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Study of Automatic Anesthesia Controller

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Abstract- **Anesthesia infusion is a closed loop system, in which anaesthesiologist follow the process of anticipating and applying the predicted dose. To figure out appropriate dose one need to continuously monitor different physiological parameters. This is a very laborious job. Many researchers are tried to advise solution to this problem. Major operations are performed to remove or reconstruct the infected parts in the human body. These operations will lead to blood loss and pain. In Bio-medical field anesthesia plays an important role in the part of painkilling. Anesthesia is very essential in performing painless surgery and so an Automatic administration of Anesthesia is needed for an effective surgery. In this design, an AVR processor is used for controlling the anesthesia machine automatically, depending upon the numerous biomedical parameters such as body temperature, heart rate, blood pressure of body etc.**

Index terms- **AVR controller, Temperature sensor, Blood pressure sensor, pulse rate sensor, LCD, Motor driver, Keypad.**

I.INTRODUCTION

For any operations the patient being in an anesthetic condition is a must. Anesthesia a practice in medicine to induce temporary state were the patient won't feel any pain during the medical procedure using anesthetics. The impact of the anesthesia should be there how long the operation goes and for that at specified time intervals they are administered. It should not be given at a single stretch as may result in serious implications. The automatic anesthesia controller system is developed using embedded systems. This system has a switch panel to control the syringe infusion system and the whole set up.

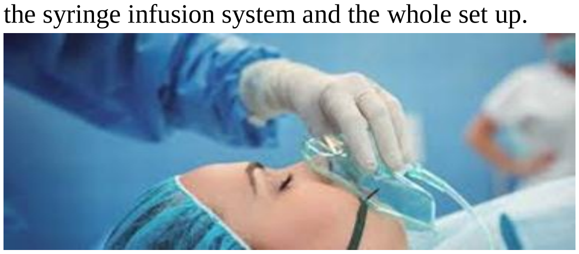

Figure1.Inhalation anaesthesia given to a patient

The anesthetist can set the amount to be given to the patient. Using the switch panel, the anesthetist can start the process and once the start signal is received by the system it controls all the system, sends a signal to the motor driver to switch on the motors and start infusing the medicine. The switch panel has switches for start, stop, forward and backward action buttons. The motor driver is capable of performing bidirectional rotation i.e. injecting and releasing action of the syringe. A minimum amount of anesthesia will be injected to the patient body, while doing this the heartbeat will be monitored. After administration it will check whether the heartbeat count is normal or not. If normal, then the second dose of the medicine will be injected. If the heartbeat shows any abnormality, then the administration will be stopped and will notify the doctor and continue only after everything becomes normal.

Figure2. Anesthesia provided through intravenous

II. LITERATURE REVIEW

Various types of research works have been done and still going on related to Automatic Anesthesia Controller. Some are listed below Fuzzy controller And Automatic Drug infusion in Cardiac Patients: M Lokesh Kumar, R Hari Kumar, a KeerthiVasan, V. K. Sudhaman: Control of mean arterial blood pressure and cardiac output is highly desirable in certain operative procedures and in post cardiac operation. This paper emphasizes on a fuzzy controller to control these two variables within the present limits by administering three drugs dopamine, Sodium

Nitro Prusside and Phenylephrine which perform the function of increasing heartbeat rate, decreases, increases blood pressure respectively. A fuzzy PD controller with 25 rules is designed to achieve this, which controls the drug delivery unit. This work makes use offew mathematical models whose response to these three drugsmimics the human cardiovascular system.[1]

Automatic drug delivery in anesthesia: O. Simanski, R. Kaehler, A. Schubert, M. Janda, J. Bajorat, R. Hofmockel, B. P. Lampe:The main goals of general anasthesia are adequate hypnosis, analgesia and maintenance of vital functions. For a number of surgical procedures neuromuscular block is essential. The work gives only a short overview about the development of the automation in drug delivery systems over the last years without the claim of completeness and expressed the much more vision.[2]

