Anesthesia Machine Control Using Raspberry Pi

Aashika R[1], K. V. Mahendra Prashanth[2]

[1]M. Tech in VLSI Design and Embedded System, SJBIT

[2]Principal, SJBIT

Abstract: ***Any surgical procedure requires the administration of anaesthesia to the patient. The patient won't feel any pain while receiving treatment thanks to the anaesthesia. The necessary time intervals are provided since the anaesthetic effect should be there regardless of how long the procedure takes. What occurs if it is not provided at the appointed time? Significant health issues will result. In order to prevent such unfavorable occurrences, this project was created to build an automated anaesthetic controller using a Raspberry Pi. The anaesthetist can choose how much anaesthesia to provide to the patient. The operation may be started by the anaesthetist using the switch panel, and once the Raspberry Pi receives the signal, it takes control of the complete setup by telling the motor driver to turn on the motors and start the anaesthetic infusion. As a little quantity of anaesthesia is administered into the patient's body, his or her heartbeat, temperature, oxygen saturation level, and body moisture state will be checked. It will determine whether or not the heartbeat count is normal after the injection. If everything appears to be in order, the second medication dose will be given. The administration shall be stopped and the doctor informed if any irregularities are detected by the medical parameters. Only until things have stabilized will the administration continue. Only once everything has restored to normal will the administration continue.***

Keywords: Anesthesia, Raspberry Pi, Heartrate, Temperature, SPO2, Body Wetness, infusion

1. Introduction

Reduced oxygenation in the post - anesthesia period is caused by the impairment of pulmonary function caused by anaesthesia and mechanical breathing, which occurs even in healthy individuals. Additionally, they result in a 50% reduction in functional residual as compared to pre - anesthesia values. It is evident that pulmonary atelectasis is a common observation in sedated individuals because it affects 85% to 90% of healthy adults. Furthermore, the majority of patients in the post - anesthesia care unit have atelectasis as their primary cause of postoperative hypoxemia, along with alveolar hypoventilation and ventilation perfusion mismatch (PACU). Numerous additional factors must be considered, including respiratory depression brought on by the kind and location of surgery that affects lung mechanics, the effects of hemodynamic impairment, and the lasting side effects of anaesthetic drugs, notably residual neuromuscular blockade. The appropriate use of anaesthesia and analgesic techniques has a measurable influence on pulmonary outcomes in the PACU when combined with attentive postoperative care. The purpose of this study is to provide healthcare professionals with the understanding they need to prevent potentially adverse consequences by concentrating on the fundamental pathophysiological causes and treatment approaches for severe respiratory episodes in the PACU. In order to avoid such risky scenarios, the creation of an automated anaesthesia project relies on a Raspberry Pi is helpful. Major surgeries either remove the compromised bodily parts or rebuild them. These procedures will cause blood loss and discomfort. Therefore, it's imperative to halt the pain and blood loss. A key element of pain treatment is anaesthesia. Automatic anaesthetic distribution is necessary for a successful procedure since anaesthesia is essential for painless surgery.

2. Functions Performed by Anaesthesia Machine

1) To assess the patient's health and begin administering the next dose of anaesthetic if everything is in order.
2) Checks for the presence of gas in operating rooms and alerts personnel if there is a leak.
3) Lessens the risks associated with anaesthesia for both patients and medical staff.
4) Notifies the anaesthetists of their upcoming dosage
5) Notifies the relevant doctor if the patient's health is out of the ordinary.

3. Objective of Anesthesia Machine

1) Calculate the anaesthetic medication dosage and properly fill the syringe with the necessary amount.
2) To monitor biological indicators and start the process of giving the next dose of anaesthesia.
3) To access and manage the system's operation remotely.

4. Identification of the Problem

1) A large anaesthetic dosage given at once puts the patient's health at danger.
2) An anaesthetist is available for long - duration operations to provide anaesthesia at intervals.
3) A mistake was made when calculating the dose.

