1. INTRODUCTION

The project aims to provide a contactless testing method to the doctors in hospitals to conduct initial health checkups like measuring the body temperature of the patients, their heart rate, pulse rate and oxygen levels. This paper was conceived as a result of the observations made during the ongoing pandemic of COVID-19, wherein the doctors are having to be in contact with the patients in order to test and treat them, thereby increasing the risk of a community spread. There is a strong requirement of contactless technology for the testing of patients to prevent spread of highly contagious disease like the novel coronavirus. The robot contains sensors like Oximeter MAX 30105 to measure the blood oxygen saturation and heart rate of the patients as a preliminary test criteria.

2. LITERATURE REVIEW

A few research papers related to medical robots have been reviewed and the following references show influence on the design of the smart medical assistant robot. Marcin Zukowski et al [1] have developed a humanoid medical assistant and companion robot dedicated to children hospitals. They have focused on the robot being able to express emotions and communicate with the children by recognizing their faces and using pictures and text on the chest display to tell stories and present educational videos. The 'Bobot' autonomously navigates through hospital rooms and performs simple medical tests like measuring patient's body temperature or heart rate and sends live video feed to the doctors and nurses. The robot is run using ODROID XU and XU4 with Ubuntu 14.04 operating system and has a dedicated Raspberry Pi 2 computer to animate the robot's eyes.

Marcin Zukowski et al [2] presented the implementation of patients' temperature measurement system for the medical robotic assistant. They have experimented with MLX90614 infrared thermometer and FLIR Lepton thermal camera and found out that the MLX90614 infrared thermometer cannot be used as the only input source of the system and to get more accurate results, robot would need to come as close as less than 0.3 metres to a patient's face. To overcome this they created a hybrid system having infrared thermometer along with thermal camera to provide ambient temperature and approximate skin temperature that can be used to detect presence of humans in front of the robot.

Kaveh Bakhtiyari, Nils Beckmann and Jürgen Ziegler [3] have proposed a non-invasive contactless Heart Rate Variability (HRV) measurement with Respiratory Sinus Arrhythmia (RSA) correction. They have incorporated Infrared and RGB cameras to measure the heart rate signal, and a 3D Depth sensor has been used to capture the human respiratory signal to correct the calculated HRV with RSA. They have performed correlation analysis by different methods and devices to find an appropriate method for HRV calculations based on the required accuracy and application. Contactless heart rate variability sensors can become an important part of sensors for preliminary health tests. Sachit Mahajan, Prof. Vidhyapathi C.M [4] have designed a medical assistant robot which helps the patient to carry the necessary medical equipment along with them. They have created a person following robot assistant which provides support to the patients. The robot uses a Pixy image recognition sensor for person detection and ultrasonic sensor for obstacle avoidance.

Azeta Joseph et al [5] have presented an overview of the current and potential applications of humanoid robotics in healthcare settings. Their paper describes various characteristics required in humanoid robots in healthcare such as presence of vision system, sensing behaviour, mobile platform and the ability to perform dexterous manipulation tasks. We explored similar human assistant robots available in various roles as helpers for the patients in hospitals.[6-10]

The scope of the present study is to design a smart medical assistant robot by exploring various contactless less sensor technologies. The robot should be compact for efficient handling and incorporate a quick learning real time environment recognition technology for its locomotion in a crowded hospital.

3.PROBLEM DEFINITION

In today's social insurance framework for patients who stays in home during post operational days or COVID-19 infected patient checking is done either via overseer/ medical caretaker. Ceaseless observing may not be accomplished by this system, on the grounds that anything can change in wellbeing parameter inside of part of seconds and amid that time if guardian/attendant is not in the premises causes more noteworthy harm. So with this innovation created period where web administers the world gives a thought to add to another keen health awareness framework where time to time constant checking of the patient is accomplished.

OBJECTIVES

The proposal in this dissertation focuses on the main objectives as mentioned below:

1. To reduce the carrying load of the treatment details and the records.
2. To develop a centralized and distributed server and database where the information is shared between different servers
3. To provide assistance to patients at home quarantine when there is no one beside them.
4. To also intimate the relative of the patient and the nearest hospital so that they are there when needed.
5. Online patient health parameters monitoring

Existing system:

In present system, the COVID-SAFE platform relies on three parts, including a wearable IoT device, smartphone app, and fog (or cloud) server. The hardware contains nodes that were developed on the Raspberry Pi Zero (RPIZ). The software parts include an application program interface (API) for interacting with users on a smartphone, and a fuzzy decision-making system on the fog server. Nodes collect specific vital data from participations and upgrade their decision-making regulations to aid users in various scenarios, such as the need to refer to a doctor, maintaining physical distance from others, and alerts regarding high-risk areas.

Proposed system

The electronics and hardware of the robot are the most significant working system which governs the functional and nonfunctional service delivery of the mobile robot. The robot is equipped with two 8V to 12V gel batteries of 1.2 Ah capacity which is charged via charging module, this ensures over charge and discharge protection and a stable power supply for charging. The batteries are mounted on the circular base to ensure stability of the robot through equal weight distribution. The base has two DC motors connected to the wheels having 5kgcm torque which is used for the locomotion of the robot and are controlled using an H bridge motor driver L293D. The development board used for governing the robot is Arduino Mega R3, based upon Atmega2560. The board is capable of handling the sensors required efficiently and offers a wide range of libraries for programming.

It also houses MAX 30100 which is a Pulse and Oximeter sensor for taking key health statistics from the patient and a DFPlayer Mini MP3 Voice Module for the patients Prescription. To facilitate easy data collection from the patients, the robot features a NOKIA 5110 LCD module which can display a custom GUI. Ultrasonic sensor is used for obstacle detection while robot in motion. Remote view IP camera is used for live communication between patient and doctor to describe patient symptom. WQ11 CAMERA can stream live video to mobile device without internet connection.

