International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-11, September 2020

Automatic Anaesthesia Regulation System (Aars) With Patient Monitoring Module using Multitask Feedback Network

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Abstract – A surgical procedure will always involve an anesthetic process to the patient to start the surgery. In major surgeries the patient will be administered with large amount of anesthesia where the procedure might take 4 to 5 hours to complete. And a complete dosage of anesthesia cannot be delivered at once. High dosage can affect the patient to enter coma stage. And low dosage can lead to more dangerous condition where the patient might regain consciousness during the middle of the surgery itself. Hence depending on the vial parameters of the patient, anesthesia can be regulated and delivered using a feedback analysis to reduce further side effects.

Index Terms - Syringe pump, DC motor, Anesthesia regulation, over dose

I. INTRODUCTION

Anesthesia is the most important process that is being followed prior to the conduction of any major or minor surgeries. Usually Anesthesia is delivered manually in clinical practices. Due to this a lot of problems occur during the surgery i.e. anesthesia might be having a very high dosage or low dosage due to which adverse effects of complexities may occur to the patient. Moreover anesthetist may fail to administer the accurate dose of anesthesia for the amount of the predestined time which could be disturbed the patient during operation. Human errors which are neglect able also may cause various side effects on the patient. Hence an automatic mechanism of mechanical syringe pump is employed to deliver and regulate anesthesia. The anesthetist can set the keypad to administer the dose of anesthesia in terms of mill liters per hours. The keypad transmits analog signal to the arduino Uno to regulate the desired dose of anesthesia to be fed into DC motor to work injection pump. Anesthesia will be administered that supports the patient's body condition and movement of syringe within the forward or backward direction supported the rotation of DC motor. This module will play a significant role within the field of medication and useful to the physicians during surgery to supply the will amount of anesthesia. In many applications within the medical industry today embedded system is employed to regulate various biological and biomedical parameters. Based on the vital parameters like temperature, heart rate, respiration rate the microcontroller will have an input of the binary values and process the signals.

Revised Manuscript Received on September 30, 2020.
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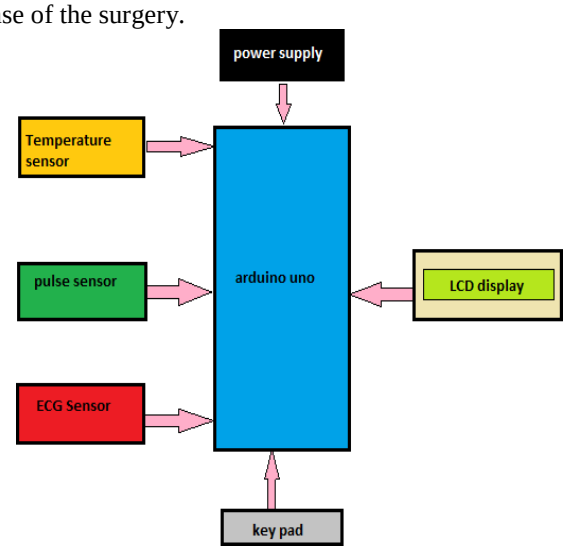
These signals according to the limit set will help in regulating the DC motor to deliver anesthesia. The peristaltic movement in the infusion pump and the to and fro movement in the syringe pump mechanism is taken for consideration. This forward and backward movement facilitated the delivery of anesthesia and regulates by delivering in the proper minimal amount. Embedded system which is the basis of many of the instrumentation and signal processing process is implemented.

II. PROBLEM DEFINITIONS

The main purpose of this project is to help the anesthetist concentrate more on the other tasks during surgery like, fluid balance, ventilation, drug application so that they can extent the patient's safety caused due to the other problem. The regulation of anesthesia is made automatic, i.e. the injection delivering anesthesia is regulated according to the patient's vital parameters. The efficiency of delivering anesthesia is improved due to complete monitoring of the patients vital parameters and helps in regulating the required dosage of anesthesia.

III. METHODOLOGY

Heartbeat sensor to monitor the heartbeat of the patient Temperature sensor to monitor the body temperature of the patient Arduino Uno is used for storing the sensor values and also for controlling the actuation mechanism Infusion set which is used during the maintenance phase of the Surgery mechanism which is used during the induction phase of the surgery.



Anesthesia control system block diagram

3.1 Hardware requirements

1) Arduino Uno
2) LCD
3) Motor driver
4) Heart beat sensor
5) Temperature sensor
6) Syringe pump
7) Keypad

3.1.1. Arduino

Uno may be a board supported the ATmega328 (datasheet) Microcontroller. it's 14 digital input / output pins (6 of which might be used as PWM outputs) , 6 analog inputs, 16 MHz oscillator , a USB interface, an influence jack, an ICSP header and a reset key. It holds the full thing necessary to support the microcontroller; simply connect into a computer with a USB cable or power it with an AC-to-DC adapter or battery to urge started.

3.1.2 Temperature sensor LM35:

LM35 provides more reliable temperature output than thermistor output. LM35 could be a precession computer circuit temperature sensor keen about the temperature around it, whose output voltage varies. It's a tiny low and cheap IC which will be used anywhere from -55 ° C to 150 ° C to calculate temperature. It is easily interfaced with any Microcontroller which has ADC or any development platform.

3.1.3 Pulse sensor:

The Pulse / Heart beat sensor works fine. The sensor has two sides, on one side the LED is placed together with an ambient light sensor and on the opposite side we've some circuitry. This circuitry is answerable for the amplification and noise cancellation work. The LED on the front side of the sensor is placed over a vein in our form. This could either be your Finger tip otherwise you ear tips, but it should be placed directly on top of a vein. Now the LED emits light which is able to fall on the vein directly. The veins will only have blood flow inside them when the guts are pumping, so if we monitor the blood flow we will also monitor the guts beats.

