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An IoT Based Health Monitoring System with Medicine Box

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Abstract

Health is characterized as a full state of physical, mental, and social well-being and not merely a lack of illness. Health is a fundamental element of people's need for a better life. Unfortunately, the global health problem has created a dilemma because of certain factors, such as poor health services, the presence of large gaps between rural and urban areas, Physicians, and nurses' unavailability during the hardest time. According to the increased usage of mobile devices and smart devices like (Fitbit, Mi-Fit) and the technology of IoT we can use it to design and make the system, Due to the shortage of nurses and the difficult health condition of the community, we decided to design this project. The project is defined as follows we monitor the patient's condition parameters by using sensors to prevent the patient from the early death, so we will design robot unit will stay with the patient all the time and monitor its condition and update the case doctor all the time and if there any change in the parameters then the robot unit will go to the patient and gives him the medicine this will be held in the medicine box, and that will be under supervised of the doctor, so the doctor can update the medicine and check it in the time

Chapter 1: introduction

1.1 Problem definition

To improve the health care filed and helping the health staff, the doctors, physicians, nurses and improving the health care level on the local level and the international level so there are more areas and cities the health care is very poor in them, so we thought about this idea and we found that the idea will help the people that living in poor areas, and helping the patients from the early death by fast connection between them and the doctors, so we design this idea as a robot unit or alternative nurse lives with the patient in its room to monitors its case and to gives him the medicine and updates the doctor by the patient case all the time

The idea will monitor the patient condition all the time and giving him the medicine under supervision of the doctor so that will reduce the cost of human being and the cost of health delivery.

1.2 The advantage of smart technology

The increased usage of mobile devices and smart devices like in health filed or health care filed like (Fitbit, Mi-Fit and etc.) allowed to us new ideas and projects that helping the institutions of health or helping doctors to connect to the patients directly without any physical connection, the second part of this smart technology is IoT the technology of IoT allowed us to connect to the parts and the chips of our project, sending and receiving the data rabidly and allowed us to connect to cloud servers to storing the data, processing, analysis

1.3 Follow up the patient's condition.

The smart system is defined and will track the patient as following: the sensor will sense the patient's vital parameters like temperature and oxygen and heart rate, and after that the parameters will be displayed on the local screen (OLED screen) for patient's monitoring, The parameters will be sent to the cloud server to store and process it and display the analyzed data on the Blynk application if there any change in the parameters the doctor will be updated and the robot unit will take action according to the update and will go to the patient to give him the medicine using the medicine box that medicine box will be on the robot unit and open based on the order that will come from the server and it will be matched for the order.

1.4 Objectives

Helping the nursing staff and institutions of health during the hardest time, Helping the patients and their families by monitoring the patient's condition all the time, Reduce the health care cost and minimize the risk.

1.5 The system usability

We can use this project that is called a line following robot in hospitals as a nurse or alternative nurse, and we can use it in our homes for the patients.

Chapter 2: System definition

2.1 Project Idea

2.1.1 Health Monitoring kit with IoT:

Patient Health Monitoring using IoT is a technology that enables the monitoring of patients without any physical contact with the patients. which may increase access to care and decrease healthcare delivery costs. This can significantly improve an individual's quality of life. It allows the patients to maintain the proper health condition, reduces the risk and minimize personal costs. In addition, to this that patients and their family members feel comfort knowing that they are being monitored and will be supported if any problem arises. Medical personnel could be present in the place for guiding the People.

2.1.2 Medico Box:

Medico Box is a technology that uses IoT in order to enable the patients to get a Real Time Updating about the medicine to be taken from Doctor or Physician. A Promising trend in healthcare is to move routine medical checks and other health care services from hospital. The use of IoT in Medicine Box has been made with the help of Mobile Application. If the Correct Medicines based on the Update received from Doctor or Physicians are taken at the right time, there are less chances that the condition of the patient getting worse.

In this project, the intelligent medicine box will help a patient to take his/her medication when it is time to take, and it depends on the health condition of the Patient. For example, if a patient has high temperature, then it will open the Box1 which contains Medicine related to High Human Body in addition to this it will get the approval from the doctor before proceeding.

The body temperature, SpO2, pulse values and medicines taken data will be stored in a server which can be accessed by both patient and doctor so that when it is time the doctor can review the medicine and can change if needed. Also, it will be helpful for doctors to keep updated about the patient's physical health condition.

