# Smart Automatic Anesthesia Regulation Dosage

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***Abstract** – The system uses a MAX30100 sensor to monitor heart rate and oxygen saturation, enabling real-time adjustments to anesthesia delivery via a servo motor connected to a syringe. The motor's movements are calibrated to heart rate data, ensuring precise dosage control. A manual override button allows health care providers to intervene during emergencies. A DHT11 sensor monitors temperature and humidity for environmental awareness, while an LCD displays real-time patient and environmental data. An Arduino Uno processes sensor inputs, controlling servo angles to administer accurate anesthesia volumes based on pre-set thresholds, ensuring patient safety and stability.*

***Index Terms** - Syringe pump, Servomotor, Anesthesia regulation, over dose*

## 1.INTRODUCTION

Automation and advanced technology are progressively revolutionizing health care systems across the globe, enhancing efficiency, accuracy, and reliability in procedures that were once dependent on manual operations and prone to human error. In particular, the administration of anesthesia—a vital element in numerous medical procedures—stands to benefit greatly from automation, offering potential improvements in patient safety and clinical outcomes. Anesthesia involves the use of drugs to induce a temporary loss of consciousness or sensation, enabling medical interventions without causing discomfort or pain to the patient. The precise regulation of anesthesia dosage is critical, as improper dosing, whether excessive or insufficient, can lead to serious complications, including cardiovascular instability, delayed recovery, or even life-threatening emergencies.

This project proposes the creation of an automated anesthesia delivery system utilizing an Arduino Unomicro-controller, a MAX30100 heart rate sensor, a servo motor connected to a syringe, and supplementary sensors such as the DHT11 temperature and humidity sensor. The core function of the system is to regulate the volume of anesthesia administered by continuously monitoring the patient's heart rate with the MAX30100 sensor. By adjusting the dosage in real-time according to the patient's physiological condition, particularly the heart rate, the system aims to improve the accuracy and safety of anesthesia delivery. A manual push button is also included to provide health care professionals with the ability to manually control anesthesia administration during emergencies Furthermore, an LCD display is integrated into the system to show real-time data on the patient's heart rate, the volume of anesthesia dispensed, and environmental factors such as temperature and humidity, as monitored by the DHT11 sensor. These signals, based on the predefined limits, are used to control the DC motor for administering anesthesia.

## 1.1 PROBLEM STATEMENT

The accurate and controlled administration of anesthesia is essential for ensuring patient safety and comfort during medical procedures. Traditionally, anesthesiologists rely on manual adjustments, constantly monitoring the patient's vital signs and modifying the anesthesia dosage as needed. However, this manual approach is susceptible to human error, delays, and inconsistencies, which can lead to complications such as over-sedation or inadequate pain management. The challenge is to automate this process, improving both precision and reliability to enhance patient outcomes.

## 2 OBJECTIVES

- Automate Anesthesia delivary based on heart rate.
- Provide manual control options.
- Display real-time information.

## 3 FUTURE SCOPE

- AI-Driven decision making.
- Adaptive regulation.

## 4 METHODOLOGY

A heartbeat sensor is employed to track the patient's heart rate, while a temperature sensor is used to monitor their body temperature. The Arduino Uno serves as the central unit for storing sensor data and controlling the actuation mechanisms. An infusion set is utilized during the maintenance phase of the surgery, and a syringe pump mechanism is implemented during the induction phase to manage the anesthesia delivery.

