International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 07 | July 2019 www.irjet.net p-ISSN: 2395-0072

Microcontroller based Anesthesia Machine with Dosage Calculator

Akshay Sharma A S[1], Chethan Ravindra Kabade[2], Hitesh K B[3], Sourabh R[4], Bhanu H S[5]

[1-4]Student, Department of Electronic and Communication Engineering, Vidyavardhaka College of Engineering, Mysore, India
[5]Bhanu H S, Assistant Professor, Department of Electronic and Communication Engineering, Vidyavardhaka College of Engineering, Mysore, India

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Abstract: Anesthesia, in Greek means "Lack of Sensation" or simply no sensation. Most of the modern day surgeries use anesthesia drugs to facilitate painless and easy surgery for both patients and also for the doctors to perform surgery. In this paper, we have developed an automatic system, that receives biomedical parameters like heartbeat, temperature and blood pressure of patient and calculates the amount of anesthetic drug required in milliliters(mL) by accepting inputs like age, weight, drug concentration, maximum allowable drug dosage. It then moves the syringe backwards so as to load the syringe with precise amount of drug. In Addition to the receiving of biomedical parameters, the signal processing, amplification is also done for better results.

Keywords: Anesthesia, Blood Pressure, Sensors, Heart Rate

I. INTRODUCTION

Anesthesia, is a state of controlled unconsciousness, usually induced for medicinal purposes including minor surgeries to major organ transplant. Anesthesia in Greek means "Lack of Sensation" or without sensation. The 3 stages of Anesthesia are, 1. Hypnosis which means degree of unconsciousness, 2. Analgesia which is inability to feel pain or degree of experienced pain, 3. Muscular Immobility, which means the inability to move the muscles, simply inability to relax or contract the voluntary muscles controlled by brain. Anesthetic drug dosage plays a very important role in patients overall well being during and after the surgery, proper dosages make operations flawless, but a simple overdosage or underdosage may cause complications, and also death in some cases. Hence, precise drug dosage plays a very vital role. The Anesthesia induction types include General Anesthesia, where a person undergoes completely unconscious, Regional anesthesia where a particular region is blocked from pain like leg, hand, arm, or spinal anesthesia. The last type here is Local Anesthesia, where only a small part of body is numbed. Both in Local and Regional Anesthesia, the patient stays conscious and fully aware. The Anesthetic drug are introduced into body either by injection(intramuscular or intravenous) or even by inhalation. Various types of Anesthesia drugs include Lidocaine, Proliocaine, Methohexital, Ketamine, Propofol., Amobarbital Pain Killers also play a major role in any surgery, which includes morphine, codeine and tramadol to provide analgesic effect to the patients.

II. PROBLEM STATEMENT

The currently existing system is that an Anesthetist analyzes the patient's biological parameters like Blood pressure, Heart Rate, Temperature and then decides the drug needed according to the type of operation and then pull the required volume of drug in a syringe and then inject it. But, this sometimes can cause overdosages due to miscalculation, leading to further complications and also death. Here, we have developed a system, that accepts the weight of patient, age, blood pressure , drug concentration and also maximum allowable dosage in mg/Kg. Then calculates the required drug dosage in mL and also monitors patient's heart rate and also temperature.

III. OBJECTIVE

The main objective of this paper is to develop a microcontroller-based anesthesia machine, that calculates the dosage of the anesthetic drug and appropriately loads the required volume in the syringe.

IV. METHODOLOGY

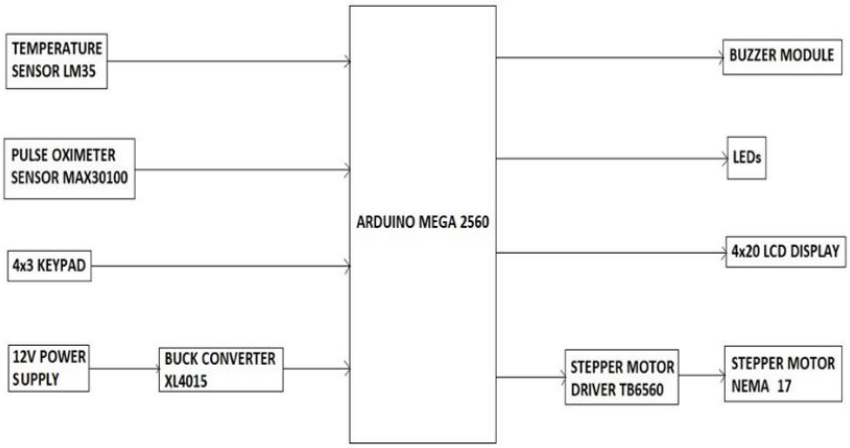

Figure 1.0: Block Diagram of the developed microcontroller based anesthesia machine

Here, we have developed a microcontroller based anaesthesia machine using an Arduino mega 2560 microcontroller, the components like LM35 temperature sensor is used to measure body temperature, pulse oximeter MAX30100 is used to measure the patient's oxygen saturation and also pulse in beats per minute(BPM). A 4x3 Keypad is used to enter the age of patient, drug dosage concentration, maximum allowable dosage (mg/Kg) and also weight of the patient in Kg. The drug dosage to be injected is calculated using the formula

Drug Dosage(in mL)=[Maximum Allowable dosage(mg/Kg) x Concentration(%)x Weight of Patient(Kg)] / 10

This calculation is done by the Arduino mega by accepting the Weight, Maximum allowable dosage and also concentration from the keypad. Age, blood pressure is also noted for monitoring purposes. After calculation, the drug dosage in mL is shown on the LCD display and asks for pop up message to insert the syringe. Then, Stepper motor pulls the syringe to pull the required amount of drug and after pulling, The LCD again gives a pop up notification to remove syringe. After removing the syringe, body temperature and pulse is read, buzzer sounds and red LED glows whenever there is any abnormality in any parameter like Hypothermia(Low body temperature), Hyperpyrexia(High Fever), Bradycardia and Tachycardia(Low and High Heart rate).