IoT is rapidly revolutionizing the healthcare industry. In this project, we have designed the IoT-Based Patient Health Monitoring System using ESP8266 & Arduino. The IoT platform used in this project is Blynk. Blynk is a new platform that allows you to quickly build interfaces for controlling and monitoring your hardware projects from your iOS and Android device. IoT device could read the SpO2, pulse rate and measure the surrounding temperature. It continuously monitors the SpO2, pulse rate and surrounding temperature and updates them to an IoT platform.

The Arduino Sketch running over the device implements the various functionalities of the project like reading sensor data, converting them into strings, passing them to the IoT platform, and displaying measured SpO2, Pulse rate and temperature on OLED Display and Blynk platform.

2.1.3 IoT technology.

The technology of IoT that allow to us communicate and interact with the patient so fast by the component that we installed it on the project, by connect it the component with the wi-fi and receive the parameters from the sensors and sending the data to the cloud server that the IoT cloud, for storing, processing, analyzing, so we will use the IoT platform for that (Blynk IoT platform)

2.1.4 stage one of the project idea

The project divided into stages the first stage, the local monitoring that we will sense the parameters using the DHT11 sensor that for temperature and humidity and the MAX30100 oximeter sensor for sense the heart rate for the patient and the rate of oxygen, to display them on the display screen that will be on the robot unit in the patient's room for the patient's family or for the people that will be available with the patient and for the patient himself till this point this is the first stage we will design it using only two sensors and the display screen.

2.1.5 stage two of the project idea

The second stage will be like that, at first we need to Wi-Fi module to connect to the cloud server and making the part of IoT so we will install the node MCU that contain the wi-fi module that will connect to the IoT cloud server, so the cloud server will receive and will be connected to robot unit throughout the node MCU, the sensors will sense the data and will display it on the OLED screen and send it to the cloud server using that node MCU, connect to the wi-fi and connect to the cloud server by using the account IoT cloud site.

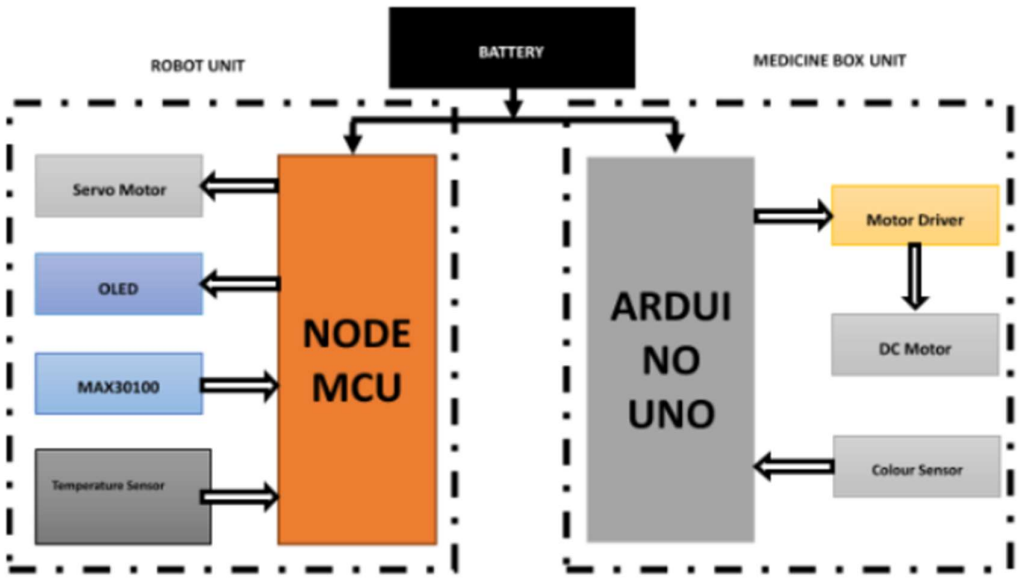
2.1.6 stage three cloud server

Receiving the data from the robot unit, store it and after that the cloud server will perform the processing on the data to check if there is any change in the parameters of the patient by checking the old parameters and the updated parameters, then it will display it on the cloud application that the doctor will monitor the patient's condition throughout this application

2.1.7 stage four robot unit action

If there is any change in the parameters of the patient the doctor will know immediately, and the server will send to the robot unit an order to go to the patient destination to gives him the medicine using the medicine box that medicine box are two boxes or more that contain the medicine for the patient and under supervision of the doctor, this robot unit will walk on track that we will design it in the patient's room.

