TECHNICAL FIELD OF INVENTION

The present invention is in the field of artificial breathing systems. More precisely, this invention presents a portable automatic artificial breathing system. This system is a motor-pump operated Bag-valve mask that allows the user to properly aid the patient with difficulty in breathing. The device is capable of providing the patient with the right amount of air and constant flow rate air delivery, replacing the manual bag- valve that requires at least one person to operate effectively. The device consistently pumps the prescribed amount of oxygen/ air to patients, depending on body weight and rate of ventilation as per age is designed to be portable and be carried on emergency care.

BACKGROUND OF PRESENT INVENTION

Prior Art:

Artificial respiration is any method of forcing air into the lungs in a person who still has a pulse but whose breathing is not adequate. Artificial respiration can be given using a pocket face mask or a bag valve mask; in the absence of emergency resuscitation equipment, mouth-to-mouth resuscitation may be done. Artificial respiration can save a life whenever breathing has stopped as in near-drowning, electric shock, choking, gas poisoning, drug poisoning, injury to the chest, or suffocation from other causes. It is also administered along with other procedures in cases of cardiac arrest. Usually one can tell that breathing has stopped by listening, observing, and feeling for respiratory movement. The cause of the stoppage of breathing may be obvious (as when a drowning person is pulled out of the water) or unknown. To be effective, artificial respiration must be begun immediately. Once begun, artificial respiration should be continued until the victim begins to breathe regularly by himself. The lungs inflate and deflate 16 to 20 times per minute in adults, 12 to 20 per minute in teenagers, 20 to 30 per minute in children 2 to 12 years old, and 30 to 50 per minute in newborns. Their elastic tissue allows them to expand and contract like a bellows worked by the diaphragm and the intercostal muscles. The diaphragm contracts, flattening itself downward, and thus enlarges the thoracic cavity. At the same time the ribs are pulled up and outward by the action of the narrow but powerful intercostal muscles that expand and contract the rib cage. As the chest expands, the air flows in. Exhalation occurs when the respiratory muscles relax and the chest returns automatically to its minimum size, expelling the air.

Various methods of artificial respiration, mostly based on the application of external force to the lungs, were once used. Methods that were popular particularly in the early 20th century but were later supplanted by more effective techniques included the modified Silvester chest-pressure–arm-lift method and many others. In the 1950s Austrian-born anesthesiologist Peter Safar and colleagues found that obstruction of the upper airway by the tongue and soft palate rendered existing artificial ventilation techniques largely ineffective. The researchers proceeded to develop techniques to overcome obstruction, such as lifting of the chin, and subsequently demonstrated that mouth-to-mouth respiration was superior to other methods in the quantity of air that could be delivered in each respiratory cycle (tidal volume).

Bag valve mask, abbreviated to BVM is a hand-held device commonly used to provide positive pressure ventilation to patients who are not breathing or not breathing adequately. A self-inflating bag may be easier to use, especially by less experienced resuscitators. The main drawback with BVMs is their manual operation requiring continuous operator engagement to squeeze the bag. This operating procedure induces fatigue during long operations, and effectively limits the usefulness of these bags to temporary relief. Moreover, an untrained operator can easily damage a patient's lungs by over compression of the bag. However, the valve assembly allows free flow of oxygen only when the bag is compressed or squeezed and therefore cannot deliver blow-by oxygen. Significant mixing with room air occurs, thereby limiting maximal oxygen delivery to only 40%, unless an oxygen reservoir is attached. More experienced resuscitators are necessary for several reasons. First, it is more prone to mechanical failure, which may occur at several points along the system. Gas must flow into the gas inlet, gas must flow out through the flow control valve, the mask must be securely attached to the bag, and the mask must make a tight seal with the patient face. If the delivered pressure exceeds what is needed, air leak syndromes such as pneumomediastinum, pneumothorax, or pneumopericardium may result. Hence it is crucial to observe the pressure applied.

