Project Report on

PRASAAR

Submission to THE ROBOTICS CLUB - SNIST as a part of INDUCTION'22

TEAM NO - 02

THE ROBOTICS CLUB

Integrating Knowledge...

THE ROBOTICS CLUB-SNIST

SREENIDHI INSTITUTE OF SCIENCE AND TECHNOLOGY

(AUTONOMOUS)

(Affiliated to JNTU University, Hyderabad)

Yamnampet, Ghatkesar, Hyderabad – 501301.

2021

CERTIFICATE

This is the project work titled '**PRASAAR**' by '**VASAVI C.**', '**K. HARSHAVARDHAN**', '**D. NEHAL**', '**G. KOVIDH ADDHISH**', '**K. SAI RAJ**', '**K. SHIVANI**', '**V. PRAKASH DHANUSH**' under the mentorship of '**Mr. N. ABINAV**' and '**Ms. R. SAATHVIKA**'. This is a record of the project work carried out by them during the year 2021-2022 as part of INDUCTION'22 under the guidance and supervision of,

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Technical head

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The President of
THE ROBOTICS CLUB

Dr. A. PURUSHOTHAM
Faculty Advisor
Mechanical Department

DECLARATION

The project work reported in the present thesis titled '**PRASAAR**' is a record work done by Team 02 in THE ROBOTICS CLUB as a part of INDUCTION'22.

No part of the thesis is copied from books/ journals/ Internet and wherever the portion is taken, the same has been duly referred in the text. The report is based on the project work done entirely by TEAM 02 and not copied from any other source.

ACKNOWLEDGMENT

This project report is the outcome of the efforts of many people who have driven our passion to explore into implementation of '**PRASAAR**'. We have received great guidance, encouragement and support from them and have learned a lot because of their willingness to share their knowledge and experience. Primarily , we would like to express our gratitude to our mentors '**Mr. N. ABINAV**' and '**Ms. R. SAATHVIKA**'. We thank our Joint Secretaries of Technical Affairs, '**Mr. SAI VENKAT REDDY**', '**Mr. BHUVAN PRATAP AGARWAL**'. Their guidance has been of immense help in surmounting various hurdles along the path of our goal. We thank all the members of Executive Body, Technical Advisory Board, Club's Incubation and Competence Committee of The Robotics Club for helping us with crucial parts of the project. We are deeply indebted to **Mr. Md. NIHAL ASJAD** - The President, **Mr. K. JAYANTH SIVA MADHAV** - The Vice President, **Mr. GELLI KUSAL VENKATA SAI SHRAVANTH** - SAB Chairman and **Ms. RUSHIKA REDDY** – General Secretary of THE ROBOTICS CLUB respectively and also every other person who spared their valuable time without any hesitation whenever we wanted.

We also thank our faculty advisor **Dr. A. PURUSHOTHAM**, Professor, Mechanical Department, who encouraged us during this project by rendering his help when needed.

