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LOW COST ANESTHESIA INJECTOR BASED ON ARM PROCESSOR

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Abstract: In the hospitals, any major operation is performed; the patient must be in anesthetizing condition. If the operation lasts for a long time, say for suppose for 4 or 5 hours, anesthesia cannot be give in a single stroke to the patient. Over dosage may cause a critical condition for the patient's towards death. If lower amount of anesthesia is to the patient, they may wakeup at the middle of the operation. Overcome this problem, the anesthetist administers few millilitres of anesthesia per hour to the patient in a particular time period. If the anesthetist fails to administer the anesthesia to the patient at the particular time interval. Overcome this problems the design of an automatic operation of an anesthesia machine based on a microprocessor is effective. In this system a keypad is provided along with the Microprocessor and syringe infusion pump. The anesthetist can set the level of anesthesia in terms of millilitres per hour to administer anesthesia to the patient with the help of keypad. when signal is received. After receiving the signal from the keypad, the Microprocessor controls the signal to the desire level and fed into the stepper motor to drive the infusion pump in proper manner. The anesthesia is administered to the patient according to the stepper motor rotation .if any uncertain condition the alarm will on.

Keywords: Patient, Anesthesia, Syringe, Processor, Stepper Motor.

I. INTRODUCTION

Major operations are performed to remove or reconstruct the infected parts in the human body. These operations will lead to blood loss and pain. Therefore it is necessary to arrest the pain and the blood loss. Anesthesia plays an important role in the part of painkilling .AAI can be defined as "Automatic administration of anesthesia based on the bio-medical parameters of the patient, eliminating future side effects and the need for an anesthetist."Anesthesia is very essential in performing painless surgery and so an Automatic administration of Anesthesia is needed for a successful surgery.

Embedded systems are used in many applications in medical field for controlling various biomedical parameters, and monitoring biomedical signals. In this design, a ARM processor is used for controlling the anesthesia machine automatically, depending upon the various biomedical parameters such as body temperature, heart rate, respiration rate etc., Major operations are performed to remove or reconstruct the infected parts in the human body. These operations lead to blood loss and pain. Therefore it is necessary to arrest the pain and the blood loss. Anesthesia plays important role in the part of painkilling. Hence, anesthesia is very essential in performing painless surgery. Advantages of using the proposed system are,

- The need for an anesthetist is eliminated.
- Level of anesthesia is not varied, so the future side effects are eliminated.
- IR detector is also included in the system for monitoring the total anesthesia level for the entire period of the surgery time.

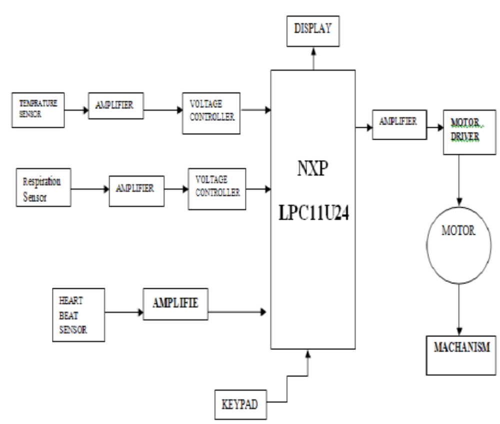

Figure 1. Block Diagram

A. Working

The keypad provided along with the Microprocessor, the anesthetist can set the level of

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anesthesia to be administered to the patient in terms of millilitres per hour (1ml to 1000ml).After receiving the anesthesia level from the keypad, the Microprocessor sets the system to administer anesthesia to the prescribed level. It then analyses various bio-medical parameters obtained from the sensors to determine the direction of rotation of the stepper motor. The rotation of the stepper motor causes the Infusion Pump to move in forward or in a backward direction and the anesthesia provided in the syringe is injected into the body of the patient. If the level of anesthesia is decreased to lower level than the set value, the alarm gets activated to alert the anesthetist to refill the anesthesia in the syringe pump to continue the process. In this design, the total timing and opposite flow of blood will also be detected by using processor.

