Journal of Positive School Psychology http://journalppw.com
2022, Vol. 6, No. 7, 780-784

Automated Anesthesia Control System With Patient Monitoring

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ABSTRACT

Providing painless surgery and delivering an accurate dose of anesthesia to the patient plays a very crucial role in any major surgeries. Failing in providing an accurate dose to the patient may show adverse effects and postoperative complications. In case of major surgeries which could take a longer period, the complete dosage of anesthesia could not be administered in a single dose to the patient since it may show lethal complications. Administering less dose of anesthesia makes the patient regain consciousness during the surgery. It is not easy for the anesthetist to deliver an accurate dose of anesthesia at regular intervals of time. To overcome such complications during surgeries a computer-controlled syringe is designed to deliver an accurate dose of anesthesia at regular intervals of time with constant speed. Therefore this project aims to introduce an automatic anesthesia control system integrating with monitoring parameters using Arduino Uno.

INTRODUCTION

Anesthesia is a medical drug that can be given to the patient to avoid pain during surgeries. It is the greatest discovery in the medicine which provides comfort to both patient and doctor while performing surgeries. Anesthesia is divided into three types General, Regional and Local Anesthesia. General anesthesia is mainly used for all major surgeries to make the patient unconscious, Local can be given to the numb small area of the body whereas Regional can be given to block pain in an area of the body such as an arm or leg. Delivery of anesthesia can be given to the patients in two ways either through inhalation or intravenous. Giving intravenous anesthesia shows a quick response in patients. Anesthesiologists are overloaded with multiple tasks like to deliver anesthesia continuously to maintain unconsciousness till the end of surgery and also need to monitor physiological parameters side by side.

This Embedded system uses a syringe pump to deliver the right amount of anesthesia to the patient. The anesthetist can set the desired amount of anesthesia that can be given to the patient with the help of a switch panel. Once the Arduino Uno receives the signal it activates the motor driver to drive the syringe pump at the preset intervals. The anesthesia is delivered to the patient according to the rotation of the stepper motor. After administration of anesthesia, the vital parameters like Temperature, Exhalation breath temperature, and Pulse are monitored side by side. If they are under the normal state then the second dose of anesthesia will be injected. On the onset of abnormality the doctor will be notified through a buzzer and anesthesia delivery would continue only if everything is under normal. Additionally, these parameters are checked by corresponding sensors. This integration of monitoring parameters increases the patient's safety and keeps the anaesthesiologists at ease.

Types of Anesthesia

- General Anesthesia.
- IV/Monitored Sedation.
- Regional Anesthesia
- Local Anesthesia.

DESCRIPTION

Arduino Uno

The UNO is the best board to get started with electronics and coding. If this is your first experience tinkering with the platform, the UNO is

the most robust board you can start playing with. The UNO is the most used and documented board of the whole Arduino family.

Fig 1:Arduino Uno

Heartbeat Sensor

This project uses bright infrared (IR) LED and a phototransistor to detect the pulse of the finger, a red LED flashes with each pulse. Pulse monitor works as follows: The LED is the light side of the finger, and phototransistor on the other side of the finger, phototransistor used to obtain the flux emitted, when the blood pressure pulse by the finger when the resistance of the photo transistor will be slightly changed.

Fig 2: Heartbeat Sensor

ECG Sensor

The AD8232 is an integrated signal conditioning block for ECG and other bio potential measurement applications. The AD8232 is a neat little chip used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram. Electrocardiography is used to help diagnose various heart conditions.It is designed to extract, amplify, and filter small bio potential signals in the presence of noisy conditions, such as those created by motion or remote electrode placement. This design allows for an ultralow power analog-to-digital converter (ADC) or an embedded microcontroller to acquire the output signal easily.

Fig 3: AD8232

LCD

LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors and instrument panels.

Fig 4: LCD

Keypad

At the lowest level, keyboards are organized in a matrix of rows and columns. The CPU accesses both rows and column through ports; therefore, with two 8-bit ports, an 8*8 matrix of keys can be connected to a microprocessor. When a key pressed, a row and column make a connect; otherwise, there is no connection between row and column. In IBM PC keyboards, a single microcontroller (consisting of microprocessor, RAM and EPROM, and several ports all on a single chip) takes care of software and hardware interfacing of keyboard. In such systems it is the function of programs stored in the EPROM of microcontroller to scan the keys continuously, identify which one has been activated, and present it to the motherboard.

Fig 4: Keypad

DHT11 Temperature & Humidity Sensor

This DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digitalsignal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and costeffectiveness.

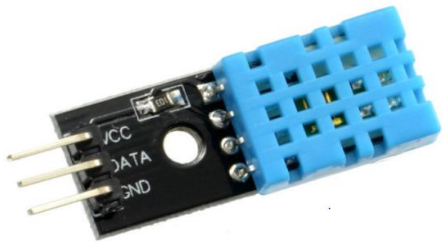

Fig 5: DHT11

Nebuliser Mask

A nebulizer mask looks and is very similar to a regular oxygen mask commonly used in the hospital. Unlike a mouthpiece, it covers the mouth and nose and is usually held onto the face using an elastic band. A nebulizer changes liquid medicine into fine droplets (in aerosol or mist form) that are inhaled through a mouthpiece or mask. Nebulizers can be used to deliver many types of medicines. The medicines and moisture help control breathing problems like wheezing and help loosen lung secretions.