Stephen K. Powelson et.al. titled “Design and Prototyping of a Low-cost Portable Mechanical Ventilator” published on 30 June 2010. This paper describes the design and prototyping of a portable mechanical ventilator for use in mass casualty cases and resourcepoor environments. The ventilator delivers breaths by compressing a conventional bag-valve mask (BVM) with a pivoting cam arm. BVM compression can be achieved with linear actuation, radial actuation, or rotary actuation. The cam concept utilizes a crescent-shaped cam to compress the BVM.

Verlyn C. Vicente*, Jesusa N. Padilla and Bartolome T. Tanguilig III titled “Portable automated bag-valve mask with android technology” published in 2016. After turning on the device, it will then prompt the user whether to operate on manual mode or through an Android device. If the manual mode is selected, the user will then have to choose whether the patient is within the age bracket of an adult or a child. The input will then trigger the piston pump to operate according to the programmed rate on the microcontroller for the desired output of air flow based on standard flow rate for an adult or a child. In automatic mode, device is controlled on an Android device. The design uses a system that is divided into three parts; the Android application, the software coded into the PIC16F877A in charge of the communication with the Android application through Bluetooth and in interpreting user inputs along with the output of the humidity sensor.

CN102500022A discloses a portable first-aid assisted respiration device, which comprises a hollow rubber ball and a rubber ball squeezing mechanism. The elastic hollow rubber ball is periodically squeezed by the rubber ball squeezing mechanism, and can output air flow required by assisted respiration to a person needing first-aid. The pressing mechanism includes a first ball jaw, a second jaw ball, ball first jaw, a second jaw with the first ball and the second ball clamp jaw holder base is fixedly connected; a first ball and a second ball seat clamp jaw holder are fixedly connected to the first linear bearing and a second linear bearing; a first and a second linear bearing along the linear bearings of a straight line and the second linear bearing shaft bearing shaft for linear movement; torque output of the motor through a gearbox to a crankshaft connected first and second links, wherein the first link longer than the second link, a first link connected to the first linear bearing, the second link connected to the second linear bearing shaft.

US 20120145151A1 relates to a device for automatically Squeezing and releasing an AMBU-bag. A device has a housing and a mechanical compression Squeezer in the housing. There are openings in the housing for inlet tubes and outlet tubes of AMBU-bag to pass in and out of the housing. A powered actuator powers the compression Squeezer. Device 100 is for use with the AMBU-bag 102 having a flexible squeeze bag 200. Strap 202 is wrapped around squeeze bag 200. Cyclical tension and/or pulling on strap cause squeezing.

Therefore, there is still a need for providing a portable automatic artificial breathing system to overcome problems existing in available prior arts.

SUMMARY OF THE PRESENT APPLICATION

Accordingly, the present invention provides a portable automatic artificial breathing system consisting of a motor-pump operated Bag-valve mask that allows the user to properly aid the patient with difficulty in breathing. The device is capable of providing the patient with the right amount of air and constant flow rate air delivery, replacing the manual bag- valve that requires at least one person to operate effectively. The device consistently pumps the prescribed amount of oxygen/ air to patients, depending on body weight and rate of ventilation as per age is designed to be portable and be carried on emergency care. The design of the prototype is one of the considerations in defining the mobility of the automated bag-valve. The design uses a crank-shaft-piston-type pumping mechanism powered by a single DC/AC motor and a rectangular case that houses the entire mechanism, circuit and bag valve device. The rectangular design was taken into account to make the design compact and small. This type of case design also ensures the efficient pumping of the piston mechanism that pumps the bag-valve device. It can be operated on power supply and has battery back-up and battery charging circuit which will come into action either during power failure or while shifting the patient. Further, the rate and volume of air flow can be variably set depending on the age and body weight of the subject or automatically based on some body parameter of the subject like blood pressure or pulse rate or heart rate variability etc. It has thus two modes of operation - Auto and manual. The volume of air flow can be varied by selecting a slot on the rotating disc; whereas, the motor speed can be varied manually by rotating the controlling knob on the motor driver circuit.