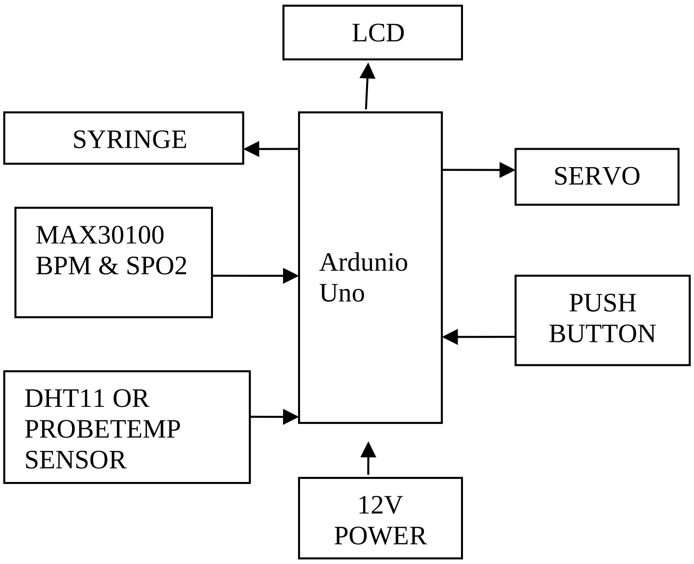


**Fig 1. Anesthesia control system block diagram.**

The Methodology Survey for the Project as Follow

The approach for developing the automated anesthesia delivery system involves a systematic integration of both hardware components and software programming to ensure precise control over anesthesia administration, guided by real-time physiological data. Initially, the system design focuses on selecting and configuring an Arduino Uno microcontroller, which functions as the central unit for processing data and managing the actuation mechanisms. The MAX30100 heart rate sensor is integrated with the Arduino, continuously monitoring the patient's heart rate and oxygen levels to provide essential information for adjusting the anesthesia dosage. The data collected from the sensor is analyzed to calculate the required amount of anesthesia, based on preset thresholds.

A servo motor, connected to a syringe, is controlled by the Arduino to deliver an exact volume of anesthesia. The movement of the servo motor is precisely calibrated to match specific volumes in the syringe, ensuring the accurate administration of anesthesia based on the heart rate data. Additionally, the DHT11 sensor is used to measure environmental factors such as temperature and humidity, as these can influence the patient's response to anesthesia and its overall effectiveness.

The system is designed to automatically adjust the servo motor based on real-time heart rate data, with the Arduino running algorithms to control the syringe's position and ensure the correct amount of anesthesia is administered. An LCD display is integrated to provide live updates on the patient's heart rate, the amount of and safety, a manual push button allows healthcare professionals to override the system's automated controls in case of an emergency. The system undergoes extensive testing and fine-tuning to ensure reliable performance and precise delivery of anesthesia, with continuous updates made based on feedback and real-world evaluations

### 4.1 HARDWARE REQUIREMENTS

- Arduino Uno
- MAX30100 Heart Rate Sensor
- DHT11 Sensor
- LCD Display
- Power Supply.
- Push button
- Syringe

- **Arduino Uno:** The central microcontroller used for processing data, controlling actuators, and executing the automation algorithms. It interfaces with various sensors and the servo motor to manage anesthesia delivery.

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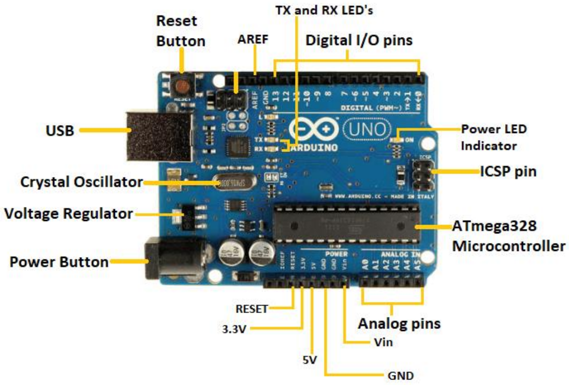


**Fig2.Arduino UNO**

- **MAX30100 Heart Rate Sensor:** A sensor for monitoring the patient's heart rate and oxygen levels. It provides real-time data to the Arduino for adjusting the amount of anesthesia delivered.
- **Servo Motor:** An actuator used to control the movement of the syringe. The servo motor is programmed to precisely adjust the syringe's position to deliver the required volume of anesthesia based on sensor data.
- **Syringe :**A medical device connected to the servo motor, used to administer the anesthesia. The syringe's volume is controlled by the movement of the servo motor to ensure accurate dosage.

**Fig3.Syringe**

- **DHT11 Sensor:** This sensor is used to measure environmental factors like temperature and humidity. The collected data helps monitor the surroundings and ensures they stay within the ideal range for safe and effective anesthesia administration.
- **LCD Display:** A screen that shows real-time data on the patient's heart rate, the volume of anesthesia delivered, and environmental conditions. It enables healthcare professionals to quickly assess the system's performance and the patient's status.
- **Manual Push Button:** A control mechanism that allows healthcare providers to manually override the automated system if needed. This feature ensures flexibility and allows for adjustments in emergency situations.
- **Power Supply:** A stable power source that supplies the required energy to the Arduino Uno, sensors, servo motor, and LCD display, ensuring the continuous and reliable operation of the entire system.
- **Connecting Wires and Breadboard:** Essential for making electrical connections between the Arduino, sensors, servo motor, and other components. The breadboard allows for easy prototyping and adjustments during development.

