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# Design Portable Health Checker Device with Blood Oxygen Monitor Project

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**Annotation:** Portable health checker device it's the process of looking at a disease, condition, or one or more medical phenomena over time. With rapid medical development of our modern societies, the health care systems are becoming much more mature and professional. In order to reduce the current burden of public health system and promote the popularity of routine health self-check, this technique has been developed for making faster and accurate pre diagnoses with ease-of-use. Pulse test is painless test, that measures a person's oxygen saturation level, this health checker device is used to check how well the heart is pumping oxygen throughout the body. It can be applied to check the status of the patients with any type of condition, such as pulmonary diseases or COPD, anemia, lung cancer etc. In such patients, diseases may require constant monitoring and care. In order to take care of this issue our system comes to rescue. It is easy to use this portable system which can be carried anywhere by the subject. This health check system is powered by At mega 328 microcontroller which consists of max30100 sensor that measure (blood oxygen, heart rate) and mlx90614 (temperature sensor) LCD and adapter.

**Keywords:** Portable health monitoring, blood oxygen saturation, pulse oximetry, Arduino-based health device, wearable medical technology.

## 1. Introduction

Portable health checker, It is a device that used to measure heart rate and blood oxygen and temperature of the body. By going deeper into details, we can explain how the sensor (max30100) can measure the heart rate and also the oxygen saturation in the blood: The MAX30100 sensor consists of two LEDs (Red and IR) and a photodetector. Both of these LEDs are used for SPO2 measurement. These two LEDs emit lights at different wavelengths, ~640nm for the red led and ~940nm for the IR LED. At these particular wavelengths, the oxygenated and deoxygenated hemoglobin have vastly different absorption properties.

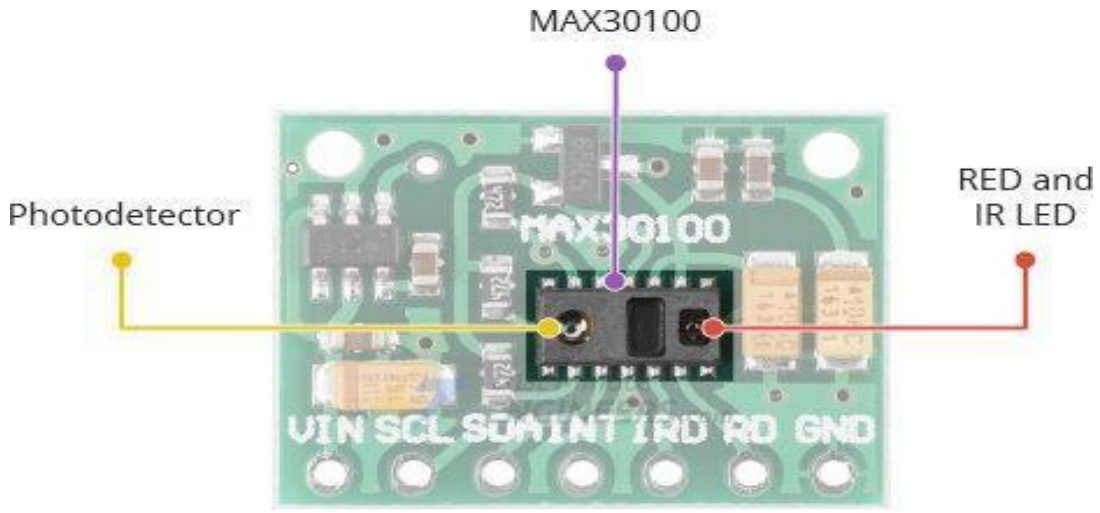



Figure (1-1): MAX30100

The study has a number of objectives, Measuring your heart rate is an easy way to gauge your health, as it provides a real-time snapshot of your heart muscle function. For most adults, a normal resting heart rate the number of heart beats per minute while at rest ranges from 60 to 100 beats per minute. The purpose of pulse oximetry is to see if your blood is well oxygenated.

