POWER OPERATED ELECTRIC TOOTHBRUSH

Exemplary embodiments of the present invention are directed towards a power operated electric toothbrush. The toothbrush includes detachable bristles configured to be attached to a front portion of the toothbrush through a predefined locking mechanism to enable an oscillo-vibratory motion of the bristles, an intraoral camera positioned above the detachable bristles to capture the images of the teeth, a first detachable configuration including the intraoral camera and an illuminating means for mounting on to the toothbrush handle and a second detachable configuration including the intraoral camera, an illuminating means and the detachable bristles for mounting onto the toothbrush handle. The toothbrush further includes an external water duct with a detachable locking mechanism for removing plaque and debris caught between the teeth utilizing an irrigation mechanism, a conduit positioned at a rear portion of the bristle driving means including a momentary switch to perform a pressure sensing activity.
POWER OPERATED ELECTRIC TOOTHBRUSH

Technical Field of the Invention

[001] The present invention generally relates to the field of electric toothbrush. More particularly the present invention relates to a power operated electric toothbrush comprising an image capturing mechanism, a plaque detecting mechanism, a detachable bristle mechanism, an external irrigating mechanism, an enhanced pressure sensing mechanism, a data transmission mechanism and the like.

Background of the Invention

[002] Generally, a toothbrush is essential to maintain a good oral hygiene. With an improved technology, several electric toothbrushes came into existence to overcome the problems associated with manual toothbrushes.

[003] The electric toothbrushes are more efficient than manual toothbrushes and are widely gaining popularity in today's automated world by the usage of general public for their convenience in busy lifestyle. As a result, different electric toothbrushes have evolved with a variety of driving mechanisms and driving methods with the aim of removing plaque. Oral irrigators also came into existence to effectively remove the plaque and debris caught between the teeth and in the gum line. However, many of them suffer from complexity of design, cleaning inefficiency, inefficiency in operation and none of the existing toothbrush provides a user-feedback mechanism.

[004] Additionally, it is essential to monitor the amount of pressure being applied on the teeth during brushing because applying excess pressure results in tissue abrasion and damage to the teeth. Thus the existing electric toothbrush designs are provided with pressure sensors to warn the users applying excessive force on the teeth. Moreover, pressure sensors are operated on the basis of cleaning force threshold level which is set at a time of the manufacture. However, the different electric toothbrush designs employ different threshold levels for the cleaning force which is undesirable.

[005] Further, one particular model of electric toothbrush is also provided with an independent video scope positioned behind the toothbrush bristles, which forms an image by converting the light formed from an object through a CCD unit and transmits the picked up image to the display unit. The video scope used is having more complexity in design with very low practical feasibility in
usage. The position of the sensor relative to the bristles will make it practically difficult or impossible to efficiently brush the teeth. In another model of toothbrush the position of the image sensor will make it practically difficult to motorise the bristle movement.

[006] Conventionally, the existing electric toothbrushes are ineffective in providing an efficient cleaning of the teeth and a better handling as the user does not know where to brush and how much to brush. None of the existing electric toothbrushes facilitate a user to efficiently brush while simultaneously capturing the image, transmitting the captured image, and check the health status of teeth by providing different capturing means and transmitting means. But the available technology exhibits a tendency towards increasingly complex, expensive, and non-commercially feasible methods to achieve the electric toothbrush design with an effective cleaning mechanism, an efficient pressure sensing mechanism and accurate capturing and transmitting mechanism. Thus the existing electric toothbrush designs include several inherent disadvantages which substantially impair their ability to solve the problem of effective cleaning and ability to check the health status of the teeth in a practical and economical way.

[007] In the light of aforementioned discussion, there exists a need for a safe, economical, convenient power operated electric toothbrush with an effective tooth brushing and irrigating action and further enabling the user to check the health status of the teeth by strategically positioning a camera relative to the bristles and having a special illuminating source to fluoresce the plaque using ultraviolet (UV) or blue light which is otherwise invisible to help in targeted brushing. In the present invention we disclose two designs of the camera toothbrush one that has a detachable camera and the other where the camera is fixed to the toothbrush. The presence of illuminating source on the toothbrush also enables this toothbrush to perform an additional function of bleaching when combined with a special bristle movement customised for this purpose. Also having the pressure sensor at the first point of contact of bristles with the teeth significantly improves the sensitivity of pressure sensing mechanism.

**Brief Summary of the Invention**

[008] The following presents a simplified summary of the disclosure in order to provide a basic understanding to the reader. This summary is not an extensive overview of the disclosure and it does not identify key/critical elements of the invention or delineate the scope of the invention. Its sole purpose is to present some concepts disclosed herein in a simplified form as a prelude to the more detailed description that is presented later.
[009] A more complete appreciation of the present invention and the scope thereof can be obtained from the accompanying drawings which are briefly summarized below and the following detailed description of the presently preferred embodiments.

[0010] A power operated electric toothbrush is disclosed. According to a first aspect, the power operated electric toothbrush includes detachable bristles fastened to a bristle driving means configured to be attached to a front portion of the toothbrush through a predefined locking mechanism. The bristle driving means enable an oscillo-vibratory motion to detachable bristles. The predefined locking mechanism associated with the bristle driving means may include but not limited to a friction grip mechanism and a spring lock mechanism. Further the power operated electric toothbrush includes a wheel-axle assembly or a gear mechanism to enable an oscillation of the bristle driving means.

[0011] According to the first aspect, the power operated electric toothbrush includes an intraoral camera including a detachable fastening means to be engaged with the toothbrush and positioned above the detachable bristles to capture the images of the teeth for enabling a targeted brushing and to detect and illuminate the plaque. The illuminating means may include but not limited to ultraviolet or blue light and white light emitting diodes. Further the images captured by the intraoral camera are configured to be displayed over WiFi enabled network devices and/or short range communication network enabled network devices. The external base station includes a transmitter configured to receive the images captured by the intraoral camera and transmit to the WiFi enabled network device and/or short range communication network enabled network device.