Computerized Anesthesia Infusion System: Rohan K.R. ,Govinda Raju. M ,Roopa .J. , Prashanth C.: To overcome such hazardous problems the design of an automatic operation of an anesthesia machine based on a micro-controller is effective. In this system a microcontroller and syringe infusion pump provided. The anesthetist can decide the level of anesthesia in terms of milliliters per hour to administer anesthesia to the patient with the help of different sensor results. After receiving the signal from the sensors the microcontroller controls the signal of the desire level and fed into the dc motor to drive the infusion pump in proper manner. The anesthesia is administered to the patient according to the dc motor rotation.[3]

Automatic anesthesia regularization system (AARS) with patient monitoring modules S.Krishnakumar , J. BethanneyJanney 1 , W. Antony Josephine Snowfy 1, S. Joshin Sharon 1 , S. Vinodh Kumar 1 : To overcome such tedious problems, this project aims to design an effective microcontroller based automatically operated anesthesia machine. In the proposed Automatic Anesthesia Regularization System, anesthesia level is controlled by multi-task feedback and microcontroller system, based on patient's condition. The Automatic Anesthesia Controller designed using microcontroller aids to control anesthesia levels during the course of surgery. Mechanical syringe infusion pump is provided to deliver anesthesia to the patient. The anesthetist can set the keypad to administer the dose of anesthesia in terms of milliliters per hour. The keypad transmits the analog signal to the microcontroller to control the required dose of anesthesia to be fed into DC motor to operate injection pump.[4]

Microcontroller based Anesthesia Injector Smt.Leela Salim1, Abey Thomas2, Akshay M3, Athul K Alias4, MuhammedIrshad E K5: If lower amount of anesthesia is administered, the patient may wake up at the middle of the operation. To avoid this, the anesthetist administers few milliliters of anesthesia per hour to the patient. If the anesthetist fails to administer the anesthesia to the patient at the particular time interval, other allied problems may arise. To overcome such hazardous problems the design of an automatic operation of an anesthesia machine based on a micro-controller is effective. In this system a microcontroller and syringe infusion pump provided. The anesthetist can decide the level of anesthesia in terms of milliliters per hour to administer anesthesia to the patient with the help of different sensor results.. After receiving the signal from the sensorsthe microcontroller controls the signal to the desire level and fed into the dc motor to drive the infusion pump in proper manner. The anesthesia is administered to the patient according to the dc motor rotation.[5]

Microcontroller based Anesthesia Injector:R. Ayswarya, S. Aswathi: To overcome such hazardous problems the design of an automatic operation of an anesthesia machine based on a micro-controller is effective. In this system a keypad is provided along with the microcontroller and syringe infusion pump. The anesthetist can set the level of anesthesia in terms of milliliters per hour to administer anesthesia to the patient with the help of keypad.[6]

III. METHOD

A. Health Parameters

Sr No.	Parameter	Range	Unit
1.	Body temperature	-55 to 125	℃
2.	Pulse rate	Nearly 72	Pulse/min
3.	Blood pressure	90-119 and 60-79	mm Hg

Different health parameters can be measured for Automatic Anesthesia Controller. Vital parameters such as temperature sensor, pulse rate sensor and blood pressure sensor can be measured. Ranges of parameters are:

B. Sensors and Components used

1. Temperature sensor:

For measuring the body temperature of the patient DS18B20 sensor is used. The sensor works with the method of 1-Wire communication. The pull-up resistor is used to keep the line in high state when the bus is not in use. The temperature value measured by the sensor will be stored in a 2-byte register inside the sensor. This data can be read by the using the 1-wire method by sending in a sequence of data. There are two types of commands that are to be sent to read the values, one is a ROM command and the other is function command.

