Measurement of Multi Parameters using Anaesthesia Injector Based on Arm Processor

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Abstract— generally the patient should be anaesthetized while major operations are done. If the operations are performed for longer run, the anaesthesia cannot be given at a stretch. The amount of anaesthesia that is delivered to the patient is very important because the over dosage can threaten the life of the patient. If lower quantity is injected then at the time of surgical procedure patient may get conscious and they will feel the surgical pain. To overcome these problems, an automatic anaesthesia machine was designed using an ARM processor. This anaesthesia machine will be very much helpful in delivering the correct amount of anaesthesia in a particular period of time. In this method, a keypad is used for setting the amount of anaesthesia by the anaesthetist and it is delivered using a syringe pump. As soon as the value is entered, the microprocessor accesses the values and starts delivering the anaesthesia through the syringe pump by initiating the stepper motor. The stepper motor is used to drive the syringe pump. According to the stepper motor rotation the amount of anaesthesia will be administered to the patient and if anything goes wrong the alarm will turn on to indicate that there is some problem with the machine.

Key words: Patient, Anaesthesia, Syringe pump, ARM processor, Stepper motor, Display.

I. INTRODUCTION

Mostly all the operations involve cutting and coagulation while treating the infected organ. This will surely lead to loss of blood and pain. Therefore the blood loss and pain has to be completely stopped are reduced. To reduce the pain anaesthesia plays a major role because of anaesthesia the patient can't feel any pain while cutting the skin. At the time of performing the surgical procedures the anaesthesia has to be administered automatically. During anaesthesia administration various biological parameters has to be measured. For measuring the parameter embedded systems are used.

In this system, the ARM processor plays an important role so that it has control the whole unit while delivering the anaesthesia automatically. The biological parameter measured is heart rate, respiration rate and temperature rate. Here the temperature and respiration rate are digitally displayed through a 7 segment LCD display. In heart rate measurement the waveform of ECG is shown through another display.

Advantages of these systems are given below

- The anaesthetist is not needed for the whole procedure.
- The amount of anaesthesia is delivered correctly.
- The patient's heart condition can be easily monitored with the help of ECG.

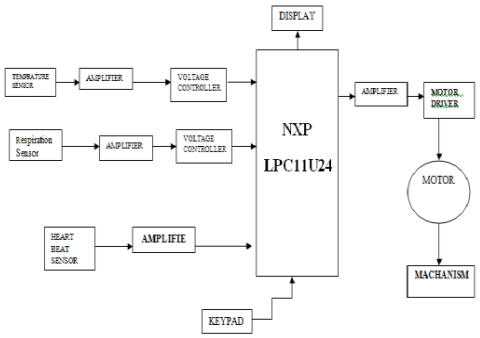

Fig: Block diagram

II. WORKING

The keypad is connected with the ARM processor in which the amount of anaesthesia to be delivered is entered. The anaesthesia to be administered in the range of millilitres per hour. When the processor receives the value it will control the system to deliver the administered level. Based on the direction of rotation of stepper motor the biological parameters are measured. The stepper motor rotation will make the syringe pump to move forward and backward to deliver the prescribed amount of anaesthesia to the patient. If the anaesthesia level in the machine is lower than the set value an alarm will be switched on to alert the anaesthetist or the nearby person to refill the cartridge to continue the process. With the help o this system the opposite blood flow can also be detected.

III. COMPONENTS REQUIRED

- Respiration sensor used to measure the respiration rate.
- Temperature sensor used to measure the body temperature of the patient.
- Heart beat sensor used to measure the heartbeat.
- Microprocessor used to control the overall process.
- Stepper motor used to control the movement of the syringe pump.
- Amplifiers are used to amplify the biomedical signal because the amplitude of those signals will be always low.
- 7 segment displays is used as a digital display for showing the values of respiration rate, temperature rate and heartbeat.
- An analog display is used for figuring out the ECG waveform.

IV. PARAMETERS

The main three parameters that are measured are used to determine the condition of the patient. Based on these parameter the stepper motor movement is determined. To analyses the biological parameters transducers and

thermistors are used. The nature of the transducer and thermistors are given below

The size of the thermistor and transducer should be small and tiny so that they can inserted onto the tissues.

A. Temperature Sensor

By using thermistors the temperature can be measured accurately. The thermistor is a semiconductor device whose resistance is sensitive to temperature and it has high temperature coefficient. The resistor value decreases with increase in temperature. The temperature co-efficient of resistance is normally negative. The resultant output is sent to the amplifier for further amplification of signals. The alternative component of thermistor is resistance thermometer. The measurement technique of these two components is same. Because of its stability, the resistance characteristics do not drift with repeated heating or cooling and high resistivity to permit the construction of small sensors.