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ABSTRACT

THE ROBOTICS CLUB - SNIST

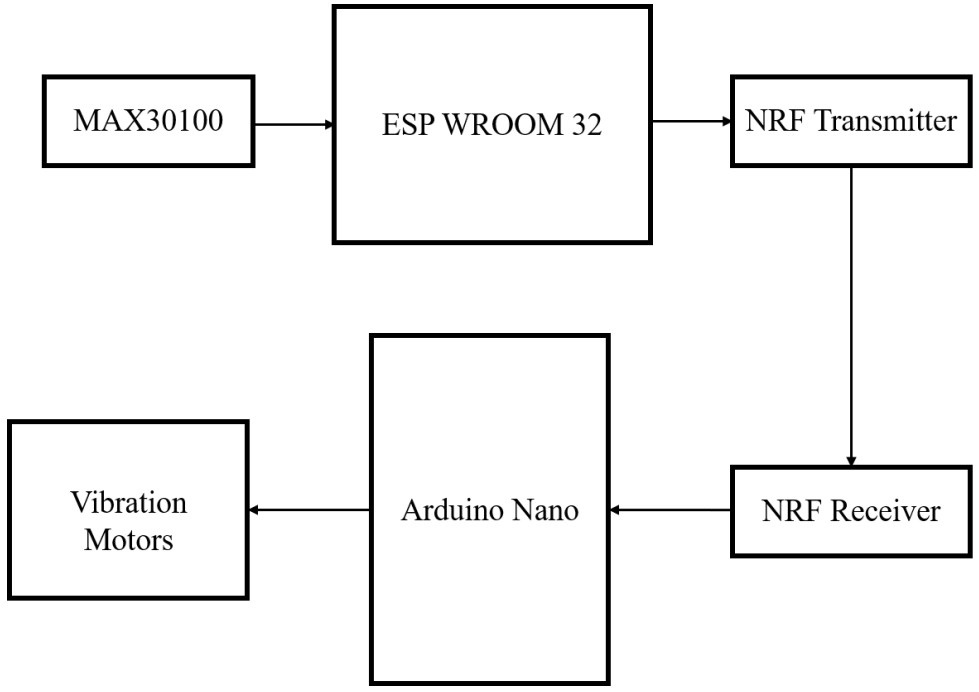
INDUCTION'22

TEAM NO 02

THE PROBLEM: Nowadays, it is observed that some people fall unconscious due to improper oxygen supply and are also prone to death if immediate care is not provided. This is caused due to poor circulation in the blood vessels. Poor circulation happens when something interferes with the complex, far-reaching circulatory system that delivers blood, oxygen and nutrients to the entire body. It is difficult to provide proper care to a person when the affected person is alone or asleep.

THE TEAMS APPROACH TO THE PROBLEM: To automate the process of boosting circulation and reducing human effort, the team propounds an automatic foot massager using a combination of sensors and IoT devices. A heart rate monitor will constantly read the patient's pulse. When the pulse drops below a certain threshold, the foot massager will activate and stimulate the arteries and veins in the patient's feet until the pulse rises to a safe level again. It activates when the oxygen level in blood drops below 80 percent and works until the normal oxygen percentage is restored.

BLOCK DIAGRAM:



TITLE OF THE PROJECT: PRASAAR

What inspired you to select the problem?

The abnormal rise in deaths due to heart-related diseases is the main reason to select this problem. Proper first aid is rarely provided for heart attacks or strokes, with incorrect measures often being followed. With this project, we aim to solve this problem and provide aid for people in case of an emergency.

What do you feel is the most innovative part of the problem?

The most innovative part of our project is to run the motors using wireless communication from the sensor segment to the massager. Also, the vibration motors stimulate the foot on the basis of conventional principles such as acupressure points.

IEEE FORMAT

Automated Foot Massager for Healthcare

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***Abstract*—Nowadays, it is observed that some people fall unconscious due to improper oxygen supply and are also prone to death if immediate care is not provided. This is caused due to poor circulation in the blood vessels. Poor circulation happens when something interferes with the complex, far-reaching circulatory system that delivers blood, oxygen and nutrients to the entire body. It is difficult to provide proper care to a person when the affected person is alone or asleep. To automate the process of boosting circulation and reducing human effort, the team propounds an automatic foot massager using a combination of sensors, vibration motors and microcontrollers. A heart rate monitor will constantly read the patient's pulse. When the pulse drops below a certain threshold, the foot massager will activate and stimulate the arteries and veins in the patient's feet until the pulse rises to a safe level again. It activates when the oxygen level in blood drops below 80 percent and works until the normal oxygen percentage is restored.**

***Index Terms*—Automation, Circulation, Pulse, Heart Rate, Oxygen Level.**

I. Introduction

The primary motive of this project is to aid in improving the healthcare for patients suffering from cardiovascular diseases. The danger of heart attacks and strokes is at its highest in recorded history. The heart attack rate increased at 2 percent every year between 2000 to 2016 among young adults.[1] In India, nearly 3 million people die due to cardiovascular diseases every year, with a 15 percent mortality rate. In fact, according to a report published in 2016, cardiovascular diseases have become the leading cause of mortality in India.[2] It has become vital to take measures against cardiac diseases. A wide range of instruments are used to estimate and counteract the threat of a heart attack. However, these machines are usually quite expensive and have to be operated by trained personnel only. Automated Foot Massager combines the techniques conventionally used to forestall cardiac arrest and common devices to enact the procedure. In case of an emergency, this apparatus has the potential to be crucial in saving a person's life.

