



**KOÇ
ÜNİVERSİTESİ**
COLLEGE OF ENGINEERING

STUDENTS

Taha Andaç - 0075785
İbrahim Furkan Özdemir - 0076689
Ozgan Tataroğlu - 0076431

INSTRUCTOR

Kerem Pekkan, PhD

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Design of automated Ambu system

Abstract: In the following paper, a novel automated Ambu system is being presented. Heart chambers get compressed by heart muscles when the human heartbeats. The heart mechanism is optimal for squeezing balloon-shaped objects. Existing automated AMBU systems are not portable, which causes them to be inefficient in times of emergency. The novel Ambu system, inspired by the heartbeat, can make automation practical and make the system portable.

Keywords: Ambu, automation, heart, web stratum, battery, pulley, electrical engine, plastic chain

1. Introduction

Ambu is another name for the bag valve mask (BVM). The device is a hand-held device that is used to provide pressure ventilation to patients who are not breathing or not breathing sufficiently. The device is used by trained professionals who work in hospitals and ambulances in times of emergency. Healthcare workers have difficulty using the Ambu. Using the Ambu takes loads of human power and time. Time consumption is a big problem for healthcare workers because they might be needed for another patient. Especially with the corona, more workers are needed for the patients in the hospitals, so making the Ambu automated would help the health sector.

Although there are already existing automated Ambu projects in the field, most of the projects are not portable or too expensive. The Ambu has to be cheap and portable to be used for emergencies. The need for cheapness is due to the fast production of Ambu. It needs to be produced fast because Ambu is frequently used and there has to be a lot of Ambu on the marketplace. The Ambu system has to be portable since it is an essential part of the first aid kit.

Using an Ambu system which is like the heart allows Ambu to be both cheap and portable. Heart has four chambers that ensure blood flow to the body. These heart chambers are similar to

the Ambu balloon, they are being exposed to pressure at certain rates, and certain speeds. Thus, an Ambu with web stratum was built.

2. Problems of Other Ambu Designs:

Not automated Ambus need human power. Additionally, speed of contraction and power of contraction can be changed by the user. So, they are not appropriate for patients' needs. They can not be used for every patient. Moreover, the mask part of an not automated Ambus is not fit to every patient's face. Someone has to keep it on patients' faces.

Automated Ambus are too big. People can not use or carry these machines easily. It is impossible to use them outside of hospitals. Also, their masks have similar problems as not automated Ambus. They do not easily fit on patients' faces. And someone must use them. Some of the automated Ambus are not portable. Being not portable is a major problem for an emergency gadget like Ambu. Design of an emergency gadget must contain portability, because the word emergency means sudden and unexpected therefore if an emergency gadget does not have a sudden effect it is useless.

3. Our Design

In some of the previous research, designers were inspired by lungs. They tried to use a negative pressure method for their Ambu designs but this method makes their design very big and useless. So, we were inspired by another organ since we want to increase portability and usefulness. We are inspired by the most powerful pump of the human body; it is the heart.

The heart has a special muscle structure. In this way, it can work tirelessly. However, we are inspired by the heart's nerve structure. It distributes self-produced electrical impulses to all hearts. In this way, all parts of the heart work synchronously.