[0012] According to the first aspect, the power operated electric toothbrush includes a first detachable configuration including the intraoral camera and an illuminating means for mounting on to the toothbrush handle.

[0013] According to the first aspect, the power operated electric toothbrush includes a second detachable configuration including the intraoral camera, an illuminating means and the detachable bristles for mounting onto the toothbrush handle.

[0014] According to the first aspect, the power operated electric toothbrush includes an external water duct including a detachable locking mechanism to be locked with the toothbrush configured
to be used in conjunction with the intraoral camera by replacing the bristles for removing plaque and debris caught between the teeth utilizing an irrigation mechanism.

[0015] According to the first aspect, the power operated electric toothbrush includes a conduit positioned at a rear portion of the bristle driving means including a momentary switch to perform a pressure sensing activity. An excess pressure applied on the teeth generates an alert through a visual warning means and an audio alerting means coupled to the conduit. The power operated electric toothbrush further includes a wireless module configured to communicate with an external transceiver for transmitting a data related images captured by the intraoral camera, an application of the excess pressure on the teeth and a brushing duration.

[0016] According to the first aspect, the power operated electric toothbrush includes an artificial intelligence mechanism for enabling a targeted brushing on capturing the images by the intraoral camera.

[0017] According to the first aspect, the system includes a first switch positioned at the front portion of a toothbrush handle to activate and deactivate a power supply to the motor, a second switch positioned at the front portion for configuring a lowest possible operating speed of the motor and to perform a bleaching action while activating the plurality of illuminating means, a third switch positioned at the front portion to activate and deactivate the main power supply, a fourth switch positioned at the back portion to activate the plurality of white light emitting diodes for capturing the video of the teeth, a fifth switch positioned at the back portion and beside the fourth switch to activate the ultraviolet or blue light for capturing the video of the teeth.

[0018] According to the first aspect, the power operated electric toothbrush includes first indicating means positioned at the bottom to indicate a charging state and a second indicating means at the bottom to indicate a presence of power.

[0019] According to a second aspect, a power operated electric toothbrush includes detachable bristles fastened to a bristle driving means configured to be attached to a front portion of the toothbrush through a predefined locking mechanism. The bristle driving means enable an oscillo-vibratory motion to the plurality of bristles. The predefined locking mechanism associated with engaging the plurality of bristles to the bristle driving means may include but not limited to a friction grip mechanism and a spring lock mechanism. Further the power operated electric
toothbrush includes a wheel-axle assembly or a gear mechanism to enable an oscillation of the bristle driving means.

[0020] According to the second aspect, the power operated electric toothbrush includes an intraoral camera engaged with the toothbrush and positioned above the detachable bristles to capture the images of the teeth for enabling a targeted brushing and to detect and illuminate the plaque. The illuminating means may include but not limited to an ultraviolet light or blue light and white light emitting diodes. Further the images captured by the intraoral camera are configured to be displayed over the WiFi enabled network devices and/or short range communication network enabled network devices. The power operated electric toothbrush further includes an external base station including a transmitter configured to receive the images captured by the intraoral camera and transmit to the WiFi enabled network device and the short range communication network enabled network device. The images captured by the intraoral camera are configured to be displayed on a screen attached to the external base station. The power operated electric toothbrush further includes an artificial intelligence means and an image recognition means embedded in the base station configured to detect the plaque and to control the motor driving the detachable bristles for the removal of plaque.

[0021] According to the second aspect, the power operated electric toothbrush discloses an external water duct including a detachable locking mechanism to be locked with the toothbrush for removing plaque and debris caught between the teeth utilizing an irrigation mechanism.

[0022] According to the second aspect, the power operated electric toothbrush discloses a conduit positioned at a rear portion of the bristle driving means including a momentary switch to perform a pressure sensing activity. An excess pressure applied on the teeth generates an alert through a visual warning means and an audio alerting means coupled to the conduit. The power operated electric toothbrush further includes a wireless module configured to communicate with an external transceiver for transmitting a data related to a plurality of images captured by the intraoral camera, an application of the excess pressure on the teeth and a brushing duration.

[0023] According to the second aspect the power operated electric toothbrush discloses a first switch positioned at a front portion to activate and deactivate a motor and to increase an operating speed of the motor, a second switch positioned at the front portion for configuring a lowest possible operating speed of the motor and to perform a bleaching action while activating the illuminating
means, a third switch positioned at the front portion to activate and deactivate a main power supply, a fourth switch positioned at the back portion to activate the plurality of white LEDs for capturing a video of the teeth and a fifth switch positioned at the back portion and beside the fourth switch to activate the ultraviolet or blue light for capturing a video of the teeth.

[0024] According to the second aspect, the power operated electric toothbrush includes a first indicating means positioned at the bottom to indicate a charging state and second indicating means at the bottom to indicate a presence of power.

**Brief Description of the Drawings**

[0025] FIG. 1 is a diagram depicting a design of detachable camera version of the toothbrush with a combination of a toothbrush handle, a brush attachment, a camera attachment and a camera attachment with detachable bristles.

[0026] FIG. 2 is a diagram depicting a combination of an interfaced toothbrush handle with a camera attachment with detachable bristles, an interfaced toothbrush handle with a camera attachment and an interfaced toothbrush handle with a brush attachment.

[0027] FIG. 3 is a diagram depicting a combination of a male electrical connector on camera attachment and a female electrical connector on a toothbrush handle and the configuration of operating switches on the toothbrush handle with the shaft on the toothbrush handle that is connected to the motor to oscillate the bristles can also be seen.

[0028] FIG. 4 is a diagram depicting a rear view of a detachable camera version of a toothbrush.

[0029] FIG. 5 is a diagram depicting a combination of electronic components embedded within a camera attachment.

[0030] FIG. 6 is a diagram depicting a perspective view of another design of a toothbrush with a non-detachable camera with bristle attachment.