This summary is provided to introduce a selection of concepts in a simplified format that are further described in the detailed description of the invention. This summary is not intended to identify key or essential inventive concepts of the claimed subject matter, nor it is intended for determining the scope of the claimed subject matter.

In accordance with the purposes of the invention, the present invention as embodied and broadly described herein provides a portable automatic artificial breathing system.

In accordance with an embodiment, the present invention provides a portable automatic artificial breathing system, capable of replacing manual bag-valve used for artificial breathing system which requires at least one person to operate effectively.

In accordance with another embodiment, the present invention provides a crank-shaft-piston-type pumping mechanism powered by a single DC/AC motor and a rectangular case (so as to make device small and compact) that houses the entire mechanism, circuit and bag valve device.

In yet another embodiment, the present invention provides a movement of the crankshaft piston that pressurizes the bag-valve-mask. The device delivers positive pressure to the patient who are breathing inadequately or not breathing.

In accordance with another embodiment, the present invention is capable of providing the patient with the right amount of air at a constant flow rate of air delivery.

In yet another embodiment, the present invention provides a device which consistently pumps the prescribed amount of oxygen/air to patients, depending on body weight and rate of ventilation required as per age.

In accordance with another embodiment, the present invention provides a device which is portable and can be easily carried in case of any emergency.

In yet another embodiment, the present invention provides a device having casing of the device designed to provide the efficient pumping of the piston mechanism that pumps the bag-valve device.

In accordance with another embodiment, the present invention provides a device which can be operated on power supply and has battery back-up and battery charging circuit which facilitates the operation of the device either during power failure or while shifting the patient.

In yet another embodiment, the present invention provides a device wherein the rate and volume of air flow can be variably set depending on the age and body weight of the subject or automatically based on some body parameter of the subject like blood pressure or pulse rate or heart rate variability etc. thereby, promotes two operational modes namely -Auto and manual.

In accordance with another embodiment, the present invention provides a device wherein the volume of air flow can be varied by selecting a slot on the rotating disc.

In accordance with another embodiment, the present invention provides a device wherein the motor speed can be varied manually by rotating the controlling knob on the motor driver circuit.

In yet another embodiment, said device is operated with an improved controller which can provide control over pressure, volume, rate and ratio of inspiration to expiration time. Further, in another embodiment, the controller of the device automatically controls pressure, volume, rate and ratio of inspiration to expiration time by observing some body parameter.

In accordance with another embodiment, the present invention provides a system capable of monitoring and controlling remotely either individually or in conjuction with other similar systems.

The details of one or more embodiments are set forth in the accompanying drawings and description below. Other features and advantages will be apparent from a reading of the following detailed description and a review of the associated drawings. It is to be understood that the following detailed description is explanatory only and is not restrictive of the invention as claimed.

BRIEF DESCRIPTION OF ACCOMPANYING DRAWINGS

To further clarify advantages and aspects of the invention, a more particular description of the invention will be rendered by reference to specific embodiments thereof, which is illustrated in the appended drawings. It is appreciated that these drawings depict only typical embodiments of the invention and are therefore not to be considered limiting of its scope. The invention will be described and explained with additional specificity and detail with the accompanying drawings in accordance with various embodiments of the invention, wherein:

Fig.1 provides block diagram of an open loop automated artificial breathing system.

Fig. 2 provides front view of the device in accordance with an embodiment of the present subject matter.

Fig. 3 provides top view of the device in accordance with an embodiment of the present subject matter.

Fig. 4 provides back view of the device in accordance with an embodiment of the present subject matter.

Fig. 5 provides schematic flow diagram of a closed-loop automated artificial breathing system in accordance with an embodiment of the present subject matter.