4. BLOCK DIAGRAM

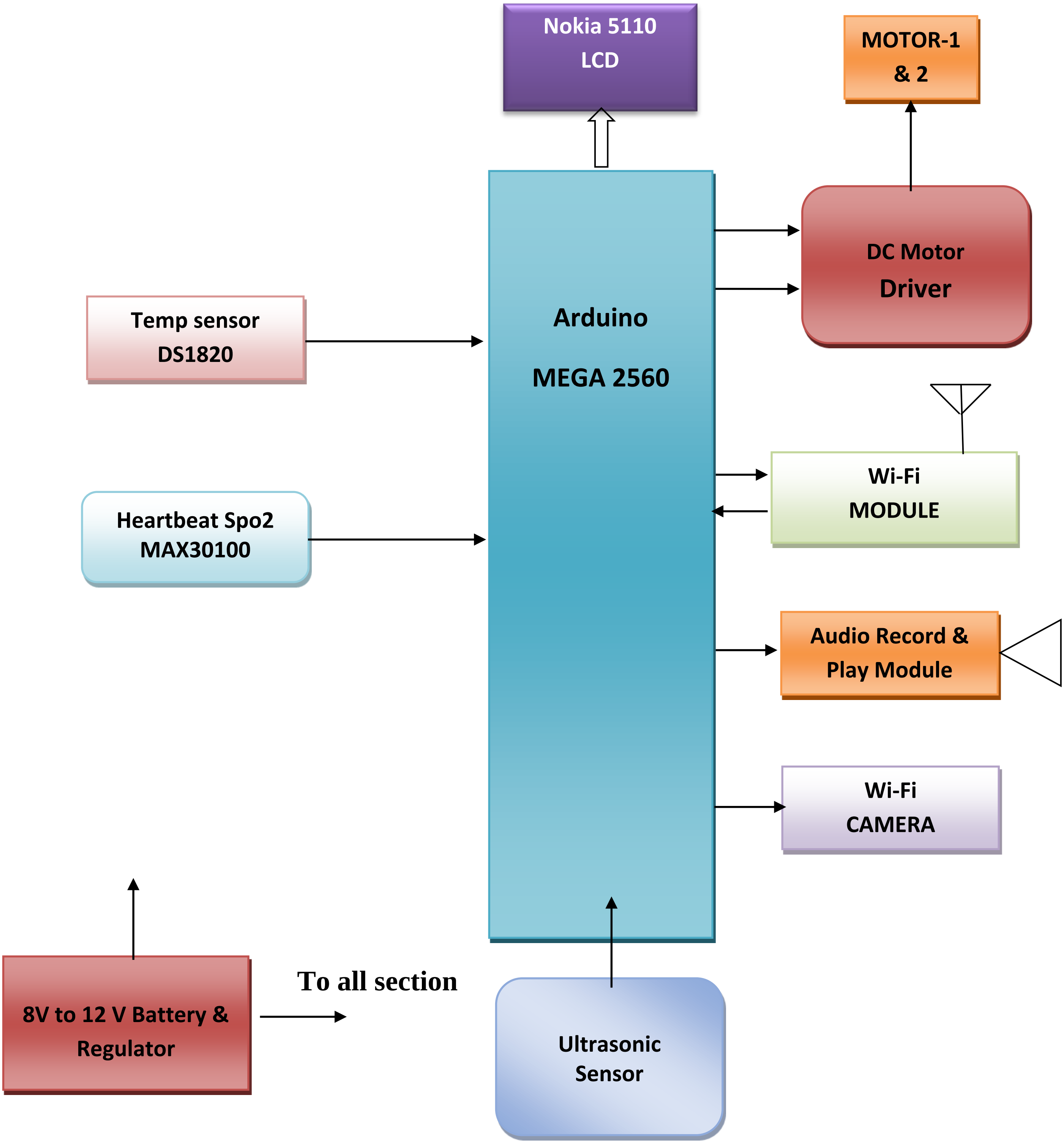


FIG 1: BLOCK DIAGRAM

Working of the block diagram:

Upon entering the hospital premises, It instructs the patients to sanitize their hands using the sanitizer dispenser mounted on the back. The robot identifies and avoids obstacles using the ultrasonic sensor. Only after using the sanitizer, the patient is able to continue the process forward. This is done to prevent unnecessary spread of contagious viruses through the touch sensors present on the robot. The robot then reads the temperature of the patient using an DS1820 and asks the patient to place their finger on the Oximeter MAX30100 to collect important data regarding their heart rate, pulse rate and blood oxygen saturation level. Through the WiFi camera, the patients are then enquired about their travel history and present symptoms or allergy history. These data are collected using a voice & video recording camera module and are directly sent to the doctor. The doctors have live access to the patient and their data. An integrated storage compartment and tray are present on the robot for material handling and transfer of medicines or medical reports to the doctor or the patients. Figure 5 describes the working protocol of the medical assistant robot. Ultrasonic sensor is used for obstacle detection while robot in motion. If the obstacle range is less than2-3 feet, robot will stop to avoid collusion.

5. HARDWARE DESCRIPTION:

Arduino MEGA

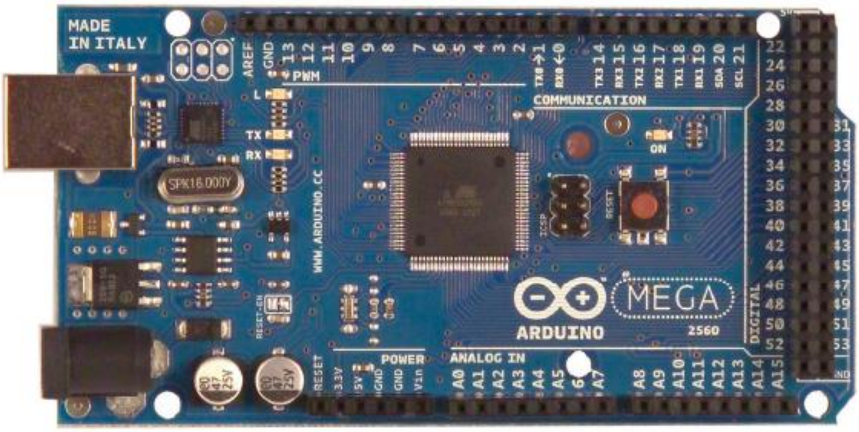


FIG 2: Arduino MEGA

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 (datasheet). It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila.