[0031] FIG. 7 is a front view of the non-detachable camera version of a toothbrush with an external water duct replacing the bristles.
[0032] FIG. 8 is a diagram depicting a rear view of a non-detachable camera version of a power operated electric toothbrush.

[0033] FIG. 9 is a diagram depicting an overview of assembling a camera and LED over power circuit board of the toothbrush and also depicts the arrangement of LEDs around the camera.

[0034] FIG. 10 is a diagram depicting a mechanism of detachable bristles.

[0035] FIG. 11 is a diagram depicting internal embodiments of a non-detachable camera version of a power operated electric toothbrush.

[0036] FIG. 12a is a diagram depicting a perspective view of an externally connected water duct replacing the bristles with detachable lock.

[0037] FIG. 12b is a diagram depicting a rear view of an externally connected detachable lock for the water duct.

[0038] FIG. 13 is a diagram depicting a pressure sensing mechanism of a power operated electric toothbrush.

[0039] FIG. 14 is a diagram depicting an external transceiver module.

[0040] FIG. 15 is a diagram depicting an external base station for WiFi enabled devices.

**Detailed Description of the Invention**

[0041] It is to be understood that the present disclosure is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the drawings. The present disclosure is capable of other embodiments and of being practised or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

[0042] The use of "including", "comprising" or "having" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. The terms
"a" and "an" herein do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced item. Further, the use of terms "first", "second", and "third", and the like, herein do not denote any order, quantity, or importance, but rather are used to distinguish one element from another. For a better understanding, components of the described embodiment are labelled with three digit component numbers. In general, the same first digit is used throughout the entire component numbers numbered and labelled within a figure. Like components are designated by like reference numerals throughout the various figures.

[0043] Referring to FIG. 1 is a diagram 100 depicting a design of detachable camera version of the toothbrush with a combination of a toothbrush handle, a brush attachment, a camera attachment and a camera attachment with detachable bristles. According to a non-limiting exemplary embodiment of the present invention, the design of the power operated electric toothbrush of the present invention enables a user to effectively perform functions including brushing by applying sufficient pressure in conjunction with irrigating the teeth. The toothbrush also configured to capture the images and transmit the captured images and other data related to the teeth to a remote monitoring means also known as a base station. The design depicts a toothbrush handle 102, an interface 104 connecting the toothbrush handle and a camera attachment 106, a brush attachment 108 and an intraoral camera attachment with detachable bristles 110.

[0044] In accordance with a non-limiting exemplary embodiment of the present invention, the power operated electric toothbrush includes a toothbrush handle 102 used for securing different attachments to perform the user desired functionalities. The toothbrush handle 102 may include multiple switches to operate user desired functionalities. The toothbrush handle 102 further includes an interface 104 connecting the toothbrush handle 102 and a detachable intraoral camera attachment 106 to perform the respective camera operations by operating the switches (described in FIG. 3) provided on the toothbrush handle 102. The detachable intraoral camera attachment 106 and an intraoral camera attachment with detachable bristles 110 included in the design further comprises a camera light emitting diode (LED) assembly positioned at the top to illuminate the area while capturing the images of the teeth.

[0045] According to a non-limiting exemplary aspect of the present invention, the design further includes an exclusive dedicated camera attachment without bristles 106 which help in using an image sensor of larger size but not limited to ¼ inch sensors which would cover a wider field of view. The dedicated camera attachment 106 further comprises an ultraviolet (UV)/Blue LEDs 106a
to illuminate the plaque, white LEDs 106b to capture the images of teeth and an opening of camera lens 106c. The captured images are further transmitted to the remote base station to detect the plaque, intraoral areas with bacterial colonization, dental caries and the like abnormalities associated with the teeth. The detachable intraoral camera attachment 106 is mounted on the toothbrush handle 102 with an interface 104.

[0046] In accordance with a non-limiting exemplary embodiment of the present invention, a standard brush attachment 108 is also included in the design which includes a multiple of bristles positioned at the top of the toothbrush required for brushing. Similarly another attachment 110 including a camera with the detachable bristles is used to aid the user in assisted brushing by visualising the problematic areas of teeth and helps the user accordingly in brushing. Thus the image sensor included in the camera is of a smaller size of typically 1/16th inch to accommodate the bristles. Further the detachable bristles design enables to replace the bristles after the end of its life or to replace the bristles with an external water duct (not shown) to perform an oral irrigation mechanism using the camera.

[0047] The artificial intelligence or image recognition technology may be embedded in the toothbrush or in external base station which can process the images captured to detect the plaque and in turn control the motor of the detachable bristle to operate until the plaque has been removed.

[0048] Referring to FIG. 2 is a diagram 200 depicting a combination of an interfaced toothbrush handle with a camera attachment with detachable bristles, an interfaced toothbrush handle with a camera attachment and an interfaced toothbrush handle with a brush attachment. According to a non-limiting exemplary embodiments of the present invention, the toothbrush includes a toothbrush handle 202 assembled with an intraoral camera with detachable bristle attachment 208, an intraoral camera attachment 204 and a brush attachment 206.

[0049] In accordance with a non-limiting exemplary embodiment of the present invention, the toothbrush handle 202 interfaces with a camera attachment 204 to form an assembled toothbrush with an intraoral camera for capturing the images of the teeth. The detachable intraoral camera attachment 204 further comprises a camera-LED assembly positioned at the top to illuminate the
brushing area while capturing the images of the teeth and its surrounding structures. The captured images are further transmitted to the external base station to detect the plaque, intraoral areas with bacterial colonization, dental caries and the like abnormalities associated with the teeth and intraoral tissues. The standard brush attachment 206 interfaces with a toothbrush handle 202 to form an assembled brush. Further the intraoral camera with detachable bristle attachment 208 comprises a camera-LED assembly with detachable bristles positioned at the top of the toothbrush to move the detachable bristles to the portions of the teeth required for brushing accordingly.