II. Literature Survey

Advancements in computing and electronics have redefined healthcare. Monitoring, medical imaging and observation have become computerized, reducing human effort and removing the possibility of human error.[3] Medical procedures involving complex machinery which required professionals at all times to be used have been replaced by smaller, more accessible models which can be used by anyone. For example, oximetry is now a simple process that can be carried out by the patient themselves. The development of more compact microprocessors, chips and sensors is the most imperative part of this.

This has lead to the evolution of basic forms of self-operating healthcare devices. Automated saline systems and dialysis apparatus are an example of this. In course of time, many more autonomous devices can be used to ensure the best possible care is provided for patients.

III. System Architecture

A. Existing System

Healthcare robots have existed since the early 1980s. Advanced robots are used to assist in surgery and perform complex tasks. Active robotic devices, in which pre-programmed data and computer-generated algorithms function without real-time operator input, were the first robots to be used in live surgical applications. In 1985, the first surgical application of industrial robotic technology was described when an industrial robotic arm was modified to perform a stereotactic brain biopsy with 0.05 mm accuracy.[4]

Despite this, robots aren't used extensively in clinical healthcare. Robotic Process Automation is restricted to disinfection and sanitation, imaging and logistics. For cardiac diseases, hand-operated tools and machinery are still prevalent, which must be used by healthcare personnel only. With this project, we aim to automate the basic treatment to be provided in the event of a cardiac arrest or stroke

B. Proposed System

For the purpose of aiding blood circulation, an automated foot massager is to be employed. It comprises of a transreceiver, two microcontrollers, a pulse oximeter and an array of vibration motors.

The oximeter monitors the heart rate and oxygen saturation levels at all times. When the oxygen level falls below a certain threshold, the microcontroller sends a signal through the transmitter module, indicating that the massager is to be turned on. When the receiver module receives this signal, the vibration motors, placed at various points on the foot, are switched on. These motors continue to operate until the

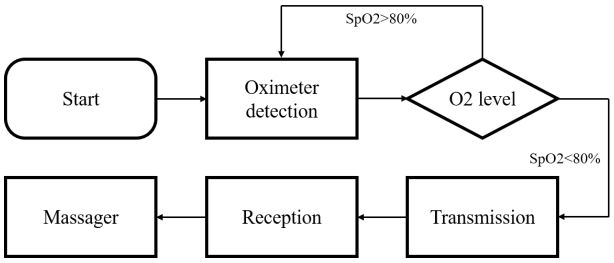

Fig. 1. Workflow

oxygen level rises to a safe level again. This process is illustrated in Fig. 1.

IV. Architecture

A. Hardware

1) ESP32 Microcontroller: ESP-WROOM-32 is a low-cost microcontroller. Operating on 3.3 V DC power supply, it has a dual-core 32-bit CPU, up to 240 MHz, 4MB flash memory with integrated WiFi and dual-mode Bluetooth. It includes LED and Motor PWM, a GPIO, an SDIO, an SPI as well as ADC and DAC units.

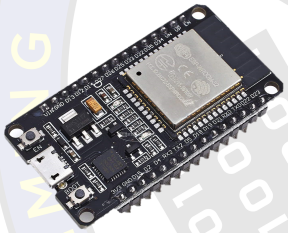

Fig. 2. ESP-WROOM-32

ESP32 also has several communication ports, such as UART, I2C, I2S, CAN and TWAI.

2) Arduino Nano: Arduino Nano is a small microcontroller based on ATmega328P. It has the same functionality as Arduino Uno on a smaller scale. It can be operated using a 9V battery or through a type-B mini-USB cable.

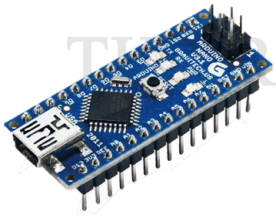

Fig. 3. Arduino Nano

It has an operating voltage of 5V, with 14 Digital I/O pins, 6 optional PWM pins and 8 Analog input pins in a dual in-line package, as well as 32 KB flash memory and 2 KB SRAM which can be programmed using the Arduino IDE.

