

DUAL MODE PERSONAL MOBILITY DEVICE (PMD), A METHOD FOR MANAGING A FLEET OF SUCH PMDS

FIELD OF INVENTION

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The present invention relates to a dual mode personal mobility device (PMD) and a method for managing a fleet of such PMDs.

BACKGROUND

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A personal mobility device (PMD) (also known as electric rideable, personal light electric vehicle, personal transporter, etc) is a class of compact, electric or internal combustion vehicle for transporting a user at speeds that do not normally exceed 25 km/h (16 mph). They can encompass electric skateboards, kick scooters, self-balancing unicycles and Segways, gasoline-fueled motorized scooters/skateboards, and so forth.

With the gain in popularity of PMD sharing services, it is a common sight to see dock-less bicycle or electric scooter fleets in many cities. Typically, the bicycles and scooters used in the fleets are basic versions with limited functionalities and operated manually.

One of the common problems for such fleets relates to indiscriminate disposal of the PMDs after use. The PMDs are often left in areas where retrieval is challenging, or left in an unsightly mess in areas where user traffic is substantial, causing blockages at pavements.

In addition, such PMD fleets typically have deployment issues and are not able to facilitate the provision of PMDs when desired by users. For example, users in lower traffic locations typically face difficulties
5 accessing the PMDs, or there are insufficient PMDs for users in high traffic locations. Typically, it becomes a labour intensive endeavour to provide desirable PMD deployment solutions. To address this issue, fleet providers typically deploy a large fleet of PMDs to meet the peak demands.

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Furthermore, such PMD fleets also typically suffer from low usage efficiency, whereby the PMDs are used mainly during peak periods or only when the PMDs are at high traffic locations. This is detrimental to the revenue stream of the fleet provider.

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It is evident that there are challenges which should be overcome in order to enable such PMD fleets to operate in an optimised manner, for both users and fleet providers.

20 In addition, existing PMDs can typically only be operated in a manned mode but not an unmanned mode. A two-wheel electric scooter typically consists of a front wheel and a rear wheel. Either the front wheel or rear wheel is actuated. It is not capable of self-balancing to operate in an unmanned mode. A handle bar connected to front wheel
25 should also be steered manually by a user to change direction of movement.

Typically, a three-wheeled electric scooter consists of two front wheels and a rear wheel. Typically, the rear wheel is actuated. While this configuration is self-balancing inherently, a handle bar connected to front wheel needs to be steered manually by the user or by the user
5 leaning in a desired direction. Alternatively, an alternative configuration consists of a front wheel and two rear wheels. The front wheel is actuated and a handle bar is connected to the front wheel for steering by the user.

10 A self-balancing unicycle and two-wheel hoverboard/Segway typically requires constant powering of the actuator to achieve self-balancing, which is not ideal for PMD sharing service from a power consumption aspect.

15 **SUMMARY**

In a first aspect, there is provided a dual mode personal mobility device, a first mode being manned and a second mode being unmanned. The dual mode personal mobility device comprises:

- 20 a base for placement of a user's feet;
- an actuator coupled to two rear wheels at a rear portion of the base;
- a steering structure at a front portion of the base, the steering structure including an angled fork for locating a front wheel; and
- 25 a detector configured to determine an angle of the front wheel with reference to a direction of travel.

It is advantageous that the actuator and the detector enable differential movement of the two rear wheels for the dual modes of the personal mobility device.

5 In a second aspect, there is provided a data-processor implemented method for managing a fleet of personal mobility devices. The method comprises:

transmitting, from a mobile phone, a request for a personal mobility device;

10 receiving, at a central server, the request;

determining, at the central server, an assigned personal mobility device in accordance with pre-defined parameters; and

transmitting, to the assigned personal mobility device, instructions for the assigned personal mobility device to traverse to a
15 desired location.

Finally, there is provided a central server configured for use in a method for managing a plurality of personal mobility devices. The central server includes at least one data processor configured to:

20 receive, from a mobile phone, a request for a personal mobility device;

process, the request;

determine, an assigned personal mobility device in accordance with pre-defined parameters; and

25 transmit, to the assigned personal mobility device, instructions for the assigned personal mobility device to traverse to a desired location.