## 4.2 SOFTWARE REQUIREMENTS

- **Arduino IDE:** The Integrated Development Environment (IDE) utilized for writing, compiling, and uploading code to the Arduino Uno.
- **Arduino Libraries:** Specialized libraries used for interfacing with various sensors and components:
- **MAX30100 Library:** Enables communication with the MAX30100 heart rate sensor to collect heart rate and oxygen level data.
- **Servo Library:** Facilitates the control of the servo motor to adjust the syringe position accurately.
- **DHT11 Library:** Allows the Arduino to retrieve temperature and humidity data from the DHT11 sensor.
- **Liquid Crystal Library:** Used to manage the LCD screen and display real-time information.
- **C++ Programming Language:** The language employed to write the control algorithms and interface code for the Arduino.
- **User Interface Software:** If applicable, software to create and manage user interfaces for the LCD display. This includes designing screens and managing data presentation to healthcare providers.
- **Firmware for Sensors:** The firmware that may be required for the sensors to function correctly and communicate with the Arduino. This includes any updates or configuration settings needed for accurate data acquisition.

## 5 RESULTS

In conclusion, the automated anesthesia delivery system developed using the Arduino Uno, MAX30100 heart rate sensor, servo motor, syringe, and additional components represents a significant advancement in precision and reliability in medical anesthesia administration. By integrating real-time monitoring with automated control, the system enhances the accuracy of

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dosage delivery based on the patient's physiological data, thereby reducing the risk of human error and improving overall safety. The inclusion of manual override options and real-time data display ensures flexibility and allows healthcare providers to respond effectively to any changes in patient condition. This system not only streamlines the anesthesia process but also sets a new standard for automated medical devices, promising improved patient outcomes and operational efficiency in clinical settings. The successful implementation and testing of this system underscore its potential to transform anesthesia management, paving.

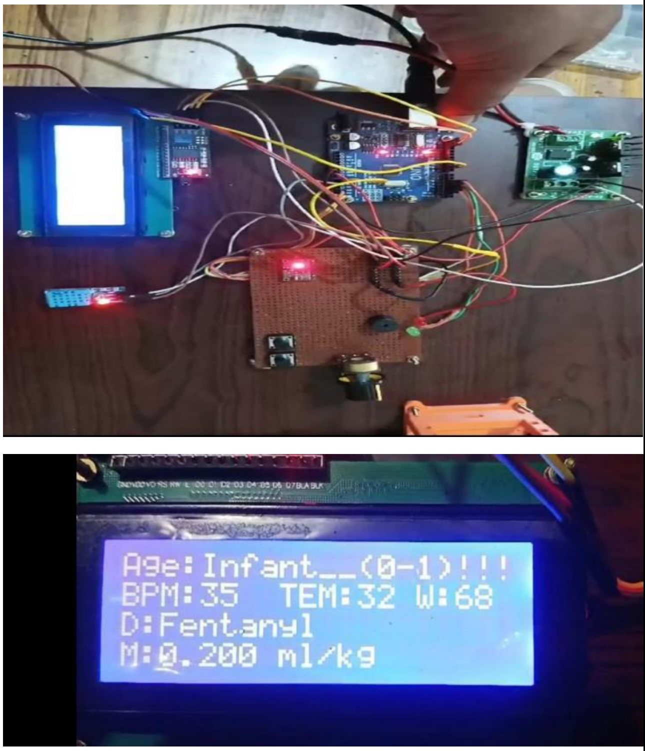


**Fig4.Temperature and pulse changes indicated to regulate Anesthesia**

## 6 CONLUSION

This project integrates various components, including the MAX30100 heart rate and SpO2 sensor, a precise drug dosage calculation system based on patient weight, and an automated servo mechanism for drug dispensation. The system ensures accurate and efficient delivery of drugs in a clinical setting, helping in critical care, especially in surgeries and ICU monitoring. The key features of the project, such as real-time heart rate and oxygen saturation monitoring, weight-based drug dosage calculation, and automated drug delivery using a servo-driven system, provide a comprehensive solution for improving patient safety and optimizing medical interventions. The combination of sensors and automated mechanisms reduces human errors and allows for precise monitoring and drug administration. The system is particularly valuable for pediatric and geriatric patients, where accurate drug dosing is crucial. However, some limitations such as a potential error margin of 0.5mL due to servo adjustments and DC power issues are noted. These errors, while small, are important to consider in high-precision applications, and steps to minimize them should be taken in future iterations of the system.

| **Age Group** | **Age value in Code** | **Ideal BPM Range** | **Condition for Red LED** |
|---|---|---|---|
| **Infants** | **Age=1** | **100-160** | **BPM<100 or BPM>160** |
| **Children** | **Age=10** | **70-120** | **BPM<70 or BPM>120** |
| **Adults** | **Age= 30** | **60-80** | **BPM<60 or BPM>80** |
| **Elders (seniors)** | **Age=65 ,age= 75** | **60-80** | **BPM<60 or BPM>80** |
| **Undefined** | **Any other value** | **N/A** | **Red LED remains off by default** |

**Table 1: Ideal BPM ranges**

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