5. Flowchart

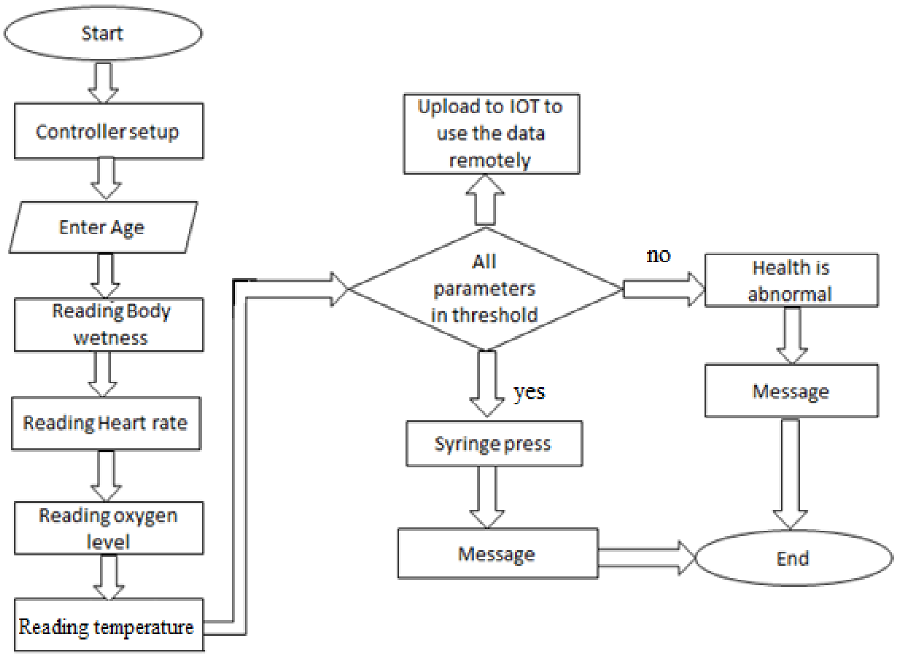

Figure 1: Flowchart of Anesthesia machine control.

The above - mentioned flow chart describes how the suggested system operates. When the power supply is turned on, the system powers up right away; controller setup happens first. The controller prompts for patient age entry following setup. The controller next measures the gas level and the moisture state, followed by the heart rate and SPO2, and finally the body temperature. The syringe push for the subsequent dosage of anaesthetic is started if all these parameters fall inside the threshold. Following the start of the subsequent dosage, the relevant doctor is informed of the amount of anaesthetic that has been administered, and all the parameters are uploaded to the cloud where they may be retrieved remotely.

6. Block Diagram

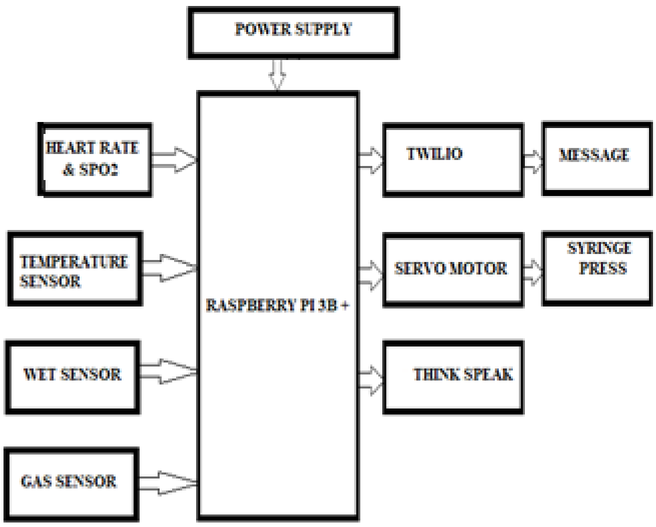

Figure 2: Block diagram

The suggested system's block diagram is shown in Figure 2. The Raspberry Pi module receives power through a DC connector. Temperature, moisture, gas, and heart rate sensors are all interfaced by the Raspberry Pi. To transmit messages, Twilio is installed on the Raspberry Pi.

The raspberry pi module is coupled to a servo motor. Everything that is measured and submitted to the IOT platform "Think Speak".

7. Results

Figure 3: CO2 and wet condition uploaded to ThinkSpeak.

Figure 4: Temperature and humidity condition uploaded to ThinkSpeak

Age	CO2	Wet Sensor	Heart Rate	SPO2	Body temperature	Next Dosage
10	Present	Not Present	115.36	97.3	36	10ml
15	Present	Not Present	113	95	35	20ml
25	Present	Present	100	99.9	37	30ml
45	Present	Present	112	96	34	20ml
60	Present	Not Present	78	80	35	Nil

Figure 5: Measurement of medical parameters with different patient's condition

8. Advantages

1) The recommended method does not require an anaesthetist to be present to oversee the anaesthetic doses given during surgery.
2) By eliminating the risk of human mistake, this increases accuracy.
3) It considers biological factors since they are essential for determining the patient's overall health.

9. Applications

1) Insulin injections can be administered using the suggested system
2) Antibiotic injections can also be administered with this approach
3) It can be used to provide an intravenous painkiller. Additionally, blood can be supplied to patients via it.
4) It can be used by cancer patients to provide medications by injection.

10. Conclusion

Modern technology has improved automation in many facets of biomedical devices. The automated syringe pump based on the Raspberry Pi was successfully constructed as a result of this analysis, and the test data was examined in order to evaluate the system's functionality. It is decided that the 10 mm acrylic syringe pump housing will be rectangular. The syringe pump may operate in a volume range of 0.10 - 30.00 ml with a flow rate resolution of 0.10 ml - 1ml and an error value of less than 5 percent. The accuracy of the automated syringe pump that was created is 95.56 percent.

11. Future Scope

This module, which may be connected to the anaesthetic ventilator for future usage, can assess the patient's blood sugar level and determine whether or not the next dose should be administered. They can also interact with EEG parameters for major procedures. When using the recommended approach, an anesthesiologist is not always required to be present physically, and the amount of anaesthesia that is needed is exactly predicted and given, preventing any future negative effects brought on by variations in anaesthetic levels.

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