Specifications:

Digital I/O Pins	54 (of which 14 provide PWM output)
Analog Input	Pins 16
DC Current per I/O	Pin 40 mA
DC Current for 3.3V	Pin 50 mA
Flash Memory	256 KB of which 8 KB used by bootloader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz

ARDUINO NANO

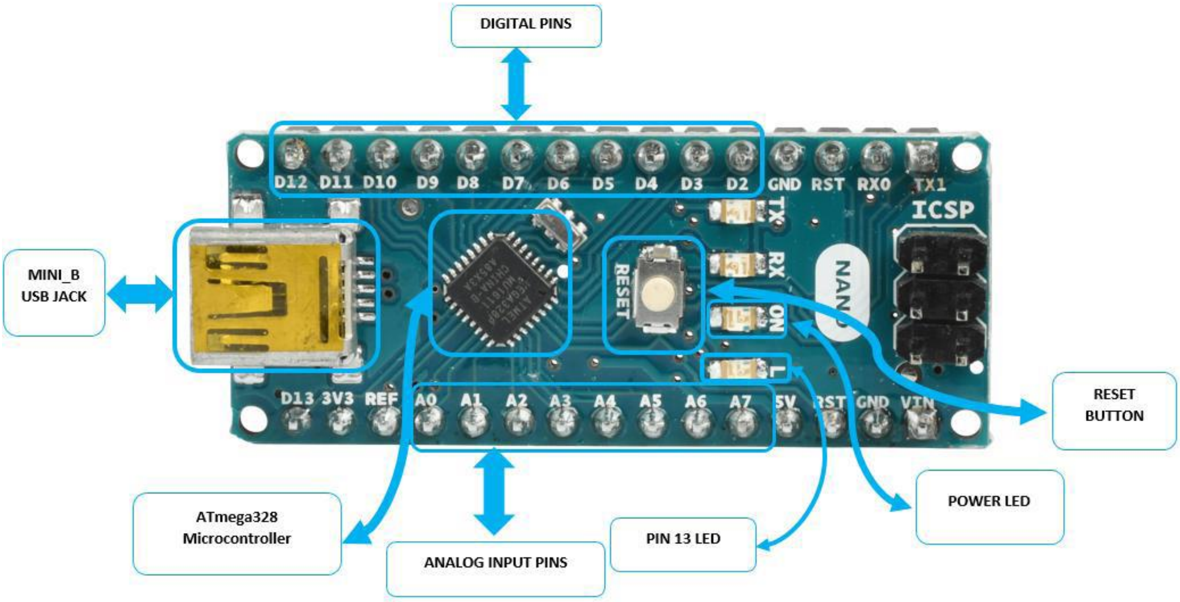


FIG 3: ARDUINO NANO

INTRODUCTION

Arduino nano differ from other Arduino as it very small so it suitable for small sized projects and it supports breadboards so it can be plugged with other components in only one breadboard.

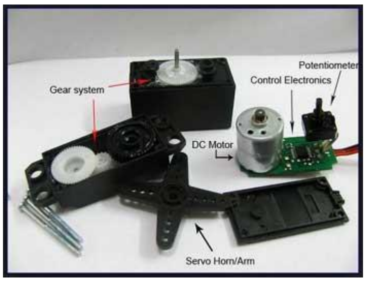
ARDUINO NANO PHYSICAL COMPONENTS

Microcontroller

In Arduino Nano 2.x version, still used ATmega168 microcontroller while the Arduino Nano 3.x version already used ATmega328 microcontroller.

Servo Motor:

Positional rotation servo motor is a most common type of servo motor. The shaft's o/p rotates in about 180o. It includes physical stops located in the gear mechanism to stop turning outside these limits to guard the rotation sensor. These common servos involve in radio controlled water, radio controlled cars, aircraft, robots, toys and many other applications.



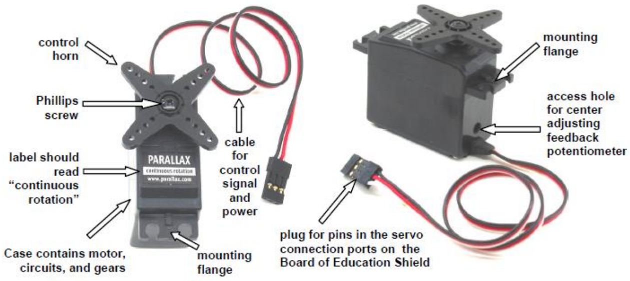


FIG 4: SERVO MOTOR:

IR Obstacle detection:

Infrared technology addresses a wide variety of wireless applications. The main areas are sensing and remote controls. In the electromagnetic spectrum, the infrared portion is divided into three regions: near infrared region, mid infrared region and far infrared region.

The wavelengths of these regions and their applications are shown below.

- Near infrared region — 700 nm to 1400 nm — IR sensors, fiber optic
- Mid infrared region — 1400 nm to 3000 nm — Heat sensing
- Far infrared region — 3000 nm to 1 mm — Thermal imaging

IR Transmitter

Infrared Transmitter is a light emitting diode (LED) which emits infrared radiations. Hence, they are called IR LED's. Even though an IR LED looks like a normal LED, the radiation emitted by it is invisible to the human eye.

The picture of a typical Infrared LED is shown below.