Medical professionals may use pulse oximeters to monitor the health of people with conditions that affect blood oxygen levels.

**Literature Review**

## 2. Theoretical Background

### 2.1 What are blood oxygen levels?

Your blood oxygen level is a measure of how much oxygen your red blood cells are carrying. Your body closely regulates your blood oxygen level. Maintaining the precise balance of oxygen-saturated blood is vital to your health.

Most children and adults don’t need to monitor their blood oxygen level. In fact, many doctors won’t check it unless you’re showing signs of a problem, like shortness of breath or chest pain.

However, people with chronic health conditions may need to monitor their blood oxygen level. This includes asthma, heart disease, and chronic obstructive pulmonary disease (COPD).

### 2.2 How your blood oxygen level is measured

The sensor emits infrared and infrared beams. These beams must pass through the finger to reach the receiver. As it passes, some of it will be absorbed by the blood. The unabsorbed portion reaches the photoreceptor as shown in figure (21).

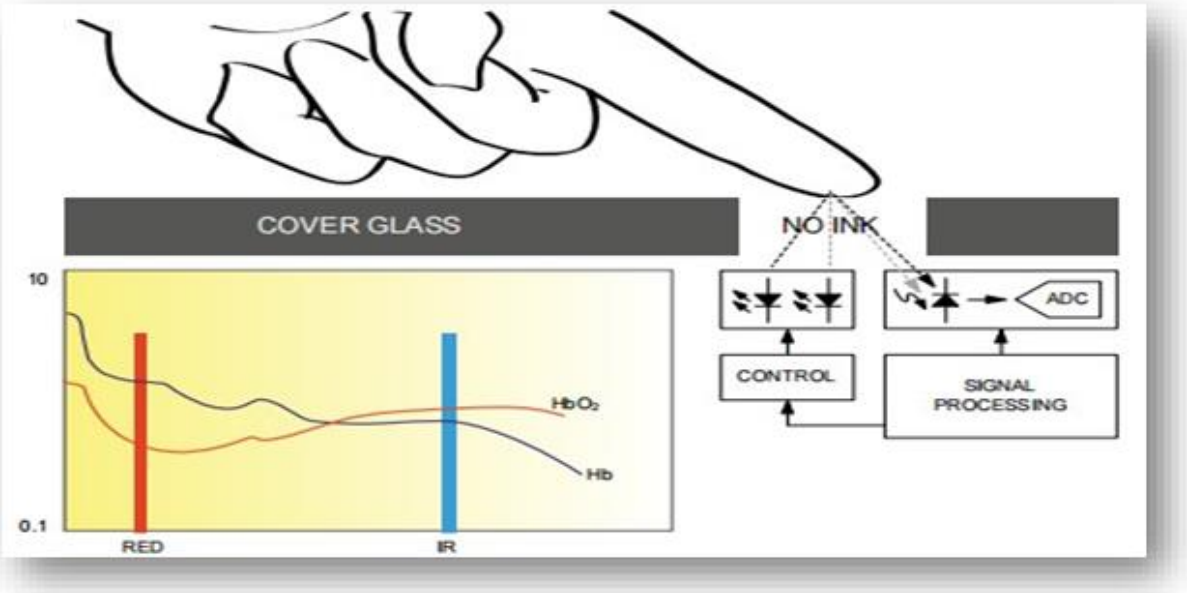



Figure (2-1): Measurement of the level of oxygen in the blood.

There are two parts to the sensor, an emitting diode, and a photo receiver. As the photodiode emits the light, it falls over the finger which has to be placed steadily. The light emitted gets absorbed by the oxygenated blood and the rest of the light is reflected through the finger and falls over the detector whose output data is then processed and read through a microcontroller as shown in figure (2- 2).