2. Pulse rate sensor

The pulse rate sensor is light type sensor to sense the blood flow and according to that it gives pulse to controller to measure the pulse rate. It is basically a Biometric Pulse Rate or Heart Rate detecting sensor. It has Plug and Play type sensor. It has an Operating Voltage of +5V or +3.3.It consumes an Current of 4Ma. It has Inbuilt Amplification and Noise cancellation circuit. Its Diameter is about 0.625. It has Thickness of 0.125. The working of the Pulse/Heart beat sensor is very simple. The sensor has two sides, on one side the LED is placed along with an ambient light sensor and on the other side we have some circuitry. This circuitry is responsible for the amplification and noise cancellation work. The LED on the front side of the sensor is placed over a vein in our human body. This can either be your Finger tip or you ear tips, but it should be placed directly on top of a vein. Now the LED emits light which will fall on the vein directly. The veins will have blood flow inside them only when the heart is pumping, so if we monitor the flow of blood we can monitor the heart beats as well. If the flow of blood is detected then the ambient light sensor will pick up more light since they will be reflect ted by the blood, this minor change in received light is analysed over time to determine our heart beats. Using the pulse sensor is straight forward, but positioning it in the right way matters. Since all the electronics on the sensor are directly exposed it is also recommended to cover the sensor with hot glue, vinyl tape or other nonconductive materials. Also it is not recommended to handle these sensors with wet hands. The flat side of the sensor should be placed on top of the vein and a slight presser should be applied on top of it, normally clips or Velcro tapes are used to attain this pressure. To use the sensor simply power it using the Vcc and ground pins, the sensor can operate both at +5V or 3.3V system. Once powered connect the Signal pin to the ADC pin of the microcontroller to monitor the change in output voltage. If you are using a development board like Arduino then you can use the readily available code which will make things a lot easier. Refer the datasheet at the bottom of the page for more information on how to interface the sensor with Arduino and how to mount it.

3. Blood Pressure sensor:

This is advanced type sensor which gives Blood pressure serially to the microcontroller. It provides the intelligent feature of automatic compression and decompression. It is Easy to operate and has a switching button to start measuring. It has 60 store groups memory measurements. It can read single or all measures. It has 3 minutes automatic power saving device. It has intelligent device debugging, automatic power to detect. It provides Local tests for: wrist circumference as 135-195mm. It has Large-scale digital liquid crystal display screen, So that It is Easy to Read Display. It provides Fully Automatic, Clinical Accuracy, High-accuracy. It requires an External Power of +5V DC. It provides Serial output data for external circuit processing

3. Motor driver:

Motor driver mosfet IRF540 is used to drive the spray motor which Advanced HEXFET® Power MOSFETs from International Rectifier utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. This benefit combined with the fast switching speed and ruggedized device design that HEXFET power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in a wide variety of applications. The TO-220 package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 watts. The low thermal resistance and low package cost of the TO-220 contribute to its wide acceptance throughout the industry. It has

Advanced Process Technology. It has Ultra Low On-Resistance. It has Dynamic dv/dt Rating. It has 175°C Operating Temperature. It is used for Fast Switching.

4. Lcd:
A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly,[1] instead using a backlight or reflector to produce images in color or monochrome.[2] LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and seven-segment displays, as in a digital clock. They use the same basic technology, except that arbitrary images are made from a matrix of small pixels, while other displays have larger elements. LCDs can either be normally on (positive) or off (negative), depending on the polarizer arrangement. LCDs are used in a wide range of applications, including LCD televisions, computer monitors, instrument panels, aircraft cockpit displays, and indoor and outdoor signage. Small LCD screens are common in portable consumer devices such as digital cameras, watches, calculators, and mobile telephones, including smartphones.

5.AVR Controller
The Atmel ATmega8A is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega8A achieves throughputs close to 1MIPS per MHz. This empowers system designed to optimize the device for power consumption versus processing speed. It has High-performance and is a low poerdevice. It has advanced RISC Architecture. It has 130 Powerful Instructions set. It consists of 32 x 8 General Purpose Working Registers. It has Fully Static Operation It has 1KByte Internal SRAM. It consists of High Endurance Non-volatile Memory Segments.

IV. PROPOSED SYSTEM

Anesthetist can determine the dose of anesthesia to be governed to the patient in terms of milliliter per hour ranging from 1ml to 1000ml using keypad provided along with the microcontroller. After getting the anesthesia level from the keypad regulator, the microcontroller set the system to administrator anesthesia at the previously prescribed level of drugs. This dosage are analysed based on various biomedical parameters received from the sensors to determine the direction of revolution of the DC motor. The revolution of the DC motor drives the DC Pump to spray anesthesia on the patient's body.