FIG 5: IR Transmitter

IR Receiver

Infrared receivers are also called as infrared sensors as they detect the radiation from an IR transmitter. IR receivers come in the form of photodiodes and phototransistors. Infrared Photodiodes are different from normal photo diodes as they detect only infrared radiation. The picture of a typical IR receiver or a photodiode is shown below.

FIG 6: IR Receiver

1-Wire Digital Thermometer (DS18B20)

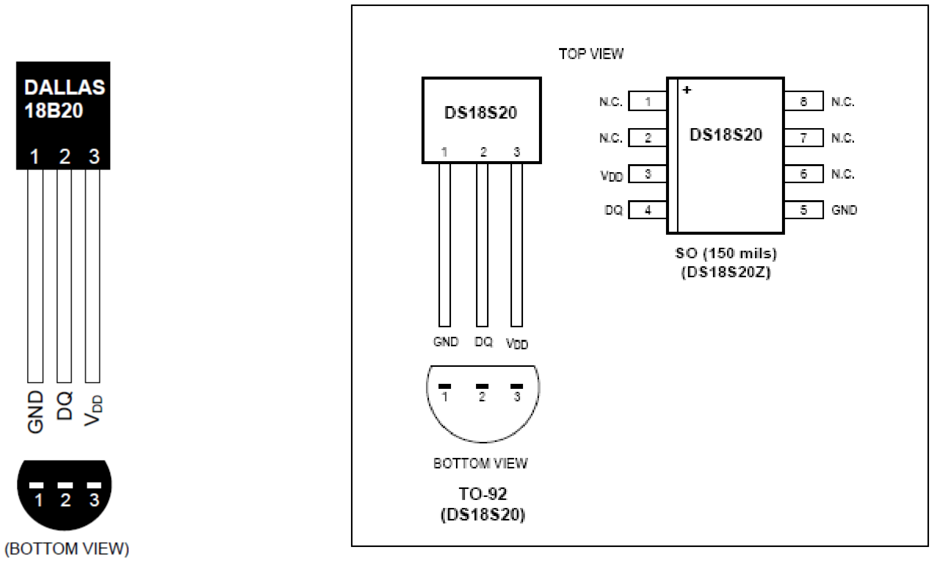


FIG 7: 1-Wire Digital Thermometer (DS18B20)

Overview Figure 1 shows a block diagram of the DS18S20, and pin descriptions are given in the Pin Description table. The 64-bit ROM stores the device’s unique serial code. The scratchpad memory contains the 2-byte temperature register that stores the digital output from the temperature sensor. In addition, the scratchpad provides access to the 1-byte upper and lower alarm trigger registers (TH and TL). The TH and TL registers are nonvolatile (EEPROM), so they will retain data when the device is powered down. The DS18S20 uses Maxim’s exclusive 1-Wire bus protocol that implements bus communication using one control signal. The control line requires a weak pullup resistor since all devices are linked to the bus via a 3-state or open-drain port (the DQ pin in the case of the DS18S20). The output of sensor is connected to pin D4 of the Arduino MEGA board. In this bus system, the microcontroller (the master device) identifies and addresses devices on the bus using each device’s unique 64-bit code. Because each device has a unique code, the number of devices that can be addressed on one bus is virtually unlimited. The 1-Wire bus protocol, including detailed explanations of the commands and “time slots,” is covered in the 1-Wire Bus System section. Another feature of the DS18S20 is the ability to operate without an external power supply. Power is instead supplied through the 1-Wire pullup resistor via the DQ pin when the bus is high.

MAX30100 Pulse Oximeter Sensor

In this project we will be Interfacing MAX30100 Pulse Oximeter Sensor with Arduino MEAGA pins SDA & SCL that can measure Blood Oxygen & Heart Rate and display it on 16x2 LCD Display. The blood Oxygen Concentration termed as SpO2 is measured in Percentage and Heart Beat/Pulse Rate is measured in BPM. The MAX30100 is a Pulse Oximetry and heart rate monitor sensor solution.

How does Pulse Oximeter Works?

Oxygen enters the lungs and then is passed on into blood. The blood carries oxygen to the various organs in our body. The main way oxygen is carried in our blood is by means of hemoglobin. During a pulse oximetry reading, a small clamp-like device is placed on a finger, earlobe, or toe.

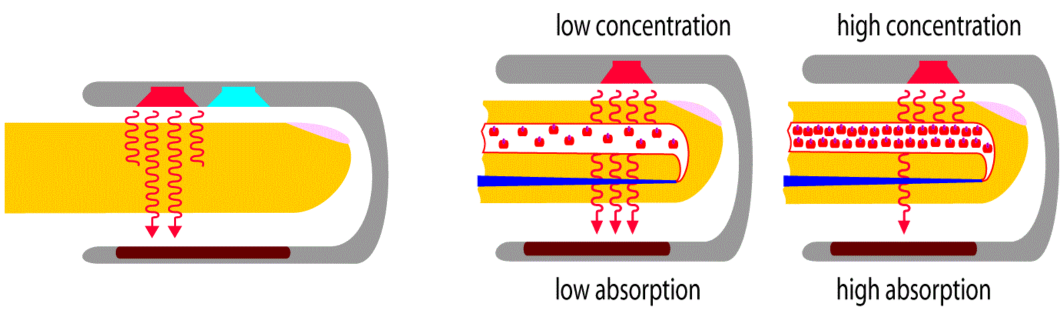


FIG 8: working of Pulse Oximeter

Small beams of light pass through the blood in the finger, measuring the amount of oxygen. It does this by measuring changes in light absorption in oxygenated or deoxygenated blood.

MAX30100 Pulse Oximeter:

FIG 9: MAX30100 Pulse Oximeter:

The sensor is an integrated pulse oximetry and heart-rate monitor sensor solution. It combines two LED's, a photo detector, optimized optics, and low-noise analog signal processing to detect pulse and heart-rate signals. It 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.