[0050] Referring to FIG. 3 is a diagram 300 depicting a combination of a male electrical connector on camera attachment and a female electrical connector on a toothbrush handle and the configuration of operating switches on a toothbrush handle with the shaft on the toothbrush handle that is connected to the motor to oscillate the bristles can also be seen. According to a non-limiting exemplary embodiment of the present invention, the female connector 302 mounted over the toothbrush handle, a male connector 304 mounted below a detachable intraoral camera attachment and also the detachable camera attachment with detachable bristles, a shaft 306 to oscillate the bristles, a toothbrush handle 308, a motor control switch 310, a bleaching action switch 312, a main power switch 318, LED indicators 314 and 316.

[0051] In accordance with a non-limiting exemplary embodiment of the present invention, the female connector 302 mounted on the toothbrush handle. The female connector 302 is used to transfer the power stored in the battery to the embodiments present in the male connector 304. This interface can also be used to connect other electronic circuit between the toothbrush handle and the camera attachment by providing additional leads. The male connector 304 mounted below a detachable intraoral camera attachment establishes a connection with the female connector 302 and gets activated to perform its respective image capturing functionalities. The male connector 304 mounted below the detachable intraoral camera attachment receives the power from female connector 302 and activates the detachable intraoral camera to capture the images of the tooth. The male connector 304 and female connector 302 can be interchanged, and have provision to isolate the exposed leads from contact with water or through physical contact. The shaft 306 is connected to the motor of the toothbrush handle to drive the bristles in an oscillatory motion.
[0052] According to a non-limiting exemplary embodiments of the present invention, the system further includes a toothbrush handle 308 included with a motor control switch 310 and a camera control switch 312. The motor control switch 310 positioned on the handle of the toothbrush 308 is used to operate the functionality of a motor by switching on the motor to perform the respective functionality of that switch. The motor control switch 310 is activated to switch on and off the motor of the toothbrush and to control the speed of motor to high or low. The switch 312 positioned at the front portion and below the switch 310 of the toothbrush is to perform the bleaching mode action on the teeth by applying bleaching agent when the LEDs are switched on and the toothbrush motor is at a very lowest possible speed for oscillating the detachable bristles in a slow motion. The main power switch 318 is positioned in the front to activate the main power supply to the embodiments of the toothbrush. The toothbrush further includes LED indicator 314 positioned at the bottom of the toothbrush to indicate a charging state and another LED indicator 316 positioned at the bottom of the toothbrush to indicate a presence of power. The power lead mounted internally in the toothbrush is used to transfer the power to the detachable intraoral camera attached in the upper part of the toothbrush to capture the images of the tooth.

[0053] Referring to FIG. 4 is a diagram 400 depicting a rear view of the detachable camera version of the toothbrush. According to a non-limiting exemplary embodiment of the present invention the toothbrush includes switches 404 and 406 positioned at the rear portion of the toothbrush.

[0054] In accordance with a non-limiting exemplary embodiment of the present invention, the switch 404 positioned at the rear portion of the power operated electric toothbrush to activate the multiple white LEDs for capturing the video of the teeth. Similarly switch 406 positioned at the rear portion of the power operated electric toothbrush is used to activate the UV/blue light for capturing the video of the teeth. The UV/blue light used for capturing the video of the teeth is switched on only for 30 seconds and later switches on the white LEDs. The UV/blue light is specifically used to easily detect plaque on the teeth.

[0055] Referring to FIG. 5 is a diagram 500 depicting a combination of electronic components embedded within a camera attachment. According to a non-limiting exemplary embodiment of the
present invention, the toothbrush camera attachment includes a lens, an image sensor and a LED assembly 502, an intraoral camera module 504 and a wireless module 506.

[0056] In accordance with a non-limiting exemplary embodiment of the present invention, the detachable intraoral camera attachment includes a lens, an image sensor and a LED assembly 502 to capture the images of the teeth. The image sensor may include but not limited to a CMOS sensor, a CCD sensor or any other image sensor used to form an image by converting the light formed from an object i.e., by converting the optical image into electronic signals. The camera image sensor is separated from the power circuit board (PCB) to minimize the space at the sensor site. The lens and LED assembly 502 is used for capturing the images in the presence of different illuminating sources. The LEDs included around the lens are white LEDs and UV/blue LEDs. These LEDs are activated when their respective switches are used for capturing the images and the UV/blue LEDs illuminates the plaque and aid the user in assisted brushing. The UV/blue LEDs are activated only for a period of 30 seconds and switches back to the white LEDs to further illuminate the light source. According to a non-limiting exemplary embodiments of the present invention, the detachable intraoral camera attachment further includes an intraoral camera module 504 positioned below the lens and LED assembly 502 to capture the images of the tooth. The captured images are further transferred to the external base station or an external transceiver module through a wireless communication module 506 included using a short range communication network. Further the short range communication network may include but not limited to a Bluetooth network, a radio frequency network, a zigbee network and the like. As an alternative arrangement, the camera PCB and wireless transmitter can also be placed in the body of the toothbrush handle which is further connected with the image sensor in the attachment by connecting interface between the toothbrush handle and camera attachment.

[0057] Referring to FIG. 6 is a diagram 600 depicting a perspective view of another design of toothbrush with a non-detachable camera with bristle attachment. According to a non-limiting exemplary embodiment of the present invention, the system includes switch 602, switch 604 and switch 606 to perform the predetermined functions. The toothbrush further includes detachable bristles 608, LED indicators 612, 614 and a camera-LED assembly 610 fixed to the toothbrush.

[0058] In accordance with a non-limiting exemplary embodiment of the present invention, the
switch 602 positioned at the front portion of the toothbrush is a motor control switch which is used to activate and deactivate the toothbrush motor and to increase or decrease the speed of the toothbrush motor. The switch 604 positioned at the front portion and below the switch 602 of the toothbrush is to perform the bleaching mode action on the teeth by applying bleaching agent when the plurality of LEDs are switched on and the toothbrush motor is at a very lowest possible speed for oscillating the detachable bristles. Similarly the third switch 606 positioned at the front portion of the toothbrush is used to activate and deactivate the main power supplied to the toothbrush.

