IoT Based Smart Wearable Pulse Oximeter

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Abstract—An Oximeter is device used to monitor the oxygen level and heart rate in blood. For a healthy person, the oxygen level is in the range between 95 -100 percent. In this device, the displayed data is sent to the cloud where the data is stored and then the displayed data in one end can be recovered in the other end with the help of MIT app inventor. The main concept of Oximeter is Light Emitting Diode (LED) emits light into a person's finger, the integrated photodetector measures variations in the light caused by changes in blood volume. The MAX30100 filters out ambient light that can interfere with an accurate reading. The I2C protocol is used to communicate with the slave (MAX30100) and master (nRF52840). MAX30100 has an inbuilt Analog to Digital Converter (ADC), so the ADC with a programmable sample rate converts the photodetector output to a digital value. And finally, the output is displayed using Organic Light Emitting Diode (OLED) and the size of the device is reduced as much as possible with the help of Altium designer software.

Index Terms – Oximeter, Heart rate, Oxygen level, nRF52840 , MAX30100 , Altium designer.

I. INTRODUCTION

Wearable Oximeter quantifies the amount of the haemoglobin in blood is conveying (oxygen saturation). A non-intrusive and easy test gauges your oxygen immersion level, or the oxygen levels in your blood. It can quickly identify even little changes in how effectively oxygen is being conveyed to the limits uttermost from the heart, including the legs and the arms. It is a backhanded technique for observing the oxygen level and there is no compelling reason to take blood tests of a people and conveys no dangers. The wearable oximeter is a little, cut like a gadget that joins to a body part, similar to toes or ear cartilage. It's most generally put on a finger, and it's frequently utilized in a basic consideration setting like crisis rooms or hospitals. In Reflective strategy, the LED and the photograph locator are set on a similar side for example beside one another. Right now, there will be some fixed light reflection back to the sensor because of the finger. With every heartbeat, there is an expansion in blood volume in the finger. This will bring about an increasingly light reflection back to the sensor. Thus on the off chance that we see the waveform of the got light sign, it will comprise of tops at every heartbeat. A fixed low worth perusing is there in the middle of the heart thumps. This worth is considered as consistent reflection and this distinction

of the pinnacle subtracted from the steady reflection esteem is the reflection esteem because of bloodstream during the heartbeat.

II. PROPOSED SYSTEM

BLOCK DIAGRAM

The red light and infrared light, which is emitted from the sensor, is allowed to pass into the finger to determine the level of oxygen saturation. The reflected light from the sensor is allowed to pass into the microcontroller using the I2C protocol. The microcontroller processes the obtained input and displays the output in the Display unit.

The components used in this project are
- Power Supply unit
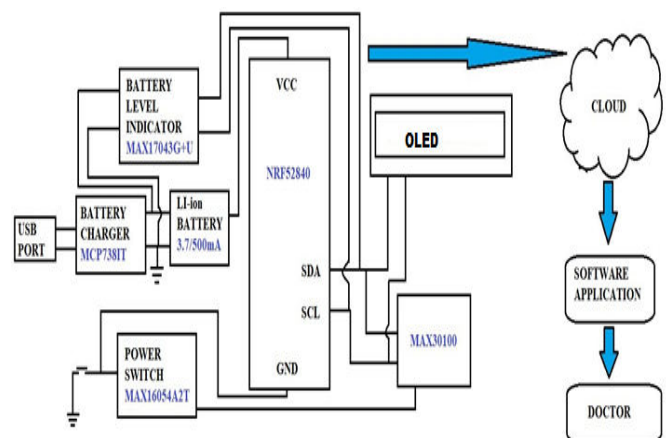- nRF52840
- Max30100
- OLED
- Switch


Figure 1: Block Diagram of Proposed System

III. COMPONENTS DESCRIPTION

MICROCONTROLLER

The nRF52840 is a ultra-low force 2.4 GHz remote System on chip (SoC) coordinating a multiprotocol 2.4 GHz handset, an ARM Cortex-M4F CPU with skimming point unit and blaze program memory. The nRF52840 System-on-Chip (SoC) is a

progressed, profoundly adaptable, ultra-low force multiprotocol SoC undeniably appropriate for ultra-low force remote applications. The implanted 2.4 GHz handset underpins Bluetooth low vitality (Bluetooth 5), 802.15.4, ANT. The J-Link Programmer is utilized to stack the program to the microcontroller Nrf52840. There are three sorts of model accessible, for example, lab, practical and product.nRF52840 controller model, making some amount of gadgets and giving for demo reason. This undertaking depends on Functional model. It comprises of two sign lines Serial Data Line (SDA) and Serial Clock Line (SCL). SDA line is utilized to send and get information among ace and slave. Right now to 127 gadgets can be associated with various location in the Master gadget. The reflected light from the sensor is permitted to go into the microcontroller nRF52840.

