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ANAESTHESIA BASED MACHINE CONTROL USING RASPBERRY PI

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Abstract:This study suggests a method for using the Raspberry Pi, an inexpensive, multipurpose microprocessor, to operate anesthetic machines. In order to precisely provide anesthetic gases and vapors to patients during surgical procedures, anesthesia machines are essential medical equipment. Customization and integration with contemporary healthcare systems are frequently restricted by the proprietary hardware and software used by traditional anesthetic machines. Through the utilization of Raspberry Pi's capabilities, we offer an adaptable and economical approach to control anesthetic machines. Our system makes use of sensors to keep an eye on critical factors including oxygen content, pressure, and gas flow rates. It then provides real-time feedback to guarantee precise anesthetic delivery. By analyzing this data and modifying the machine's settings accordingly, the Raspberry Pi maximizes patient comfort and safety .Moreover, our methodology facilitates smooth integration with electronic health records.

Keywords: Anesthesia, Raspberry Pi, Heartrate, Temperature, SPO2, Body Wetness, infusion.

I. INTRODUCTION

Modern healthcare relies heavily on anesthetic equipment to ensure the safe and efficient administration of anesthesia during surgical procedures. To maintain patient sedation and critical functions, these machines are outfitted with advanced hardware and software that controls the flow of anesthetic gases and vapors. However, proprietary systems that restrict modification, flexibility, and compatibility are frequently included with traditional anesthetic machines. A rising number of people are interested in investigating alternate approaches to anesthetic machine control that make use of open-source platforms like Raspberry Pi. A low-cost and adaptable microcontroller option that can interface with a variety of sensors and peripherals is provided by Raspberry Pi. The Raspberry Pi's power can be used to create control systems for anesthetic machines that are programmable.

II. EXISTING ARCHITECTURE

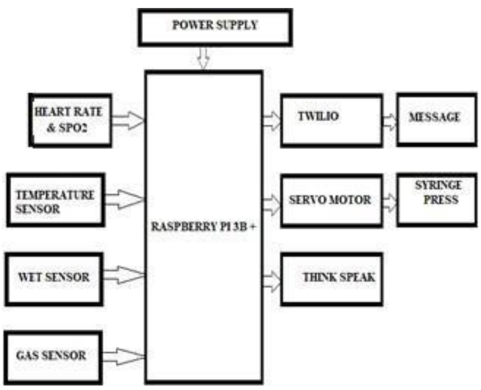

Figure 1. Existing Block Diagram

anesthesia machine's block diagram, as seen in Figure. A heartbeat sensor is used to track a patient's heartbeat. Heart rate, which is often measured in beats per minute (BPM), is the number of heartbeats in a given amount of time. The external surface of an artery is used to detect and quantify the pulse rate, which is expressed in beats per minute, or BPM. The patient's body temperature is tracked using a temperature sensor. a sensor whose output is linearly proportional to the temperature in centigrade. The rate of breathing per minute is measured with a respiration sensor. The anesthetist can adjust the level of anesthesia by using the syringe pump that comes with the raspberry pi.Anesthesia to be given to the patient in milliliters per hour (from 1 to 1000 milliliters). Subsequently, it examines multiple biomedical variables acquired from the sensors to ascertain the Servo Motor's rotational orientation.The servo motor's rotation drives the infusion pump to move either forward or backward, injecting the patient's body with the anesthesia contained in the syringe. In this concept, the raspberry pi will also be used to detect the blood's entire timing and opposite flow.