Fig. 6 provides wireless monitoring and control of multiple Patient Artificial Breathing systems in accordance with an embodiment of the present subject matter.

It may be noted that to the extent possible, like reference numerals may have been used to represent like elements in the drawings. Further, those of ordinary skill in the art will appreciate that elements in the drawings are illustrated for simplicity and may not have been necessarily drawn to scale. For example, the dimensions of some of the elements in the drawings may be exaggerated relative to other elements to help to improve understanding of aspects of the invention. Furthermore, one or more elements may have been represented in the drawings by conventional symbols, and the drawings may show only those specific details that are pertinent to understanding the embodiments of the invention so as not to obscure the drawings with details that will be readily apparent to those of ordinary skill in the art having benefit of the description herein.

DETAILED DESCRIPTION OF THE PRESENT APPLICATION

For promoting an understanding of the principles of the invention, reference will now be made to the embodiments illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated system, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur to one skilled in the art to which the invention relates.

It will be understood by those skilled in the art that the foregoing general description and the following detailed description are exemplary and explanatory of the invention and are not intended to be restrictive thereof. Throughout the patent specification, a convention employed is that in the appended drawings, like numerals denote like components.

Reference throughout this specification to “an embodiment”, “another embodiment” or similar language means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. Thus, the appearances of the phrase “in an embodiment”, “in another embodiment” and similar language throughout this specification may, but do not necessarily, all refer to the same embodiment.

Various embodiments of the invention will be described below in detail with reference to the accompanying drawings.

The present invention is directed to a Bag valve mask is a device, which deliver positive pressure to the patient who are, breathing inadequately or not breathing it is a hand held device. The Bag-Valve-Mask (BVM) remains a bit of gear that can be either reusable or dispensable. It can be utilized with various diverse estimated covers to guarantee a satisfactory seal for all patients. There are various distinctive measured packs to better suit specific patients, for example, grown-up, pediatrics and neonates.

The present application relates to portable automatic artificial breathing system consisting of a motor-pump operated Bag-valve mask that allows the user to properly aid the patient with difficulty in breathing.

Figure 1 describes that in the present invention, device comprises of essentially four components i.e. Controller, Motor, Crankshaft and bag valve mask.

In one of the embodiment, the present application provides a portable automatic artificial breathing system comprising:

a) a controller;

b) motor operably connected with the controller;

c) crank-shaft-piston-type pumping mechanism operably connected with the motor; and

d) bag valve mask operably connected with the crankshaft piston-type pumping mechanism.

In yet another embodiment, the present application provides a system, wherein the system is capable of delivering required amount of air at a constant flow rate to patient in accordance with one or more body parameters selected from group of body weight, rate of ventilation, age, blood pressure, pulse rate or heart rate variability of the patient.

In yet another embodiment, the present application provides a system, wherein the crank-shaft-piston-type pumping mechanism is powered by a power generating mechanism selected from a group of single DC/AC motor, battery, chargeable battery, AC supply, motor driver circuit, battery charging circuit.

In yet another embodiment, the present application provides a system, wherein movement of the crankshaft piston pressurizes the bag-valve-mask and delivers positive pressure to a person who is not breathing or having difficulty in breathing.

In yet another embodiment, the present application provides a system, wherein the volume of air flow can be varied by selecting a slot on the rotating disc of the system.

In yet another embodiment, the present application provides a system, wherein the motor speed can be varied manually by rotating the controlling knob on the motor driver circuit.

In yet another embodiment, the present application provides a system, wherein the system is housed in a small rectangular case.

Fig. 2 provides front view of the device in accordance with an embodiment of the present subject matter. **Fig. 3** provides top view of the device in accordance with an embodiment of the present subject matter. **Fig. 4** provides back view of the device in accordance with an embodiment of the present subject matter.