Working of MAX30100 Pulse Oximeter and Heart-Rate Sensor

The device has two LEDs, one emitting red light, another emitting infrared light. For pulse rate, only the infrared light is needed. Both the red light and infrared light is used to measure oxygen levels in the blood.

When the heart pumps blood, there is an increase in oxygenated blood as a result of having more blood. As the heart relaxes, the volume of oxygenated blood also decreases. By knowing the time between the increase and decrease of oxygenated blood, the pulse rate is determined.

It turns out, oxygenated blood absorbs more infrared light and passes more red light while deoxygenated blood absorbs red light and passes more infrared light. This is the main function of the MAX30100: it reads the absorption levels for both light sources and stored them in a buffer that can be read via I2C.

Nokia 5110 Graphic LCD:

PCD8544 LCD Driver

At the heart of the module is a powerful single-chip low power CMOS LCD driver controller from Philips – PCD8544.

The chip is designed to drive a graphic display of 84×48 pixels. It interfaces to microcontrollers through a serial bus interface similar to SPI.

Thanks to the PCD8544 controller's versatility, it includes on-chip generation of LCD supply and bias voltages which results in low power consumption making it suitable for power sensitive applications. In a normal state, the LCD consumes as low as 6 to 7mA only.

As per datasheet, this chip operates in the range of 2.7 to 3.3 V and has 3v communication levels. So, for any 5V logic microcontroller like Arduino, some sort of logic level shifting is required (otherwise display may get damaged).

LCD Backlight

The LCD also comes with a backlight in different colors viz. Red, Green, Blue & White.

The backlight is nothing but four LEDs spaced around the edges of the display.

If you want to change the backlight of the LCD, just remove the LCD off the board by pushing the metal clips at the back side. When the screen comes off, you will notice the four LEDs soldered around the edges of the display. Just replace the LEDs with desired color LEDs.

Wiring Nokia 5110 LCD display module to Arduino

Before we get to uploading code and sending data to the display, let’s hook the display up to the Arduino.

Connections are fairly simple. As we are implementing software SPI, we have flexible pin options. You can connect data transmission pins to any digital I/O pin. In our case the serial clock(CLK), serial data(DIN), data/command(DC), chip enable(CE) and reset(RST) pins are connected from pin pin 6 to 10 on Arduino MEGA.

But unfortunately, the LCD has 3v communication levels, so we cannot directly connect these pins to the Arduino. We need some protection. This can be done by shifting levels.

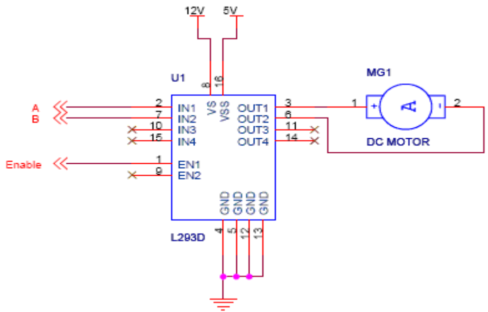
One of the cheap and easiest way to shift levels is to add resistors inline with each data transmission pin. Just add 10kΩ resistors between the CLK, DIN, D/C, and RST pins and a 1kΩ resistor between CE.

Finally, The backlight(BL) pin is connected to 3.3V via 330Ω current limiting resistor. You can add a potentiometer or connect this pin to any PWM-capable Arduino pin, if you wish to control its brightness.

L293D IC (DC MOTOR DRIVER)

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. These pins are connected to Arduino MEGA Pins 22, 24, 26, 28 for two motors data input an Pin 2 & 3 PWM signal for controlling the speed of the motors.

When an enable input is high, the associated drivers are enabled and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications. On the L293, external high-speed output clamp diodes should be used for inductive transient suppression. A VCC1 terminal, separate from VCC2, is provided for the logic inputs to minimize device power dissipation. The L293and L293D are characterized for operation from 0°C to 70°C.



Truth Table

A	B	Description
0	0	Motor stops or Breaks
0	1	Motor Runs Anti-Cloclwise
1	0	Motor Runs Clockwise
1	1	Motor Stops or Breaks

For above truth table, the Enable has to be Set (1). Motor Power is mentioned 12V, but you can connect power according to your motors.

FIG 10: L293D IC (DC MOTOR DRIVER)

DC Motor:

DC motors are configured in many types and sizes, including brush less, servo, and gear motor types. A motor consists of a rotor and a permanent magnetic field stator. The magnetic field is maintained using either permanent magnets or electromagnetic windings. DC motors are most commonly used in variable speed and torque.

Motion and controls cover a wide range of components that in some way are used to generate and/or control motion. Areas within this category include bearings and bushings, clutches and brakes, controls and drives, drive components, encoders and resolves, Integrated motion control, limit switches, linear actuators, linear and rotary motion components, linear position sensing, motors (both AC and DC motors), orientation position sensing, pneumatics and pneumatic components, positioning stages, slides and guides, power transmission (mechanical), seals, slip rings, solenoids, springs.

Description:

FIG 11: DC Motor:

BO (Battery Operated) light weight DC geared motor which gives good torque and rpm at lower voltages. This motor can run at approximately 150 RPM when driven by a single Li-Ion cell. Great for battery operated light weight robots. A specific type of DC geared motors that can be operated through battery and that why known as Battery Operated (BO) motors. It is used for light weight applications mostly. Available in different torque and RPM

Features:

- Input Voltage(V): 4.5 - 9 V
- Current rating: 0.07A (maximum on load)
- Speed(RPM): 100 RPM+-10%

Ultrasonic Sensor HC-SR04:

An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonar sensor and the object.