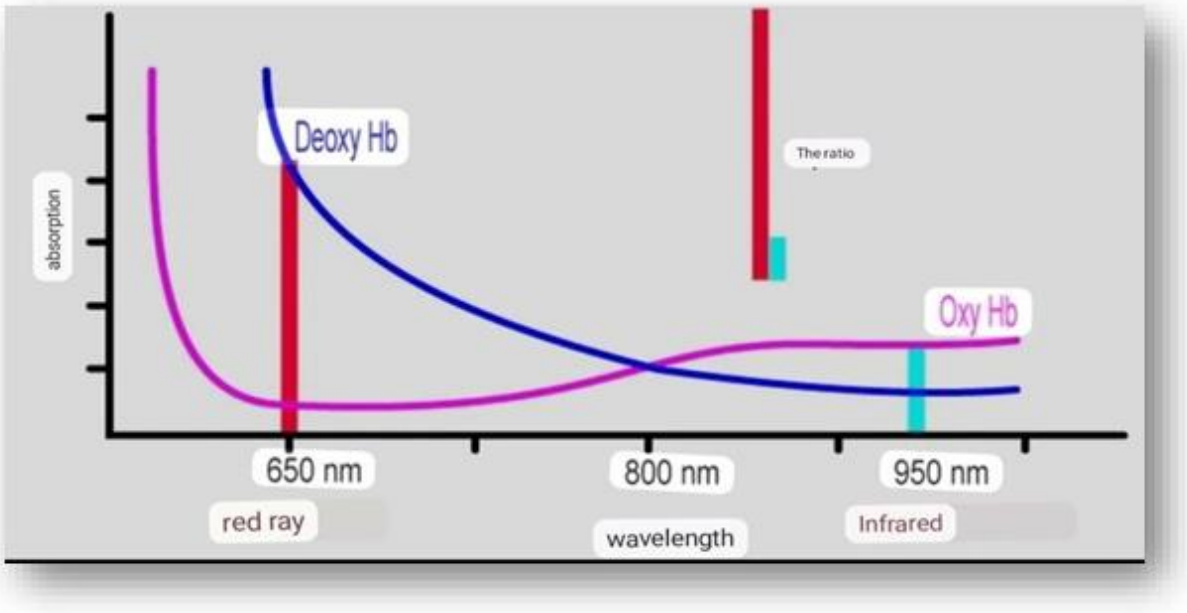



Figure (2-2): Determining the ratio of both oxygenated and deoxygenated blood according to the ratio of red and infrared light.

### 2.3 Heart rate measurement

In terms of heart rate, it is measured using infrared radiation only as shown in figure (2-3), as follows:

To measure the heart rate, we do not require the Red LED, only the IR LED is needed. This is because oxygenated hemoglobin absorbs more infrared light.

The heartbeat rate is the ratio of time between two consecutive heartbeats. Similarly, when the human blood is circulated in the human body then this blood is squeezed in capillary tissues. As a result, the volume of capillary tissues is increased but this volume is decreased after each heartbeat. This change in volume of capillary tissues affects the infrared light of the sensor, which transmits light after each heartbeat