It will be appreciated that the broad forms of the invention and their respective features can be used in conjunction, interchangeably and/or independently, and reference to separate broad forms is not intended
5 to be limiting.

DESCRIPTION OF FIGURES

A non-limiting example of the present invention will now be described
10 with reference to the accompanying drawings, in which:

FIG 1 is a front perspective view of an example of a personal mobility device of the present invention;

FIG 2 is a rear perspective view of the personal mobility device of FIG
15 1;

FIG 3 is a schematic view of an example control unit of the personal mobility device of FIG 1;

FIG 4 is a schematic view of an example system for managing a fleet of personal mobility devices;

20 FIG 5 is a schematic view of an example server of FIG 4;

FIG 6 is a process flow of a method for managing a fleet of personal mobility devices;

FIG 7 is a schematic view of an example interfacing manner with the personal mobility device of FIG 1.

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DETAILED DESCRIPTION

The present invention discloses a dual mode personal mobility device (PMD) which is able to function in a first manned mode and a second unmanned mode. In addition, the present invention also discloses a system and method for managing a fleet of the PMDs, the system and method being configured to optimise deployment of the fleet of the PMDs and to minimise indiscriminate parking of the PMDs.

Further to the definition of the term PMD as provided in the background, it should be appreciated that PMD also is intended to cover any transportation device that can carry at least one user for a short distance, typically for “first mile” or “last mile” applications. The transportation device is actuated and need not involve substantial exertion by the at least one user, other than to activate actuation of the transportation device and to steer the transportation device.

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Referring to FIGs 1 and 2, there is shown an example of a PMD 100 of the present invention. The PMD 100 can be operated in a first manned mode and a second unmanned mode. In the first mode, a user can mount the PMD 100 and ride it as per a typical scooter by controlling a speed and direction of the PMD 100. In the second mode, the PMD 100 can, by utilizing sensors integral with the PMD 100, move either independently or be controlled remotely. Further details of the operation of the PMD 100 will be provided in subsequent paragraphs.

25 The PMD 100 includes a base 105 which is configured to support a weight of at least one user, and an actuator 115 of the PMD 100. The base 105 includes a standing area 107 for placement of the user's

feet. The standing area 107 can include an anti-slip surface so that the PMD 100 can be operated even in wet weather conditions without risk of the user slipping off the PMD 100.

- 5 The actuator 115 of the PMD 100 is configured to provide locomotion for the PMD 100 when activated. The actuator 115 of the PMD 100 can comprise two motors that can be controlled independently. For example, both motors can be powered at different speeds and directions. The actuator 115 is located at a rear portion 120 of the
- 10 base 105 (ie the PMD 100). A front portion 125 of the PMD 100 includes a mount 135 for mounting of a steering structure 140. A handlebar 150 of the steering structure 140 is configured to be held by the user during the first manned mode to enable steering (ie. a directional change) of the PMD 100 with a front wheel 110(a) of the
- 15 PMD 100. The handlebar 150 can include a speed controller 155 for the user to control the actuator 115 of the PMD 100. The speed controller 155 can include a switch to reverse a direction of operation for the actuator 115. The speed controller 155 can include a functionality which aids in braking of the PMD 100 using the actuator
- 20 115.

The actuator 115 can be covered within a cowl that can be lockable to restrict access to the actuator 115. The rear portion 120 of the PMD 100 can also include at least one weatherproof wide-angle sonar

25 sensor 170 that is configured to detect oncoming obstacles to enable the PMD 100 to avoid the obstacles during the second unmanned mode. In some embodiments, the sonar sensor 170 can be replaced

by solid state LiDAR. The cowl can also cover at least one battery for powering the actuator 115, whereby the at least one battery can be hot-swapped.