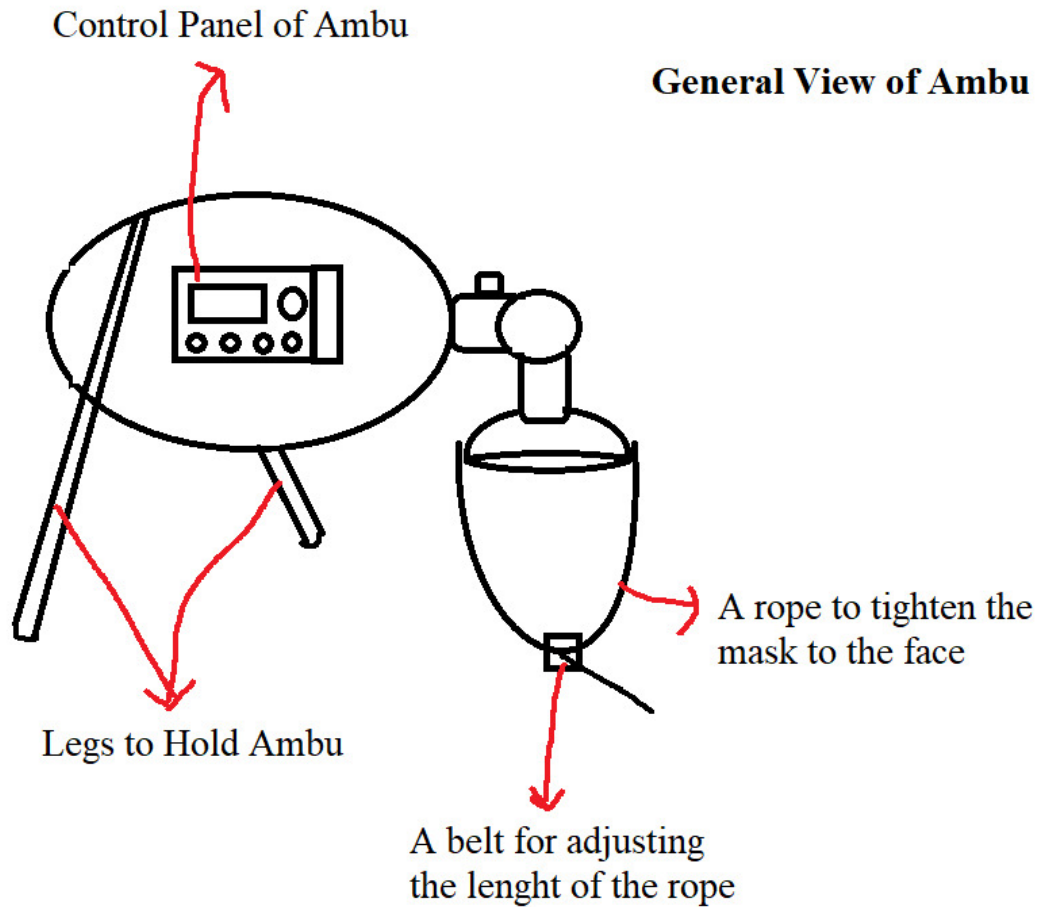
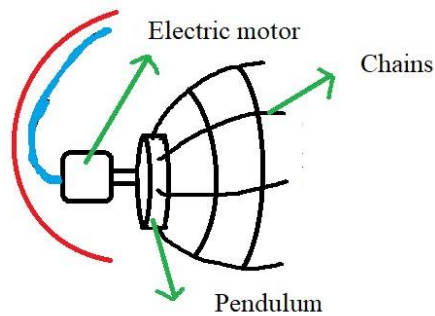


Fig. 1 General overview of our design.

We tried to make our Ambu work with our system that is designed as a web. Our ambu's self-inflating bag has three stratus. There is the air that will be given to the patient inside of the innermost plastic stratum. We developed a web stratum which is built by plastic chains and pulleys over the innermost plastic stratum.

Detailed Drawing of Web Stratum

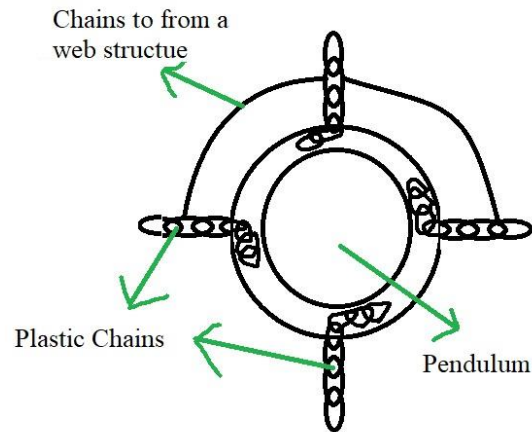
Side View of Web Stratum



The red curve demonstrates the third stratum of the Ambu. The blue curve is the electric cable that comes from the control board of the Ambu

The electric motor will move the pendulum to the right while the other electric motor moves the pendulum on the other side left

Pendulum and Chains



The pendulum will wrap the chains, after that the Ambu will be squeezed by the tight web structure and Ambu will send oxygen

Fig. 2 Explains how the system works.

These plastic chains are tied to the pulleys which are placed at the two poles of the Ambu. These pulleys can spin because of electric engines that are placed over pulleys. These pulleys wrap these plastic chains around themselves. Thus, free plastic chains are shortened and Ambu convulses. And the third stratum of Ambu protects all these mechanisms which are made of plastic. There are wires which provide the electrical needs of electric engines inside of the third stratum. Furthermore, there is a control panel over the third stratum.

