

Electromechanically Actuated with Biomaterials Auxetic Device

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Abstract - Advances in science over the centuries can be seen in various areas of medicine. One such area is in the treatment and healing process of wounds. The wound is any break in the epidermis, or outermost layer of the skin. The people who suffers from chronic wounds due to the lack of proper drug delivery. The design of drug delivery system which automatically identifies the pH of the wound, the pH sensor have two electrodes, a measuring and reference electrode. These values are read by the microcontroller and initiates the process of drug delivery. according to the value of the pH, the phases are defined. For each phase of the wound, the appropriate is drug is delivered by the activation of relay of the motor. The drug which enhance the process of wound healing. While applying drugs to the wound site there will be the formation of exudates and sloughs. The formation of these substances is the indication of infection and barrier to the wound healing. For the removal of these substances we were using the vibrator in the device. The vibrator is activated after a drug is delivered to the wound site there by the formed slough can easily removed. The drug is delivered to the wound site through a specialize mechanism which ensures that drug is delivered to all the areas of the wound.

Keywords: Slough, Chronic Wounds, Vibrator, Drug

INTRODUCTION

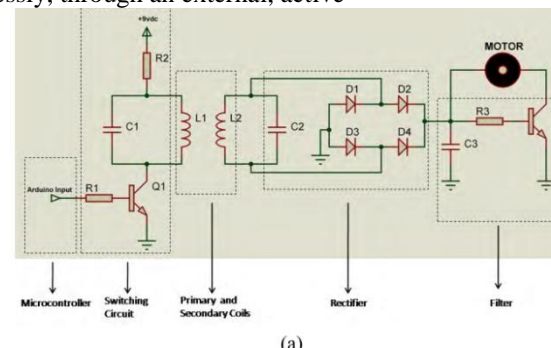
A wound can be described as a defect or a break in the skin, resulting from physical or thermal damage or as a result of the presence of an underlying medical or physiological condition. According to the Wound Healing Society, a wound is the result of 'disruption of normal anatomic structure and function with consecutive loss of function. The design of device is to ensure the wound healing process efficiently and to reduce the distress of patient. A delivery system in the context of wound healing should do the following for its cargo: 1) Maintain its bioactivity through protection from proteolysis in the wound bed, 2) Localize its bioavailability by preventing rapid dilution in wound fluid and systemic uptake and distribution, 3) Facilitate its release or presentation within the wound at a physiologically relevant rate and duration. For an efficient wound healing process the infection and slough should be removed from the wound site. This can be done by the desloughing processes. When the desloughing process completed the delivery of drugs through the flexible delivery system achieves the efficient drug distribution at the wound area. Thus the drug delivery and desloughing process is processed by according to the pH value of the

wound. These processes enhances the wound healing process

EXISTING SYSTEM

The design and fabrication of a wound healing device for chronic wounds, with multiple functions for controlled drug delivery and exudate removal, has been described in this paper. The structural features have been machined and modified through laser cutting in a biocompatible polymer cast.

Miniaturized versions of electronically actuated (lead-screw and pulley) mechanisms are used for the specific purpose of controlled drug delivery. These mechanisms have been studied and tested, being controlled through a microcontroller setup. An auxetic polymeric barrier membrane has been used for restricting the drug quantities administered. Drug delivery mechanisms are powered wirelessly, through an external, active