III. PROPOSED ARCHITECTURE

The suggested system's operation is shown in the flow chart that was given. The system starts up immediately upon turning on the power supply; controller setup takes place beforehand. After setup, the controller requests the patient's age. Subsequently, the gas level and moisture status are measured by the controller, which then proceeds to measure the heart rate, SPO2, and body temperature. If all of these factors are inside the threshold, the syringe push for the next anesthetic dosage is initiated. The amount of anesthetic provided is communicated to the appropriate doctor upon the initiation of the next dosage, and all the parameters are uploaded to the cloud for remote retrieval. Using the switch panel, the anesthetist can initiate the procedure.The Raspberry pi catches the signal, then assumes command of the configuration.The Raspberry Pi instructs the motor driver to activate the motors and begin the infusion of anesthesia.Additionally, the Raspberry Pi has the ability to regulate the patient's level of anesthesia.The respiration rate per minute can be determined by the Raspberry Pi by using a respiration sensor.The Raspberry Pi has the ability to control the amount of anesthesia that will be given to the patient via a syringe pump.A temperature sensor, humidity sensor, heart rate sensor, spo2 sensor, co2 sensor, and wet sensor can all be used with the Raspberry Pi.A microcontroller, such as an Arduino UNO, can receive readings from the Raspberry Pi and analyze them.Based on the patient's age, weight, and other factors, the microcontroller can calculate the right dosage.

