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Automatic Tooth Color Tester Device

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Abstract: Teeth have a very meaningful function for humans which is to help chew, cut food. Therefore the teeth must be treated properly. Although treatment has been done but there are still changes in tooth color. This device can reduce human error from medical officers who conduct examinations. Besides these things, this device is also very useful for determining the colors of teeth in accordance with existing parameters. In this module the average percentage of errors in the color of white teeth is + 2.32%, the color of yellow teeth is + 2.53%, while the color of brown teeth is + 2.34%, and the Ua value of the measurement results is 0.01 while the U95 value is 0.04. From the results of voltage measurements on the colors of yellow and brown teeth there is the same voltage, this is due to differences in the thin color of the teeth, the measurement position of the reading and selection of sensors and the light source used.

Keywords: Tooth color, LDR sensor, LED, microcontroller.

INTRODUCTION

In line with the increasingly rapid advances in technology that encourage people to think about doing activities and activities easily and lightly, so the old ways and need a long time are increasingly abandoned. In the field of medicine, the development of this technology will facilitate the operation of medical device, one of which is a teeth instrument.

As it is known that teeth are an important part in the process of digestion. With genetic influences and external influences such as diet and differences in tooth sensitivity, can affect tooth color. According to the author's observations of the examination of tooth discoloration is currently still done manually by means of matching with the teeth color measurement card.

METHOD

The research design used in the preparation of this Final Project is a research design that is Pre-Experimental. This type of research used in the preparation of this Final Project is a type of research "After Only Design" which is only to see the results of teeth color measurement automatically without seeing before. But there is already a control group that is measuring the color of teeth manually. The weakness of this study is that it does not know the initial situation, so the results obtained are difficult to conclude. In designing this device there are two variables used including:

a. Independent Variables [1]: Independent variables are often called influence variables treatment variable, in this case acting the independent variable is the tooth color level.
b. Bound Variables: Bound variables are often called effect variables, variable is affected, not free, in this case which acts as a dependent variable is Resistance to LDR [2]–[8].

System work components

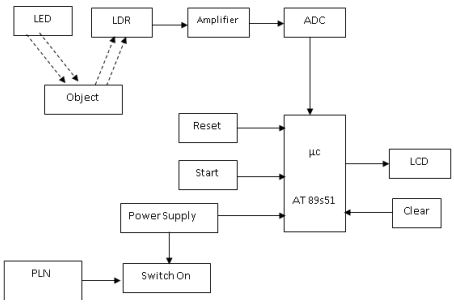

Fig. 1. System block diagram

The grid provides the voltage to the power supply, the AC voltage will be converted into a DC voltage. The voltage will supply all circuits when the On switch is pressed while to start the check then press the start button.

LEDs provide light to the object so that the light is reflected to the LDR [9]–[14], where the output from the LDR will be input to the amplifier to be strengthened so that the ADC can read it.

The output from the amplifier will go into the ADC circuit to be converted into digital data where the output will be processed by the IC microcontroller [15]–[20] which then the processed results will be displayed on the LCD. To repeat the inspection then press the clear button.

System work flow

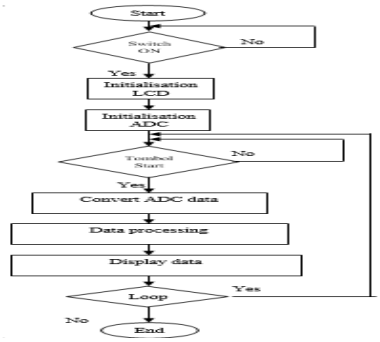

Fig. 2. System work flow

The workflow system [21]–[32] shown in the figure consists of Start the device process. Switch On. To begin the introduction of LCD and ADC. LCD initialization. Introduction of LCD. ADC initialization. Introduction of ADC. Start. To start reading. ADC changed the analog trade entered to be made a digital trade so that it could be sent to Micro. Retrieve ADC data from the conversion results. LCD Displays the final results of the microcontroller. This LCD serves to display the final results of the Micro in the form of the text of the teeth. If yes, then return to the initial process, but if not, then go down (END).