[0059] According to a non-limiting exemplary embodiments of the present invention, the toothbrush further includes a non-detachable camera 610 positioned above the detachable bristles 608 to capture the images of the teeth and to aid the user in assisted brushing. The captured images are further transmitted to the external base station to detect the plaque, intraoral areas with bacterial colonization, dental caries and the like abnormalities associated with the teeth. The power operated electric toothbrush includes LED indicators 612 and 614 positioned at the bottom front portion of the toothbrush. The LED indicators 612 indicates when the toothbrush is in charging mode represent the presence of power and the LED indicator 614 positioned at the bottom of the toothbrush is to indicate the presence of power. The power operated electric toothbrush further includes a camera-LED assembly 610 positioned above the detachable bristles 608 of the toothbrush which is effectively sealed with a transparent or visible covering and the like.

[0060] In accordance with a non-limiting exemplary embodiment of the present invention, the camera-LED assembly 610 is fixed in a particular angle for capturing the images of the teeth along with the tip of the detachable bristles. This will aid the user in assisted brushing for transmitting the captured images to the external base station or external transceiver module to detect the plaque, intraoral areas with bacterial colonization, dental caries and the like abnormalities associated with the teeth. The power operated electric toothbrush further includes a miniature camera 1/8th inch of a CMOS sensor to form an image by converting the light formed from an object i.e., by converting the optical image into electronic signals. The toothbrush includes a wireless communication module for connecting the toothbrush to display devices which includes a personal computer, a mobile device, a personal digital assistance and the like. The data captured by the toothbrush is transmitted to the external transceiver module or external base station through a wireless communication mode using a short range communication network. Further the short range communication network includes a Bluetooth network, a radio frequency network, WiFi network, a zigbee network and the
like. The data can be transferred to the display unit by connecting the external transceiver module with the display unit through an AV pin or USB or an external base station for smart phones or other wireless devices.

[0061] The artificial intelligence or image recognition technology can be embedded in the toothbrush or in external base station which can process the images captured to detect the plaque and in turn control the motor of the detachable bristle to operate until the plaque has been removed.

[0062] Referring to FIG. 7 is a front view 700 of the non-detachable camera version of a toothbrush with an external water duct replacing the bristles. According to a non-limiting exemplary embodiment of the present invention, the power operated electric toothbrush further includes a camera-LED assembly 712 positioned above the detachable water duct of the toothbrush which is effectively sealed with a transparent or visible covering and the like.

[0063] In accordance with a non-limiting exemplary embodiment of the present invention, the design of the power operated electric toothbrush of the present invention enables the user to effectively perform oral irrigating function, capturing the images and transmitting the data related to the teeth and surrounding tissues to a remote monitoring means. The user attaches the external water duct 710 to the toothbrush from an external water tank 716 by removing the detachable bristles. The system further includes switch 702, switch 704 and switch 706 to perform the predetermined functions. The toothbrush also includes a camera-LED assembly 712 and LED indicators 708 and 714 fixed to the toothbrush.

[0064] In accordance with a non-limiting exemplary embodiment of the present invention, the switch 702 positioned at the front portion of the toothbrush is used to activate and deactivate the toothbrush motor and to increase or decrease the speed levels of the toothbrush motor. The switch 704 positioned at the front portion and below the switch 702 of the toothbrush performs the bleaching mode action on the teeth by applying bleaching agent when all the LEDs are switched on and the toothbrush motor is at a very lowest possible speed for oscillating the detachable bristles in a slow motion. However, the brushing and/or bleaching functions can not be performed when the water duct 710 is attached. Switch 706 positioned at the front portion of the toothbrush is used to activate and deactivate the main power supplied to the toothbrush.
According to a non-limiting exemplary embodiments of the present invention, the non-detachable camera 712 positioned above the detachable water duct 710 is used to capture the images of the teeth and aid the user in assisted oral irrigation. The indicator 708 indicates when the toothbrush is in charging mode and another indicator 714 to provide an indication to represent the presence of power.

In accordance with a non-limiting exemplary embodiment of the present invention, the camera-LED assembly 712 is fixed in a particular angle for capturing the images of the teeth along with the tip of the detachable water duct. This will aid the user in assisted oral irrigation by transmitting the captured images to the remote monitoring means to detect the plaque, intraoral areas with bacterial colonization, dental caries and the like abnormalities associated with the teeth. The power operated electric toothbrush further includes a miniature camera 1/8th inch of a CMOS sensor to form an image by converting the light formed from an object i.e., by converting the optical image into electronic signals. The power operated electric toothbrush further includes an external water duct 710 which can be detachably locked to perform an irrigation mechanism to effectively reach and remove the plaque and debris caught between the teeth, in gum line and the like. The irrigation mechanism is activated to supply the water from the external water tank 716 to the teeth through an external water duct 710 which can be detachably locked. The toothbrush includes a wireless communication module for connecting the toothbrush to display devices which includes a personal computer, a mobile device, a personal digital assistance and the like. The data captured by the toothbrush is transmitted to the external transceiver module or external base station through a wireless communication mode using a short range communication network. The data can be transferred to the display unit by connecting the external transceiver module with the display unit through an AV pin or USB or an external base station for smart phones and other wireless devices.

Referring to FIG. 8 is a diagram 800 depicting a rear view of a non-detachable camera version of a power operated electric toothbrush. According to a non-limiting exemplary embodiment of the present invention, the rear view of the power operated electric toothbrush depicts switch 802 and switch 804 to perform the predetermined functionalities of the switches.

In accordance with a non-limiting exemplary embodiment of the present invention, switch 802 positioned at the rear portion of a power operated electric toothbrush is used to operate the video capturing mode of an intraoral camera positioned above the detachable bristles of the toothbrush when all the white LEDs are switched on. Similarly the switch 804 positioned at the rear
portion of a power operated electric toothbrush and switch 802 is also used to activate the UV/blue light for capturing the video of the teeth by switching on the video mode of an intraoral camera positioned above the detachable bristles of the toothbrush. The UV/blue light is specifically used to illuminate plaque which is easily detectable. The UV/blue light used for capturing the video through an intraoral camera is switched on only for 30 seconds and later switches on the white LEDs for further capturing the video.