3) MAX30100 Sensor: MAX30100 is an integrated, non-invasive pulse oximeter and heart rate sensor. Operating on a 3.3 V power supply, it consists of two LEDs, a photodetector and low-noise analog signal processing to measure pulse oximetry and heart-rate.

Fig. 4. MAX30100 Sensor

4) NRF Transceiver 24L01: NRF24L01 is a single chip radio transceiver with a 2.4 GHz bandwidth. It has an LNA and PA circuit, as well as a reverse polarised SMA connector. It has a transmission rate of 250 Kbps and operating voltage from 3.3 V to 6 V. It is an extremely efficient device for wireless communication.

Fig. 5. NRF24L01 Transceiver

5) Micro Vibration Motor: A Micro Vibration Motor is a coreless DC motor used to indicate reception of a signal by means of vibration. It is a small, lightweight, compact-sized motor with low noise and power consumption. It can be controlled and adjusted by varying the power supply from 1.8 V to 3.3 V.

Fig. 6. Micro Vibration Motor

6) Vector board: A vector board is a solderable board used for prototyping electrical circuits and components. Components and wires can be soldered to provide electrical connections on this board.

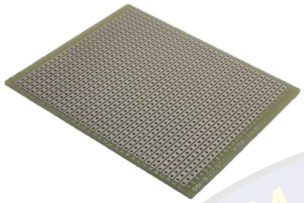

Fig. 7. Vector board

7) Jumper Wires: A jumper wire is an electrical wire or group of wires used to connect circuits without soldering. They have connectors or pins at their ends. Depending upon the configuration of end connectors, they are classified into three types: male-to-male, male-to-female and female-to-female.

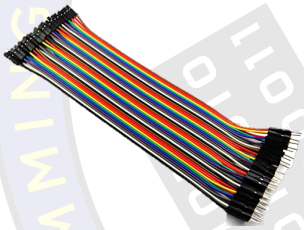

Fig. 8. Jumper Wires

B. Software

1) Arduino IDE: Arduino Integrated Development Environment is an open-source application software created by Arduino. It is used to write and upload code on to the Arduino boards. It supports C and C++ programming languages, and has a built-in compiler.

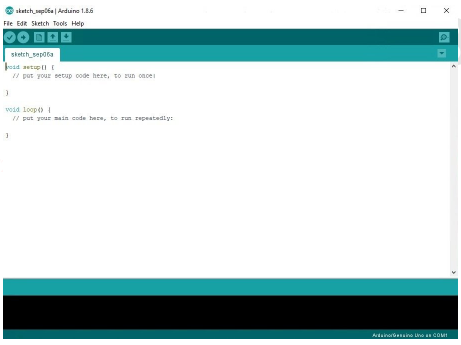

Fig. 9. Arduino IDE

2) Fusion 360: Fusion 360 is a computer-aided designing (CAD) software application for 3-D modelling and simulation. It's other functions include computer-aided manufacturing (CAM) and computer-aided engineering (CAE), as well as designing printed circuit boards.

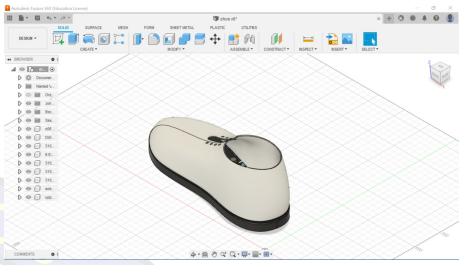

Fig. 10. Fusion 360

3) Fritzing: Fritzing is an open-source electronic design automation (EDA) software to design electronics hardware, printed circuit boards and schematic circuit diagrams. It is an offshoot of the Processing programming language and the Arduino microcontroller.