Figure 2: nRF52840 Microcontroller
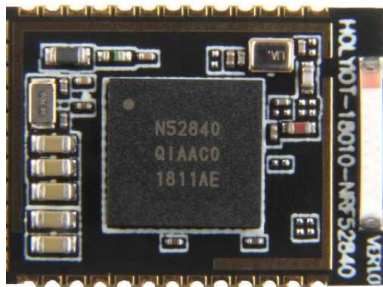
PULSE MONITORING SENSOR

It is an incorporated heartbeat oximeter sensor. It consolidates two LEDs, a photograph finder, advanced optics, and low clamor simple sign preparing to recognize beat oximetry signals. Both the red light and infrared light are utilized to quantify oxygen levels in the blood. It is realized that oxygenated blood assimilates increasingly infrared light and passes progressively red lights while deoxygenated blood retains red light and passes progressively infrared light. This is the primary capacity of the MAX30100: it peruses the retention levels for both light sources and put away them in a support that can be perused through I2C. It faculties the oxygen level and goes to the microcontroller. Information is put away in a FIFO cradle. It can stockpile to 16 estimations, where each example is of size 4 bytes. Initial two bytes are for IR estimation and the last two bytes are for RED estimation. FIFO cushion cannot be perused therefore with I2C since the FIFO focuses on a similar location. It has quick information yield ability and it's a low commotion signal handling to distinguish the oxygen level. Contingent upon the measure of Oxygenated haemoglobin or De-Oxygenated haemoglobin the proportion of red light ingested versus Infrared light (R/IR) assimilated will change.
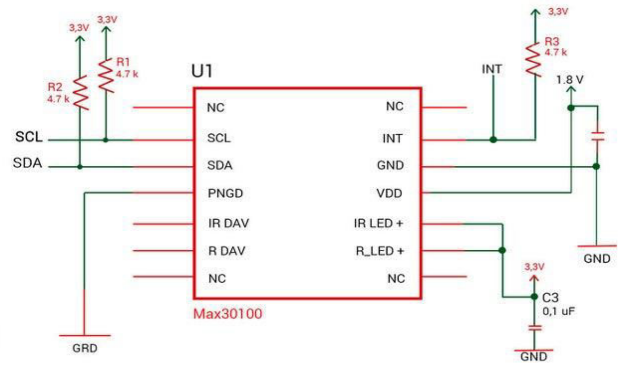

Figure 3: MAX30100 Sensor

OLED DISPLAY

Organic LED-A showcase innovation that offers rich hues, high differentiation, profound blacks, wide review point, low influence and quick reaction time for activity scenes. Rather than silicon or gallium, which LEDs are made of, OLEDs use "natural" carbon discharging layers. The plastic, natural layers of an OLED are more slender, lighter and more adaptable than the crystalline layers in a LED or LCD. Since the light radiating layers of an OLED are lighter and doesn't require Backlighting, the substrate of an OLED can be adaptable. OLED is a sort of level screen show like a LCD. It is a strong state gadget and devours low force; gives incredible brilliance.

Figure 4: I2C OLED display

BATTERY MONITOR

The MAX17043/MAX17044 are ultra-minimized, ease, have side fuel-measure frameworks for lithium-particle (Li+) batteries in handheld and versatile hardware. The MAX17043 is arranged to work with a solitary lithium cell and the MAX17044 is designed for a double cell 2S pack. The MAX17043/MAX17044 utilizes a complex Li+ battery-displaying plan, called Model Gauge to follow the battery's relative condition of-charge (SOC) consistently over a broadly changing charge/release profile. Dissimilar to customary fuel checks, the Model Gauge calculation disposes of the requirement for battery relearn cycles and an outside current-sense resistor. Temperature remuneration is conceivable in the

application with insignificant cooperation between a µC and the gadget. The IC can be situated on the framework side, lessening cost and store network requirements on the battery. Estimation and evaluated limit informational indexes are gotten through an I2C interface.
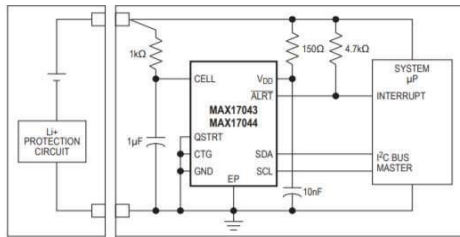

