THINK INDIA (Quarterly Journal)

ISSN: 0971-1260
Vol-22-Issue-2-April-June-2019

Microcontroller Based Automated Anesthesia Injector

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Abstract:The project deals with the development of an automatic anesthesia/fluid injector using embedded system technology. By passing an instruction using mobile/computer device the nodeMCU receives the signal and it processes those signals and activates the motor driver to drive the linear actuator accurately, the pressure of linear actuator is controlled by the micro controller unit. The injector consists of temperature sensor for measuring the temperature variation in the body, Respiration Sensor to measure respiration, Heartbeat Sensor for measuring heartbeat, the linear actuator is used to control the pressure of syringe and is performed under the supervision ofmicrocontroller. This project can be used in surgeries which last for longer hours. During such surgeries complete dose of anesthesia cannot be monitored in a single dose.Sothe anesthesia can be administered to the patient in few ml by the machine, and also to inject any kind of medicines to patients.

Keywords-nodeMCU, respiratory sensor, heartbeat sensor, temperature sensor, linear actuator, motor driver.

I.INTRODUCTION

In the hospitals, when any major operation is performed, the patient must be inanesthetized condition. If the operation lasts

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for a long time, say for suppose for 4 or 5 hours, complete dose of anesthesia cannot be administered in a single stroke. It may lead to the patient's death. If lower amount of anesthesia is administered, the patient may wakeup 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. Also any other medicines needs to be injected in a

ISSN: 0971-1260
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given time interval or only once can be injected without human intervention by operating the machine through mobile phone.

II.DESIGN AND DETAIL

EXPERIMENTAL

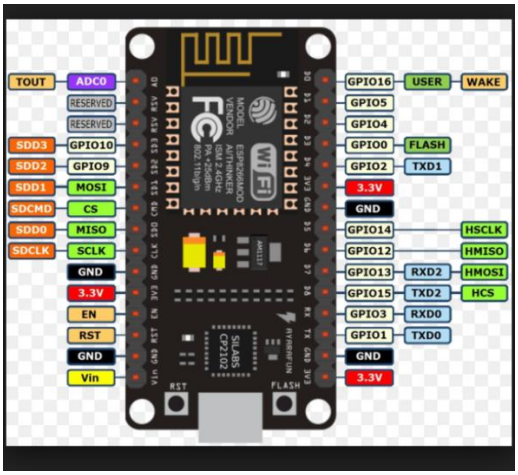
(A)NODEMCU (ESP8266)

Espressif Systems' Smart Connectivity Platform (ESCP) is a set of high performance, high integration wireless SOCs, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed WiFi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement.

ESP8266EX offers a complete and self-contained WiFi networking solution; it can be used to host the application or to offload WiFi networking functions from another application processor. When ESP8266EX hosts the application, it boots up directly from an external flash. In has integrated cache to improve the performance of the system in such applications.

Alternately, serving as a WiFi adapter, wireless internet access can be added to any micro controller based design with simple connectivity (SPI/SDIO or I2C/UART interface).

ESP8266EX is among the most integrated WiFi chip in the industry; it integrates the antenna switches, RF balun, power amplifier, low noise receive amplifier, filters, power management modules, it requires minimal external circuitry, and the entire solution, including front-end module, is designed to occupy minimal PCB area.



(B) TEMPERATURE SENSOR

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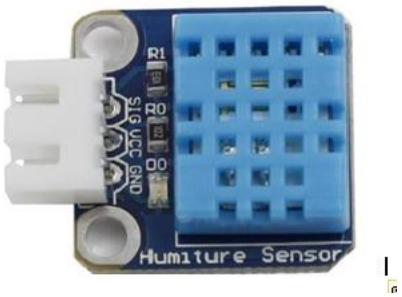
The DHT11 Humidity and Temperature Sensor consists of 3 main components. A resistive type humidity sensor, an NTC (negative temperature coefficient) thermistor (to measure the temperature) and an 8-bit microcontroller, which converts the analog signals from both the sensors and sends out single digital signal. The DHT11 is a commonly used Temperature and humidity sensor. The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is also factory calibrated and hence easy to interface with other microcontrollers. The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±1°C and ±1%.



(C) HEARTBEAT SENSOR

The DF Robot heart rate sensor is a thumb-sized heart rate monitor designed for Arduino microcontrollers. It includes a Gravity interface, for easy plug-and-play connectivity. This sensor is a pulse sensor which is developed based on PPG (PhotoPlethysmoGraphy) techniques. This is a simple and low-cost optical technique that can be used to detect blood volume changing in the micro vascular bed of tissues. It is relatively easy to detect the pulsatile component of the cardiac cycle according to this theory.

The sensor has two holes that you can use to attach to the belt. It can be wraped on finger, wrist, earlobe or other areas where it has contact with skin. The heart sensor has two kinds of signal output mode analog pulse mode and digital square wave mode. The output mode can be changed using the dial switch. It includes a Gravity interface, for easy plug-and-play connectivity.