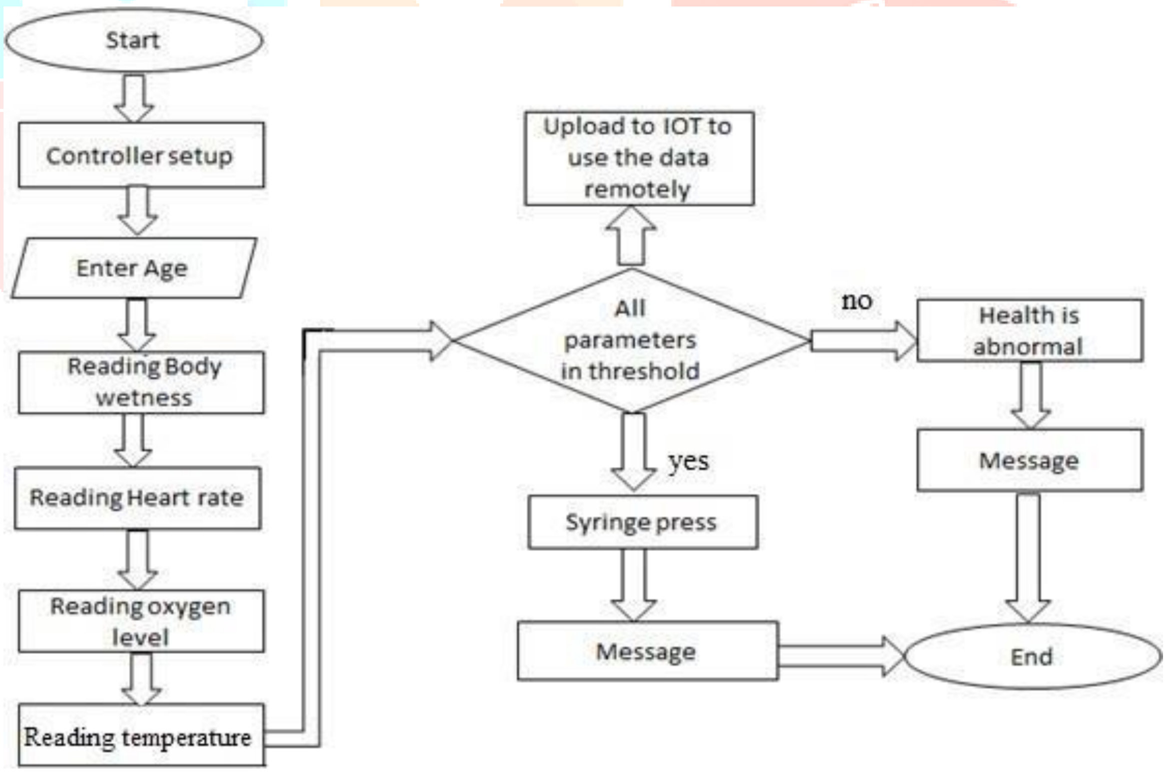

Figure 2. Proposed Flow Diagram

IV. LITERATURE SURVEY

"Syringe Pump Based on Arduino for Electro spinnerApplication," Amir Supriyanto, Rani Anggriani, and Sri Wahyu Suciyati, Journal of Physical Science, 2021. In this study, a syringe pump control system was created to regulate the volume and flow rate of a liquid or solution. Using an Arduino Uno microcontroller board, stepper motors' speed and pulse width modulation (PWM) are controlled to create the syringe pump. A four-digit, seven-segment display, an Arduino Uno controller, a stepper motor for syringe driving, and a keypad matrix for input interface are the instruments utilized. The injection pump, whose speed has been set to the flow rate, is pushed by the syringe pump. The velocity of the By adjusting the stepper motor's delay time using the Arduino Uno's PWM pins, pace and volume may be determined. The observed flow rate range for the syringe pump is 0.10–12.00 ml h–1. The device can be used in medical settings to regulate the amount and pace at which medicinal fluids flow, as well as to create nanofibers through the electrospinning process.[1]**Hanumant R. Vani, Pratik V, Makh, Mohanish, and Chandurkar K. Regularization of Anesthesia using Heart Beat Sensor 2014's first nine issues of International Journal of Engineering, Education, and Technology (ARDIJEET), 2 (1).** When anesthetic is administered during surgery, the patient may die if a large or low amount is given. The note anesthetist gives the patient a few milliliters of anesthetic at regular intervals to prevent such a predicament. The goal of this project is to create an efficient, autonomously run anesthetic machine using a microcontroller to get over such tiresome issues. Based on the state of the patient, the suggested Automatic anesthetic Regularization System uses a microcontroller system and multi-task feedback to regulate the anesthetic level. Throughout operation, anesthetic levels can be managed with the help of the Automatic anesthetic Controller, which is made utilizing a microcontroller. An anesthesia infusion pump with a mechanical syringe is supplied to The one receiving care. The anesthetist has the ability to program the keypad to deliver the anesthetic dosage in milliliters per hour. The microcontroller receives an analog input from the keypad, which it uses to determine how much anesthetic should be delivered into the DC motor in order to run the injection pump. The anesthesia was given according to the patient's physical condition and the direction in which the DC motor rotated to move the syringe—forward or backward. In the realm of medicine, this module will be extremely important and helpful to doctors doing large surgeries in order to administer the appropriate level of anesthetic.[2]**Misal US, SA Joshi, and MM Shaikh carried out a postgraduate educational review on delayed recovery following anesthesia. Anesthesia Res. Essays 10 (2), 2016, 164–172.** One of the main problems an anesthesiologist faces is delayed waking from anesthesia. Patients typically wake up during the postoperative phase quickly when fast-acting anesthetics are used. The length of the procedure, the patient, the anesthetic, and unpleasant stimulation all have an impact on how quickly a patient emerges from anesthesia. The anesthetic drugs and medications used during the perioperative period are the main causes of delayed waking after anesthesia. Acknowledging nonpharmacological factors is crucial since they can have major consequences. Delayed recovery after anesthesia may also be caused by some underlying metabolic disorders, including hypoglycemia, severe hyperglycemia, and electrolyte imbalance, particularly hypernatremia, hypoxia, hypercapnia, central anticholinergic syndrome, chronic hypertension, liver disease, hypoalbuminemia, uremia, and severe hypothyroidism. Unexpectedly long recovery period following general anesthesia may also result from thrombosis, embolism, hemorrhage, or intraoperative cerebral hypoxia. Maintaining breathing, circulation, and airway integrity is the main goal of management; nevertheless, an accurate diagnosis of the underlying cause is essential for the initiation of appropriate therapy. Based on our clinical experience, an internet literature search, and standard anesthesiology textbooks, this thorough review addresses the risk factors, etiology, evaluation, and therapy of delayed recovery.[3]**Collins, V. J. "Fundamental Considerations of General Anesthesia," Third Edition, Philadelphia, Lea & Febiger, 1993, 314–359.** In this work, a microcontroller-based fuzzy logic control system was used to assess the depth of anesthesia caused by sevofluorane based on the patient's heart rate and blood pressure readings. Sevofluorane, one of anesthesiologists' first choices for inhalation anesthesia, is the anesthetic agent for which the device was created. The following are the systems' possible advantages: To improve patient comfort and safety, In order to draw anesthesiologists' focus to other physiological factors that they must regulate by reducing their workload, In order to create the best possible anesthetic agent, Using the best anesthetic agent possible can assist safeguard the environment. to reduce an operation's expenses in order to save money.[4]**Raspberry Pi-Based Anesthesia Machine Control System Development (2020):** This study looks into the viability of using a Raspberry Pi to run anesthetic machines. It investigates how to combine anesthetic delivery methods with the computational capabilities of the Raspberry Pi to enhance control and monitoring functionalities. In an attempt to improve anesthetic delivery across a range of healthcare environments, the study emphasizes how scalable and economical such a system may be.[5]

