveway of the carpark, and a rear said display panel facing the parking lot when the display assembly is mounted within the carpark, wherein a front and rear said e-paper screen is respectively mounted on the front and rear display panels.
21. An electronic vehicle parking management system for a carpark according to any one of claims 13 to 20, each parking display assembly including a screen light for illuminating the e-paper screen or each said e-paper screen in low light conditions.
22. An electronic vehicle parking management system for a carpark according to any one of claims 13 to 21, each parking display assembly further including a sound emitting device for providing an audio warning signal.
23. An electronic vehicle parking management system for a carpark according to any one of claims 13 to 22, further including an LED indicator mounted on the housing of each said parking display assembly for providing additional parking information relating to the parking lot.
24. An electronic vehicle parking management system for a carpark according to any one of claims 13 to 23, wherein the e-paper screen is controlled by an electronic control system, and the electronic control system is located within the housing of each said parking display assembly.