The device is capable of providing the patient with the right amount of air and constant flow rate air delivery, replacing the manual bag- valve that requires at least one person to operate effectively. The design of the prototype is one of the considerations in defining the mobility of the automated bag-valve.

The present invention relates to a Portable automatic artificial breathing system, capable of replacing manual bag-valve used for artificial breathing system which requires at least one person to operate effectively. The device comprises a crank-shaft-piston-type pumping mechanism powered by a single DC/AC motor and a rectangular case that houses the entire mechanism, circuit and bag valve device. The rectangular design was taken into account to make the design compact and small. This type of case design also ensures the efficient pumping of the piston mechanism that pumps the bag-valve device. The operation of device involves a movement of the crankshaft piston that pressurizes the bag-valve-mask. The device delivers positive pressure to the patient who is breathing inadequately, or not breathing. The device is capable of providing the patient with the right amount of air at a constant flow rate of air delivery. The device consistently pumps the prescribed amount of oxygen/air to patients. Further, the rate and volume of air flow can be variably set depending on the age and body weight of the subject or automatically based on some body parameter of the subject like blood pressure or pulse rate or heart rate variability etc. It has thus two modes of operation - Auto and manual. The volume of air flow can be varied by selecting a slot on the rotating disc; whereas, the rate of respiration can be set by varying motor speed which can be varied manually by rotating the controlling knob on the motor driver circuit. The design of the device is portable and can be easily carried in case of any emergency. The casing of the device is designed to provide the efficient pumping of the piston mechanism that pumps the bag-valve device. The device can be operated on power supply and has battery back-up and battery charging circuit which facilitates the operation of the device either during power failure or while shifting the patient.

The device is operated with an improved controller which can provide control over pressure, volume, rate and ratio of inspiration to expiration time.

Further, in another embodiment, the controller of the device automatically controls pressure, volume, rate and ratio of inspiration to expiration time by observing some body parameter. **Figure 5** provides schematic flow diagram of a closed-loop automated artificial breathing system in accordance with an embodiment of the present subject matter. The Controller is operably connected to a motor which is functionally connected to a crankshaft. The crankshaft is operably in connection with a bag valve mask and said bag valve mask is functionally connected with a patient parameter monitoring system. Said patient parameter monitoring system provides information of body parameters of the patient to the controller which controls the whole device based on received information. Therefore, in one the embodiment, the present disclosure provides a closed loop automated artificial breathing system.

In accordance with another embodiment, the present invention provides a system capable of monitoring and controlling remotely either individually or in conjuction with other similar systems. **Figure 6** provides wireless monitoring and control of multiple Patient Artificial Breathing systems in accordance with an embodiment of the present subject matter. The present disclosure provides a system wherein first patient artificial breathing system is operably connected to a central monitoring and control system via wireless connection. Similarly, second patient is operably connected to the central monitoring and control system via wireless connection. More number of artificial breathing systems of patients are operably connected to the central monitoring and control system via wireless connection. Hence, n^{th} patient’s artificial breathing system is connected via wireless connection to the central monitoring and control system. In yet another embodiment, invention is not limited to wireless connection and other kinds of remote communication systems can be used according to availability of remote communication systems.

ADVANTAGES:

The non-limiting advantages of the present invention are presented below:

1. The present application overcomes the problem of manually operated system, for example, the present system does not require continuous operator engagement to squeeze the bag and the problem of damaging a patient's lungs by over compression of the bag does not occur.

2. The present application provides a system which does not induces fatigue during long operations, and effectively increases the usefulness of artificial breathing system.

3. The system has a battery back-up and a battery charging circuit which facilitates the operation of the device either during power failure or while shifting the patient.

4. The present device is simple to operate and experienced operator is not necessary.

5. The system is capable of delivering required amount of air at a constant flow rate to patient in accordance with one or more body parameters selected from group of body weight, rate of ventilation, age, blood pressure, pulse rate or heart rate variability of the patient.

6. The system is capable of monitoring and controlling multiple patient artificial breathing systems via wireless connection.