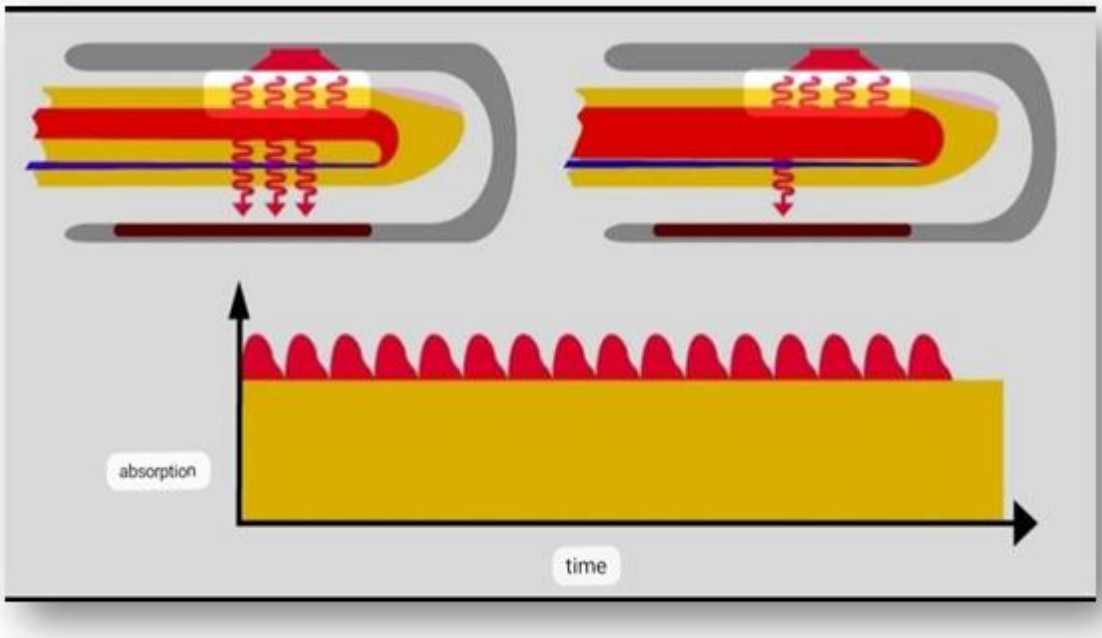



Figure (2-3): Pulse Rate Measurement

**2.4 Body temperature**

Normal human body temperature is the typical temperature range found in humans. The normal human body temperature range is typically stated as 36.5–37.5 °C (97.7–99.5 °F).

Human body temperature varies. It depends on sex, age, time of day, exertion level, health status (such as illness and menstruation), what part of the body the measurement is taken at, state of consciousness (waking, sleeping, sedated), and emotions. Body temperature is kept in the normal range by a homeostatic function known as thermoregulation, in which adjustment of temperature is triggered by the central nervous system.

**3.1 Materials and Methods**

To make a portable health checker device you have to use these basics components:

1- Arduino UNO

Arduino Uno is a microcontroller board, developed by Arduino.cc, based on the Atmega328 microcontroller and is marked as the first Arduino board developed as shown in figure (3-2) (UNO means "one" in Italian).

The software used for writing, compiling & uploading code to Arduino boards is called Arduino IDE (Integrated Development Environment)

Features of Arduino Uno:

- It has an operating voltage of 5V while the input voltage may vary from 7V to 12V.
- Arduino UNO has a maximum current rating of 40mA, so the load shouldn't exceed this current rating or you may harm the board.
- It comes with a crystal oscillator of 16MHz, which is its operating frequency.

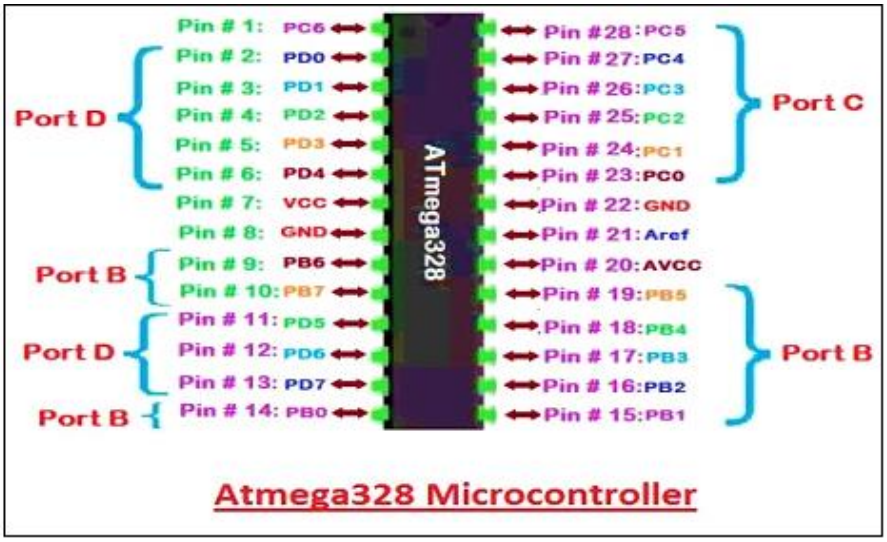
- Arduino Uno Pinout consists of 14 digital pins starting from D0 to D13.
- It also has 6 analog pins starting from A0 to A5.