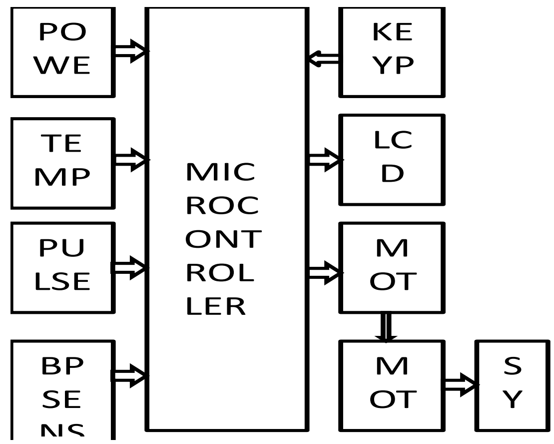

Figure3.block diagram

V. FLOW CHART

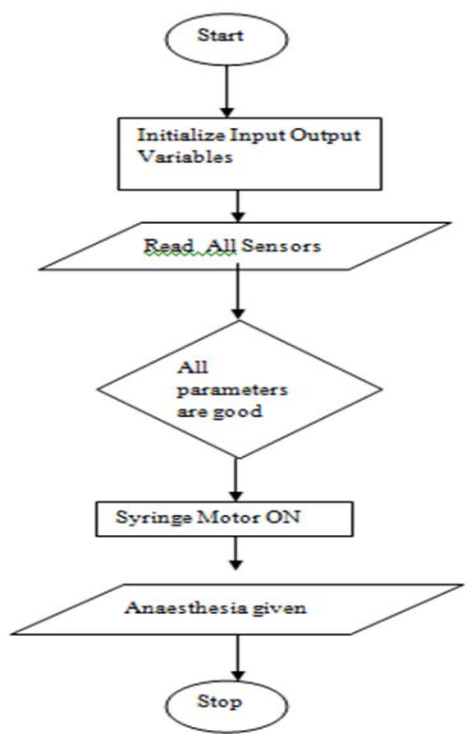

Figure 4. Flow chart

VI.CONCLUSION

Automatic Anesthesia Regularization System controls drug infusion depending upon the patient's body state. Temperature sensor, heartbeat sensor and respiration sensor senses the temperature, heartbeat and Blood Pressure respectively and gives corresponding analog values to signal conditioning circuit. The Signal conditioning circuit then provides the binary value to the microcontroller depending upon the binary value given to the controller to drive the syringe pump motor. Syringe placed in motor for injects the drug to patient based on the patient's condition. Every 30 seconds all the parameters were sensed to check the patient's condition, which were monitored and intimated in the display whether normal or abnormal. Infra-red heart beat monitor was kept between the fingers to detect the heart rate. If the heart beat rate exceeds 40 beats per 30 seconds, it was intimated as abnormal condition and the pump infused according to the programmed condition.

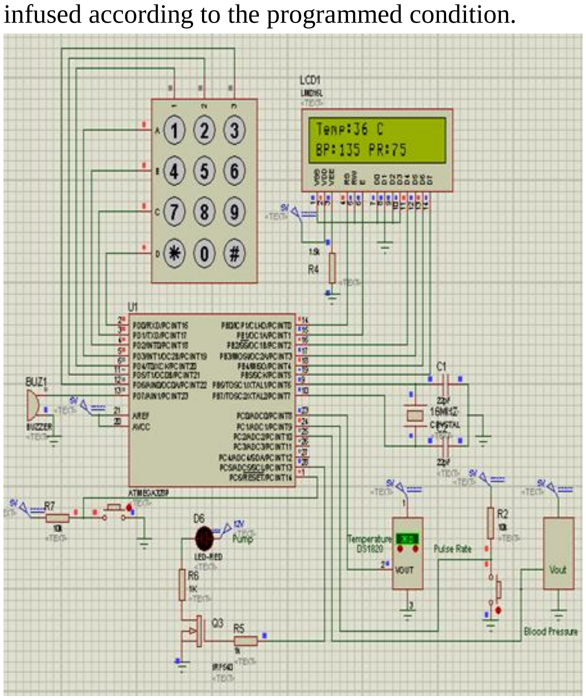

Figure5.Simulation

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