5 The PMD 100 has three wheels 110 positioned in a manner that provides stability. A front wheel 110(a) is mounted to a front fork 145 of the steering structure 140. The front fork 145 is angled slightly to provide a “caster wheel” effect when the PMD 100 is moving in the second unmanned mode. Without the “caster wheel” effect, the front
10 wheel 110(a) is likely to turn to an undesirable angle and get locked-up during the second unmanned mode, causing challenges in relation to manoeuvring of the PMD 100 during the second unmanned mode. Two wheels 110(b), 110(c) are located at the rear portion 120 of the PMD 100. The two wheels 110(b), 110(c) are coupled to the actuator
15 115. The actuator 115 can be a single or two gear-motors, for example, brush DC motor, brushless DC motor, hub motor and the like. The two wheels 110(b), 110(c) can be independently controlled to enable differential steering during both the first manned mode and the second unmanned mode.

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The PMD 100 can include a processing package 160 which contains a plurality of sensors and processors. Referring to FIG 3, there is shown a schematic diagram of an example of the processing package 160. The processing package 160 can be integral with the PMD 100, or the
25 processing package 160 can be retro-fitted to the PMD 100. The processing package 160 is mounted to the steering structure 140 in a manner where movement of the steering structure 140 does not cause

displacement of the processing package 160 in relation to the base 105. This ensures that the plurality of sensors and processors of the processing package 160 are not affected by the movement of the steering structure 140, and that the PMD 100 is stable due to the
5 relatively fixed centre of gravity even during movement of the PMD 100 in the second unmanned mode.

As shown, the processing package 160 includes the following components in electronic communication via a bus 305:

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1. a communications transceiver 310;
2. a Bluetooth transceiver 320;
3. random access memory ("RAM") 360;
4. a processor 370;
- 15 5. non-volatile memory 380;
6. a speaker 330;
7. front camera 340;
8. rear camera 350;
9. downward camera 390
- 20 10. GPS location module 395;
11. compass module 385.

Although the components depicted in FIG 3 represent physical components, FIG 3 is not intended to be a hardware diagram; thus
25 many of the components depicted in FIG. 3 may be realized by common constructs or distributed among additional physical components. Moreover, it is certainly contemplated that other existing

and yet-to-be developed physical components and architectures may be utilized to implement the functional components described with reference to FIG 3.

5 In general, the non-volatile memory 380 functions to store (e.g., persistently store) data and executable code including code that is associated with the functional components for the processing package 160. In some embodiments, for example, the non-volatile memory 380 includes code and software to facilitate the implementation of one or
10 more of the indicated components as well as other components well known to those of ordinary skill in the art that are not depicted for simplicity. In many implementations, the non-volatile memory 380 is realized by flash memory (e.g., NAND or ONENAND memory), but it is certainly contemplated that other memory types may be utilized as
15 well. Although it may be possible to execute the code from the non-volatile memory 380, the executable code in the non-volatile memory 380 is typically loaded into RAM 360 and executed by the processor 370. The processor 370 in connection with RAM 360 generally operate to execute the instructions stored in non-volatile memory 380 to
20 effectuate desired functional components. For example, the processor 370 can transmit instructions to the actuator 115 to control a differential speed of rear wheels 110(b), 110(c).

The communications transceiver 310 is configured to enable long
25 range communication via wireless networks. The communications transceiver 310 can communicate via, for example, wireless local area networks (e.g. 802.11a, 802.11b, 802.11g, 802.11n, 802.11ac),

cellular networks (e.g., a CDMA network, a GPRS network, a UMTS networks, an LTE network), and other types of communication networks. The communications transceiver 310 can enable a connection of the PMD 100 to a central server. The communication
5 transceiver 310 can be used to send sensor data (such as images/videos from cameras, GPS location, wheel odometry, compass data, and so forth) to a central server. The communication transceiver 310 can also be used to send PMD 100 device parameters such as battery level, motor temperature to the central server. The
10 communication transceiver 310 is also used to receive commands or instructions from the central server, such as more accurate PMD location through sensor fusion algorithms processed in the central server. Another command received from the central server is to unlock the PMD 100 for a user to start a ride or lock the PMD after the user
15 has ended a ride in the first manned mode. Another command received from the central server is to control the movement of the PMD in the second unmanned mode.

The Bluetooth transceiver 320 is also configured to enable short range
20 communications, for example, with a user's mobile phone such that ride and cost information relating to use of the PMD 100 can be provided to the user. In some embodiments, the Bluetooth transceiver 320 can be replaced with other short range protocol transceivers. It should be appreciated that the Bluetooth transceiver 320 can be
25 integrated with the communications transceiver 310 when the communications transceiver 310 is configured for both long and short range communication.

The speaker 330 can be configured to emit audio signals to provide audio feedback (for example, in relation to a status of the PMD 100) to the user, and to alert other persons in the vicinity when in the second
5 unmanned mode.

The processing package 160 also includes a plurality of cameras located within respective ports. The front camera 340 is configured to record oncoming traffic footage and process images while the PMD
10 100 is used in the first manned mode. The rear camera 350 is configured to record oncoming traffic footage and process images while the PMD 100 is used in the second unmanned mode. The downward camera 390 is directed towards the front wheel 100(a) and is configured to record footage of a turning angle of the front wheel
15 110(a) such that an appropriate differential speed can be applied to rear wheels 110(b), 110(c) to reduce wheel slip and to ensure stability of the PMD 100. The downward camera 390 can use a wide-angle fish eye lens such that a wide-angle view of the front wheel 110(a) can be captured. It should be noted that there can be more than a single front
20 camera 340, more than a single rear camera 350 and more than a single downward camera 390. Alternatively, the front camera 340, rear camera 350 and downward camera 390 can be replaced by an omnidirectional camera with a 360-degree field of view in the horizontal plane, or with a visual field that covers the entire sphere.

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An encoder in the steering structure 140 can be used to provide an alternative to the downward camera 390 for determining the turning

angle of the front wheel 100(a).

Finally, the GPS location module 395 and the compass module 385 aid in location and movement of the PMD 100 respectively.

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During the first manned mode, the user steps on the base 105 of the PMD 100 and holds onto the handlebar 150 for support and to steer the PMD 100. The PMD 100 traverses in a manner whereby the front wheel 110(a) is a leading wheel and the rear wheels 110(b), 110(c) are
10 trailing wheels. The user manipulates the speed controller 155 to control both a speed and direction of the PMD 100. In the first manned mode, a turning angle of the front wheel 100(a) is continually monitored using the downward camera 390 of the processing package 160 so that the rear wheels 100(b), 100(c) rotate with a speed
15 differential which minimizes wheel slip and reduces a turning radius when an appropriate situation arises.

During the second unmanned mode, the PMD 100 does not carry a user, and receives remote instructions to move to another location. In
20 some embodiments, when a load is detected on the base 105 of the PMD 100 in the second unmanned mode, the PMD 100 consequently disables the actuator 115. In the second unmanned mode, the PMD 100 moves in a manner where the front wheel 110(a) is a trailing wheel whilst the rear wheels 110(b), 110(c) are leading wheels. In the
25 second unmanned mode, differential steering using the rear wheels 110(b), 110(c) is used so that the rear wheels 100(b), 100(c) rotate with a speed differential, and the front wheel 100(a) rotates freely as a

castor wheel. In addition, the at least one weatherproof wide-angle sonar sensor 170 is configured to detect oncoming obstacles to enable the PMD 100 to avoid the obstacles during the second unmanned mode. In some embodiments, the remote instructions are provided by
5 a remote operator viewing real-time images received from the cameras on the PMD 100 to remotely control the PMD in the second unmanned mode by transmitting speed and direction commands to the PMD 100.

In some embodiments, the total width of the PMD 100 is about
10 620mm. Such a width enables a pair of PMDs 100 to traverse abreast with one another on a typical footpath/pavement of about 1500mm. Preferably, the PMD 100 weighs less than 20kg and is speed limited to 25km/h for both modes. In this regard, the PMD 100 is able to meet the Singapore Land Transport Authority's regulatory requirements for
15 similarly categorised devices. Correspondingly, the PMD 100 should also be able to meet similar regulatory requirements set by similar authorities in other countries. It should be noted that the PMD 100 can be engineered to operate in different climates and weather conditions.

20 In some instances, the speed limitation for the PMD 100 can be raised to a higher speed limit, if it is determined that the user is experienced to handle the PMD 100. For example, a pertinent software application on a user's mobile phone which is used to activate the PMD 100, can record both a distance and a duration that the user has spent on the
25 PMD 100, and exceeding a pre-determined threshold for either distance or duration can lead to a raising of the speed limit for the particular user registered with the pertinent software application.

Alternatively, the speed limitation for the PMD 100 is controlled by a central server and can be dependent on regulatory restrictions within a respective country and/or a user profile.

- 5 The above described PMD 100 provides a number of advantages. Firstly, the PMD 100 can be redeployed without physical intervention, as it can be controlled remotely since it is connected to a wireless network. Furthermore, the PMD 100 is designed to minimise instances of instability, regardless of whether in the first manned mode or second
10 unmanned mode.

Referring to FIG 4, there is shown an example of a system 400 for managing a fleet of PMDs 100.

- 15 In this example, the system 400 includes a central server 410 wirelessly connected to a plurality of PMDs 100, and a plurality of mobile phones 430 via a communications network 420. The communications network 420 can be of any appropriate form, such as the Internet and/or a number of local area networks (LANs). The
20 central server 410 is able to communicate with the plurality of PMDs 100 within the system 200 over the communications network 420 using standard communication protocols.

- The mobile phones 430 are typically smart phones with the capability
25 of running software applications which can enable users of the smart phones to interface with the central server 410 and the PMDs 100.

Referring to FIG 7, there is shown a manner of short range interfacing with each PMD 100 using the mobile phone 430. The short range interfacing can be using for example, Bluetooth, Zigbee, and the like. For example, the mobile phone 430 includes a software app which
5 enables interfacing with the PMD 100 to enable a plurality of tasks to be carried out. For example, PMD 100 can provide trip parameters for display on the mobile phone 430, PMD 100 can be unlocked/activated using the mobile phone 430, PMD 100 can provide error messages for display on the mobile phone 430, and so forth.

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CENTRAL SERVER 410

The central server 410 is typically administered by an entity operating the fleet of PMDs 100. The central server 410 typically processes data
15 transmitted from the fleet of PMDs 100 and transmits instructions to the fleet of PMDs 100 to manage the fleet of PMDs 100. While the central server 410 is illustrated as a single computing system, it should be appreciated that the central server 410 can be a distributed set-up utilising a plurality of computing systems.

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The components of the central server 410 can be configured in a variety of ways. The components can be implemented entirely by software to be executed on standard computer server hardware, which may comprise one hardware unit or different computer hardware units
25 distributed over various locations, some of which may require the communications network 420 for communication.

In the example shown in FIG 5, the central server 410 is a commercially available server computer system based on a 32 bit or a 64 bit Intel architecture, and the processes and/or methods executed or performed by the central server 410 are implemented in the form of programming instructions of one or more software components or modules 522 stored on non-volatile (e.g. hard disk) computer-readable storage 524.

The central server 410 includes at least one or more of the following standard, commercially available, computer components, all interconnected by a BUS 535:

1. random access memory (RAM) 526;
2. at least one computer processor 528, and
- 15 3. external computer interfaces 530:
 - a. universal serial bus (USB) interfaces 530a (at least one of which is connected to one or more user-interface devices, such as a keyboard, a pointing device (e.g., a mouse 532 or touchpad),
 - b. a network interface connector (NIC) 530b which connects the central server 410 to the data communications network 420; and
 - 20 c. a display adapter 530c, which is connected to a display device 534 such as a liquid-crystal display (LCD) panel device.

The central server 410 includes a plurality of standard software modules, including:

1. an operating system (OS) 536 (e.g., Linux or Microsoft Windows);

2. web server software 538 (e.g., Apache, available at <http://www.apache.org>);
3. Javascript or Python modules 540; and
4. structured query language (SQL) modules 542 (e.g., MySQL, available from <http://www.mysql.com>), which allow data to be stored in and retrieved/accessed from an SQL database 516.

Together, the web server 538, Javascript module 540, and SQL modules 542 provide the central server 410 with the general ability to allow users with the mobile phones 430 equipped with standard web browser software to access the central server 410 and in particular to provide data to and receive data from the database 516. It will be understood by those skilled in the art that the specific functionality provided by the central server 410 to such users is provided by scripts accessible by the web server 538, including the one or more software modules 522 implementing the processes performed by the central server 410, and also any other scripts and supporting data 544, including markup language (e.g., HTML, XML, Java) scripts, and the like.