Figure (3-2) Arduino UNO R3.

### 3.1.2 Microcontroller Unit

Atmega328 microcontroller is placed on the board that comes with a number of features like timers, counters, interrupts, PWM, CPU, I/O pins and based on a 16MHz clock that helps in producing more frequency and number of instructions per cycle.

- It is an open-source platform where anyone can modify and optimize the board based on the number of instructions and tasks they want to achieve.
- This board comes with a built-in regulation feature that keeps the voltage under control when the device is connected to the external device.




### 3.1.3 Oxygen sensor max30100

The MAX30100 is an integrated pulse oximetry and heart rate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heartrate signals. 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 as shown in figure (3-3).


Figure (3-3): oxygen sensor max30100

Features & Specifications:

1. Operating Voltage - 1.8V to 3.3V
2. Input Current - 20mA
3. Integrated Ambient Light Cancellation
4. High Sample Rate Capability
5. Fast Data Output Capability

### 3.1.4 MLX90614

Is a Contactless Infrared (IR) Digital Temperature Sensor that can be used to measure the temperature of a specific object ranging from-70°C to 382.2°C. The sensor uses IR rays to measure the temperature of the object without any physical contact and communicates with the microcontroller using the I2C protocol.

MLX90614 Working Principle

As mentioned above, the MLX90614 sensor can measure the temperature of an object without any physical contact with it. This is made possible by a law called the Stefan-Boltzmann Law, which states that all objects and living beings emit IR Energy and that the intensity of that emitted IR energy is directly proportional to the temperature of that object or living Being. The MLX90614 sensor therefore calculates the temperature of the object by measuring the amount of IR energy emitted from it.

MLX90614 Specifications

- Operating Voltage: 3.6V to 5V (available in 3V and 5V version)
- Supply Current: 1.5mA
- Object Temperature Range: -70° C to 382.2°C
- Ambient Temperature Range: -40° C to 125°C
- Accuracy: 0.02°C
- Field of View: 80°
- Distance between object and sensor: 2cm-5cm (approx.)


Figure (3-4): MLX90614

### 3.1.5 Lcd screen 4*20.

- In a 20x4 LCD module, there are four rows in display and in one row twenty character can be displayed and in one display eighty characters can be shown.
- This liquid crystal module uses HDD44780 (It is a controller used to display monochrome text displays) parallel interfacing.
- The liquid crystal display interfacing code is easily accessible. We just required eleven input and output pinouts for the interfacing of the LCD screen.
- Liquid crystal display works on two types of the signal first one is data and the second one is for control. as shown in figure (3-5).

Figure (3-5): LCD 20X4 screen

Features

- These are some features of 20 x 4 LCD modules that are described here with the detailed.
- The most important feature of this module is that it can display 80 characters at a time.
- The cursor of this module has 5x8 (40) dots.
- On this module already assembled the controller of RW1063.
- This module operates on the plus five volts input supply and can also work on the plus three volts.
- The plus three volts pinout can also be used for the negative supply.
- The duty cycle of this module is one by sixteen (1/16).
- The light-emitting diode of this module can get supply from the pinout one, pinout two, pinout fifteen, pinout sixteen, or pinout A and K.