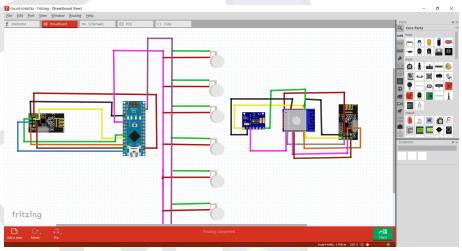

Fig. 11. Fritzing

V. Working Mechanism

The working mechanism can be broadly divided into two parts: Hand Sensor Segment and Foot Massager Segment. Pulse oximetry and heart rate monitoring are the major parts of the former, while the latter is responsible for performing the reflexology.

A. Hand Sensor Segment

The oximeter and transmitter are connected to the microcontroller as shown in Fig. 7.

Fig. 12. Hand Sensor Section

ESP-WROOM-32 is used to control the sensor division. MAX30100 constantly monitors the patient's blood oxygen saturation levels and heart rate. These values are also displayed on the serial monitor. When the SpO2 level falls below 80 percent, the NRF transmitter sends a signal to the receiver module.

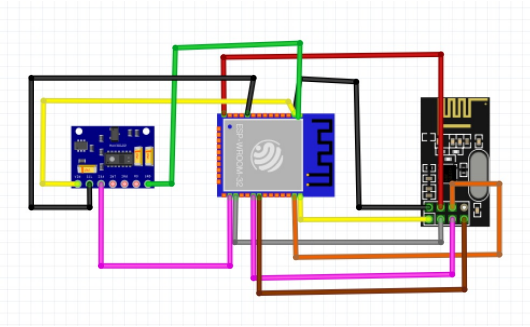

Fig. 13. Hand Sensor Circuit Diagram

B. Foot Massager Segment

The microcontroller is linked to the receiver and vibration motors as seen in Fig. 8.

Fig. 14. Foot Massager Section

The foot massager is controlled using Arduino Nano. When the NRF receiver comes across a HIGH signal from the transmitter module, the vibration motors are turned on. The micro vibration motors are placed in a manner so as to maximise their efficiency and improve the patient's condition as quickly as possible. The positioning is based upon acupressure points.

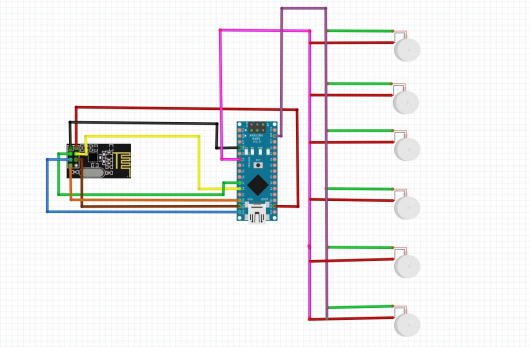

Fig. 15. Foot Massager Circuit Diagram

VI. Algorithm

A. ALGORITHM FOR HAND SENSOR SEGMENT

- Hand sensor apparatus is placed near wrist.
- MAX30100 measures BPM, SpO2 and temperature of human body.
- If the value of SpO2 is greater than 80 percent, then MAX30100 continues measuring the vitals of the person.
- If the value of SpO2 is less than 80 percent, then ESP32 microcontroller activates NRF transmitter module.
- The NRF transmitter sends a signal of "HIGH" to the receiver.

B. ALGORITHM FOR BLYNK APP

- MAX30100 measures BPM, SpO2 and temperature of human body.
- These values are sent to ESP WROOM 32 microcontroller.
- ESP32 sends these values to Blynk app via WiFi module.

C. ALGORITHM FOR FOOT MASSAGER

- Foot apparatus is placed at the foot.
- If NRF receiver does not receive any message from the transmitter, vibration motors are set to low.
- If NRF receiver receives a message of "HIGH" from the transmitter, it relays the message to the microntroller unit.
- The microcontroller unit, Arduino Nano, sets the vibration motors to high so they can massage the foot.

VII. Future Enhancements

The model developed by our team is a rudimentary prototype. It can be replicated on a large scale by developing sturdier, more reliable designs for universal healthcare benefits.

Depending upon its functionality, the robot can be modified to monitor and counteract a wider variety of health issues. Future variants could potentially be used at all times, as well as to treat other maladies.