Figure 5: Battery Indicator

BATTERY CONTROLLER

The MCP73831/2 gadgets are profoundly best in class straight charge the executive's controllers for use in space-restricted, cost-touchy applications. The MCP73831/2 is accessible in an 8-Lead, 2 mm x 3 mm DFN bundle or a 5-Lead, SOT-23 bundle. For applications charging from a USB port, the MCP73831/2 cling to all the determinations administering the USB power transport. The MCP73831/2 utilizes a consistent current/steady voltage accuse calculation of selectable preconditioning and charge end. The steady voltage guideline is fixed with four accessible alternatives: 4.20V, 4.35V, 4.40V or 4.50V, to oblige new, developing battery charging prerequisites. The Consistent current worth is set with one outside resistor.
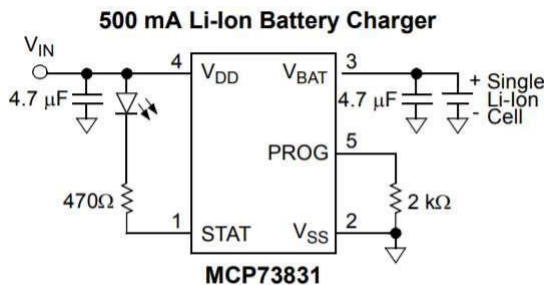

Figure 6: BATTERY CONTROLLER

POWER SWITCH

The MAX16054 is a pushbutton on/off controller with a solitary switch denouncer and worked in the lock. It acknowledges a loud contribution from a mechanical switch and delivers a clean locked advanced yield after a plant fixed capability delay. The MAX16054 takes out contact skip during switch opening and shutting. The MAX16054 highlights a corresponding yield, OUT, which is the upset territory of OUT. Nonconcurrent CLEAR info permits an outer sign to constrain the yield flip-flop low. Undervoltage-lockout hardware guarantees that OUT is in the off state upon power-up. The MAX16054 requires no outside segments, and its low stock current makes it perfect for use in convenient hardware.
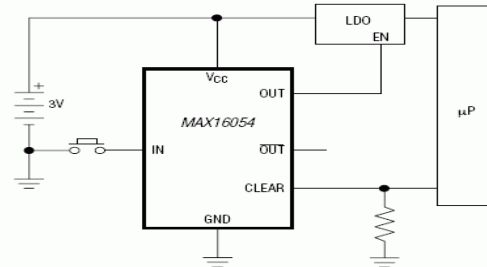

Figure 7: POWER SWITCH

UNIVERSAL SERIAL BUS (USB)

USB is a Universal Serial Bus. It utilizes 4 protected wires: two for power (+5v and GND) and two for differential information signals. In a USB information link, Data+ and Data-signals are transmitted on a wound pair with no end required. Half-duplex differential flagging is utilized to lessen the impacts of electromagnetic commotion on long queues. D+ and D-word together; they are not independent simplex associations. A USB gadget must show its speed by pulling either the D+ or the D-line high to 3.3 volts. These draw up resistors at the gadget end will likewise be utilized by the host or centres point to recognize the nearness of a gadget associated with its port. Without a draw up resistor, USB expects there is nothing associated with the transport.
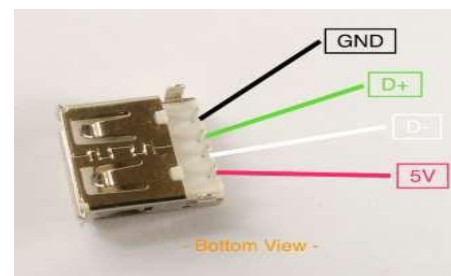

Figure 8: FEMALE USB PORT

CLOUD

Cloud computing is the on-request accessibility of PC framework assets, particularly information stockpiling and registering power, without direct dynamic administration by the client. The term is regularly used to delineate server ranches

open to various customers over the Internet. Huge mists, transcendent today, regularly have capacities disseminated over numerous areas from focal servers. On the off chance that the association with the client is moderately close, it might be assigned an edge server. With the assistance of the cloud, the information transmitted to the cloud is recouped at the opposite end.