IMPLEMENTATION

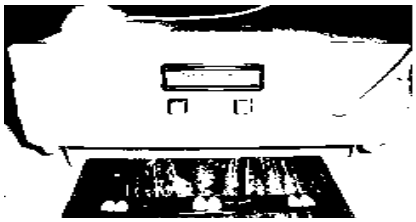

Fig. 3. Device visualisation

Tooth discoloration is an average tooth color disorder that can be seen clinically. Color changes can be divided into the following categories:

Formative color changes. This type of color change is hereditary or congenital. The causes for this formative color change are:

a. Erythroblastosis Fetalis is anemic congenital hemolitis, a blood rupture which results in structural disruption and discoloration of teeth - teeth. This happens because of a mismatch of proteins in the fetus and maternal blood, which is called rhesusfactor (Rh). The result of rhesusfactor is an anemic severe hemolitis, which appears as jaundice (Icterus Gravis Neonatorum). Tooth color changes that will occur vary greatly: green, blue, gray, yellow and brown. The cause of this change is the presence of bilirubin in the teeth bones and these changes will disappear little by little.
b. Fluorosis Endemila is an email that has fluorosis that shows opacity. Brown discoloration occurs due to infiltration of color ingredients from food.

Tetracycline discoloration

Tooth discoloration that occurs due to antibiotics given during infancy, this antibiotic is often known as Tetracycline. The original tetracycline used causes a yellow discoloration under fluorescent UV light. Oxidation affected by sunlight darkens yellow to brown.

Sensors schematic

a. LED. In making this device, the authors use LEDs as a light source on teeth which will be captured by the LDR with different intensities according to the media (teeth).
These LEDs are usually referred to as light diodes, when given a forawrd bias or forward currents generate light at the P-N meeting. At the time of recombination the electrons that release their energy will produce light or heat. This diode has two legs, namely anode and cathode.
LED (Light Emitting Diode) is a diode that can emit light when the legs are stressed according to the required voltage. There are two LED voltage sources that can be given AC voltage for AC LEDs and DC voltage for DC LEDs (In DC LEDs the voltage should not be reversed).
b. LDR. In making this device, the author uses the LDR as a series of light sensor transducers that is receiving light reflection from the media (teeth).
LDR is a resistor whose resistance changes because of changes in the intensity of the light absorbed. LDR is also a resistor that has a negative temperature coefficient, where the resistance is influenced by light intensity. LDR is formed from Cadmium Sulfide (CDS) or ceramic powder. In general, CDS is also called Photo Conductive equipment, as long as there are variations in light intensity.

Buffer schematic

LM 741 IC as an operational amplifier. The LM 741 Series is an operational amplifier for general use that looks better than the industry standard. This amplifier has properties that are always right and can protect the inserted and removed material. Op-Amp 741 which is produced by national semiconductor has 1 Op-Amp that is operated with dual supply, namely + 12 V and -12 V.

ADC 0804 schematic

ADC is an extension of Analog to Digital Converter which means converter from analog to digital. The function of the ADC is to convert analog data into digital data which will later be entered into a digital component, the AT89S51 microcontroller.

There are 2 inputs from ADC, namely positive (+) and negative (-) inputs. The ADC 0804 consists of an 8 bit Analog to Digital Converter microprocessor.

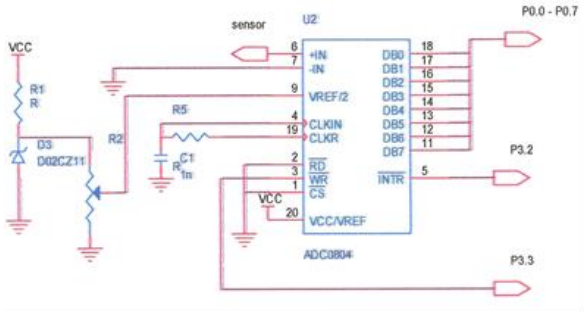

Fig. 4. ADC 0804 schematic diagram

V (+) and V (-) are input analog differential voltage so that the voltage data to be processed by the ADC is the difference between Vi (+) and Vi (-). Vref is the ADC reference voltage used to adjust the input voltage at Vi + and Vi-. This reference voltage is half the maximum input voltage. It is intended that at the

time of maximum input of digital data will also be maximized. The clok frequency of the ADC can be regulated by external R and C components on the Rclk and Cclk pins.

Chip select function is to activate the ADC which is activated by logic low. Read is input that is used to read digital data from active convection results in low conditions. Write function to start the ADC conversion is activated in low logic conditions. The instruction is to detect whether the conversion has been completed or not, if it has, then the instruction pin will issue a logic low. Digital output data as much as 8 bytes (DB0 - DB7) binary 0000 0000 through 1111 1111, so the possibility of decimal numbers that will appear is 0 to 255 can be taken at pins D0 through D7. DB0 - DB7 has latching properties.