3.1.4 ECG Sensor:

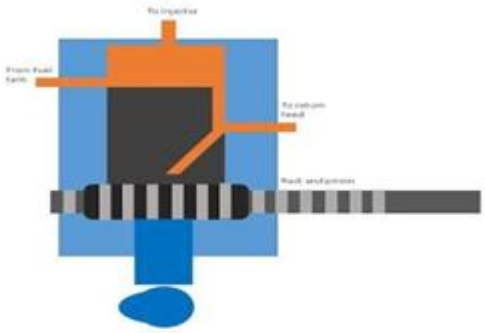
The AD8232 is an integrated signal conditioning system for ECG and other applications for bio potentials calculation. it's in-built the presence of noisy conditions like those produced by motion or remote placement of electrodes to gather, amplify, and filter tiny bio potential signals. The AD8232 module breaks out nine IC connections which may be soldered to pins, wires or other connectors SDN, LO+, LO-, OUTPUT, 3.3V, GND provide critical pins for the employment of an arduino or other development board on this display. RA (Right Arm), LA (Left Arm), and RL (Right Leg) pins also are included on this board to mount and use your own custom sensors. There's also an LED indicator light, which pulsates to the rhythm of a heart beat.

3.1.5 Keypad:

In this system we use mode switch that encompass dual operation i.e. automation mod and manual mode this switch is controlled by keypad.

3.1.6 Injection pump:

Generally, there's a mini pump that issued to transfer fuel from the tank into the injection pump. This pump works mechanically, meaning it's driven by the crank shaft engine. When the crankshaft rotates, the mini pump will send diesel oil from the tank into the injection pump through the inlet feed. From the inlet feed, the fuel directly fills the fuel barrel and it's able to be pressed.



The injection pumps mechanism:

The pump camshaft is connected to the engine crankshaft, so when the engine cranks automatically the pump camshaft rotates. This rotation will move the plunger, in order that the plunger is pressed upwards and as a result the fuel that's already within the fuel barrel is pressed with high and enters the injector. When the cam has finished pressing the plunger, the plunger returns to the underside position. This can reopen the fuel barrel chamber, so the fuel from the inlet feed filling the fuel barrel directly.

IV. RESULTS

All the vital parameters are monitored or every 30s. Depending on the limits set, the anesthesia regulation will be initiated. The temperature, Blood pressure, ECG analysis and respiration rate will be monitored. The higher the blood pressure and heart rate, the regulation of anesthesia will be given via syringe pump mechanism and deliver the drugs in few mille liters. Therefore the anesthesia regulation is depending on the patient's body state. All the values of the vital parameters will be fed as input to arduino as binary bits. Hence depending on the binary bits the amount of anesthesia to be delivered is initiated. If the temperature is below 20^0 C, or if the heart beat drops less than 40 beats per minute, if respiration rate is reduces to 10 cycles per minute, then the regulation of anesthesia will be automatically started and delivered to the patient in minimal amount to save the patient from dying.

Administration of anesthesia pharmacologically induced temporary loss of sensation and reversible state of loss of responsiveness, loss of muscle reflexes provided simultaneously.

Fig: Syringe connected to DC motor, ECG sensors, temperature sensor, pulse sensors connected to arduino

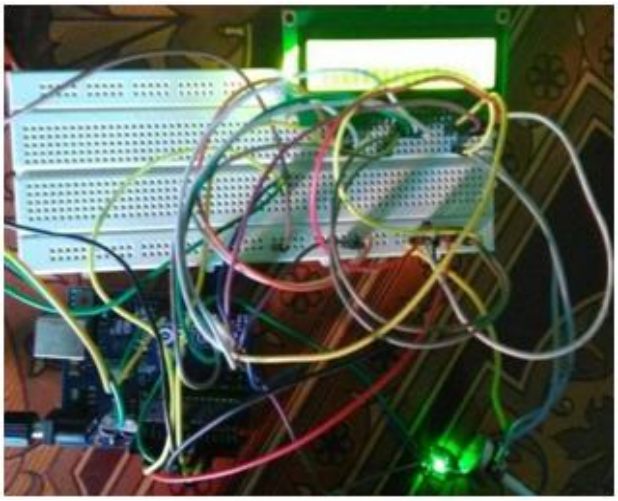


Fig: Temperature and pulse changes indicated to regulate anesthesia.

Patients die due to adverse effects of improper administration of anesthesia. For painful surgeries drug delivery has to be done and cannot be avoided .Proper delivery of anesthesia with utmost care can only reduce these adverse effects. But human errors do occur. This project will help in delivering the drug automatically and save the patient from this adverse effect of drug delivery. A speedy and accurate operation will also be facilitated.

V. CONCLUSION

All the diagnostic procedures are mostly automatic now days with the increase in development of the instrumentation in biomedical field. But during a surgery with major problem or minor problem, the delivery of anesthesia remains very crucial and has to be delivered with an accurate amount. This project can also be used when an anesthesia machine and ventilator are combined together. The vital parameter monitoring help in the surgical procedures. This is extremely very helpful to the anesthesiologist in monitoring the other important parameters as well. This project can be connected to EEG electrodes and also monitor the complete physiological parameters. Advantages of using the proposed system are physical presence of anesthetist isn't always required, the specified level of anesthesia is precisely calculated and administered in order that future side effects thanks to variations in anesthesia levels are eliminated. During the compete procedure the anesthesia will be regulated

S.No	Age	Temperature Sensor	Pulse Sensor
1	21	Normal temperature	71 beats per minute
		High temperature	36.6 Celsius
2	44	Normal tempera ture	73 beats per minute
		High temperature	39.5 Celsius

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