The LCD display used in the project is mainly used to display pop up messages to enter the parameters mentioned in the above.

Arduino Mega Microcontroller development platform is used here since this particular platform has all the required amplifiers, analog to digital converters(ADC), Voltage regulators, USB to TTL logic converter, inbuilt RAM, ROM, Clock circuitry and also slots for inserting signal in or out pins.

Figure 2.0: Sample LCD photographs of the developed system

Figure 3.0 :Developed Microcontroller based anesthesia machine

Figure 4.0 :Flow Chart of the developed microcontroller based anesthesia machine

V. RESULTS AND DISCUSSION.

In this project, the microcontroller development platform Arduino Mega 2560 is used along with LM35 Temperature sensor, MAX30100 Pulse oximeter, Keypad for entering the weight, height and blood pressure is entered manually. The output will be seen using a stepper motor which in turn moves a syringe to inject the anesthetic drug properly at a pre-defined rate for a proper and safe surgeries. A buzzer is used in order to indicate an empty syringe during an operation. Testing of the components for proper working is done to ensure its proper functionality. All the components are assembled according to the block diagram.

VI. CONCLUSION

Microcontroller is made use to perform anesthesia injecting operation, where the quantity to be inject and the timing is provided. 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 digital signal is then fed into the input port of the Microcontroller. The Microcontroller displays the parameters in digital value in the display device. The parameters like temperature, respiration and heartbeat rate the stepper motor speed is varied. If the level of the temperature or respiration is increased or decreased the level of anesthesia was controlled automatically with the help of micro-controller and the stepper motor actions. Syringe infusion pump is mechanically connected to the motor. Making use of sensor it detects its destination where it need to inject then by precisely drives the plunger. Since the surgery time varies, externally it is reset or turned off. Modern technologies have developed using embedded systems promoting comfortable and better life. Microcontroller based anesthesia machine is one of the efficient systems plays its major role in Bio-Medical field. Using this system time management is obtained since the periodic interval is set using program. 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. The transducers used are just those that find applications inpatient monitoring systems and experimental work on four parameters namely blood pressure, temperature, pulse and respiratory activity, more precision might obtained if multiple parameters like retinal size, age and weight are considered.

VII. REFERENCES.

[1] D Hemapriya, K Amrudha Shree, S Deepika, R Karthiyayini "Feedback Control approach in Controlled Sedation for Intensive Care Unit", IEEE international conference on innovations in green energy and healthcare (ICIGEHT), 2017.

[2] D Y Pawade, T S Diwase, T R Pawade "Designing and Implementation of Fuzzy Logic Based Automation System to Estimate dose of Anesthesia" Confluence 2013,the next generation information technology summit(4th international conference), 2013.

[3] Clara M Ionescu "Computer assisted drug delivery for general anesthesia: Completing the puzzle" SAMI, IEEE 17th World symposium on applied medicinal intelligence and information, 2019.

[4] Deepfranklin P, Krishnamoorthi M "Monitoring multiple biomedical parameter to automate anesthesia injector using FPGA" 2nd international conference on computer, communication and Signal Processing (ICCCSP), 2018.

[5] H A Alzomor, B K Ouda "Low cost, Compact and Pulsated Constant Current Microcontroller based Nerve Locator", Cairo International Biomedical Engineering conference (CIBEC), 2012.

[6] A Yardimci, A Ferikoglu, N Hadimioglu "Depth Control of Anesthesia with Microcontroller based Fuzzy Logic System", Proceedings of 23rd Annual EBMS International conference, 2001.

[7] Fatima Hameed Khan, Usman Ashraf, Muhammad Awais Bin Altaf, Wala Saadeh "A patient-specific machine learning based EEG processor for accurate estimation of Depth of Anesthesia", IEEE Biomedical Circuits and system conferences (BioCAS), 2018.

[8] A C Fisher, A F G Takatk, G. Sidaras, A.G. Jonesand S.M. Mostaf "Deriving a real time depth of anesthesia index from the middle latency auditory evoked potential (MLAEP)" IET 3rd international conference MEDSIP advances in medical signal and information processing, 2006.

[9] Engr Rana Muhammad Shakeel "Microcontroller based anesthesia injector" 2007.

[10] Ming Huang, Zhenjuan Zhang "Design and Implementation of the Anesthesia Machine Monitoring System" 8th international conference on biomedical engineering and informatics (BMEI) 2015.

[11] N Engshi, M Aliyari, M Tehshenlab "Anesthesia Control based on Intelligent Controllers" IEEE 978-1-4244-2902, 2009.

[12] D A Linkens, H U Rehman "Nonlinear control for anesthesia depth using neural network and regression" Proceedings of IEEE international symposium on intelligent control, 1992.

[13] Smt.Leela Salim, Abey Thomas, Akshay M, Athul K Alias, Muhammed Irshad E K "Microcontroller based Anesthesia Injector" International Research Journal of Engineering and Technology (IRJET) 2019.