Microcontroller minimum system schematic

AT89S51 Microcontroller IC is a component of Atmel's production oriented control with CMOS logic level. This component belongs to the MCS '51 family. The integration circuit has a single chip microcomputer equipment. The equipment in question is the CPU (Central Processing Unit) which consists of components that are interconnected with other components. Among them are the Register, ALU (Arithmetic Logic Unit) and the Control Unit.

LCD schematic

LCD is a dot matrix display that is used to display writing in the form of numbers or letters as desired (according to the program used to control it). In this final project the author uses a dot matrix LCD with 2 x 16 characters, so the legs are 16 pins

RESULT AND DISCUSSION

System Test Result

After making the module it is necessary to conduct testing and measurement. For this reason, the authors make data collection through a process of measurement and testing. The purpose of the measurement and testing is to determine the accuracy of the module making by the author or to ascertain whether each part (component) of the series of modules in question has worked in accordance with its function as planned.

Table 1. The Measurement results of the tooth color output voltage from sensor.

No.	Teeth color		
	White	Yellow	Brown
1.	1.22 Volt	1.11 Volt	1.05 Volt
2.	1.20 Volt	1.09 Volt	1.08 Volt
3.	1.19 Volt	1.10 Volt	1.00 Volt
4.	1.18 Volt	1.06 Volt	1.02 Volt
5.	1.14 Volt	1.07 Volt	1.05 Volt

In this module the voltage measurement results on the color of white teeth obtained an error percentage of 2.34%, the uncertainty value in the measurement of 0.01 and this device is feasible to use because - U95 <measuring value> + U95 namely: 1.005 <1.07> 1 , 07.

From the results of voltage measurements on the yellow and brown teeth of the same voltage range (Brown teeth: 1.08 Volts), this can be caused by differences in the thin color of the teeth and the measurement position of the readings, so the reading results can change.

Discussion

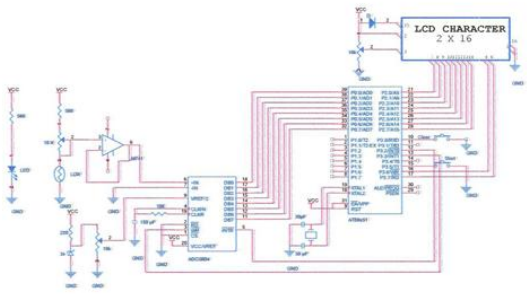

Fig. 5. Overall system schematic

This circuit is powered by DC voltages +5, +12 and -12 Volts, where the voltage is obtained from the regulator circuit. +5 Volt DC voltage is used to supply the target boart circuit (AT89s51 microcontroller), ADC 0804, LCD and sensors (LED and LDR). Voltage +12 and -12 Volt DC are used to supply the amplifier circuit (Buffer).

The sample used here is teeth. From the sample will get light from the LED which is then reflected by the teeth to the LDR, the results of the reflection will be forwarded to the amplifier circuit (buffer). Output from the buffer circuit in the form of analog voltage will be converted into digital data through IC ADC 0804.

After that, ADC 0804 data waits for commands from the microcontroller in the form of pressing the start button. If the start button is pressed then the ADC data will be entered or received by the microcontroller through port 0. The microcontroller then processes the data received from ADC 0804 and translates it as a type of tooth color, the results of the translation will be displayed to the LCD. To repeat the reading then press the clear button then press the start button.

CONCLUSION

After conducting the experiment it turns out that the Teeth Color Test Device can be made using LED and LDR sensors, the LED here functions as a light source and the LDR functions as a light sensor transducer, which receives light reflection from the media (teeth), from the sensor the voltage is 1.22 Volt ; 12Volt and 1.07Volt which voltage will be processed by micro, so the results will be displayed on the LCD, namely white, yellow and brown teeth.

1. Color reading of teeth using LEDs and LDR that is by illuminating the LEDs on the teeth which then results of the gear is received by the LDR, with the amount of light used is 1345Lux and with a reading distance of 2.5 cm.
2. Teeth color test equipment is usually used to determine teeth warrants, which in everyday life are commonly used in the installation of dentures.
3. In this module the average percentage of errors in the color of white teeth is + 2.32%, the color of yellow teeth is + 2.53%, while the color of brown teeth is + 2.34%, and the Ua value of the measurement results is 0.01 while the U95 value is 0.04.
4. From the results of voltage measurements on the colors of yellow and brown teeth there is the same voltage, this is due to differences in the thin color of the teeth, the measurement position of the reading and selection of sensors and the light source used.
5. The use of a microcontroller circuit in this device is very supportive for controlling the color of the teeth automatically, reading the size results and summing up the size results including white, yellow or brown teeth.

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