Fig 6: Mask

Methodology

In this project, we have used Arduino UNO microcontroller which acts as brain of our system, hence the entire system program is stored in it. The system consists of temperature, heart beat and ECG sensors which are used to monitor the patient's vitals and the drug is infused accordingly through the keypad. These processes will be displayed on LCD display. Historically there have been 2 methods of administering IV drugs during anesthesia: bolus dose and continuous infusion. Bolus doses are typically administered with a handheld syringe. Infusions are typically administered with an infusion pump. Every anesthetic drug accumulates in tissue during drug delivery.

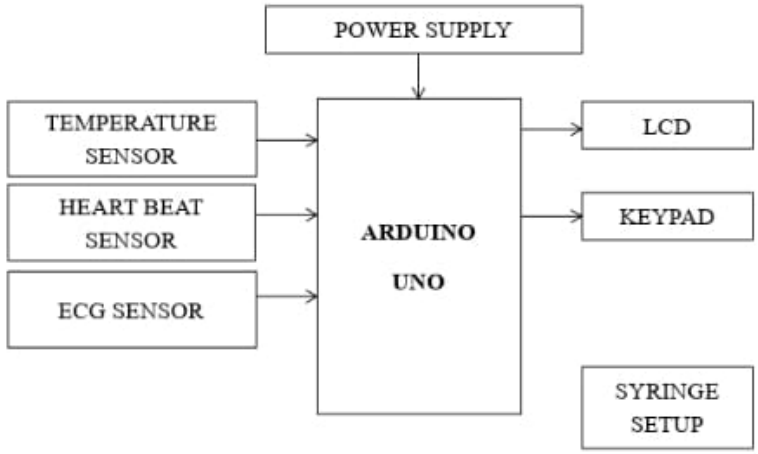

Fig 7: Block diagram for Patient Monitoring

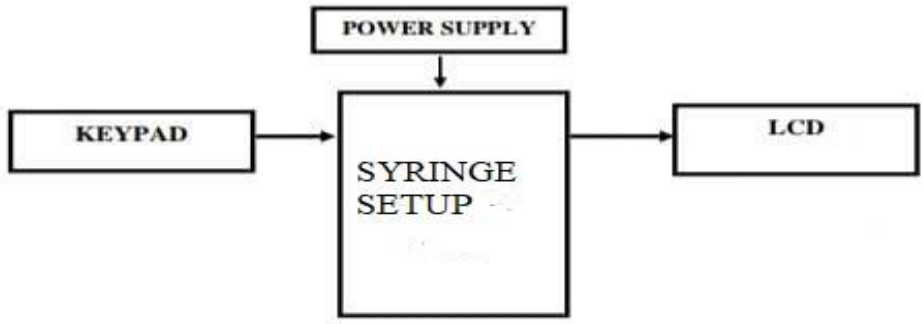

Fig 8: Block diagram for Syringe Setup

Result

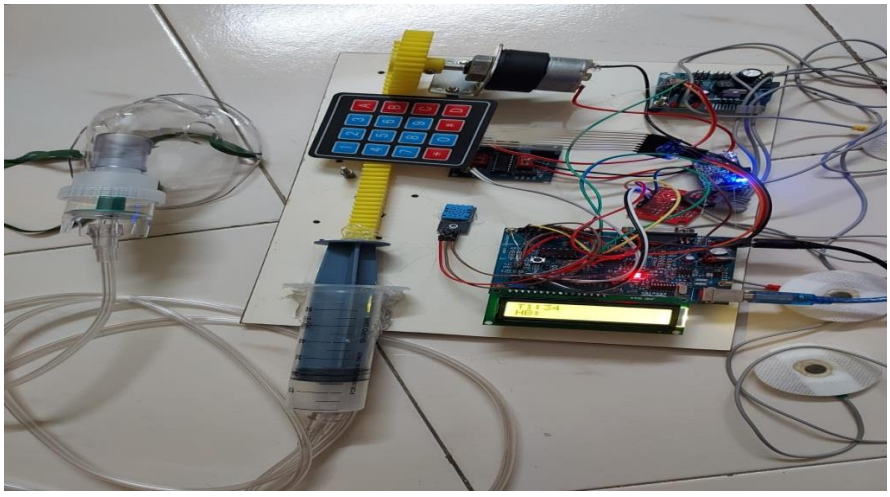

Fig 9: Output

Applications

- To integrate monitoring system along with the anesthesia machine
- To reduce the human error
- To make it applicable in emergency situation

CONCLUSION

From the overall conduct of the project, monitoring patient's parameters plays very crucial role when patient is under anesthesia. It's not easy for anesthesiologists to focus on multiple tasks. So Embedded patient monitoring system has been

designed with different sensors to give alert to anesthesiologist if any abnormality occurs while delivering anesthesia to the patient via syringe pump which in turn controlled by stepper motor.

This project can be improved further by integrating few more monitoring parameters like SpO2, Blood pressure sensor. It can also be improved to control the motor with anyone of the parameter by making it stop if any abnormality occurs in patient's vital signs.

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