These and other aspects, as well as advantages, will be more clearly understood from the following description taken in conjugation with the accompanying drawings.

It should be understood at the outset that although illustrative implementations of the embodiments of the present disclosure are illustrated below, the present invention may be implemented using any number of techniques, whether currently known or in existence. The present disclosure should in no way be limited to the illustrative implementations, drawings, and techniques illustrated below, including the exemplary design and implementation illustrated and described herein.

The terminology and structure employed herein is for describing, teaching and illuminating some embodiments and their specific features and elements and does not limit, restrict or reduce the spirit and scope of the invention.

More specifically, any terms used herein such as but not limited to "includes," "comprises," "has," "consists," and grammatical variants thereof do not specify an exact limitation or restriction and certainly do not exclude the possible addition of one or more features or elements, unless otherwise stated, and furthermore must not be taken to exclude the possible removal of one or more of the listed features and elements, unless otherwise stated with the limiting language "must comprise" or "needs to include."

Whether or not a certain feature or element was limited to being used only once, either way, it may still be referred to as "one or more features" or "one or more elements" or "at least one feature" or "at least one element." Furthermore, the use of the terms "one or more" or "at least one" feature or element do not preclude there being none of that feature or element, unless otherwise specified by limiting language such as "there needs to be one or more . . . " or "one or more element is required."

Unless otherwise defined, all terms, and especially any technical and/or scientific terms, used herein may be taken to have the same meaning as commonly understood by one having an ordinary skill in the art.

Reference is made herein to some “embodiments.” It should be understood that an embodiment is an example of a possible implementation of any features and/or elements. Some embodiments have been described for the purpose of illuminating one or more of the potential ways in which the specific features and/or elements of the invention fulfill the requirements of uniqueness, utility, and non-obviousness.

Although one or more features and/or elements may be described herein in the context of only a single embodiment, or alternatively in the context of more than one embodiment, or further alternatively in the context of all embodiments, the features and/or elements may instead be provided separately or in any appropriate combination or not at all. Conversely, any features and/or elements described in the context of separate embodiments may alternatively be realized as existing together in the context of a single embodiment.

While specific language has been used to describe the present subject matter, any limitations arising on account thereto, are not intended. As would be apparent to a person in the art, various working modifications may be made to the method in order to implement the inventive concept as taught herein. The drawings and the foregoing description give examples of embodiments. Those skilled in the art will appreciate that one or more of the described elements may well be combined into a single functional element. Alternatively, certain elements may be split into multiple functional elements. Elements from one embodiment may be added to another embodiment.

Abstract Of The Invention

PORTABLE AUTOMATIC ARTIFICIAL BREATHING SYSTEM

The invention is in the field of artificial breathing systems. More precisely, this invention presents a portable automatic artificial breathing system. This system is a motor-crankshaft operated Bag-valve mask that allows the user to properly aid the patient with difficulty in breathing. The device is capable of providing the patient with the right amount of air and constant flow rate air delivery, replacing the manual bag- valve that requires at least one person to operate effectively. The device consistently pumps the prescribed amount of oxygen/ air to patients, depending on body weight and rate of ventilation as per age is designed to be portable and be carried on emergency care.