2.2 Block Diagram



In this block diagram, the Temperature sensor, SpO2, and Pulse sensor are used to collect temperature and pulse readings. Communication can be done by the controller by sending the data to the IoT Platform. Data processing is done at the server end. Thus, the Temperature and Pulse Readings will be shown in the IoT Platform. A color sensor-based line follower robot is used to distribute the medicines and to hold the health monitoring kit with a medicine box.

2.3 Working System

This working system contain four process the first process is sensing, second process is processing unit that the Arduino unit, the medico box and the display screen, third process cloud server that storing, processing, analyzing the data, the fourth process analysis process that analyze and display the data.

2.3.1 Sensing process

Sensing – The parameters are collected from the sensor.

2.3.2 Processing unit

Processing Unit – The data that are sensed from the sensors will be processed to be ready

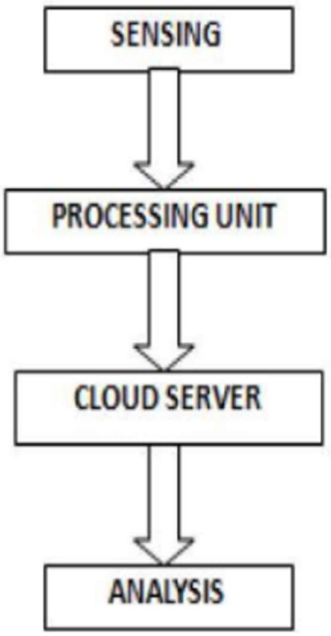
2.3.3 Cloud server

Cloud Server – Will receive the processed data to analyze and send it to the app to be displayed

2.3.4 Analysis

Analysis – The data received after cloud server processing and display it on the platform, the application and depending on the change of this parameters the doctor will act – The medical box will activate.

2.4 Working system diagram.



In this system the parameters are collected from the sensor are analyzed if any abnormal readings are found in Pulse or Temperature this system will inform the Doctor and will activate the Medical Box depending upon its need.

Chapter 3: The components that we will use it in our project (requirements)

3.1 Arduino Uno

Arduino's processor essentially makes use of the Harvard structure in which this system code and application statistics have separate reminiscence. The code is saved inside the flash application reminiscence, while the statistics is saved within the side of the statistics reminiscence. The Atmega328 has 32 KB of flash reminiscence for storing code, 2 KB of SRAM, and 1 KB of EEPROM and operates with a clock pace of 16MHz.

The Arduino software program is well-matched with all styles of running structures like Windows, Linux, Macintosh, etc.

3.2 Battery 6V

In electricity, a battery is a tool consisting of 1 or more electrochemical cells that convert saved chemical electricity into electric electricity. An unusual place electricity supply for lots of families and business applications. There are all sorts of batteries: number one batteries and secondary batteries.

A 6V battery is a lead-acid kind cell. It is likewise referred to as a lantern battery. It commonly makes use of 4 large. 6V batteries are utilized in canine schooling devices, clinical instruments, movie and virtual cameras, and plenty of different devices. A battery is a tool that converts chemical power immediately to electric power. It includes some voltaic cells; every voltaic molecule includes half-cells linked in collection through a conductive electrolyte containing anions and cations. One half-

molecular consists of an electrolyte and the electrode to which anions migrate, and the opposite half-molecular consists of an electrolyte and the electrode to which cations migrate. Some battery cautions are connecting the charger, initial, bulk charge mode, absorption charge mode, and float charge. Battery types are lead-acid batteries, disposable batteries, and solar-powered batteries.

3.3 Node MCU

Node MCU is an open supply IoT platform. It makes use of many open supply projects, which includes Launceston, and spiffs. It consists of firmware that runs at the ESP8266 Wi-Fi, and hardware that's primarily based totally on the ESP-12E module.ESP-12E is designed and evolved via way of means of Shenzhen Doctors of Intelligence & Technology (SZDOIT) primarily based totally on the Ultra-low energy intake UART-Wi Fi ESP8266, that's mainly for cellular gadgets and alertness of IoT. Now, ESP-12E is broadly carried out to the internet, verbal exchange in the