[0069] Referring to FIG. 9 is a diagram 900 depicting an overview of assembling a camera and LED over PCB of the toothbrush and also depicts the arrangement of LEDs around the camera. According to a non-limiting exemplary embodiment of the present invention, the power operated electric toothbrush includes LEDs assembled over a PCB 902 is sealed with a transparent or visible cover 904. The LED assembly 906 comprises white LEDs 908 and UV/blue LEDs 910 placed around the camera lens opening 912.

[0070] In accordance with a non-limiting exemplary embodiment of the present invention, the intraoral camera positioned above the detachable bristles of the toothbrush further comprises a set of LEDs placed over a PCB 902 which are used in different modes of operation. The camera-LED assembly 906 positioned over the PCB 902 further comprises four white LEDs 908 used for a normal mode of operation, and four UV/blue LEDs 910 used for critical examination mode of operation and the like operating modes are placed around the opening of a camera lens 912. The LEDs assembled over the PCB 902 and the intraoral camera are efficiently sealed with a transparent covering 904 providing adequate waterproof. The white LEDs 908 placed around the opening of a camera lens 912 on the camera-LED assembly 906 are used to capture the images of the teeth and similarly the UV/blue LEDs placed around the opening of a camera lens 912 on the camera-LED assembly 906 are used to fluoresce the plaque.

[0071] Referring to FIG. 10 is a diagram 1000 depicting a mechanism of detachable bristles. According to a non-limiting exemplary embodiment of the present invention, the power operated electric toothbrush includes the detachable bristles 1006 positioned over a bristle driver 1008 which can be replaceable through a locking mechanisms including but not limited to a friction grip 1002 or a spring lock 1004. This design can also be used with the other design comprising the detachable camera attachment with detachable bristles.

[0072] In accordance with a non-limiting exemplary embodiment of the present invention, the detachable bristles 1006 are positioned over the bristle driver 1008 in the front portion of the
toothbrush. The detachable bristles 1006 can be replaceable through a friction grip 1002 or a spring lock 1004 mechanism. The friction grip 1002 or the spring lock 1004 when placed at the bottom of the detachable bristles 1006 are used to lock the detachable bristles attachment 1006 by the bristle driving means 1008 for not allowing the detachable bristles 1006 to move in any axial direction. The friction grip 1002 and the spring lock 1004 are further used to enable the detachable bristle attachment to oscillo-vibrate in horizontal axis by the oscillo-vibration of the bristle driving means through a rotary mechanism employing either a wheel-axle design or a gear mechanism.

[0073] Referring to FIG. 11 is a diagram 1100 depicting internal embodiments of a non-detachable camera version of a power operated electric toothbrush. According to a non-limiting exemplary embodiment of the present invention, the power operated electric toothbrush includes LED indicator 1102 and another LED indicator 1104 placed over a PCB 1108, a secondary coil 1106 positioned below the battery 1110 and a motor 1112.

[0074] In accordance with a non-limiting exemplary embodiment of the present invention, the power operated electric toothbrush including a PCB 1108 is positioned internally below the front portion of toothbrush and above the rear portion of toothbrush. The PCB 1108 is used to mechanically support and electrically connect the electronic components included in the toothbrush for forming a pathway to transfer the electricity for activating all the several small components. The LEDs 1104 and 1102 are assembled over a PCB 1108 to indicate their specific operation. The LED 1102 indicates that the toothbrush is in charging condition and the LED 1104 indicates the presence of power in toothbrush. The power operated electric toothbrush further includes a battery 1110 to be charged using induction charging by placing the toothbrush in an external base station with a primary coil. The battery 1110 is charged by the secondary coil 1106 positioned below the battery.

[0075] According to a non-limiting exemplary embodiment of the present invention, the battery 1110 included in the power operated electric toothbrush stores the power while the toothbrush is in charging condition and the stored power means can be used by the user by switching on the third switch 1118 which is used to activate and deactivate the main power. The power means when switched on starts supplying power to all the PCBs to activate the several components connected with the PCB and similarly when first switch 1114 is activated the motor 1112 starts driving the bristles either by gear mechanism or by wheel-axle assembly to perform an effective brushing. The switch 1116 positioned at the front portion and below the switch 1114 of the toothbrush performs the bleaching mode action on the teeth by applying bleaching agent when all the LEDs are switched
on and the toothbrush motor is at a very lowest possible speed for oscillating the detachable bristles in a slow motion.

[0076] Referring to FIG. 12a is a 1200a diagram depicting a perspective view of an externally connected water duct replacing the bristles with detachable lock. According to a non-limiting exemplary embodiment of the present invention, the power operated electric toothbrush comprising an external water duct 1204a with detachable locks 1202a replacing the position of the detachable bristles is used for irrigation mechanism along with the intraoral camera 1206a.

[0077] In accordance with a non-limiting exemplary embodiment of the present invention, the power operated electric toothbrush includes an external water duct 1204a with detachable locks 1202a to securely support the duct for avoiding the movement at the time of usage. The external water duct 1204a engages with the toothbrush and when connected to an external water pump, performs an irrigation mechanism to effectively reach and remove the plaque and debris caught between the teeth, in the gum line and the like. The external water duct 1204a further includes a water opening means/nozzle 1208 and water supplying means. The water supplying means receives the water from external water pump. Further the water supplied through the water supplying means can be directed to all portions of the teeth using the nozzle 1208. The intraoral camera 1206a included in the power operated electric toothbrush is used to assist the user in directing the water jet into the areas of interest.

[0078] Referring to FIG. 12b is a diagram 1200b depicting a rear view of an externally connected detachable lock for the water duct. According to a non-limiting exemplary embodiment of the present invention, the power operated electric toothbrush includes the detachable locks 1202b, an external water duct 1204b used for irrigation mechanism.