MIT APP INVENTOR

MIT App Inventor lets you create applications for Android telephones utilizing an internet browser and either the associated telephone or emulator. The App Inventor servers store your work and assist you with monitoring your undertakings. The App Inventor Blocks Editor, where you amass program hinders that indicates how the parts ought to carry on. In an internet browser, go to App Inventor 2 at http://ai2-test.appinventor.mit.edu/. If you are not at present marked into your Google Account, you will be approached to sign in. Application Inventor spares the entirety of your tasks to our server, under the name on your google account, so any advancement you make presently will be put something aside for whenever you open the program. In the wake of marking in, if this is the first occasion when you are utilizing App Inventor 2, you will see a clear activities page.

1.   Click New on the left side, close to the highest point of the page.
2.   Enter the venture name in the discourse box that shows up, at that point click OK.

IV SOFTWARE DESCRIPTION

ALTIUM DESIGINER

Altium Designer is one of the most mainstream of the very good quality PCB structure programming bundles available today. It is created and advertised by Altium Limited. Counting a schematic, PCB module, and an auto-switch and differential pair steering highlights, it underpins track length tuning and 3D displaying. Altium Designer incorporates apparatuses for all circuit configuration undertakings: from schematic and HDL configuration catch, circuit reenactment, signal trustworthiness investigation, PCB structure, and FPGA-based inserted framework plan and improvement. Likewise, the Altium Designer condition can be modified to meet a wide assortment of clients' requirements. The Altium Designer condition comprises two primary components:
•   The principle record altering zone of Altium Designer appeared on the correct side
•   The Workspace Panels. There are various boards in Altium Designer, the default is that some are docked on the left half of the application, some are accessible in jump out mode on

the correct side, some are drifting, and others are covered up.

PROCEDURE FOR DESIGNATION

1.   CREATE A NEW PROJECT

1. In the Main Menu, select File > New > Project > PCB Project. You can see there will be a PCB Project1 behind which is "No Document Added".
2. Then Back to the File, select New > Schematic. 3.   Back to the File once more, select New > PCB. 4.   To spare your task, perfectly click PCB Project1 > Save Project As••• and you can spare the undertaking in the opportune spot with the name you need.

2.   PLACE SCHEMATIC PARTS

1. Open your spared schematic document.
2.On the left part, click Libraries bar, select Libraries and you'll see the segments you need in your plan.
3. Select segments and snap Place *** bar to expel it onto the white paper on the right. Set them to any bearing dependent on your necessities.

3. UPDATE THE PCB FROM THE SCHEMATIC

1. After the adjustment of the schematic, it is a great opportunity to refresh PCB from the schematic. Select Design > Update PCB Document***.
2. Here are the fundamental realities of the PCB plan.
3. In request to utilize it even more advantageously and cause it to follow the basic propensities for engineers, it is important to change this reality into impression see. Back to the schematic, double-tap any segment, in the Models, select Footprint and afterward add.
4. In the PCB Model, click the Browse tab and select the correct segment impression see.
5. Then you can evacuate these showcases as indicated by your structure necessary to make it look clear and slick.

4. BOARD SHAPE AND LAYER

1. Circuit board configuration ought to be finished with a specific limit so board shape must be reclassified. Snap Design and select Board Shape > Redefine Board Shape.

2. Usually, a PCB has a few layers. All the while, we need to characterize the particular layer for segments on custom PCB. Snap Design and select Layer Stack Manager.

5. RULES AND ROUTING

1. Click Design, select Rule... what's more, you can pick the principles type.

2. There is a simple method to set defeats. Snap AutoRoute, and afterward select all...

3. Auto defeats are essentially not the most ideal way. There's another method to course.Snap Interactively Route Connections and you can set your courses as you wish.

6. INTERNAL PLANES AND SIGNAL LAYERS

Snap Design and select Layer Stack Manager. Here you can click Add Layer and Add Plane to include a plane or a layer to your PCB.