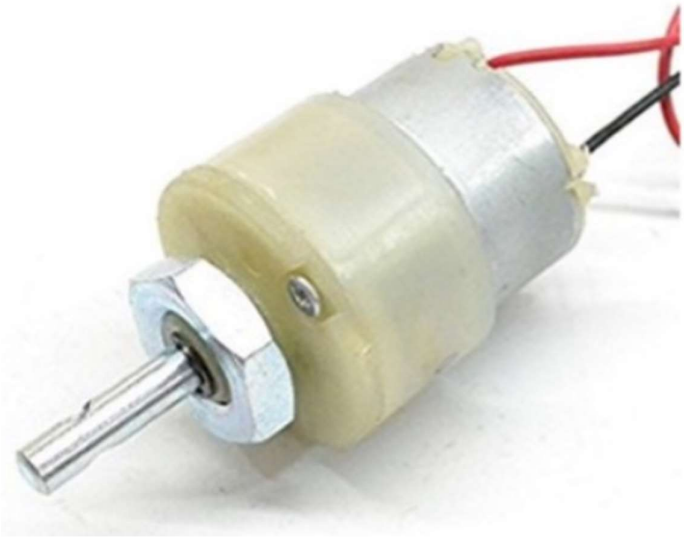
neighborhood area, clever home, business control, handed-gadgets, etc.ESP-12E Devitt has used the layout of the onboard antenna and encapsulated via way of means of 2. fifty-four direct insertions. It may be very handy to debug and deplume the device. IN ESP12E Devitt, Hardware API operation is encapsulated via way of means of Lau language, which can keep away from the hardware trouble for software program engineers, after which can velocity the expansion of products. This is simply the ESP-12 chip. If you're seeking out the breakout board with onboard regulator and preferred header compatibility.

3.4 Servo motor

A servo motor is an electrical tool that can push or rotate an item with terrific precision. If you need to rotate the item at a few precise angles or distances, you then definitely use a servo motor. It is simply made of an easy motor which runs via servo mechanism.

Basically, servo cars are labeled AC and DC servo cars relying upon the character of delivery used for its operation. Brushed everlasting magnet DC servo cars are used for easy programs attributable to their cost, performance, and simplicity. A servo includes a Motor (DC or AC), a potentiometer, tools meeting, and a controlling circuit. First, we use tools meeting to lessen RPM and to boom torque of motor such that there may be no electric sign generated on the output port of the potentiometer. Servomotor features are linear dating among the rate and electric powered manage signal. , Steady country stability, Wide variety of pace management. The advantages of a servomotor are higher output than a 50Hz motor of the same size.

3.5 DC motor



Used for robot unit moving.

3.6 motor drivers

The L293D is designed to offer bidirectional force currents of as much as 600mA at voltages from four. five V to 36 V. gadgets are designed to force inductive masses inclusive of relays, solenoids, dc, and bipolar stepping motors, in addition to different high-current/high-voltage masses in positive-deliver applications. All inputs are TTL compatible. Each output is a whole totem-pole force circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and a couple of enabled through 1,2EN and drivers three and four enabled through three,4EN.

OLED display screen

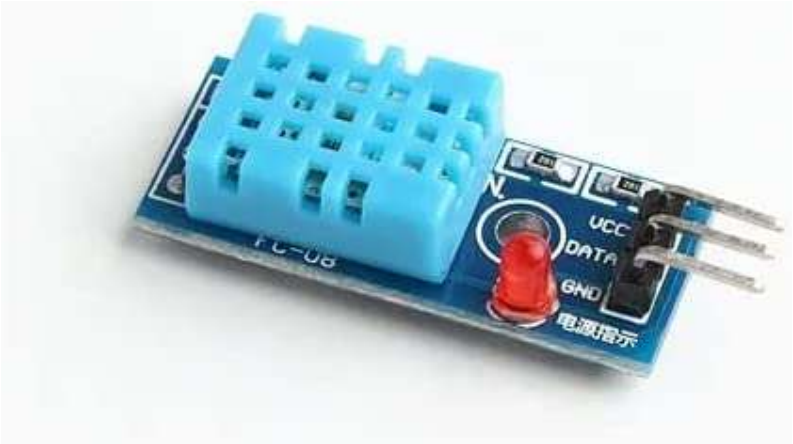
Used for monitoring local monitoring for the patient.

3.7 TCS Color sensor

Used to detect the color of the track.

3.8 DHT11 temperature and humidity sensor

This sensor is used for sense the temperature of the patient and the temperature of the room.