B. Components requirement

- Temperature Sensor – to measure body temperature
- Respiration Sensor – to measure respiration
- Heart Beat Sensor – to measure heartbeat
- Micro-Controller – to Control the overall operation
- Stepper Motor – to control the movement of the Syringe Infusion Pump

II. PARAMETERS

The measurement of bio-medical parameters is a vital process. These parameters determine the overall condition of the patient. It plays a very significant process in the level of anesthesia that has to be administered to the patient. Only based on these parameters the movement of the stepper motor is determined.

Transducers and Thermistors are the key links in all sensors designed to describe and analyze the bio-medical parameters. The transducers used here are just those that find applications in patient monitoring systems and experimental work on four parameters namely blood pressure, temperature, pulse and respiratory activity. Both transducers and Thermistors are made in a wide variety of forms suitable for use in medical applications. They are available as

- Wafers for applying on the skin surfaces
- Tiny beads for inserting into the tissues

.

A. Temperature Sensor

The most accurate method to measure temperature is to use Thermistors and Resistance Thermometers. Thermistors or thermal resistor is a two-terminal semiconductor device whose resistance is temperature sensitive. The value of such resistors decreases with increase in temperature. The Thermistors have very high temperature coefficient of resistance of the order of 3% to 5% per ºC, making it an ideal temperature transducer. The temperature co-efficient of resistance is normally negative. The output of the temperature sensor is given to the amplifier stages. Resistance thermometers can also be used to measure the body temperature. Important characteristics of resistance thermometers are high temperature co-efficient to resistance, stable properties so that the resistance characteristics does not drift with repeated heating or cooling or mechanical strain and high resistivity to permit the construction of small sensors.

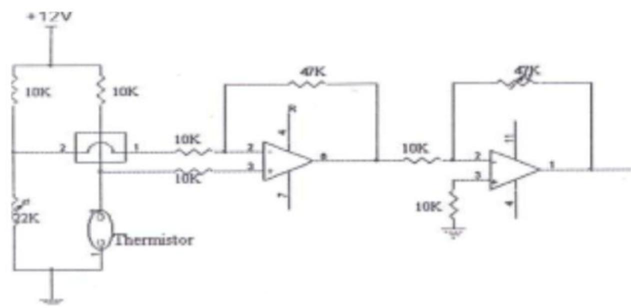

Figure 2. Circuit to measure Temperature

B. Respiration Sensor

The primary functions of the respiratory system are to supply oxygen to the tissues and remove carbon dioxide from the tissues. The action of breathing is controlled by muscular action causing the volume of the lung to increase and decrease to affect a precise and sensitive control of the tension of carbon dioxide in the arterial blood. Under normal circumstances, this is rhythmic action.

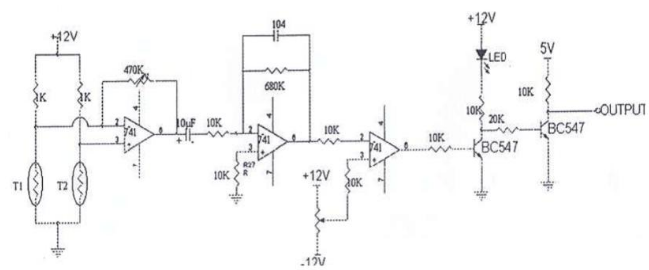

Figure 3. Circuit to measure Respiration

C. Heart Beat Sensor

Heart rate is our body's way of telling how hard it is going. It is very vital that heart beat has to be in normal while administering anesthesia to the patient. Normal heart beat is 72 beats per minute. A sensor is designed for monitoring the changes in the heart beat of the human body. There are 2 ways of monitoring heart rate information from the body. They are

- Electrocardiogram (ECG)

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- PULSE

The E.C.G or Electrocar diagram gives the electrically picked up signals from the limbs due to the nervous activity of the heart. The electrodes are pasted on to the 2 hands and the left leg, the right leg electrode serving as the common or ground reference. The signals are picked up and amplified by high gain differential amplifiers and then the electrocardiogram signal is obtained.

The *pulse signal* refers to the flow of blood that passes from the heart to the limbs and the peripheral organs once per beat. Usually, the physician looks for the pulse on the wrist of the patient. The artery is near the surface of the skin and hence easily palpable. This pulse occurs once per heart beat. These pulse signals can be picked up by keeping a piezo-electric pick up on the artery site (in the wrist).