VIII. Conclusion

In conclusion, our robot will be able to provide basic aid to patients in event of a heart attack or stroke. It will ensure that people do not have to wait for professional healthcare services or rely on untrained assistance in case of an emergency.

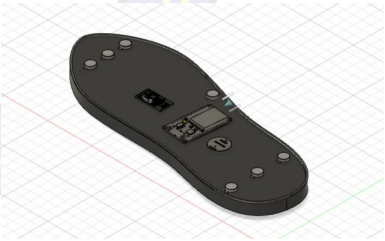

Fig. 16. CAD Design of Prototype

Upon development of our prototype, we observed that the robot was capable of monitoring the patient and enacting safety procedure as and when required. It operates efficiently until the oxygen levels are restored to safe stage again.

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SOURCE CODE:

Transmitter:

```
#include <Wire.h>
#include "MAX30100_PulseOximeter.h"
#define BLYNK_PRINT Serial
#include <Blynk.h>
#include <WiFi.h>
#include <BlynkSimpleEsp32.h>
#include <SPI.h>
#include <nRF24L01.h>
#include <RF24.h>

#define REPORTING_PERIOD_MS 1000

RF24 radio(2,5);

const byte address[6] = "00001";

char auth[] = "o9cpifjCPMMCHenG8RHr57WK6-Tpr-od";
char ssid[] = "The Robotics Club";
char pass[] = "trcsnist@2022";

PulseOximeter pox;

float BPM, SpO2;
uint32_t tsLastReport = 0;


void onBeatDetected()
{
    Serial.println("Beat Detected!");
}

void setup()
{
    Serial.begin(115200);


    Blynk.begin(auth, ssid, pass);

    Serial.print("Initializing Pulse Oximeter..");

    if (!pox.begin())
    {
        Serial.println("FAILED");
        for(;;);
    }
    else
    {
        Serial.println("SUCCESS");
        pox.setOnBeatDetectedCallback(onBeatDetected);
```

```
    }

        pox.setIRLedCurrent(MAX30100_LED_CURR_7_6MA);

  radio.begin();
  radio.openWritingPipe(address);
  radio.stopListening();

}

void loop()
{
    pox.update();
    Blynk.run();

    BPM = pox.getHeartRate();
    SpO2 = pox.getSpO2();
    if (millis() - tsLastReport > REPORTING_PERIOD_MS)
    {
        Serial.print("Heart rate:");
        Serial.print(BPM);
        Serial.print(" bpm / SpO2:");
        Serial.print(SpO2);
        Serial.println(" %");

        Blynk.virtualWrite(V3, BPM);
        Blynk.virtualWrite(V4, SpO2);

        tsLastReport = millis();
  if(SpO2<80)
  {
    buttonstate = 1;
  }
  while(buttonstate==1)
  {
  radio.write(&buttonstate, sizeof(buttonstate));
  Serial.print(buttonstate);
  break;
  }

  delay(1000);
    }
  delay(1000);
    }
}
```

Receiver:

```
#include <Wire.h>
#include <WiFi.h>
#include <SPI.h>
#include <nRF24L01.h>
#include <RF24.h>

#define REPORTING_PERIOD_MS 1000
```

```
RF24 radio(7, 8);  // CE, CSN
boolean buttonstate=0;
const byte address[6] = "00001";

void setup(){
  Serial.begin(115200);
  radio.begin();
  pinMode(6,OUTPUT);
  radio.openReadingPipe(0,address);
  radio.setPALevel(RF24_PA_MIN);
  radio.startListening();-

}
void loop(){
  if(radio.available()){
     radio.read(&buttonstate,sizeof( buttonstate));
     if(buttonstate==1){
      Serial.print("ON");
      digitalWrite(6,HIGH);
      delay(5);
    }
  }
}
```

RECORD OF EXPENSES

Component	Quantity	Price
Arduino Nano	1	800/-
ESP WROOM 32	1	600/-
MAX30100	1	250/-
Pair of Socks	1	130/-
NRF24L01	2	420/-
Vibration Motors	6	300/-
Vector Board	1	20/-
Jumper Wires	As Required	60/-

Total cost – 2580/-

MEMBERS	SCORE: MECH: ELE: PROG:

REMARKS: