

“A battery dock”**CROSS REFERENCE TO RELATED APPLICATION**

[001] This application is based on and derives the benefit of Indian Provisional Application 201841044681, filed on 27th November 2018, the contents of which are incorporated herein by reference.

TECHNICAL FIELD

[002] Embodiments disclosed herein relate to battery systems, and more particularly to docking systems comprising of at least one enclosure and associated electronics for holding at least one battery.

BACKGROUND

[003] Currently available docking systems for batteries comprise of simple enclosures for batteries, wherein the enclosures serve as mere repositories for holding the batteries. The enclosures are connected to external electronic control means, which can communicate/charge the battery present in the enclosure. Further, the dock is not secure, wherein the battery can be removed easily (without authorization) from the dock. Also, currently available solutions are specific to vehicle models and corresponding battery configurations.

SUMMARY

[004] Embodiments disclosed herein provide a docking enclosure for a battery, the docking enclosure includes a control unit interfacing with at least one external entity.

[004a] According to an aspect, there is provided a dock including: a lid; a body; and a base, wherein the base includes a Dock Interface Unit (DIU), wherein, the lid is adapted to close an opening defined on a first side of the body; the body defines a plurality of mounting points; and the DIU includes: a controller, wherein the controller is configured to power up the DIU on determining that a battery has been inserted into the dock using at least one of: a hall effect sensor and one or more mounting magnets; a transceiver; a DC-DC converter; a throttle control circuit; at least one interface, wherein the at least one interface is configured to perform one or more of the following: communicate with at least one external object using one or more communication ports; provide a swappable electrical connection with the battery inserted in the dock; provide a fixed electrical connection to the at least one external object; and a filtering circuit, wherein the filtering circuit is configured to filter out any interference or noise in a signal received by the at least one interface from the at least one external object.

[005] These and other aspects of the embodiments herein will be better appreciated and understood when considered in conjunction with the following description and the accompanying drawings. It should be understood, however, that the following descriptions, while indicating at least one embodiment and numerous specific details thereof, are given by way of illustration and not of limitation. Many changes and modifications may be made within the scope of the

embodiments herein without departing from the spirit thereof, and the embodiments herein include all such modifications.

BRIEF DESCRIPTION OF FIGURES

[006] Embodiments herein are illustrated in the accompanying drawings, through out which like reference letters indicate corresponding parts in the various figures. The embodiments herein will be better understood from the following description with reference to the drawings, in which:

[007] FIGs. 1a-1c depict example views of the dock, according to embodiments as disclosed herein;

[008] FIG. 2 depicts a dock interface unit, according to embodiments as disclosed herein;

[009] FIG. 3 depicts sloping which assists alignment of the battery, according to embodiments as disclosed herein.

[0010] FIG. 4a depict example view of the dock containing one battery;

[0011] FIG. 4b depict example view of the dock containing two batteries;
and

[0012] FIG. 4c depict example view of the dock containing three batteries.

DETAILED DESCRIPTION

[0013] The embodiments herein and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiments that are illustrated in the accompanying drawings and detailed in the following description. Descriptions of well-known components and processing techniques are omitted so as to not unnecessarily obscure the embodiments herein. The examples used herein are intended merely to facilitate an understanding of ways in which the embodiments herein may be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the embodiments herein.

[0014] The embodiments herein achieve a docking enclosure for a battery and a control unit for a dock (which can contain a battery) interfacing with external entities (such as a device being powered by the battery, the battery, other batteries, and so on). Referring now to the drawings, and more particularly to FIGS. 1a through 2, where similar reference characters denote corresponding features consistently throughout the figures, there are shown embodiments.

[0015] FIGs. 1a- 1c depict example views of the dock. The dock 10 includes a lid 110, a body 120 a base 130. In an embodiment, the lid 110 is adapted to close an opening defined on one side of the body 120, thereby securing the elements provided therein. The body 120 defines a plurality of mounting points 122. In an embodiment, each of the mounting points 122 provided on the body 120 is adapted to secure the dock 10 to an external object. In an embodiment, the base 130 is provided opposite to the lid 110 and is adapted to close an opening defined on the other side of the body 120. The base 130 defines a cavity 134 and includes a Dock Interface Unit (DIU) 132, and a plurality of mounting points 130m. Each of the mounting points 130m is adapted to secure the dock 10 to the external object at a bottom position thereof. Further, the DIU includes a controller 132c, a filtering circuit 132f, a transceiver 132t, a DC-DC converter 132d, a throttle control circuit 132e and at least one interface 132i.

[0016] The lid 110 can prevent liquid ingress. The lid 110 can apply an arresting force to prevent motion of one or more entities present in the dock 10. The lid 110 can comprise of one or more locking features to prevent the theft of the components present in the dock 10. The lid 110 may comprise one or more stages of locking to ensure theft and abuse proofing with provision for bypass and manual override. The lid 110 can be locked using at least one of a manual stage, an electronic stage, a mechanical stage or an electromechanical stage. In an embodiment, the electromechanical stage can include a locking with the connector guide pin.

[0017] Further, the external object is one of a vehicle, a charging station, a power supply point, and so on. In an embodiment, the mounting points provided on the body is adapted to secure the body to the external object to at least avoid the lateral movement of the dock. In an embodiment, the mounting points are made of a metal bracket. Further, the mounting points provided on the base is adapted to secure the base to the dock.

[0018] Further, the body 120 of the dock includes a detecting means 134 adapted to detect presence of at least a battery. In an embodiment, the detecting means is one or more mounting magnets 136. The magnets 136 can be used to determine the presence of battery inside the dock, such as a battery.

[0019] In an embodiment, the base 130 further includes a plurality of connectors, for connecting the dock to the external body. In an embodiment, the connector is at least one of an electrical connector. In an embodiment, the connectors can be a mechanical connector and a automotive connector. The dock 10 includes a means to align the battery to the connector and securely lock and hold the battery in position inside the dock 10. In an embodiment, the connector can have a play of a pre-determined range. The connector can be mounted in the dock 10 from the inside. This can ensure that the battery can be removed only if the lid 110 of the dock is opened. In an embodiment, the interface 132i of the DIU 132 is adapted to detect the presence of the dock 10 inside the object and the presence of the battery inside the dock 10. In an embodiment, the presence of the

dock is detected through at least one magnetic sensors or through conversion of protocol between battery and vehicle/external object.

[0020] The dock may also contain a sliding mechanism, wherein the sliding mechanism can comprise a set of guides. The guides can be used for easy insertion and removal of batteries from the dock. The guides can ensure that the battery is inserted in an apt manner, so as to ensure that the battery can connect with the connectors.

[0021] In an embodiment herein, the dock 10 may comprise of a means for accessing one or more fuses present in the dock. This can enable the fuses to be inspected, changed, and so on.

[0022] The at least one interface 132i can comprise at least one means for interfacing the DIU 132 with at least one entity present in an external body. Embodiments herein have been explained using a vehicle as an example of the external body. Examples of the entities present in the vehicle that interface with the DIU 132 can be, but not limited to, a throttle circuit, an auxiliary power, a battery, a motor controller, vehicle ignition, and so on. The interface 132i can enable the DIU 132 to communicate with the entities. The interface 132i can interface with a power supply means, such as a battery present in the dock, an internal battery, and so on.

[0023] The interface 132i may incorporate one or more communication ports to facilitate communication with external devices like the vehicle or a charge or battery interchange station. Examples of the interface 132i may be, but not limited to, one or more of a Controller Area Network (CAN), a Universal Asynchronous Receiver/Transmitter (UART), wireless interface (such as Wi-Fi, Wi-Fi Direct, Bluetooth, and so on) or discrete analog and digital signals. The interface 132i can work with different protocols (such as different CAN protocols) and different baud rates. The interface 132i can provide a swappable electrical connection with a battery present in the dock. The interface 132i can further provide a fixed electrical connection with the vehicle. The contents of swappable

electrical connection with the battery has been incorporated in patent application no. 201941000708.

[0024] The filtering circuit 132f can filter out interference/noise in signals received by the interface 132i from the connected entities. Examples of the interference can be Electro-Magnetic Interference (EMI), and so on. In an embodiment, the filtering circuit 132f is configured to filter the noise from the vehicle by a combination of low pass and high pass filters.

[0025] The DC-DC converter 132d can convert voltage from an input voltage level to a required voltage level. The DC-DC converter 132d can comprise at least one of a low-dropout linear regulator Power Management Integrated Circuit (PMIC) or a Switched Mode Power Supply (SMPS) PMIC. The DC-DC converter 132d can comprise an on-board reverse polarity protection means.

[0026] The controller 132c can receive inputs from the interface 132i directly or via the transceiver 203 or via the filtering circuit 202. The controller 132c is configured to receive information about the presence of battery in the dock using a suitable means such as a hall effect sensor or mounting magnets, and so on. On detecting that a battery has been inserted into the dock, the controller 132c can power up the DIU 132. Only on detecting that the vehicle has been turned on (via inputs from the ignition), the DIU 132 provides power to the at least one external entity.

[0027] The controller 132c can delay providing power to at least one auxiliary/accessory present in the vehicle. In an embodiment, the power can be delayed until the vehicle is authenticated and the key is turned on. In an embodiment, where there is a multi-battery system, the controller 132c can delay providing power until all the batteries are inserted in the vehicle and communication is established.

[0028] The controller 132c can initiate a pre-charge action to charge a bulk input capacitance located in the external entity (vehicle). In an embodiment, the

pre-charge is initiated when the battery is inserted into the vehicle and on every on/off cycle of the vehicle key switch. Once the input capacitance is charged, the controller 132c will turn on a main power/Bidirectional MOSFET/load Switch. This can enable arresting of the leakage current delivered by the load switch.

[0029] The controller 132c can provide speed control and limit the speed of the vehicle, if required by sensing the throttle position. This can depend on factors such as State Of Charge (SOC) of one or more batteries present in the dock or other docks connected to it, user history, predicted usage and so on. The controller 132c can determine the remaining SOC of the battery present in the dock 10 and batteries present in docks connected to it (if any). On determining that the SOC is below a pre-defined threshold, the controller 132c can provide an indication to the user. The indication can be provided to the driver and/or passenger using at least one of a visual, or auditory means on any suitable interior means such as an infotainment system, a standalone alerting system/indicator, a dashboard, speakers, vibrating means, haptic sensors, and so on.

[0030] In an embodiment herein, the controller 132c can provide a throttle signal analog sense and corresponding analog out as per the battery status through the throttle control circuit 132e. In an embodiment herein, the controller 132c can provide resistive throttle by inserting a limit attenuator in the resistive throttle path of the Dock Interface Unit (DIU).

[0031] The controller 132c can determine the intent of the driver, based on inputs from the ignition and throttle. The controller 132c can provide an indication to the user, on the vehicle being ready for operation. The indication can be provided to the driver and/or passenger using a visual, and/or auditory means using at least one of an infotainment system, a standalone alerting system/indicator, a user device, a dashboard, speakers, vibrating means, haptic sensors, and so on.

[0032] The controller 132c can also lock the dock using the lock 207. The controller 132c can control the lock/unlock the door of the dock, based on the results of the authentication or on receiving an instruction from a remote entity

(such as a user device, a server, and so on). Based on a combination of conditions and lock sensing, the controller 132c can determine unauthorized opening of the dock door, and generate theft/abuse alarms and indications.

[0033] The controller 132c can also control and manage one or more thermal elements 206 present in the DIU 132 or the dock to regulate the temperature for a battery present in the dock, under different conditions of usage. In an embodiment, the thermal elements can be controlled by using at least one thermal management mode. Examples of the thermal management mode can be, but not limited to, heat sinks, heat dissipaters, thermal insulation layers to 'thermally isolate' the batteries from the ambient, active heating or cooling devices like thermoelectric devices, fluid circulation loop, vapour compression, gel packs or other phase change materials. In an embodiment herein, the dock 10 can comprise a means for providing thermal insulation from ambient conditions.

[0034] The controller 132c can control one or more other docks, which are present in the external entity. The dock in which the controller 132c and the other docks can be in a master-slave relationship respectively. The controller 132c can identify and authenticate batteries present in the dock or other docks connected to it. The controller 132c can use an identification means present in the battery and information received from a control system and/or user for identification and authentication.

[0035] The controller 132c can regulate the flow of power from the battery present in the dock or other docks connected to it. This can depend on factors such as State of Charge (SOC) of one or more batteries present in the dock or other docks connected to it, user history, predicted usage, and so on.

[0036] The controller 132c can comprise protection means to protect the DIU 132 from overcurrent/overload conditions. In an embodiment, the controller 132c protects the DIU by limiting the speed of the vehicle. The controller 132c can also protect one or more docks connected to it, from overcurrent/overload conditions. In an embodiment, the controller 132c can control the vehicle power modes and can switch between high, medium and low mode of power operation.

[0037] The controller 132c can determine the remaining SOC of the battery present in the dock 10 and batteries present in docks connected to it (if any). On determining that the SOC is below a pre-defined threshold, the controller 132c can provide an indication to the user.

[0038] In an embodiment, figure 3 depicts the sloping to assist the alignment of the battery. Figures 4a-4c are the example views of the dock containing one, two, and three batteries respectively.

[0039] In operation, the dock is placed inside the external object at a predetermined location. A battery is inserted in the dock. The presence of the dock inside the object and the presence of the battery inside the dock is detected through the interface 132i of the DIU 132. On detecting that a battery has been inserted into the dock, the controller 132c can power up the DIU 132. Further, the DIU 132 provides power to the at least one external entity, on detecting that the vehicle has been turned on.

[0040] The embodiments disclosed herein can be implemented through at least one software program running on at least one hardware device and performing network management functions to control the network elements. The network elements shown in FIG. 2 include blocks which can be at least one of a hardware device, or a combination of hardware device and software module.

[0041] The embodiment disclosed herein describes a docking enclosure for a battery and a control unit for a dock (which can contain a battery) interfacing with external entities (such as a device being powered by the battery, the battery, other batteries, and so on). Therefore, it is understood that the scope of the protection is extended to such a program and in addition to a computer readable means having a message therein, such computer readable storage means contain program code means for implementation of one or more steps of the method, when the program runs on a server or mobile device or any suitable programmable device. The method is implemented in at least one embodiment through or together with a software program written in e.g. Very highspeed integrated circuit Hardware Description Language (VHDL) another programming

language, or implemented by one or more VHDL or several software modules being executed on at least one hardware device. The hardware device can be any kind of portable device that can be programmed. The device may also include means which could be e.g. hardware means like e.g. an ASIC, or a combination of hardware and software means, e.g. an ASIC and an FPGA, or at least one microprocessor and at least one memory with software modules located therein. The method embodiments described herein could be implemented partly in hardware and partly in software. Alternatively, the invention may be implemented on different hardware devices, e.g. using a plurality of CPUs.

[0042] The foregoing description of the specific embodiments will so fully reveal the general nature of the embodiments herein that others can, by applying current knowledge, readily modify and/or adapt for various applications such specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein have been described in terms of embodiments, those skilled in the art will recognize that the embodiments herein can be practiced with modification within the spirit and scope of the embodiments as described herein.

CLAIMS

1. A dock comprising:

a lid;

a body; and

a base, wherein the base comprises a Dock Interface Unit (DIU),

wherein,

the lid is adapted to close an opening defined on a first side of the body;

the body defines a plurality of mounting points; and

the DIU comprises:

a controller, wherein the controller is configured to power up the DIU on determining that a battery has been inserted into the dock using at least one of: a hall effect sensor and one or more mounting magnets;

a transceiver;

a DC-DC converter;

a throttle control circuit;

at least one interface, wherein the at least one interface is configured to perform one or more of the following:

communicate with at least one external object using one or more communication ports;

provide a swappable electrical connection with the battery inserted in the dock;

provide a fixed electrical connection to the at least one external object; and

a filtering circuit, wherein the filtering circuit is configured to filter out any interference or noise in a signal received by the at least one interface from the at least one external object.

2. The dock as claimed in claim 1, wherein the plurality of mounting points provided on the body can secure the dock to the at least one external object.
3. The dock as claimed in claim 2, wherein the base defines a cavity and a plurality of mounting points.
4. The dock (10) as claimed in claim 3, wherein the base is adapted to close an opening defined on a second side of the body.
5. The dock as claimed in claim 4, wherein each of the mounting points provided on the base is adapted to secure the dock to the at least one external object.
6. The dock as claimed in claim 5, wherein the at least one interface of the DIU is adapted to detect the presence of the dock inside the at least one external object and the presence of the battery inside the dock using a plurality of magnetic sensors and a plurality of protocols.
7. The dock as claimed in claim 6, wherein the filtering circuit of the DIU can filter out any interference or noise in received signals using at least one of a low pass filter and a high pass filter.
8. The dock as claimed in claim 7, wherein the controller can control at least one thermal element in the DIU based on at least one thermal management mode.
9. The dock as claimed in claim 8, wherein the controller can delay providing power to least one auxiliary present in the at least one external object, wherein the delay is provided when the at least one external object is authenticated, and a key switch is turned on.

10. The dock as claimed in claim 9, wherein the controller can initiate a pre-charge action to charge an input capacitance based on at least one on/off cycle of the key switch and the battery insertion into the at least one external object.
11. The dock as claimed in claim 10, wherein the controller controls a lock, wherein the lock can be used for securing the battery present in the dock.
12. The dock as claimed in claim 11, wherein the controller is further configured to regulate the flow of power from the battery to or from the at least one external object based on at least one of a State of Charge (SOC), a user history, and a predicted usage.
13. The dock as claimed in claim 12, wherein the controller can protect the DIU from at least one overload condition by limiting the speed of the at least one external object.
14. The dock as claimed in claim 13, wherein the controller can control the mode of power operation of the at least one external object.