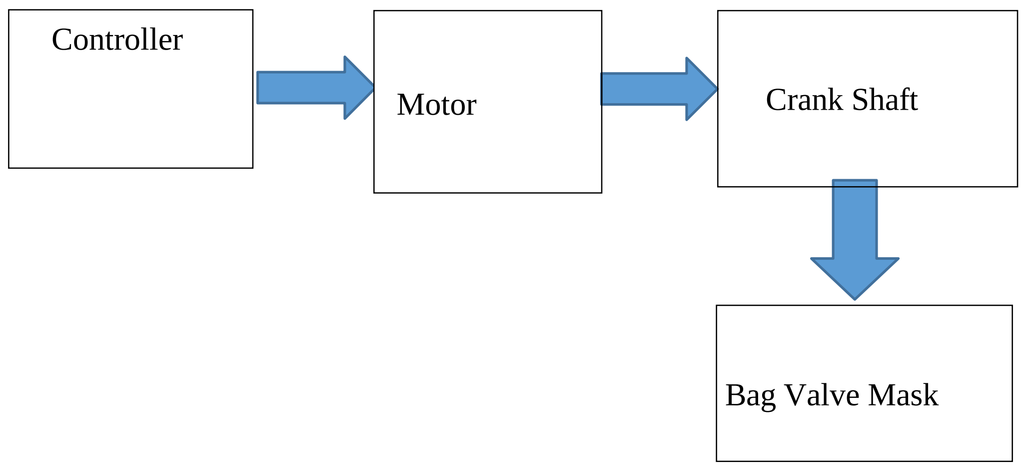

Fig1: Schematic flow diagram of an open-loop Automated artificial breathing system