[0079] In accordance with a non-limiting exemplary embodiment of the present invention, the power operated electric toothbrush includes an external water duct 1204b with the detachable locks 1202b to securely support the duct for avoiding the movement at the time of usage. The external water duct 1204b engages with the toothbrush and when connected to an external water pump, performs an irrigation mechanism to effectively reach and remove the plaque and debris caught between the teeth, in gum line and the like.

[0080] Referring to FIG. 13 is a diagram 1300 depicting a pressure sensing mechanism of a power
operated electric toothbrush. According to a non-limiting exemplary embodiment of the present invention, the pressure sensing mechanism depicts detachable bristles 1302, bristle driving means 1304, a conduit 1306 with a momentary switch comprising two contact points 1308 and 1310 positioned on either side of the spring 1312.

[0081] In accordance with a non-limiting exemplary embodiments of the present invention, the pressure sensing mechanism of the power operated electric toothbrush is used for providing an alert through a visual warning means and an audio warning means coupled within a conduit 1306 when an excess pressure is applied on the teeth. The power operated electric toothbrush also includes a guiding means connected to the bristle driving means 1304 and the other side coupled to a conduit 1306 includes a compression means. The conduit 1306 comprises momentary switch made of two contact points 1308 and 1310 positioned on either side of the spring 1312. During brushing, the excessive pressure applied on the detachable bristle attachment 1302 enables the movement of the bristle driving means 1304 for enabling the intrusion of the guiding means into the conduit 1306. The application of excess pressure on the teeth leads to the intrusion of the bristle driving means. The momentary switch gets activated when the two contact points 1308 and 1310 within the conduit 1306 meet by the compression of the spring 1312 to form a power circuit and activate the audio visual warning means. The audio warning is placed within the toothbrush handle and the visual warning is in the remote display device.

[0082] Referring to FIG. 14 is a diagram 1400 depicting an external transceiver module. According to a non-limiting exemplary embodiment of the present invention, the external transceiver module is communicatively coupled to the power operated electric toothbrush. The data related to images captured by the image capturing means, application of the excess pressure on the teeth, and brushing duration are transmitted to the external transceiver module through the data transmitter of the power operated electric toothbrush.

[0083] In accordance with a non-limiting exemplary embodiment of the present invention, the external transceiver module includes a transceiving means 1402 to receive and transmit the data and the images of the teeth. A first transmission means 1404 of the external transceiver module enables to transmit the data and the images of the teeth to the television. A second transmission means 1406 of the external transceiver module enables to transmit the data and the images to USB enabled
communicating devices like computers. The first transmission means 1404 and the second transmission means 1406 are a folded in an interior of the casing of the external transceiver module in a non working condition through a pivot 1408 which is provided to the casing of the external transceiver module.

[0084] The artificial intelligence or image recognition technology may be embedded into the external display devices like a computer that can communicate with the toothbrush through this external transceiver module and helps to detect the plaque which in turn controls the motor driving the bristles to operate until the plaque has been removed. The data transmitter in the toothbrush transmits the data and images of the teeth and other intraoral structures to the communicating devices through a short range communication network. The short range communication network includes a bluetooth network, a zigbee network, a WiFi network, a 61owPAN network, a radio frequency network and the like. The external transceiver module further includes a provision for accommodating a card reading means 1410 for storing the received data and images of the teeth. The data and the images can be stored in an external data storage card means. The external transceiver module includes an internal rechargeable battery which is used to power the transceiver module. The internal rechargeable battery is charged when the external transceiver module is plugged into the communicating device through the second transmission means 1406.

[0085] Referring to FIG. 15 is a diagram 1500 depicting an external base station for WiFi enabled devices. According to a non-limiting exemplary embodiment of the present invention, the camera mounted on the upper part of the toothbrush 1502 communicates with the WiFi/bluetooth enabled devices 1506 but not limited to a smart phone through a WiFi/bluetooth transmitter included in the external base station 1504. The WiFi/bluetooth transmitter of the base station 1504 receives the images captured by the camera of the toothbrush 1502 and transmits to the WiFi/bluetooth enabled devices 1506. The transmitted images are displayed on the WiFi/bluetooth enabled devices 1506 but not limited to a smart phone through a short range communication network. Further the short range communication network includes a Bluetooth network, a radio frequency network, WiFi network, a zigbee network and the like. The hardware used for image recognition to detect the plaque in the captured images and artificial intelligence enabled brushing are comprised within the external base station 1504 and communicates with the toothbrush 1502 through transceiver in the external base station. The external base station 1504 included in the system acts as a wireless relay hub, so that
the hardware related to wireless communication within the toothbrush 1502 can be kept minimal and compact. The external base station 1504 also further includes hardware required for the purpose of providing induction charging to the toothbrush 1502 and also a water tank and a pump installed for performing the oral irrigation function of the toothbrush 1502. The external base station 1504 can have its own dedicated display so that the users can use it without the need for other external display devices and it can also have its own external data storage facility like the SD card.

[0086] While specific embodiments of the invention have been shown and described in detail to illustrate the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.
Claims:

1. A power operated electric toothbrush comprising:

   a plurality of detachable bristles fastened to a bristle driving means configured to be attached to a front portion of the toothbrush through a predefined locking mechanism, whereby the bristle driving means enable a oscillo-vibratory motion to the plurality of bristles;

   an intraoral camera comprising a detachable fastening means to be engaged with the toothbrush and positioned above the plurality of detachable bristles to capture the images of the teeth for enabling a targeted brushing and to detect and illuminate the plaque, whereby the illuminating means comprising an ultraviolet including blue light and a plurality of white light emitting diodes;

   a first detachable configuration comprising the intraoral camera and an illuminating means for mounting on to the toothbrush handle;

   a second detachable configuration comprising the intraoral camera, an illuminating means and the plurality of detachable bristles for mounting onto the toothbrush handle;

   an external water duct comprising a detachable locking mechanism to be locked with the toothbrush configured to be used in conjunction with the intraoral camera for removing plaque and debris caught between the teeth utilizing an irrigation mechanism;

   a conduit positioned at a rear portion of the bristle driving means comprising a momentary switch to perform a pressure sensing activity, whereby an excess pressure applied on the teeth generates an alert through a visual warning means and an audio alerting means coupled to the conduit; and

   an artificial intelligence means; and an image recognition means embedded in a base station configured to detect the plaque and to control the motor driving the plurality of detachable bristles for the removal of plaque.
2. The power operated electric toothbrush of claim 1, wherein at least one first switch positioned at the front portion of a handle to activate and deactivate a power supply to a motor and to increase an operating speed of the motor.