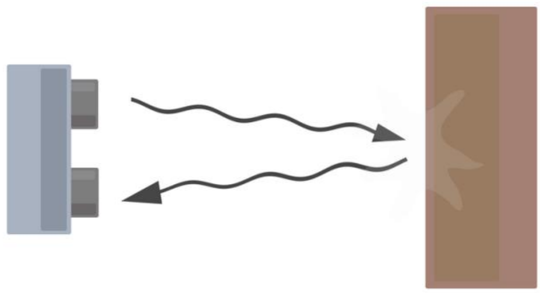


FIG 12: Diagram of the basic ultrasonic sensor operation

$$distance = \frac{speed\ of\ sound\ \times time\ taken}{2}$$

Since it is known that sound travels through air at about 344 m/s (1129 ft/s), you can take the time for the sound wave to return and multiply it by 344 meters (or 1129 feet) to find the total round-trip distance of the sound wave. Round-trip means that the sound wave traveled 2 times the distance to the object before it was detected by the sensor; it includes the 'trip' from the sonar sensor to the object AND the 'trip' from the object to the Ultrasonic sensor (after the sound wave bounced off the object). To find the distance to the object, simply divide the round-trip distance in half.

In order to generate the ultrasound you need to set the Trig on a High State for 10 µs. That will send out an 8 cycle sonic burst which will travel at the speed sound and it will be received in the Echo pin. The Echo pin will output the time in microseconds the sound wave traveled.

Control signals ECO & TRIG pins are connected to Pin 12 , 13 of the Arduino MEGA.

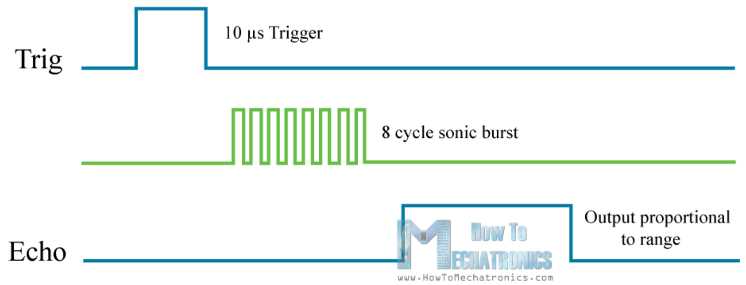


FIG 13: Ultrasonic Sensor HC-SR04:

For example, if the object is 10 cm away from the sensor, and the speed of the sound is 340 m/s or 0.034 cm/µs the sound wave will need to travel about 294 µs. But what you will get from the Echo pin will be double that number because the sound wave needs to travel forward and bounce backward. So in order to get the distance in cm we need to multiply the received travel time value from the echo pin by 0.034 and divide it by 2.

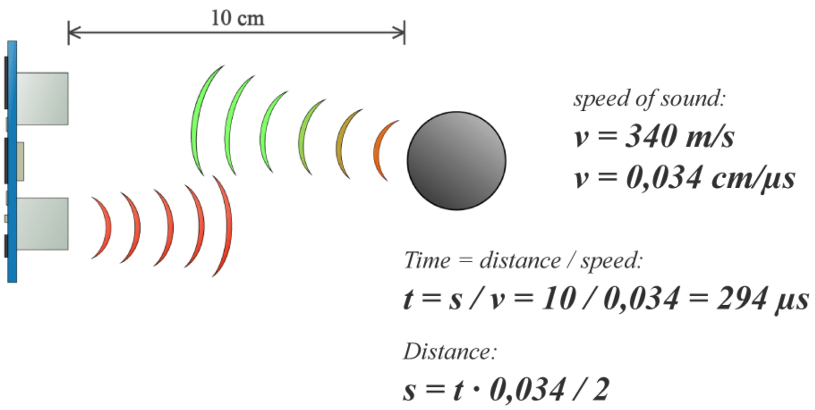


FIG 14: Ultrasonic Sensor HC-SR04:

Wi-Fi ESP8266:

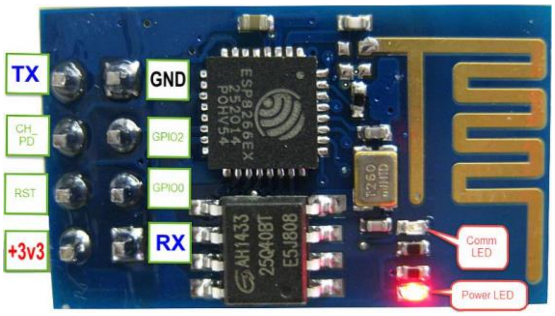


FIG 15: Wi-Fi ESP8266:

Overview:

ESP8266 offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor. Communication is established by using Serial1 port of the Arduino MEGA pins

When ESP8266 hosts the application, and when it is the only application processor in the device, it is able to boot up directly from an external flash. It has integrated cache to improve the performance of the system in such applications, and to minimize the memory requirements.

Alternately, serving as a Wi-Fi adapter, wireless internet access can be added to any microcontroller-based design with simple connectivity through UART interface or the CPU AHB bridge interface.

ESP8266 on-board processing and storage capabilities allow it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. With its high degree of on-chip integration, which includes the antenna switch balun, power management converters, it requires minimal external circuitry, and the entire solution, including front-end module, is designed to occupy minimal PCB area.

Sophisticated system-level features include fast sleep/wake context switching for energy-efficient VoIP, adaptive radio biasing for low-power operation, advance signal processing, and spur cancellation and radio co-existence features for common cellular, Bluetooth, DDR, LVDS, LCD interference mitigation.

Sealed maintenance free battery:

Battery (electricity), an array of electrochemical cells for electricity storage, either individually linked or individually linked and housed in a single unit. An electrical battery is a combination of one or more electrochemical cells, used to convert stored chemical energy into electrical energy. Batteries may be used once and discarded, or recharged for years as in standby power applications. Miniature cells are used to power devices such as hearing aids and wristwatches; larger batteries provide standby power for telephone exchanges or computer data centers.

FIG 16:: SMF Battery

SMF battery which means Sealed Maintenance Free battery are sealed completely because there is no need to add water. The electrolyte used is in the form of gel which fills the cavity of plates. Just like other batteries, it also emit H2 and O2 gases and due to sealed batteries both these gases combine to form water.

SMF batteries measure created in an eco-friendly, ISO Certified & trendy plant with a huge producing capability and square measure being sold-out worldwide. There are differences between SMF batteries and other tubular batteries. In SMF Batteries no distilled water or effort is needed and requires only a . There are a wide selection of SMF battery on the market to suit all applications of standby power needs like UPS, electrical converter and Emergency Lights, communication system, hearth Alarm & Security Systems, Railway communication, Electronic group action and money Registers, star Lanterns and Systems, etc. The SMF batteries are available industrial plant charged conditions and have a high period thereby requiring longer time intervals between recharging of batteries available. As we are one of the leading SMF battery manufacturers, we provide the genuine and products that tops in six stigmatic tests.

DFPlayer Mini MP3 module

Brief Introduction

FN-M16P is a serial MP3 module that is with a perfect integrated MP3 and WMV decoder chip. It provides micro SD card driver, and supports FAT16 and FAT32 file systems. It is able to play back specified sound files and realize other functions through simple serial commands. In the meantime, this module supports AD key control mode that facilitates users to develop their jobs in some simple applications. Without the cumbersome underlying operating, easy to use, stable and reliable are the most important features of this module. It works on serial protocols, in this system Arduino Serial2 port is using for the communication.

Pin Configuration and Summary

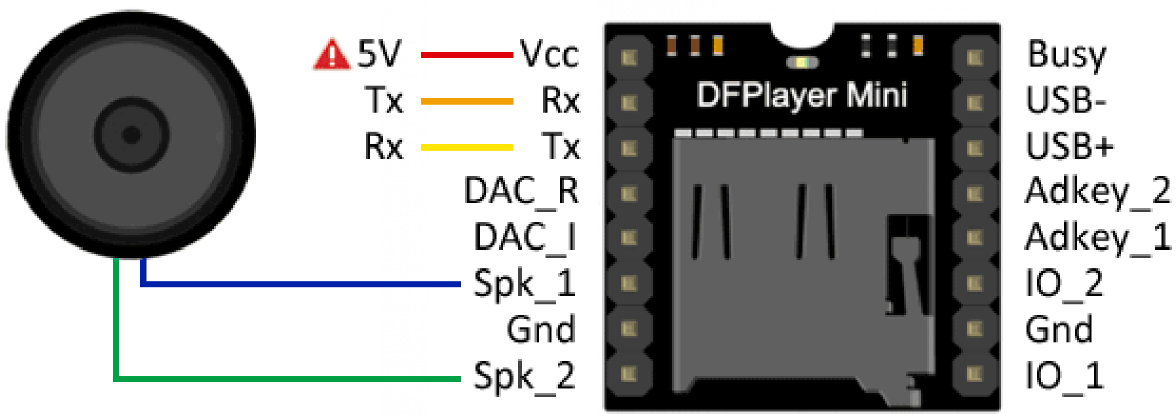


FIG 17: Pin Configuration and Summary

ENEM WQ11 Mini WiFi IP Wireless:

Wireless communication is the transfer of information over a distance without the use of electrical conductors or “wires”. The distances involved may be short or long

- SMALL & NEW DESIGN: WQ11 is a mini camera which is perfect as a security surveillance camera,
- REMOTE VIEW IP CAMERA FUNCTION: WQ11 can stream live video to your mobile device with just an internet connection. View live feed from ANYWHERE IN THE WORLD
- HIGH QUALITY VIDEO: The 1280 x 720 P video resolution together with wide angle lens, allows see exactly what’s going on through the video
- SUPPORTS MOTION DETECTION AND NIGHT VISION: Can start recording / send notification to mobile when motion is detected. Works brilliantly in the dark with supported IR night vision technology
- SUPPORTS TWO WAY AUDIO AS WELL: While remote viewing on APP, you can also listen and send your audio in real time two ways. Can take images and record in mobile as well, else recording is also saved in Micro SD card(support 32 GB, not included)

FIG 18: ENEM WQ11 Mini WiFi IP Wireless

V380 Camera App:

FIG 19: V380 Camera App:

V380 is a new generation of intelligent security cloud camera free application, can easily realize the remote video monitoring and management. By this software can view the process of real-time video anytime and anywhere.

6. SOFTWARE REQUIREMENT

Arduino

Arduino is a type of computer software and hardware company that offers open-source environment for user project and user community that intends and fabricates microcontroller based inventions for construction digital devices and interactive objects that can sense and manage the physical world. For programming the microcontrollers, the Arduino proposal provides an software application or IDE based on the Processing project, which includes C, C++ and Java programming software. It also support for embedded C, C++ and Java programming software.

FIG 20: Arduino

Source code Library used:

```
#include <SPI.h>
#include <MFRC522.h>
#include <ESP8266_Lib.h>
#include <BlynkSimpleShieldEsp8266.h>
#include <OneWire.h>
#include <DallasTemperature.h>
#include <Adafruit_GFX.h>      // include adafruit graphics library
#include <Adafruit_PCD8544.h>
```

Pins assign in code:

```
const int EnablePin1 = 2;
const int EnablePin2 = 3;
#define MT11   22
#define MT12   24
#define MT21   26
#define MT22   28

Adafruit_PCD8544 display = Adafruit_PCD8544(6, 7, 8, 9, 10);
const int trigPin = 13;
const int echoPin = 12;
#define ONE_WIRE_BUS 4
#define Pox Serial3
#define Audio Serial2
#define EspSerial Serial1
```

How Blynk Works

Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, vizualize it and do many other cool things.

There are three major components in the platform:

Blynk App - allows to you create amazing interfaces for your projects using various widgets we provide.