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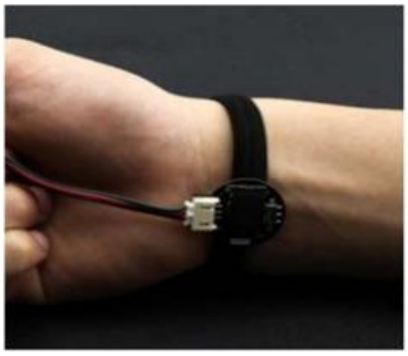
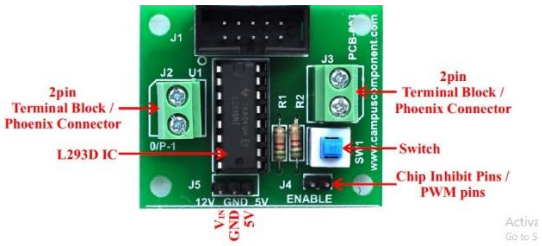


(D) RESPIRATORY SENSOR

The module is made using Gas Sensor MQ3. The sensitive material used for this sensor is SnO2, whose conductivity is lower in clean air. It has a good resistance to disturbances due to smoke, vapor and gasoline. This module provides both digital and analog outputs. MQ3 sensor module can be easily interfaced with Microcontrollers, Arduino Boards, Raspberry Pi etc. It has a high sensitivity and fast response time. Sensor provides an analog resistive output based on respiratory rate. The drive circuit is very simple, all it needs is one resistor. A simple interface could be a 0-3.3V ADC. It is used to measure the respiratory rate of a person.

(E) MOTOR DRIVER

The L293D motor driver is available for providing User with ease and user friendly interfacing for embedded application. L293D motor driver is mounted on a good quality, single sided non-PTH PCB. The pins of L293D motor driver IC are connected to connectors for easy access to the driver IC's pin functions. The L293D is a Dual Full Bridge driver that can drive up to 1Amp per bridge with supply voltage up to 24V. It can drive two DC motors, relays, solenoids, etc. The device is TTL compatible. Two H bridges of L293D can be connected in parallel to increase its current capacity to 2 Amp.



(F) LINEAR ACTUATOR

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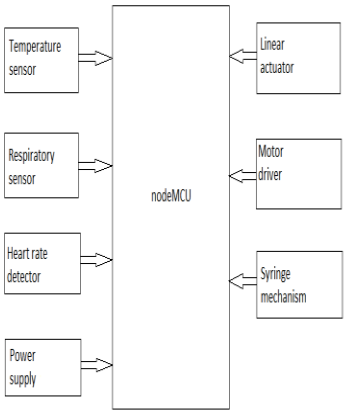
The most common design for an electric linear actuator is a DC motor with a transmission, usually a worm gear, connected to a screw/nut assembly. This basic design converts the rotational motion in the DC motor to a linear motion.

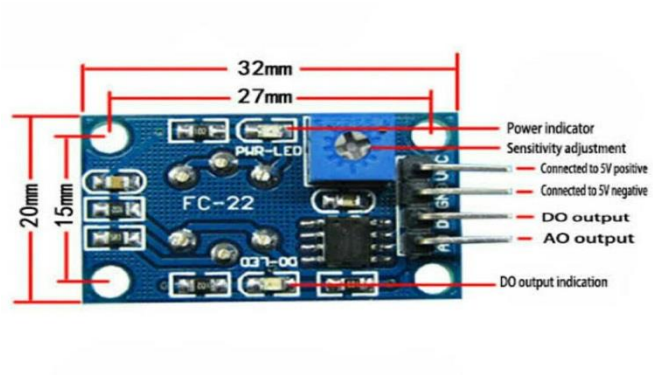
Linear actuators provide a quiet, safe, energy-efficient and smooth motion. The worm gear and screw/nut assembly is a quiet solution that results in a low-noise actuator. Furthermore, the actuator's easy-to-drive requirements allow for a safe connection to a battery power supply source. The actuator's self-lock system also makes sure the actuator will not move in the opposing direction when an external load is applied.

III WORKING PRINCIPLE

The instruction for the ml of medicine to be injected is passed using the mobile application. The nodeMCU receives the signal and it processes these signals and activates the linear actuator to drive the syringe mechanism accurately, The fluid injector consists of temperature sensor for measuring the temperature variation in the body, respiration sensor to measure respiration, heart beat sensor for measuring heart beat and the overall operation is performed under the supervision of micro controller. After the parameters are measured, the fluid drug is injected into the patient with the help of the syringe mechanism if the parameters are normal. If the measured medical parameters are abnormal then an alert will be sent to the doctor.

IV BLOCK DIAGRAM





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V CONCLUSION

Modern technologies have developed automation in every sphere of biomedical instrumentation. This project is also based on automation drug regulation system will be very much useful to surgeon to check the current position of anesthesia so that the proper anesthesia or other fluids will be injected to patients. Protection is intelligent than prevention and cure. This project on automatic fluid drug regularization system is one of the efficient protecting systems in medical industries. This system is very useful to the anesthesiologists who monitor the particular parameter for the patient and regularize the anesthesia. This module can be connected along with the syringe pump or the anesthesia ventilator for future implementation. They can also connect with the EEG parameters for major operations.

ACKNOWLEDGEMENT

We are thankful to Mr. Senthilkumar Assistant Professor in Depart of Electronics and Communication Engineering, Sri Sairam Engineering College , Chennai for providing us with proper guidance and encouragement to carry out the paper work.

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[2]^ Standards for Basic Anesthetic Monitoring. Committee of Origin Standards and Practice Parameters (Approved by the ASA House of Delegates on 21 October 1986, amended 20 October 2010 with an effective date of 1 July 2011)