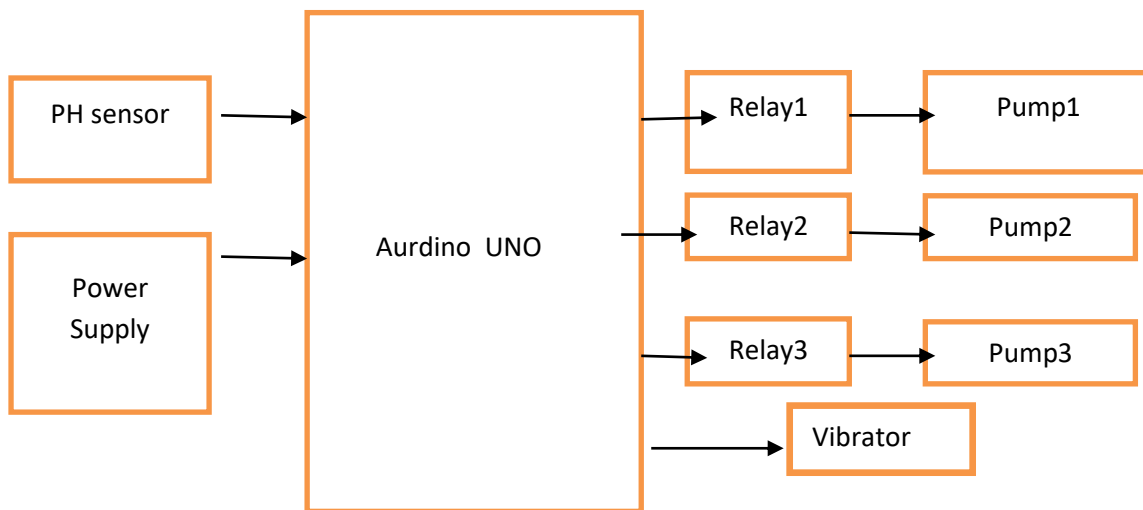


RF

component; this communicates with a passive component that is buried inside the wound healing device.

The exudate removal efficiency of the device has been assessed through several simple tests using simulated wound exudate. It has been found that reasonably precise quantities of drug dosages to be administered to the wound site can be controlled through both drug delivery mechanisms; however, the lead-screw mechanism provides a better control of auxetic barrier membrane actuation and hence controlled drug delivery. We propose that this device can have potential clinical significance in controlled drug delivery and exudate removal in the management of chronic wounds.

BLOCK DIAGRAM



The drug delivery system which uses the technique of pumping , thus the drugs get pump in to a collector . From the collector slowly the drug is released to the tube when the relay gets switched to the appropriate drug pump according the ph monitored at the wound site. From the tube the drug is delivered to the wound bed pouch which is covers at the wound site , the wound bed is made up on biocompatible material having numerous pores in the biocompatible plastic pouch , inside the plastic pouch there is four layer of auxetic film . The auxetic film which has the negative poisons ratio , reduces the force of the drugs and slows the delivery of the drugs. Thus we achieves the controlled drug delivery.

On the time of drug delivery there will be the formation of the slough at the wound site, for the efficient wound healing process slough should be removed from the wound site. For chronic wounds the process of self woud healing process will not be effective, also the body itself cannot remove the slough. Here for removing the slough we are using a pad which made up of creep band connected to a vibrator , which activates after the drug delivery. After removing the slough from the wound site the pH is again measured. Then it transfers the information to the microcontroller, microcontroller is the main part of the system ,according to the level of ph the microcontroller activates the relay of the pump which suites for the current ph value , the drug collected in three different pouches for three different ranges of the pH value.

There we defines three ranges of pH value according to the changes of pH value of the skin. The normal ph of the skin is 5 – 6 the skin is lightly acidic in nature . when a wound is formed in the skin , the initial stage of the inflammatory stage of wound make the ph at the most basic phase the skin and it ranges from 8 . This is the indication for normal wound healing process of wound. When the ph range is about 7 then the process of wound healing is not properly going. Thus for values ranges from below 7 drug A released to the wound site . The ph value ranges above 7 will deliver the drug B to the wound site , and for the ph value 7 the drug C will be delivered to the wound site. Thus the system which enhances the wound healing process .

Components details

Arduino uno

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to- DC adapter or battery to get started.You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.Uno means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards. Arduino is an open-source electronics platform based on easy-to- use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming

language (based on Wiring), and the Arduino Software (IDE), based on Processing. Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers -students, hobbyists, artists,



PH sensor

The pH level in a chronic wound bed is a key indicative parameter for assessment of the healing progress. Due to fragility and inability to measure multiple wound regions simultaneously, commercial glass microelectrodes are not well-suited for spatial mapping of the wound pH. To address this issue, here present an inexpensive flexible array of pH sensors fabricated on a polymer-coated commercial paper (palette paper). Each sensor consists of two screen-printed electrodes, an Ag/AgCl reference electrode and a carbon electrode coated with a conductive proton-selective polymeric (polyaniline, PANI) membrane. Laser-machining is used to create a self-aligned passivation layer with access holes that is bonded over the sensing and reference electrodes by lamination technology. Characterization of the pH sensors reveal a linear ($r^2 = 0.9734$) relationship between the output voltage and pH in the 4–10 pH range with an average sensitivity of -50 mV/pH. The sensors feature a rise and fall time of 12 and 36 s for a pH swing of 8-6-8. The sensor biocompatibility is confirmed with human keratinocyte cells.

RELAY

Overview

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be ON or OFF so relays have two switch position and they are double throw (changeover) switches.

Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) can not provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these

programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

devices can supply relay coils directly without amplification.

Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relay with 4 sets of changeover contacts are readily available. Most relays are designed for PCB mounting but you can solder wires directly to the pins providing you take care to avoid melting the plastic case of the relay.

The supplier's catalogue should show you the relay's connection. The coil will be obvious and it may be connected either way round. Relay coils produce brief high voltage 'spikes' when they are switched off and this can destroy transistors and ICs in the circuit. To prevent damage you must connect a protection diode across the relay coil.

The relay's switch connections are usually contains COM, NC and NO.

COM = Common, always connect to this; it is the moving part of the switch.

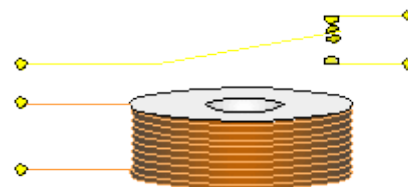
NC = Normally Closed, COM is connected to this when the relay coil is *off*.

NO = Normally Open, COM is connected to this when the relay coil is *on*.

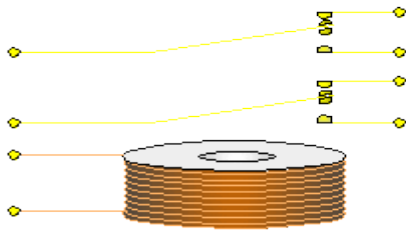
Connect to COM and NO if you want the switched circuit to be *on when the relay coil is on*.

Connect to COM and NC if you want the switched circuit to be *on when the relay coil is off*.

Most relays are SPDT or DPDT which are often described as "single pole changeover" (SPCO) Or "double pole changeover"(DPCO).



This is a Single Pole Double Throw relay. Current will flow between the movable contact and one fixed contact when the coil is energized and between the movable contact and the alternate fixed contact when the relay coil is energized. The most commonly used relay in car audio, the Bosch relay, is a SPDT relay..



This relay is a Double Pole Double Throw relay. It operates like the SPDT relay but has twice as many contacts. There are two completely isolated sets of contacts.

Relay Construction:

Relays are amazingly simple devices. There are four parts in every relay:

- Electromagnet
- Armature that can be attracted by the electromagnet
- Spring
- Set of electrical contacts

A relay consists of two separate and completely independent circuits. The first is at the bottom and drives the electromagnet. In this circuit, a switch is controlling power to the electromagnet. When the switch is on, the electromagnet is on, and it attracts the armature. The armature is acting as a switch in the second circuit. When the electromagnet is energized, the armature completes the second circuit and the light is on. When the electromagnet is not energized, the spring pulls the armature away and the circuit is not complete. In that case, the light is dark.

When you purchase relays, you generally have control over several variables:

- The voltage and current that is needed to activate the armature
- The maximum voltage and current that can run through the armature and the armature contacts
- The number of armatures (generally one or two)
- The number of contacts for the armature (generally one or two -- the relay shown here has two, one of which is unused)
- Whether the contact (if only one contact is provided) is normally open (NO) or normally closed (NC)

Relay Applications:

In general, the point of a relay is to use a small amount of power in the electromagnet coming, say, from a small dashboard switch or a low-power electronic circuit -- to move an armature that is able to switch a much larger amount of power. For example, you might want the electromagnet to energize using 5 volts and 50 milliamps (250 mill watts), while the armature can support 120V AC at 2 amps (240 watts).

Relays are quite common in home appliances where there is an electronic control turning on something like a motor or a light. They are also common in cars, where the 12V supply voltage means that just about everything needs a large amount of current. In later model cars, manufacturers have started combining relay panels into the fuse box to make maintenance easier.

In places where a large amount of power needs to be switched, relays are often **cascaded**. In this case, a small relay switches the power needed to drive a much larger relay, and that second relay switches the power to drive the load.

Relays can also be used to implement Boolean logic.

Advantages of Relay:

- Relays can switch AC and DC, transistors can only switch DC.
- Relays can switch high voltages, transistors cannot.
- Relays are a better choice for switching large currents (> 5A).

Relays can switch many contacts at once.