Blynk Server - responsible for all the communications between the smartphone and hardware. You can use our Blynk Cloud or run your private Blynk server locally. It's open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.

Blynk Libraries - for all the popular hardware platforms - enable communication with the server and process all the incoming and outcoming commands.

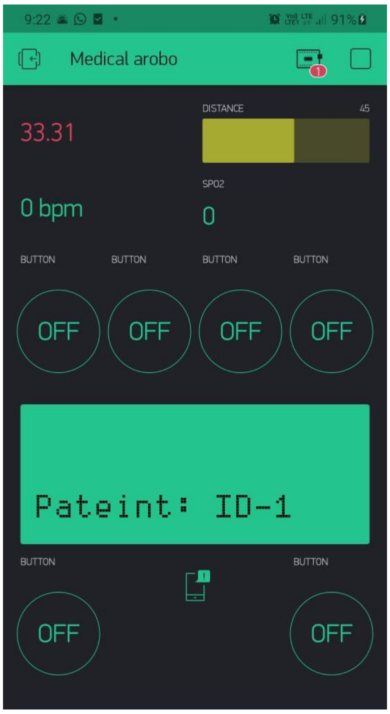


FIG 21: **Blynk**

7.METHODOLOGY

A detailed study has been carried out for the design of various components of the robot. The major systems of the robot include the mechanical aspect, electronic sensors and circuitry and the user interface and user experience of the robot with human beings. The robot is designed for the preliminary health checkup and also as an assistant for the patients and doctors. To utilize the space present inside the robot structure, it is modified to accommodate a specially designed compartment for material handling and transportation of medical supplies to the doctors and patients.

Mechanical Design

The design of the robot was inspired from the viewpoint that it being an assistant to the patients of all ages, it should be appealing, approachable and also friendly towards them. To achieve this, an acrylic design concept was found to be the most suitable and light weight. The robot features rectangle with a camera featured on it to enhance the aesthetic look. 1.5 inch Robotic wheels are added on either side. They also double as a support structure to hold the material handling tray which can be used to transport medical supplies as well.

A 20x20mm T-slot acrylic extrusion is used for the internal support structure of the robot because acrylic is lightweight and provides sufficient strength. Keeping the future scope in mind it gives flexibility and modularity as the extrusion is easily replaceable and adjustable to accommodate changes in the components.

For the outer casing of the robot a polypropylene thermoplastic is selected as the robot is designed for use in hospital premises and hence requires the use of medical grade plastics. The casing material used should be dust free, biocompatible, eco-friendly, be durable for long term, should not react with chemicals present in hospitals and also be resistant to corrosion and high temperature so as to withstand the high wear and constant sterilization that the hospital equipment’s are subjected to.

The batteries are placed on the base of the robot to keep the center of gravity of the robot as low as possible.

Yutaka Hiroi and Akinori Ito [11] studied the influence of the height of a robot on the comfort of verbal interaction. They clarified the comfortable height for verbal interaction and then studied what degree of vertical change from this height would be acceptable. From which they concluded that the comfortable height of interaction with robots should be lower than human height or human eye level for both the standing and sitting postures. The most suitable height was when the robot’s height from the floor surface was around 300mm lower than the human’s height from the floor surface to eye level. Besides, raising or lowering the robot by 100mm does not adversely affect the comfortableness of interaction. Although if it is raised by 300mm or lowered 200mm, the dialog becomes uncomfortable. Change in distance from human to the robot does not have any effect on the comfortable height for dialog. The average height of humans in India is 5.25 feet (1600mm) and taking aforementioned findings into consideration, the robot height is set at approx 4 feet (1200mm).

The aesthetics of the robot are designed keeping in mind the need for it being approachable and appealing to all ages. It should be a companion for the patients rather than just a machine. The outer casing design is kept as simple as possible for ease of manufacturing of the casing and also due to sanitary conditions required in the hospital. The design features consists of an automatic sanitizer dispenser machine at the back of the robot which is deliberately designed to make the task of refilling the sanitizer efficient by simply removing the empty bottle and replacing with a new one. This methodology is adapted instead of a concealed sanitizer dispenser to avoid repeated reopening of the robot casing to refill and also to eliminate accidental leakage of fluid inside the robot casing. The robot also has a tray and a concealed compartment incorporated for efficient material handling and transportation of important items such as patient files and medicines to the doctor as well as the patient.

8.ADVANTAGES & DISADVANTAGES

Advantages:

1. Minimize the contact and the time of interaction between doctors and patients.
2. This system will minimize spreading of Novel coronavirus.
3. Two way voice and video communication so, patient can easily communicate with doctor.
4. Doctor can operate and monitor patient from remote using IoT cloud.
5. Easy to operate the system, no need special training to doctor.

Disadvantage:

1. Battery backup is low due to continues use.

9. PROBABLE OUTCOME

1. Hospital ward.
2. Personal care taker.
3. Commercial business complex.
4. Factories/industries
5. Software companies

CONCLUSION

The design of the smart medical assistant robot has been presented in this project. The internal structure of the robot has been tested for safety with a load of 1kg) using Ansys and Fusion 360. The outer casing of the robot was chosen to be made of medical grade plastics to maintain the global medical standards of sanitation and being biocompatible. The components are designed and selected with consideration to reduce the weight of the robot and at the same time be safe and efficient. The current scenario requires innovative contactless solutions to prevent the spread of contagious diseases. Our project has the potential to be a viable solution for this. The fabrication and testing of the robot is the next stage in this project. Real time environment recognition technologies like LIDAR and SLAM can be implemented along with Artificial Intelligence and Machine learning to make the robot adaptive to changing environment and being more approachable to the patients. Speech recognition technology can be used to understand the feedback from patients of different backgrounds and help interact with them more efficiently in the future. Accurate heart rate measurement through image processing, facial recognition and retinal scanning techniques can also be implemented for the identification of patients and for advance contactless tests.

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