Fig. 2 Front view

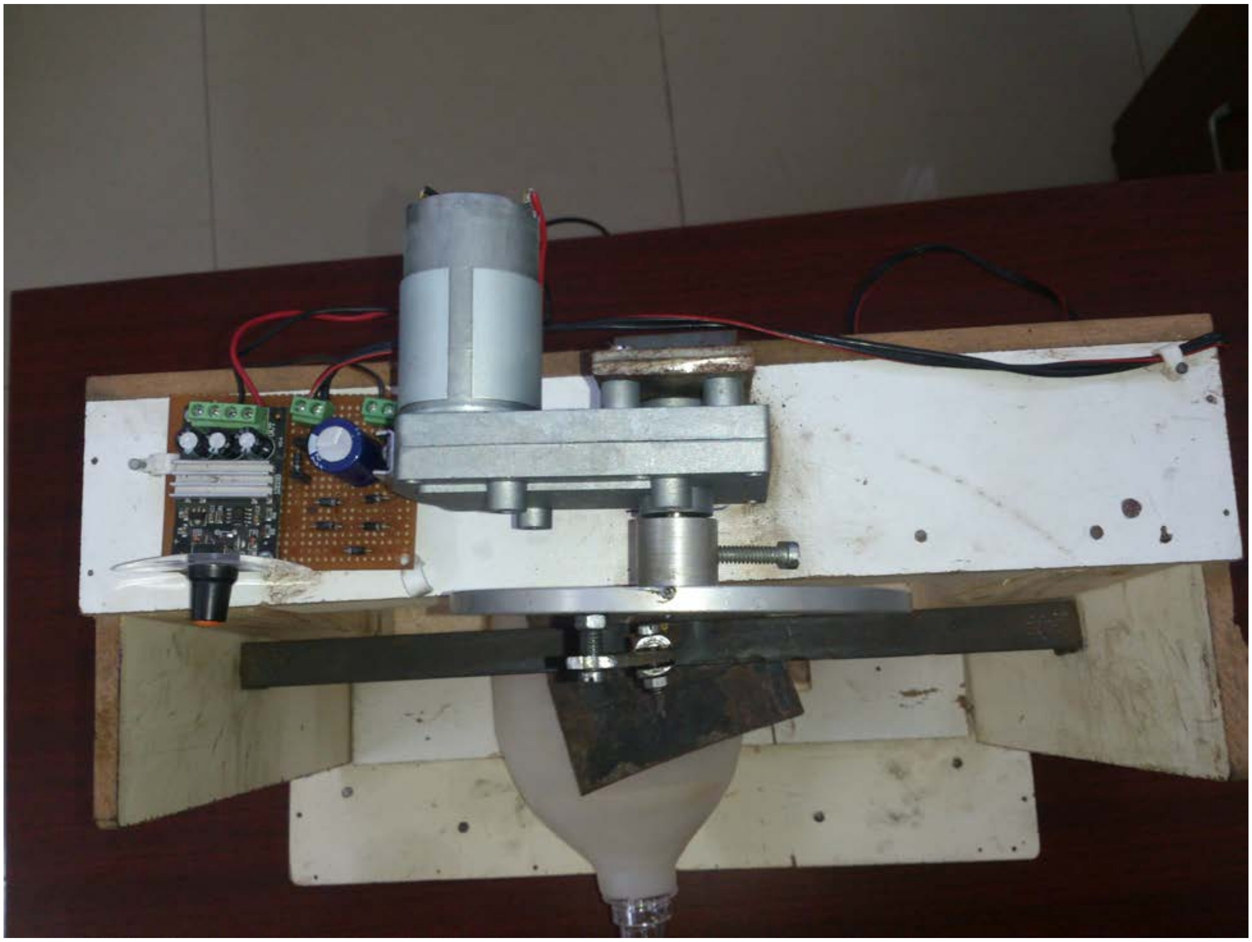

Fig. 3 Top view

Fig. 4 Back view

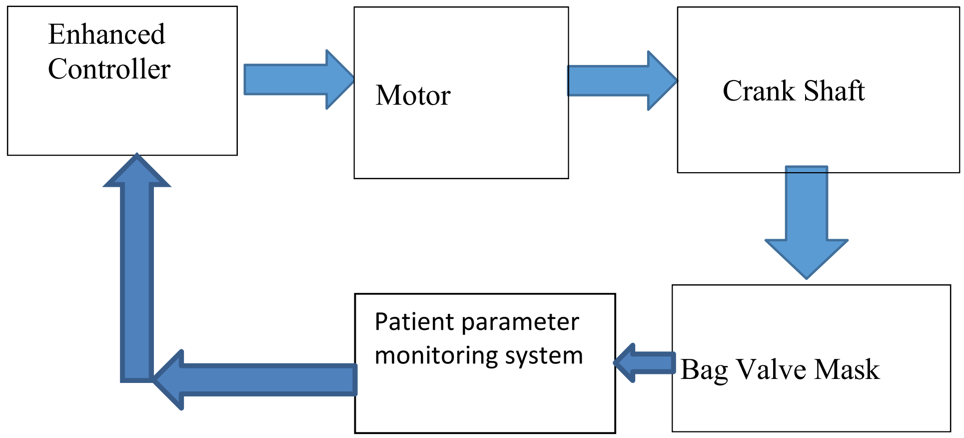

Fig5: Schematic flow diagram of a closed-loop Automated artificial breathing system

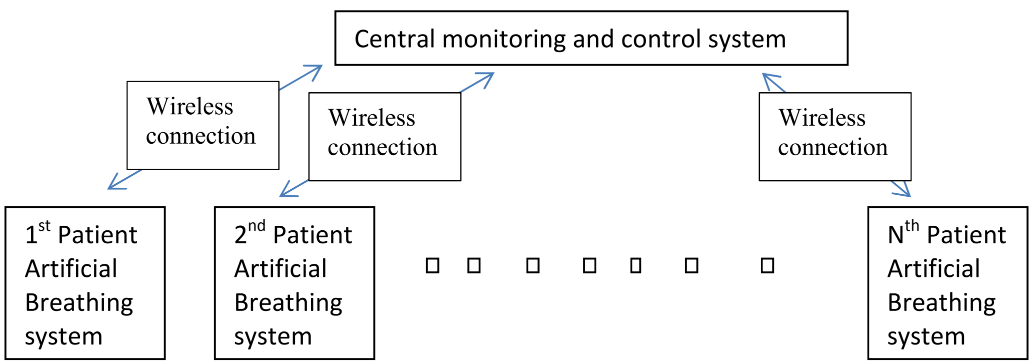

Fig. 6 Wireless monitoring and control of multiple Patient Artificial Breathing systems

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