### 3.2 Working Principle

The I2C protocol involves using two lines to send and receive data: a serial clock pin (SCL) that the Arduino Controller board pulses at a regular interval, and a serial data pin (SDA) over which

data is sent between the two devices. As the clock line changes from low to high (known as the rising edge of the clock pulse), a single bit of information - that will form in sequence the address of a specific device and a command or data - is transferred from the board to the I2C device over the SDA line. When this information is sent - bit after bit -, the called upon device executes the request and transmits it's data back - if required - to the board over the same line using the clock signal still generated by the Controller on SCL as timing. Because the I2C protocol allows for each enabled device to have it's own unique address, and as both controller and peripheral devices to take turns communicating over a single line, it is possible for your Arduino board to communicate (in turn) with many devices, or other boards, while using just two pins of your microcontroller.

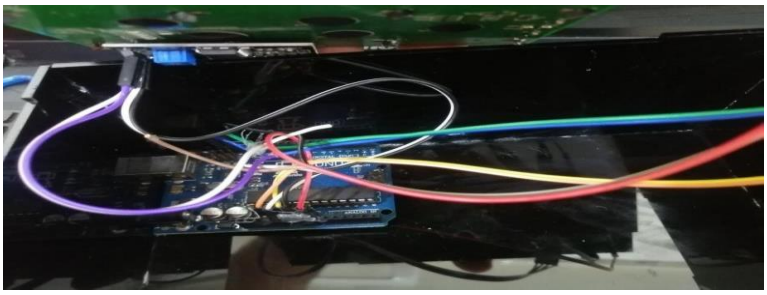


Figure (3-6): Internal components of the device.

Figure (3-7): External components of the device.

**4. 1 Results**

The oxygen meter shows two readings as follows:

1. The Spo2 stands for blood oxygen saturation levels, which are expressed as a percentage.
2. The bpm stands for beat per minute.
3. The object stands for Body temperature.

Oxygen should be above 90-92% measured in Spo2 and heart rate from 60-100 measured in PR and any number lower than this indicates hypoxia that needs medical intervention Body temperature should be 36-37C.

### 4.2 Discussion

The oximeter measures the amount of oxygen saturation of blood in the arteries by calculating the light absorption of the vascular tissue pulse in two successive wavelengths. It measures the amount of oxygen in the blood without withdrawing any drop of blood from the patient. It is used to take readings in the following cases:

1. Operating room. Monitoring the patient's condition outside the operating room.
2. Monitor oxygen levels and heart rate while giving the patient a strong anesthetic and analgesic.
3. Knowing the patient's situation inside the home (the patient can use it without the need for help from another person).
4. Routine monitoring to ensure that the patient is not at risk of developing hypoxemia.
5. It serves as an early warning system for people at increased risk of death from silent pneumonia and heart disease.

This device is one of the easiest ways in which the patient's oxygen level can be monitored. And we use the MLX90614 to measure the Body temperature it is used to take readings in the following cases.

1. Side effects of medication
2. Stress or anxiety
3. Multiple sclerosis
4. Diabetes mellitus
5. Age
6. Overactive thyroid
7. Menopause

### 5.1 Conclusion

An Arduino UNO board, an oxygen sensor, and an LCD screen were used to create this device. The device is easy to operate and inexpensive. It is a noninvasive way to measure oxygen saturation, unlike blood gas analysis that requires analysis of a blood sample drawn in the laboratory. Because of its simplicity of use and ability to provide continuous and instantaneous oxygen saturation values, it is available anywhere a patient's oxygen is unstable including most hospital wards, operating rooms, emergency rooms, and intensive care. The oximeter is of sensitive importance in emergency medicine and is also very useful for patients with respiratory or heart problems, especially chronic obstructive pulmonary disease, or for diagnosing certain sleep disorders such as apnea and dyspnea.[44] Portable battery-powered oximeters are useful for pilots operating in a non-pressurized aircraft above 10,000 feet (12,500 ft in the US)[45] where supplemental oxygen is required. Portable oximeters are also useful for mountaineers and athletes whose oxygen levels may drop at high altitudes or with exercise. Some portable oximeters use software that tests your blood's oxygen and pulse, and serves as a reminder to check your blood's oxygen levels. The device can be used as a wearable device, in Fitness Assistant Device, and as a medical monitoring device.

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