V. RESULTS AND DISCUSSIONS

System Functionality

The anesthesia machine control system successfully regulates anesthesia delivery based on sensor inputs, including monitoring vital signs such as oxygen saturation, heart rate, and respiratory rate.The user interface allows clinicians to adjust anesthesia parameters, view real-time data, and receive alerts for abnormal conditions. Safety features, such as alarm systems and fail-safe mechanisms, ensure patient safety and regulatory compliance.

Performance Evaluation

The system demonstrates reliable operation and responsiveness in controlling anesthesia delivery components, with minimal latency between sensor inputs and actuator outputs.Performance metrics, such as control accuracy, response time, and stability, meet or exceed specified requirements.Testing under various scenarios and conditions confirms the robustness and effectiveness of the control algorithms and software.

Clinical Implications

The anesthesia machine control system provides clinicians with enhanced control and monitoring capabilities, improving patient safety and anesthesia management during surgical procedures.Real-time feedback and alarm systems enable timely intervention in case of adverse events or patient condition changes, reducing the risk of complications.

Technical Challenges and Solutions

Challenges encountered during the development process, such as hardware compatibility issues, sensor calibration, and software optimization, were addressed through systematic troubleshooting and iterative refinement.Integration of multiple hardware components and software modules required careful coordination and testing to ensure seamless operation and interoperability.