7. MOUNTING HOLES AND FILE GENERATION

1. Click the yellow gap on the top.
2. Here, you can set the gap size, shape, net, etc.

3. Add a string to your PCB. Snap Place and select String.

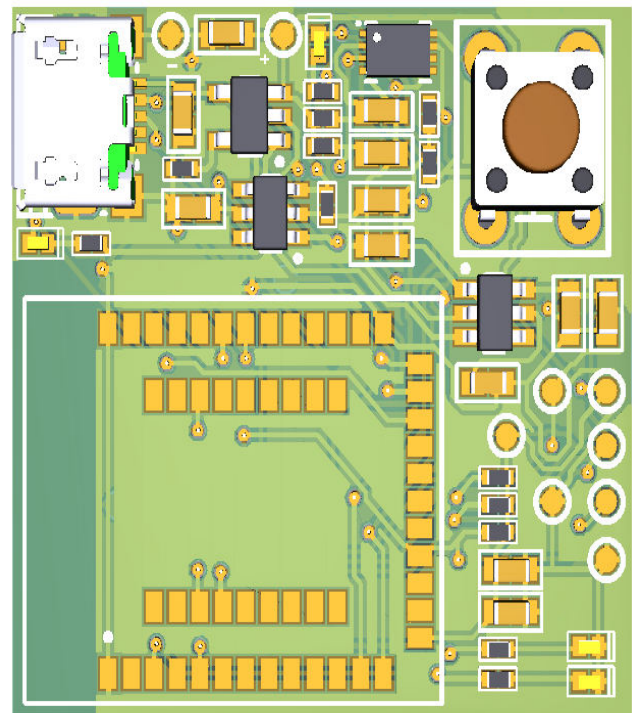## V.OUTPUT

Figure 11 : Output Display

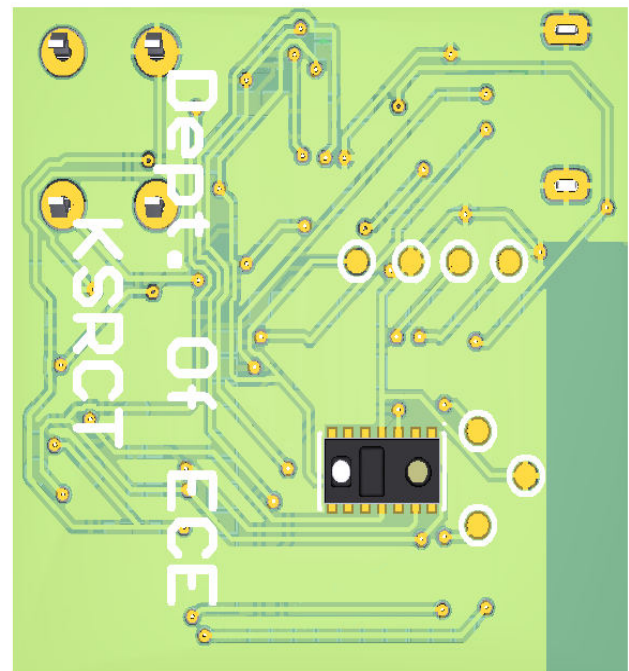**Figure 10 : 3D Model Design of Oximeter-Top Layer**

Figure 11 : 3D Model Design of Oximeter-Bottom Layer

VI. CONCLUSION

Therefore, on the basis of the above-mentioned papers modifications we have made with accuracy and we enabled the Bluetooth in the microcontroller and made to connect with mobile terminal where we will send the received data to the cloud via mobile internet. We developed a mobile application where we can retrieve the data from the cloud. So far we have designed PCB circuit of our project. The track width that we have used is of 0.2mm and the via is of radius 0.1mm. We have set rules as following, the distance between the tracks should be 0.2mm. We have designed the module in a compressed manner of integrating all the complex components in the dimensions of height 29.7 mm and length of 28.6 mm. The sensor is integrated at the bottom layer of the PCB board. All the other components are placed on the top layer. We have placed the order in an online platform for integration which is known as PCBPOWER. The PCB board is made of FR4 material, it is a NEMA grade designation for glass-reinforced epoxy laminate material. The PCB made at the Tg of 130ºC to 140ºC, where Tg stands for Glass transition temperature. It is the base material parameter that stands for the temperature (°C) on which the base material become mechanically unstable. Tg is the value that needs to guarantee the mechanical stability of the PCB during operational life time of the PCB. The thickness of the PCB is about 1.6mm and the bare copper on the PCB would oxidize and compromise the components soldering. As one of the last working steps in the PCB manufacturing, the bare copper on the PCB is coated with a surface finish. The surface finish protects the underlying copper against oxidation and therefore increases storability. In addition, the surface finish is responsible for raising the wetting ability of the contact areas for soldering. The selectable surface finishes vary in shelf life, typical application and price. Yet the surface finish is mostly determined by the following processing steps, the final product or the designated point of use of the final product, thus we used HAL SnPb, thus it is suitable for standard SMD. As soon as possible it will be launched as Smart watch.

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