Vibration sensor

The DT series of piezo film sensors elements are rectangular elements of piezo film with silver ink screen printed electrodes. They are available in a variety of different sizes and thickness. The DT film element produces more than 10 milli volts per micro strain, about 60 dB higher than the voltage output of a foil strain gage. The capacitance is proportional to the area and inversely proportional to the thickness of the element. The DT series sensors are the simplest form of piezo film sensors, used primarily as dynamic strain gages and contact microphones for vibration or impact detection. These are available without any leads for those applications where the customer wants to make his own lead attachment. They can be readily adhered to a surface with double-sided tape or epoxy. Lead attachment can be achieved by compressive clamping, crimps, eyelets, conductive epoxy or low temperature solders.

DT elements are supplied with a thin urethane coating over the active sensor area; the lead attachment legs are free of the insulating urethane coating. It is a low-cost cantilever-type vibration sensor loaded by a mass to offer high sensitivity at low frequencies. Pins are designed for easy installation and are solder able. Horizontal and vertical mounting options are offered. The active sensor area is shielded for improved RFI/EMI rejection. Rugged, flexible PVDF sensing element withstands high shock overload. Sensor has excellent linearity and dynamic range, and may be used for detecting either continuous vibration or impacts. The mass may be modified to obtain alternative frequency response and sensitivity selection. The figure 4.5 shows the structural view of vibration sensor.

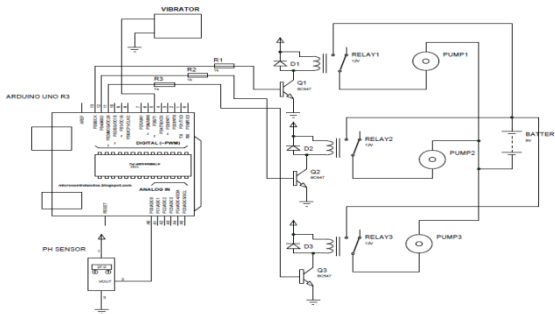
SUBMERSIBLE PUMP MINI WATER PUMP

Micro dc 3-6v micro submersible pump mini water pump for fountain garden mini water circulation system diy projectdc 3v to 6v submersible pumpmicro mini submersible

water pump 3v to 6vdc water pump for diydc pump for hobby kitmini submersible pump motorthis is a low cost, small size submersible pump motor which can be operated from a 2.5 ~ 6V power supply. It can take up to 120 liters per hour with very low current consumption of 220ma. Just connect tube pipe to the motor outlet, submerge it in water and power it. Make sure that the water level is always higher than the motor. Dry run may damage the motor due to heating and it will also produce noise.



CIRCUIT DIAGRAM



CIRCUIT DSCRIPTION

The PH sensor is connected to pin A0 of the arduino. Three relays are connected to the digital pins 11,12 and 13 and a vibrator is connected to the 5th pin of arduino.

The PH sensor reads the PH value at the wound surface. If the PH value is in between 6.5 and 7.5 the realy1 is on. if the PH value is greater than 7.5 relay2 is turned on and if the value is less than 6.5 relay3 will be on. Three pumps are connected to the relays. When the relay turned on, the pump connected to the relay will on.

The input to the relay from arduino is through transistor BC547.Which is given to the base of the transistor. When the arduino pin is high, the base of the transistor will be high and the transistor turned on, thereby the relay becomes on.

The vibrator ison for a duration of 1 second before the pump turned on.

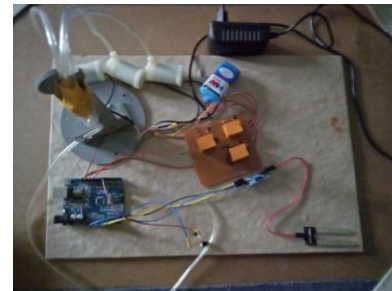
RESULT

The PH sensor senses the each phase and takes reading of each stage of the wound. The value of the each wound phase is recorded in the PH sensor.By undertaking the PH values the drugs are delivered.For all process the needed programs are stored in the Aurdino UNO.The Aurdino UNO controls all the timing sections of the working model.

The relay act as a switch and controls the drug delivery.For each stage there will be gap for the drug delivery,inorder to this it make sures the timing of each sections. The drugs are delivered to the wound bed which will be wrapped around the wound.

The wound bed is created according to the size of the wound.The wound bed materials requires a biocompatible material for the drugs to be carried.The drug carrying bag is holed and the bag is covered by the bandage.So that the drugs are delivered.

The vibrator is connected to it.With the help of the vibrator the sloughs can be removed.Thus all the process of the drug delivery system is done successfully.



CONCLUSION

The drug delivery system which delivers the drugs at the wound site and the slough is removed from the wound site which enhances the wound healing process . further the device can be modified for invivo study.

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