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The boundaries between the modules and components in the software modules 522 are exemplary, and alternative embodiments may merge modules or impose an alternative decomposition of functionality of modules. For example, the modules discussed herein may be decomposed into submodules to be executed as multiple computer processes, and, optionally, on multiple computers. Moreover, alternative embodiments may combine multiple instances of a

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particular module or submodule. Furthermore, the operations may be combined or the functionality of the operations may be distributed in additional operations in accordance with the invention. Alternatively, such actions may be embodied in the structure of circuitry that implements such functionality, such as the micro-code of a complex instruction set computer (CISC), firmware programmed into programmable or erasable/programmable devices, the configuration of a field- programmable gate array (FPGA), the design of a gate array or full-custom application- specific integrated circuit (ASIC), or the like.

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Respective steps of processes of the central server 410 may be executed by a module (of software modules 522) or a portion of a module. The processes may be embodied in a non-transient machine - readable and/or computer-readable medium for configuring a computer system to execute the method. The software modules may be stored within and/or transmitted to a computer system memory to configure the central server 410 to perform the functions of the module.

20 The central server 410 normally processes information according to a program (a list of internally stored instructions such as a particular application program and/or an operating system) and produces resultant output information via input/output (I/O) devices 530. A computer process typically includes an executing (running) program or portion of a program, current program values and state information, and the resources used by the operating system to manage the execution of the process. A parent process may spawn other, child

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processes to help perform the overall functionality of the parent process. Because the parent process specifically spawns the child processes to perform a portion of the overall functionality of the parent process, the functions performed by child processes (and grandchild
5 processes, etc.) may sometimes be described as being performed by the parent process.

Referring to FIG 6, there is shown a method 600 for managing a fleet of PMDs. The method 600 can be carried out using the system 400,
10 where the PMD 100 as earlier described is utilised. The method 600 enables the fleet of PMDs 100 to be deployed in an optimal manner. For the purpose of illustration, it is assumed that the method 600 is performed at least in part using one or more electronic processing devices such as a suitably programmed microcontroller forming part of
15 a PMD 100 and in communication with the central server 410, or the like.

At step 610, a user utilises a mobile phone 430, possibly using a pertinent software application which is used to activate the PMD 100,
20 and/or to transmit a request to the central server 410 for a PMD 100. Typically, the request is transmitted via the communication network 420.

At step 620, the request is received and processed at the central
25 server 410. At step 630, it is determined whether a PMD 100 is available at a location desired by the user of the mobile phone 430. If no PMD 100 is available, a PMD 100 will be assigned for the user in

accordance with parameters such as, for example, distance from the desired location, power level of the PMD 100, priority user level of the user, demand level for the PMD 100, and so forth. The aforementioned parameters can be ranked in importance when determining an
5 assignment of the PMD 100. Typically, “close” would mean a distance of within 200m from the desired location. If a PMD 100 is “close”, typically, the mobile phone user would traverse to the PMD 100 and utilize the PMD 100. Consequently, at step 640, the central server 410 would direct an assigned PMD 100 towards the desired location to
10 replace the PMD 100 being utilised by the user.

If a PMD 100 is not “close” to the desired location, at step 650, the central server 410 would direct an assigned PMD 100 towards the desired location to fulfil the request transmitted by the mobile phone
15 430. Subsequently, at step 660, the central server 410 would direct a secondary PMD 100 towards the desired location of the user to avoid a shortfall of the PMD 100 at the desired location of the user. A determination of the secondary PMD 100 can be similar to the process carried out in step 630.

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It should be appreciated that the method 600 can be geo-fenced to avoid situations where users have to wait excessive durations for PMDs 100 to arrive at their location. This is because the speed of the PMDs 100 in the second unmanned mode is typically slow to avoid
25 accidents or alarm with people around the unmanned PMDs 100.

The above described method 600 provides a number of advantages.