III. HARDWARE DESCRIPTIONS

A. Processor

The design approach of the Microprocessor mirrors that of the microprocessor. The microprocessor design accomplishes a very flexible and extensive repertoire of multi-byte instructions. These instructions work in hardware configurations that enables large amount of memory and IO to be connected to address and data bus pins on the integrated circuit package. The Microprocessor design uses a much more limited set of single and double byte instructions that are used to move code and data from internal memory to the ALU. The pins are programmable that is capable of having several different functions depending on the wishes of the programmer. It is concerned with getting data from and to its own pins.

B. Stepper Motor

A stepper motor transforms electrical pulses into equal increments of rotary shaft motion called steps. A one-to-one correspondence exists between the electrical pulses and the motor steps. They work in conjunction with electronic switching devices. The function of switching device is to switch the control windings of the stepper motor with a frequency and sequence corresponding to the issued command. It has a wound stator and a non exited rotor. Stepper motors are classified as 2-phase, 3-phase or 4-phase depending on the number of windings on the stator.

C. Stepper Motor Driver Circuit

In Automatic Anesthesia Injector, a 4-phase stepper motor is used. Consider the four phases as S1, S2, S3 and S4. The switch sequence can be used to rotate the motor half steps of 0.9º clockwise or counter clockwise.

To take first step clockwise from S2 and S1 being on, the pattern of 1's and 0's is simply rotated one bit position around to the right. The 1 from S1 is rotated around into bit 4. To take the next step the switch pattern is rotated one more bit position. To step anti-clockwise the pattern is rotated to the left by one bit position.

Table 1.
4-Phase Stepper Switch Sequence

STEP	S4	S3	S2	S1
1	0	1	1	1
2	0	0	0	1
3	1	0	0	1
4	1	0	0	0
5	1	0	0	0
6	0	0	0	0
7	0	1	1	0
8	0	1	1	0
1	0	1	1	1

This clockwise and counter clockwise movement of the stepper motor is coordinated with the movement of the Syringe by means of a mechanical interface

D. Syringe Infusion Pump

The Syringe Infusion pump provides uniform flow of fluid by precisely driving the plunger of a syringe towards its barrel. It provides accurate and continuous flow rate for precisely delivering anesthesia medication in critical medical care. It has an alarm system activated by Infra-Red Sensor and limit switches.

The pump will stop automatically with an alarm when the syringe is empty or if any air-bubble enters the fluid line. Glass and plastic Syringes of all sizes from 1ml to 30ml can be used in the infusion pump. The flow rates can be adjusted from 1ml to 99ml/hr. Since it accepts other syringe size also, much lower flow rate can be obtained by using smaller syringes.

IV. SOFTWARE DESCRIPTIONS

A program is required which when burnt into the EPROM will operate with the NXP LPC11u24 to do the function of monitoring the bio-medical parameters.

- To read the input from the keypad provided with the Microprocessor.
- To activate the internal timer and enable it to interrupt the microprocessor (ARM cortex M0) whenever the timer overflows.
- To read the parameters such as heart rate, respiration, body temperature once in every specified interval.

- To check for the correctness of the parameter values and activate the alarm set with the system when the level of Anesthesia goes down.
- To calculate the stepper motor movement (increase the speed or decrease the speed) with the parameters provided by the Sensors.
- Continue the above until switched OFF or RESET.

A. To Summarize

By using various electrical circuits the bio-medical parameters can be found. The output of the circuits is amplified by means of an amplifier and fed into an A/D converter. The digitized signal is then fed into the input port of the Microprocessor. The Microprocessor displays the parameters in digital value in the display device. If the level of the temperature or respiration is increased or decreased the level of anesthesia was controlled automatically with the help of processor and the stepper motor actions.

V. CONCLUSION

The Arm processor read the signal from the heartbeat sensor and temperature sensor, and its corresponding change in heartbeat and temperature of the patient the anaesthesia is to be given . Anaesthesia Machine is efficient protecting systems which is very useful for surgical side. Which is used for Major operation of the patient and its very comfort for the doctor who gave treatment to the patient, and so it's very chap machine used in commercial operation also it fully automated.

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