3.9 Pulse rate or heart rate and oxygen rate sensor

The MAX30100 operates from 1.8V and 3.3V power supplies and can be powered down through software with negligible standby current, permitting the power supply to remain connected at all times

IoT platform

Internet of Things (IoT):

The internet of things, or IoT, is a tool of interrelated computing devices, mechanical and digital machines, objects, animals, or people which may be furnished with identifiers (UIDs) and the potential to interchange data over a network without requiring human-to-human or human-to-laptop interplay. An element within the internet of things can be a person with a coronary heart display screen implant, a farm animal with a biochip transponder, a car that has included sensors to alert the reason pressure whilst tire pressure is low or each different natural or man-made object that can be assigned an Internet Protocol (IP) address and is able to transfer data over a network. Increasingly, businesses in some industries are using IoT to carry out greater efficiency, better understand customers to deliver stepped-forward client service, decorate decision-making and growth the charge of the enterprise. How does IoT artwork? An IoT environment consists of web-enabled smart devices that use embedded systems, which include processors, sensors and communique hardware, to accumulate, deliver and act on data they accumulate from their

environments. IoT devices percent the sensor data they accumulate with the resource of the usage of connecting to an IoT gateway or exceptional facet device in which data is each sent to the cloud to be analyzed or analyzed locally.

Sometimes, the ones devices talk with exceptional related devices and act on the information they get from one another. The devices do most of the artwork without human intervention, regardless of the reality that people will interplay with the devices — for instance, to set them up, deliver instructions or get proper access to the data. The sizeable set of packages for IoT gadgets is divided into numerous packages. These are the subsequent packages particularly customer application, clever domestic, clinical and tech care, transportation, constructing and domestic automation, commercial application, manufacturing, agriculture, infrastructure application, electricity control and environmental monitoring. While the idea of IoT has been in lifestyles for a prolonged time, a hard and fast of recent advances in a number of an incredible era has made it practical. They are Access to low-cost, low-energy sensor era, Connectivity, Cloud computing platforms, Machine learning and analytics, and Conversational artificial intelligence (AI). Industrial IoT refers to the application of the IoT era in enterprise settings, especially with understanding instrumentation and manipulation of sensors and devices that interact with cloud technologies. Recently, industries have used gadget-to-gadget communication (M2M) to gain wireless automation and manipulation.

BLYNK App:

Blynk is a brand new platform that lets you fast construct interfaces for controlling and tracking your hardware initiatives out of your iOS and Android device. The primary recognition of the Blynk platform is to make it super smooth to increase the cell telecall smartphone application. As you may see on this course, growing a cell app that may speak in your Arduino is as smooth as dragging a widget and configuring a pin. With Blynk, you could manage an LED or a motor out of your cell telecall smartphone with 0 programs. This is truly the primary test that I will show on this course. But don’t permit this simple to make you believe you studied that Blynk I s simplest beneficial for trivial applications. Blynk is a strong and scalable device this is utilized by hobbyists and the enterprise alike.,. You also can use it to manipulate clever fixtures that may study out of your routines. Blynk is loose to apply for non-public use and prototyping. Their commercial enterprise version generates earnings with the aid of promoting subscriptions to corporations that need to put up Blynk-powered apps for their hardware merchandise or services.

The BLYNK Smartphone App:

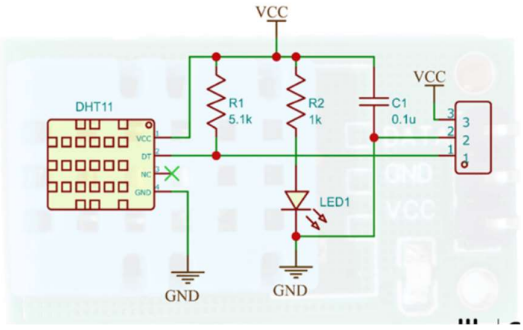
The Blynk app is absolutely an app editor. It permits you to create one or extra projects. Each mission can comprise graphical widgets, like digital LEDs, buttons, fee presentations or even a textual content terminal, and might interact with one or extra devices. With the assistance of the Blynk library, it's far more viable to govern Arduino or ESP32 pins immediately out of your phone, while not having to write down any code at all.