Firstly, the method 600 minimises instances of PMD 100 shortage at a particular location, as there is a replacement mechanism in the method 600. Furthermore, the method 600 ensures that a PMD 100 can be delivered upon user request, which leads to conveniences for users. In
5 addition, the method 600 ensures that PMDs 100 left in areas of low demand does not remain at the areas of low demand and will traverse to areas of higher demand, increasing utility of each PMD 100.

Throughout this specification and claims which follow, unless the
10 context requires otherwise, the word “comprise”, and variations such as “comprises” or “comprising”, will be understood to imply the inclusion of a stated integer or group of integers or steps but not the exclusion of any other integer or group of integers.

15 Persons skilled in the art will appreciate that numerous variations and modifications will become apparent. All such variations and modifications which become apparent to persons skilled in the art, should be considered to fall within the spirit and scope that the invention broadly appearing before described.

CLAIMS

1. A dual mode personal mobility device, a first mode being
manned and a second mode being unmanned, the dual mode
5 personal mobility device comprising:
 - a base for placement of a user's feet;
 - an actuator coupled to two rear wheels at a rear portion of the
base;
 - a steering structure at a front portion of the base, the steering
10 structure including an angled fork for locating a front wheel; and
 - a detector configured to determine an angle of the front wheel
with reference to a direction of travel,
 - wherein the actuator and the detector enable differential
movement of the two rear wheels for the dual modes of the personal
15 mobility device.
2. The dual mode personal mobility device of claim 1, wherein the
detector comprises at least one camera in a processing package.
- 20 3. The dual mode personal mobility device of claim 1, wherein the
detector comprises an encoder in the steering structure.
4. The dual mode personal mobility device of any of claims 1 to 3,
wherein the actuator enables braking for the personal mobility device.
- 25 5. The dual mode personal mobility device of any of claims 1 to 4,
wherein the angled fork prevents the front wheel from being locked up

in the second mode.

6. The dual mode personal mobility device of any of claims 1 to 5,
wherein the actuator can be at least one unit selected from a group
5 consisting of: brush DC motor, brushless DC motor, and hub motor.

7. The dual mode personal mobility device of claim 2, wherein the
processing package is separable from the dual mode personal mobility
device.

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8. The dual mode personal mobility device of any of claims 1 to 7,
wherein performance parameters of the dual mode personal mobility
device varies in accordance to a respective user.

15 9. The dual mode personal mobility device of any of claims 1 to 8,
further comprising a sensor located at the rear portion of the base, the
sensor being configured to detect oncoming obstacles in the second
mode.

20 10. A data-processor implemented method for managing a fleet of
personal mobility devices, the method comprising:

transmitting, from a mobile phone, a request for a personal
mobility device;

receiving, at a central server, the request;

25 determining, at the central server, an assigned personal mobility
device in accordance with pre-defined parameters; and

transmitting, to the assigned personal mobility device,

instructions for the assigned personal mobility device to traverse to a desired location.

11. The method of claim 10, wherein the pre-defined parameters is
5 selected from a group consisting of: distance from the desired location, power level of the personal mobility device, priority user level of a user of the mobile phone, and demand level for the personal mobility device.

10 12. The method of claim 11, wherein the pre-defined parameters are ranked.

13. The method of any of claims 10 to 12, further comprising:
transmitting, to a secondary assigned personal mobility device,
15 instructions for the secondary assigned personal mobility device to traverse to the desired location.

14. The method of any of claims 10 to 13, being carried out within a
geo-fenced area.

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15. A central server configured for use in a method for managing a plurality of personal mobility devices, the central server including at least one data processor configured to:

receive, from a mobile phone, a request for a personal mobility
25 device;

process, the request;

determine, an assigned personal mobility device in accordance

with pre-defined parameters; and

transmit, to the assigned personal mobility device, instructions for the assigned personal mobility device to traverse to a desired location.

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16. The central server of claim 15, wherein the pre-defined parameters is selected from a group consisting of: distance from the desired location, power level of the personal mobility device, priority user level of a user of the mobile phone, and demand level for the personal mobility device.

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17. The central server of claim 16, wherein the pre-defined parameters are ranked.

15 18. The central server of any of claims 15 to 17, the central server including at least one data processor further configured to:

transmit, to a secondary assigned personal mobility device, instructions for the secondary assigned personal mobility device to traverse to the desired location.

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