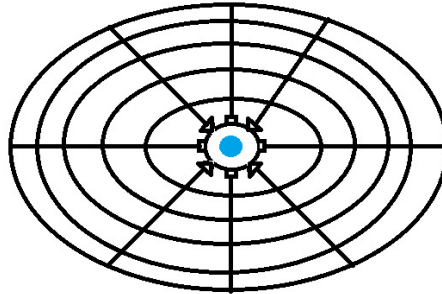
Stratums of Ambu

Innermost Plastic Stratum

The innermost stratum of the Ambu has the same properties as the plastic Ambu balloon. The only difference is, it has two more layers above it.

Web Stratum

One pillar of the web stratum



The blue circle in the middle of the web stratum is an electric motor which will move the pulley in the middle.

Lines that go into the pulley demonstrate plastic chains that form a web innermost plastic stratum.

Third Stratum

This part holds the controller of ambu and has the electrical cables which are connected to motors on the gears of the mechanism

Fig. 3 Shows the stratums of the Ambu.

Another part of Ambu which is developed by us is the mask. The belt system we have developed ensures that the mask fits the patient's face perfectly.

Manpower can be saved by this design. Furthermore, the number of contractions and power of contraction were based on the person who used the Ambu in previous designs. However, they can be regulated by people owing to our design. Additionally, The lightness of our design also provides a solution to the weight problem of other automated Ambu designs.

More Detailed Drawing of the Control Panel

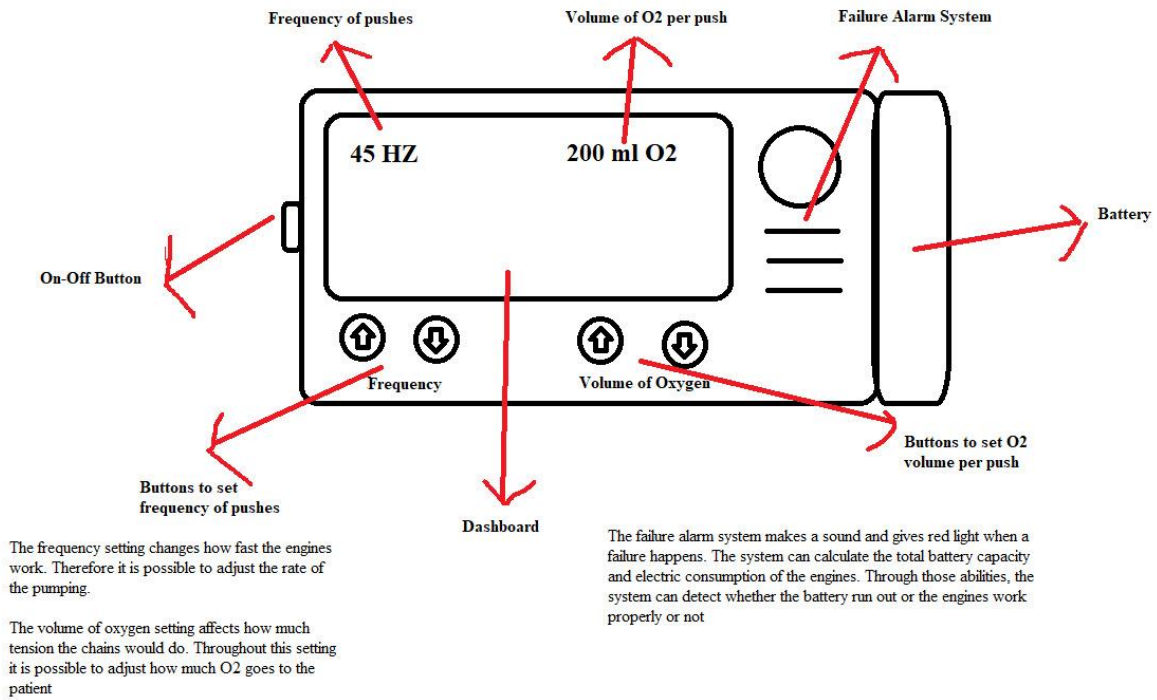


Fig. 4 Explains how the control panel works.