The BLYNK Server:

The Blynk Cloud server is a fantastic desire for maximum projects, as it's far from usually there, prepared to use. We will use the Cloud server withinside the first few experiments on this route that will help you get began out with minimum effort. However, as you may see, the Cloud Blynk server has imposed barriers. Some barriers are because of the topology of the server: relying on your geographical location. Blynk is the usage of the idea of "electricity" to put into effect a pricing gadget for its widgets. In the Cloud server you can begin a brand-new mission with one thousand electricity gadgets. An LED widget might cost a little you two hundred gadgets, l easing 800 gadgets for the different widgets.

First circuit design:

At first, we will design circuit for the temperature sensor DHT11, with the Arduino Uno



The schematic diagram for the DHT11 module is given below. As mentioned earlier, the board has a very low components count. The VCC and GND are directly connected to the DHT11, and a pullup resistor is added to the DATA pin. Sufficient filtering is provided with the tantalum and multilayer capacitors. An LED with a current limit resistor is used as a power indicator.

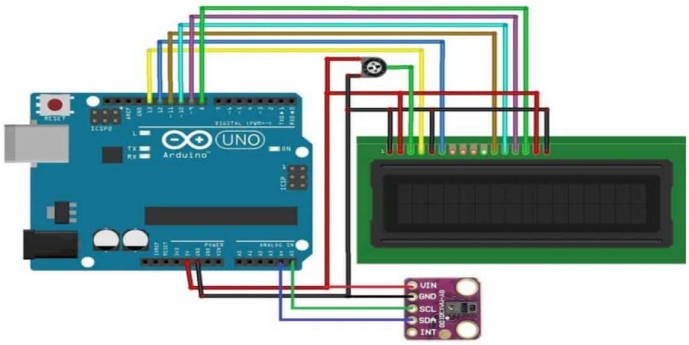
DHT11 software code:

```
// Include Libraries
#include "Arduino.h"
#include "DHT.h"
// Pin Definitions
#define DHT_PIN_DATA    2
// Global variables and defines
// object initialization
DHT dht(DHT_PIN_DATA);
// define vars for testing menu
const int timeout = 10000;      //define timeout of 10 sec
char menuOption = 0;
long time0;
// Setup the essentials for your circuit to work. It runs first every time your circuit is powered with electricity.
void setup()
{
  // Setup Serial which is useful for debugging
  // Use the Serial Monitor to view printed messages
  Serial.begin(9600);
  while (!Serial) ; // wait for serial port to connect. Needed for native USB
  Serial.println("start");
  dht.begin();
  menuOption = menu()
}
// Main logic of your circuit. It defines the interaction between the components you selected. After setup, it runs over and over again, in an eternal loop.
void loop()
{
  if(menuOption == '1') {
  // DHT22/11 Humidity and Temperature Sensor - Test Code
  // Reading humidity in %
  float dhtHumidity = dht.readHumidity();
  // Read temperature in Celsius, for Fahrenheit use .readTempF()
  float dhtTempC = dht.readTempC();
```

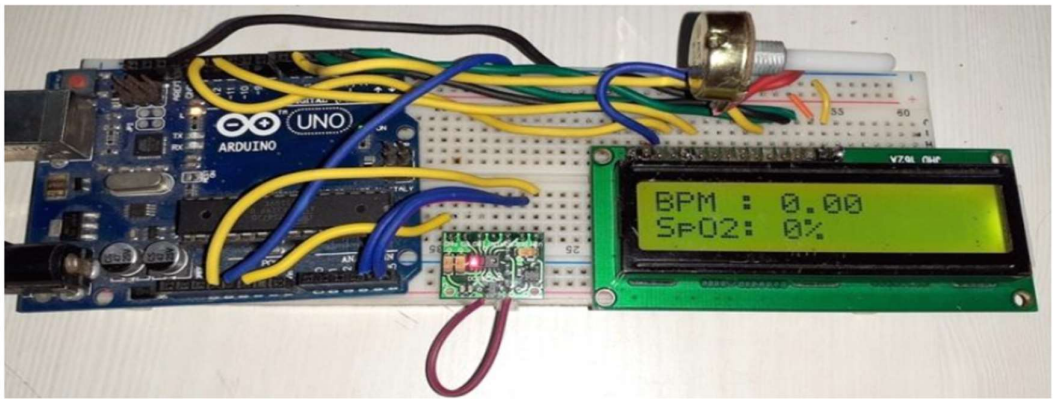
```
  Serial.print(F("Humidity: ")); Serial.print(dhtHumidity); Serial.print(F(" [%]\t"));
  Serial.print(F("Temp: ")); Serial.print(dhtTempC); Serial.println(F(" [C]"));
  }
  if (millis() - time0 > timeout)
  {
    menuOption = menu();
  }
}
```

Second sensor pulse oximeter heart rate and SpO2 with OLED display screen

Now let us use the 16X2 OLED Display to see the value of BPM & SpO2 instead of Serial Monitor. Assemble the circuit as per the circuit diagram below.