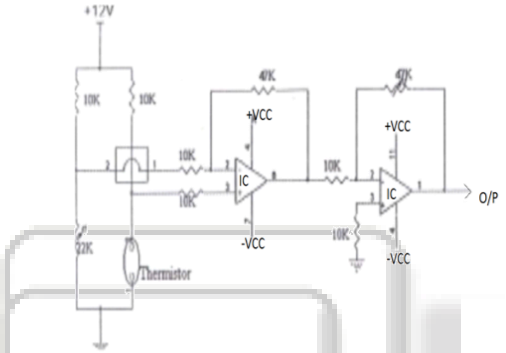

Fig: Circuit to measure temperature

B. Respiration Sensor

The respiratory system is used to supply oxygen and remove carbon dioxide from the tissues. The breathing action is controlled by the internal and external inter-coastal muscles. The carbon dioxide from the blood was removed and the respiration sensor is used to measure the respiratory rate.

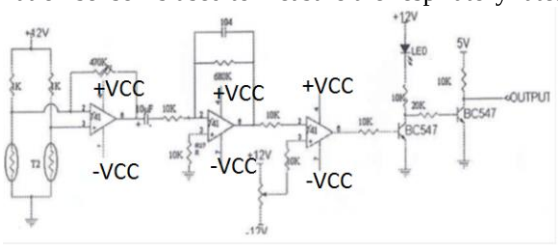

Fig: Respiration rate meter

C. Heart Beat Sensor

The heart beat sensor is used to monitor the condition of the heart. The conduction system involves heart which is in the size of the owner's fist. The normal heart beat range in 72 beats per minute. The heart beat rate can be measured in two ways

- Electrocardiogram
- Pulse rate

1) Electrocardiogram:

The ECG is the measurement of electrical activity of the heart. The measurement is based on Einthoven triangle. The electrodes are placed on the right arm, left arm and left leg. The reference electrode is placed on the right leg. The potential difference between two electrodes is measured as the electrical activity of the heart. The Einthoven triangle states that the sum of instantaneous voltage of three electrodes will be equal to zero. Then the signals are picked up by the electrodes and then passed to a high gain differential amplifier and then ECG signal is obtained.

2) Pulse:

The pulse signal refers to the flow of blood that passes from heart to the limbs. The pulse was measured on the wrist of the patient. Pulse rate is different from the heart rate. This pulse occurs once per heartbeat. These signals can be picked up by keeping a piezo-electric pick up on the wrist.

V. HARDWARE DESCRIPTION

A. Processor

The microprocessor is used to control the whole unit. This has more memory and IO devices that are connected to the data bus and pins in the integrated circuits. The microprocessor uses the single and double byte instruction that are used to move the data from the memory device to the ALU. The pins in the microprocessor are programmable so that each and every pin has several functions.

B. Stepper Motor

A stepper motor is used to covert the electrical pulse into equal incriminatory steps. The stepper motor work in connection with the electronic switching devices. The switching device is used to control the windings of the stepper motor with particular frequencies. It has a stator and the non-exited rotor. Stepper motor is classified into 2-phase, 3-phase or 4-phase depending on the stator windings.

C. Syringe Pump

Syringe pump is used to deliver the correct amount of medication in a regular period of time. During critical care the syringe pump is used to deliver the anaesthesia to the patient continuously by moving the plunger towards the medication. An IR sensor is attached to the syringe pump for alarm. The pump will automatically give an alarm when there is any bubbles in the medication or if there is no medication. Smaller amounts can also be delivered using small syringes.

VI. SOFTWARE DESCRIPTION

To measure the biological parameters the processor need some program to operate NXP LPC11u24

- The microprocessor should read the valued from the keypad.
- When the timer overflows the internal timer is enabled to interrupt the processor.
- In a specified interval of time the biological parameters are measured.
- When the level of anaesthesia goes down the alarm will be turned on.
- The movement of the stepper motor is determined.

VII. SUMMARY

The electrical signals are used to measure the biological parameters. The resultant signals are amplified through an amplifier and the signal voltage is controlled by a voltage controller. After amplification the signal is sent to the microprocessor then it follows the analog to digital

convertor. This A/D convertor is used to convert the analog signals of respiration, temperature and heart beat rate into digital values. A separate display is used for figuring out the ECG waveform. During the measurement if the amount of anaesthesia needed by the patient whether it increases or decreases this machine will automatically administers the required amount.

VIII. CONCLUSION

The processor used here will read the signal from the sensor and provide the required anaesthesia to the patients. This design is fully automatic and very much helpful for the doctors who are treating the patients. It is the cheap and best approach handled by the doctors.

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