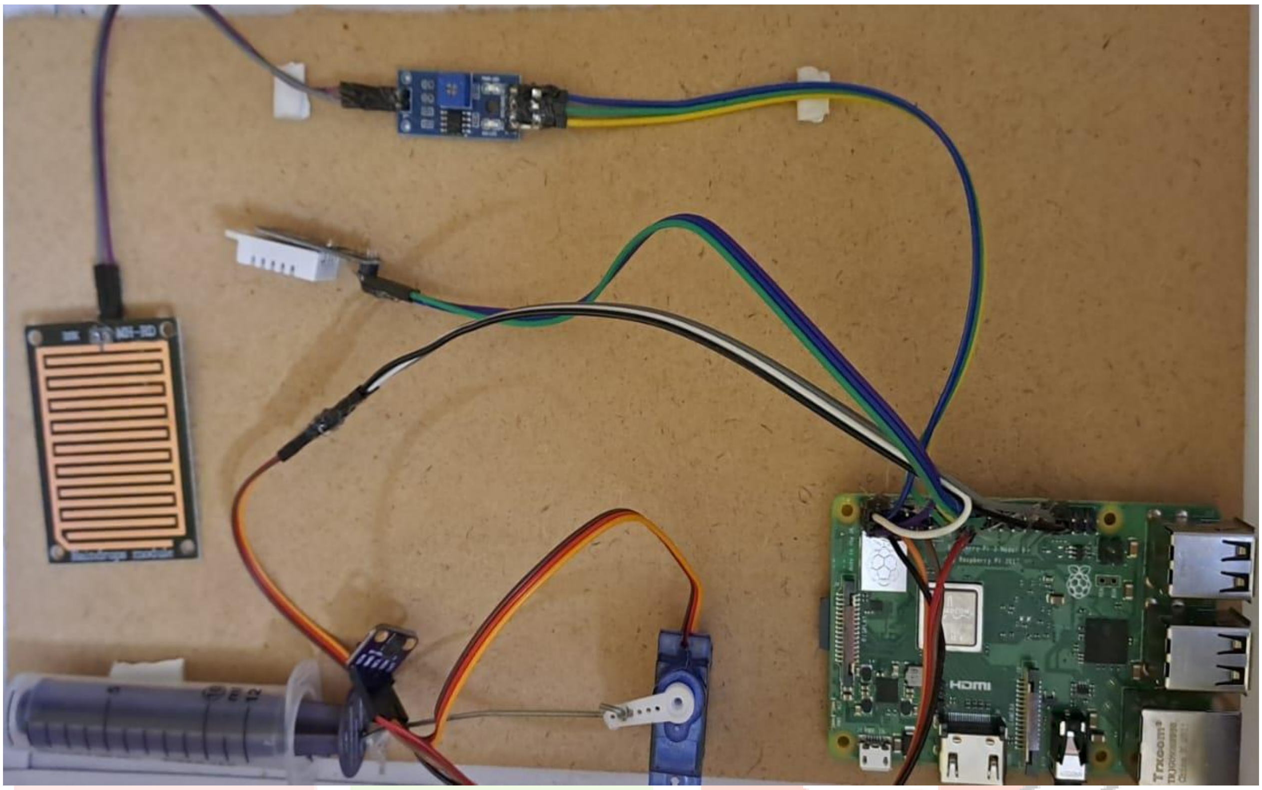

Figure 3. Output

VI. CONCLUSION

Modern technology has improved biomedical device automation in several ways. The Raspberry Pi-based automated syringe pump was successfully constructed as a result of this study, and the performance of the system was evaluated by examining the test results. The 10 mm acrylic syringe pump housing's rectangular shape has been decided upon. The syringe pump can operate in the volume range of 0.10–30.00 ml and the flow rate resolution of 0.10 ml–1 ml with an error value of less than five percent. The accuracy rate of the designed automatic syringe pump is 95.56 percent.

VII. REFERENCES

[1] Amir Supriyanto, Rani Anggriani, Sri Wahyu Suciyati,"Syringe Pump Based on Arduino for Electro spinner Application", Journal of Physical Science, 2021.

[2] Gokilavani. R, Gokulapriya. M, Jasmine Christy. A. R,Jeeva. R. Thiyagarajan. N, "Anesthesia control system"Microfluidic Syringe Pump Using Arduino", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 2019.

[3] A. Juarez et al. "AutoSyP: A Low - Cost, Low - PowerSyringe Pump for Use in LowResource Settings." The American Journal of Tropical Medicine and Hygiene 95.4 (2016): 964–969. PMC. Web.29 Sept.2018.

[4] Surya V, Srutartha B, Shreya K, Kathirvelu D 2018 Ocular Drug Delivery System Using Open - SourceSyringe Pump. Asian Journal of Pharmaceutical and Clinical Research 11 (6): 2018, 152 - 157.

[5] B. Tebrean, S. Crisan, C. Muresan and T. E. Crisan, "Low Cost Command and Control System for Automated Infusion Devices", International Conference on Advancements of Medicine and Health Care through Technology, 2017.

[6] Hafez Fouad, Hesham Farouk, "Design and Implementation of Wireless Sensors Network and Cloud Based Telemedicine System for Rural Clinics and Health Centers. ", International Journal of Scientific & Engineering

Research, 2015

[7] I. Saidi, L. A. Ouni and M. Benrejeb, “Design of an Electrical Syringe Pump Using a Linear Tubular Step Actuator, ” International Journal of Sciences and Technologies of Automatic control & computerengineering IJ - STA, Volume 4, No - 2, December 2015.

[8] Collins V. J. “General Anesthesia Fundamental Considerations”, 3th Edition, Philadelphia,Lea&Febiger, 1993, 314 - 359.

[9] Durgadevi S, Anbananthi Embedded System: Patient Life Secure System Based On Microcontroller. International Journal for Advance Research in Engineering and Technology, 2014, 142 - 147.

[10] HanumantR. Vani, Pratik V, Makh, Mohanish & Chandurkar. K Anesthesia Regularization using HeartBeat Sensor International Journal Of Engineering, Education And Technology (ARDIJEET), 2 (1), 2014, 1 – 9.