Connect the Vin pin of MAX30100 to Arduino 5V or 3.3V pin, GND to GND. Connect the I2C Pin, SCL & SDA of MAX30100 to A5 & A4 of Arduino. Similarly connect the LCD pin 1, 5, 16 to GND of Arduino and 2, 15 to 5V VCC. Similarly connect LCD pin 4, 6, 11, 12, 13, 14 to Arduino pin 13, 12, 11, 10, 9, 8. Use 10K Potentiometer at pin 3 of LCD to adjust the contrast of OLED.



The circuit code:

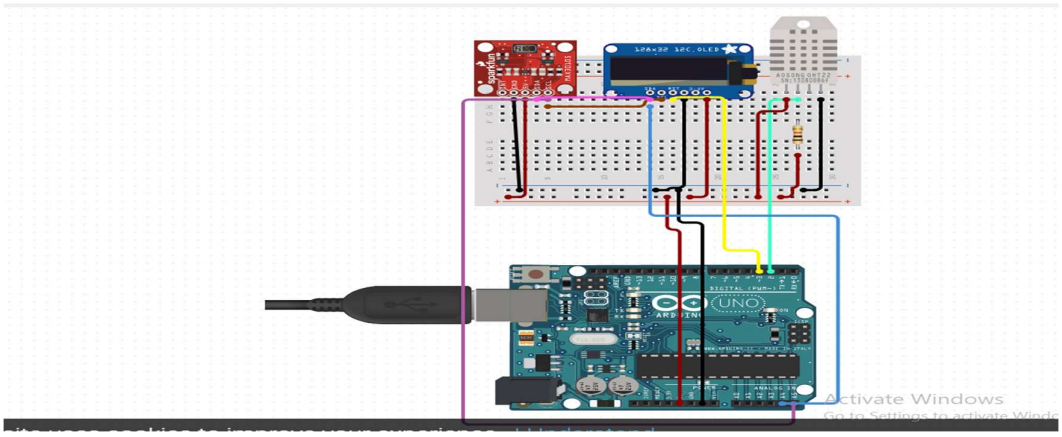
```
#include <LiquidCrystal.h>
#include <Wire.h>
#include "MAX30100_PulseOximeter.h"
LiquidCrystal lcd(13, 12, 11, 10, 9, 8);
#define REPORTING_PERIOD_MS     1000
PulseOximeter pox;
uint32_t tsLastReport = 0;
void onBeatDetected()
{
    Serial.println("Beat!");
}
void setup()
{
    Serial.begin(115200);
    Serial.print("Initializing pulse oximeter..");
    lcd.begin(16,2);
    lcd.print("Initializing...");
    delay(3000);
    lcd.clear();
    // Initialize the PulseOximeter instance
    // Failures are generally due to an improper I2C wiring, missing power supply
    // or wrong target chip
    if (!pox.begin()) {
        Serial.println("FAILED");
        for(;;);
    } else {
        Serial.println("SUCCESS");
    }
     pox.setIRLedCurrent(MAX30100_LED_CURR_7_6MA);
    // Register a callback for the beat detection
    pox.setOnBeatDetectedCallback(onBeatDetected);
}
```

```
void loop()
{
  // Make sure to call update as fast as possible
  pox.update();
  if (millis() - tsLastReport > REPORTING_PERIOD_MS) {
    Serial.print("Heart rate:");
    Serial.print(pox.getHeartRate());
    Serial.print("bpm / SpO2:");
    Serial.print(pox.getSpO2());
    Serial.println("%");

    lcd.clear();
    lcd.setCursor(0,0);
    lcd.print("BPM : ");
    lcd.print(pox.getHeartRate());

    lcd.setCursor(0,1);
    lcd.print("SpO2: ");
    lcd.print(pox.getSpO2());
    lcd.print("%");
        tsLastReport = millis();}}
```

Full first circuit design:



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