3. The power operated electric toothbrush of claim 1, wherein at least one second switch positioned at the front portion for: configuring a lowest possible operating speed of the motor; and to perform a bleaching action while activating the plurality of illuminating means.

4. The power operated electric toothbrush of claim 1, wherein at least one third switch positioned at the front portion to activate and deactivate a main power supply.

5. The power operated electric toothbrush of claim 1, wherein at least one fourth switch positioned at the back portion to activate the plurality of white light emitting diodes for capturing a video of the teeth.

6. The power operated electric toothbrush of claim 1, wherein at least one fifth switch positioned at the back portion and beside the at least one fourth switch to activate the ultraviolet including blue light for capturing the video of the teeth.

7. The power operated electric toothbrush of claim 1, wherein at least one first indicating means positioned at the bottom to indicate a charging state.

8. The power operated electric toothbrush of claim 1, wherein at least one second indicating means at the bottom to indicate a presence of power.

9. The power operated electric toothbrush of claim 1, wherein the predefined locking mechanism associated with the bristle driving means comprising at least one of: a friction grip mechanism; and a spring lock mechanism.

10. The power operated electric toothbrush of claim 1, wherein the images captured by the intraoral camera configured to be displayed over the at least one WiFi enabled network devices and the at least one short range communication network enabled network devices.

11. The power operated electric toothbrush of claim 1, wherein an external base station comprising a transmitter configured to receive the images captured by the intraoral camera and transmit to at least one of: a WiFi enabled network device; and a short range
12. The power operated electric toothbrush of claim 1 comprising at least one of: a wheel axle assembly; and a gear mechanism to enable an oscillation of the bristle driving means.

13. The power operated electric toothbrush of claim 1, wherein a wireless module configured to communicate with an external transceiver for transmitting a data related to at least one of: a plurality of images captured by the intraoral camera; an application of the excess pressure on the teeth; and a brushing duration.

14. A power operated electric toothbrush comprising:

- a plurality of detachable bristles fastened to a bristle driving means configured to be attached to a front portion of the toothbrush through a predefined locking mechanism, whereby the bristle driving means enable an oscillation of the bristles;

- an intraoral camera engaged with the toothbrush and positioned above the plurality of detachable bristles to capture the images of the teeth for enabling a targeted brushing and to detect and illuminate the plaque, whereby the illuminating means comprising an ultraviolet light including blue light and a plurality of white light emitting diodes;

- an external water duct comprising a detachable locking mechanism to be locked with the toothbrush for removing plaque and debris caught between the teeth utilizing an irrigation mechanism; and

- a conduit positioned at a rear portion of the bristle driving means comprising a momentary switch to perform a pressure sensing activity, whereby an excess pressure applied on the teeth generates an alert through a visual warning means and an audio alerting means coupled to the conduit.

15. The power operated electric toothbrush of claim 14, wherein the images captured by the intraoral camera configured to be displayed over the at least one WiFi enabled network devices and the at least one short range communication network enabled network devices.
16. The power operated electric toothbrush of claim 14, wherein an external base station comprising a transmitter configured to receive the images captured by the intraoral camera and transmit to at least one of: a WiFi enabled network device; and a short range communication network enabled network device.

17. The power operated electric toothbrush of claim 16, wherein the images captured by the intraoral camera configured to be displayed on a screen attached to the external base station.

18. The power operated electric toothbrush of claim 16, wherein at least one of: an artificial intelligence means; and an image recognition means embedded in the base station configured to detect the plaque and to control the motor driving the detachable bristles for the removal of plaque.

19. The power operated electric toothbrush of claim 16, wherein the predefined locking mechanism associated with engaging the plurality of bristles to the bristle driving means comprising at least one of: a friction grip mechanism; and a spring lock mechanism.

20. The power operated electric toothbrush of claim 14 comprising at least one of: a wheel axle assembly; and a gear mechanism to enable an oscillation of the bristle driving means.

21. The power operated electric toothbrush of claim 14, wherein at least one first switch positioned at the front portion to activate and deactivate the motor and to increase the operating speed of the motor.

22. The power operated electric toothbrush of claim 14, wherein at least one second switch positioned at the front portion for: configuring a lowest possible operating speed of the motor; and to perform a bleaching action while activating the plurality of illuminating means.

23. The power operated electric toothbrush of claim 14, wherein at least one third switch positioned at the front portion to activate and deactivate the main power supply.

24. The power operated electric toothbrush of claim 14, wherein at least one fourth switch
positioned at the back portion to activate the plurality of white light emitting diodes for capturing the video of the teeth.

25. The power operated electric toothbrush of claim 14, wherein at least one fifth switch positioned at the back portion and beside the at least one fourth switch to activate the ultraviolet including blue light for capturing a video of the teeth.

26. The power operated electric toothbrush of claim 14, wherein at least one first indicating means positioned at the bottom to indicate a charging state.

27. The power operated electric toothbrush of claim 14, wherein at least one second indicating means at the bottom to indicate a presence of power.

28. The power operated electric toothbrush of claim 14, wherein a wireless module configured to communicate with an external transceiver for transmitting a data related to at least one of: a plurality of images captured by the intraoral camera; an application of the excess pressure on the teeth; and a brushing duration.