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Robot for COVID-19

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ABSTRACT: Withthe tremendous increase in the number of patients affected by COVID-19 there is also a shortage in the number of paramedical staff treating the patients. This is due to the contact of staff with the patients causing transmission of the virus to the staff. For dealing with this problem a robot is designed and fabricated such that it can perform the main tasks of paramedical staff so that the risk of contact between patient and staff can be avoided. This robot is basically designed to carry the supplies required by the patients during the period of treatment. The supplies this robot carrying could be the medicines, food, bedsheets, etc. For eliminating direct contact this robot is designed to control remotely from outside of the patient's room. The ultimate aim of this robot is to carry a load up to 20 Kg from one place to another with a signal received from outside of the room.
KEYWORDS: Robot,NodeMCU,COVID-19, motor ,medical cart.

I. INTRODUCTION

According to WHO currently 19.6 million people have been affected by the COVID-19 virus and 727 thousand people have lost their lives with the same. In India, only 104 doctors have died treating COVID-19 up to July 2020.

The main reason behind these deaths is the transmission of viruses from patients to doctors orparamedical staff during the time of treatment. This transmission occurs in the time of contact between doctors and patients. Though it is mended to wear PPE kit in the time of treatment there's always been some chances of virus transmission. For eliminating this chances there is a need for elimination of direct contact of patients with doctors or any other paramedical staff as much as possible.

Nowadays we are hugely surrounded by embedded system technology and devices. In the field of medical science, it plays a vital role in saving the lives of people. So for maintaining isolation for the COVID-19 patient embedded system plays a vital role.

For creating isolation to the COVID-19 patient we created a robot which will carry all the supplies required by patient during the time of treatment like medicines,food,clothing, bedsheets, etc. For controlling this robot remote technology is used which will enable the person to control the robot from outside of the room creating an isolation wall between the person and the patient. The technology used for controlling the robot is wi-fi communication which provides range up-to two rooms easily.

The structure of the robot is designed such that it could take load up to 40 Kg easily without having any breakdown. The structure of the robot is made up of plastic material so that it could be carried from one place to another easily. For taking the load of 20 kgs with the plastic structure analysis of structure is carried out Ansys software. For carrying the items easily structure of the robot has a shape like a housekeeping cart(cuboidal) so that items could be placed properly on the cart.

According to ergonomics of the patient in isolationward robot is designed to have a height of 3 feet from the ground so that patients could easily take items from the cart without leaving the bed.
For making robot movable the base of the structure is fitted with four-wheels of 6cm diameter made out of plastic with rubber strip periphery so that proper traction to the robot can be given. Wheels are connected to the structure with dc motor in between for driving the wheels. The motors used in the base are high torque geared dc motors with a capacity of 10kg-cm with 150 rpm each. These motors provide structure total carrying capacity of 40 Kg with a speed of 30m/min.

For driving robots forward and backward all motors rotate with the same speed and direction whereas for turning robot in a direction left and right side of motors rotates in the opposite direction

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till the required turn. With this mechanism,the robot can be driven anywhere in a given space.

For the electronic part of the robot main controlling used chosen is Node MCU which will control the robot according to the signal received from the sender side. This microcontroller is connected to the motor with a motor driver in between which takes the signal from microcontroller and drives the motor by supplying power from the battery to the motor according to the signal.

The battery used in the structure is based on Li-ion technology with the benefit of a higher power to weight ratio as compared to lead-acid batteries. The battery comprises 15 li-ion cells with 2200 mAh capacity each in 3S-5P configuration providing a total capacity of 11000mAh with 11.1V output.

For controlling the robot remotely wi-fi communication technology is used. In the transmitter node of the system cell phone is used with an app to transmit the signal to the robot. In receiver side signal is received by Node MCU for controlling the robot.

II. REQUIREMENTS

III. Hardware

a. Structure

It is a skeleton made up of PVC pipes with a total load capacity of 40Kgs

b. Controlling unit

Node MCU which is based on ESP8266 Wi-Fi chip is used as a main controlling unit. Node MCU because of ESP8266 Wi-Fi chip with 13GPIO can act as both a receiver and controller unit for receiving signals from the transmitter and controlling motors

The ESP8266 is a low-cost WiFi microchip with full TCP/IP stack and microcontroller capability produced by manufacturer Espressif Systems in Shanghai, China. The ESP8266 is the name of a micro controller designed by EspressifSystems.c(Kotecha, 2019)

c. Transmitter

An android or IOS based cell phone with an app to send the signal to Node MCU via Wi-fi

d. Motor

4 high torque geared DC motors with a capacity of 10 Kg-cm with 150rpm are used for driving the robot which requiresan optimal current of .5 amp on no-load condition.

e. Motor driver board

For driving the motors max of 4amp are required for each motor on high load conditions for that reason a custom H-bridge motor driver is designed with the help of bc547,bc557,TIP41C, and TIP 42C. For taking input from microcontroller bc 547 and bc 557 are used and for running the motor TIP41c and TIP42c are used with collector current upto 6Amps.(electronoobs, 2020)

f. Battery

The Li-ion battery pack in 3S-5P configuration with a total capacity of 11000mAh is used due to its lightweight and more power to space ratio.

g. BMS

BMS analyses real-time measurements from the chemical battery, then adjusts charging/discharging parameters and communicates this information to end-users. These sensors can monitor battery voltage, state of charge (SOC), state of health (SOH), temperature, and other critical measurements. (Crown Battery, 2018)

IV. Software

a. Arduino IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions, and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.(SM, 2015)

b. Libraries

For coding the Node MCU certain libraries like ESP8266WiFi.h,WiFiClient.h,ESP8266WebServer.h are required which are third party libraries.

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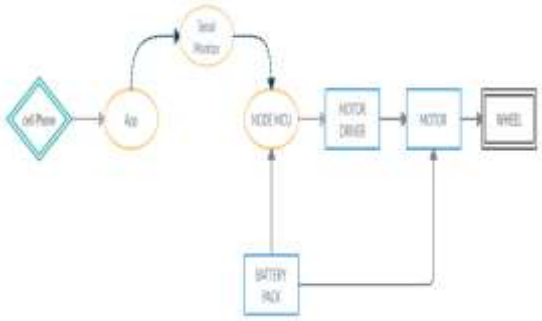
V. CONSTRUCTION

A cuboidal structurer of dimension 1ft x 1.5 ft x 3ft made of PVC pipes is placed on a wooden square of dimension 1ft x1.5 ft. Four motors on the base of the wooden block are fitted with screws with
6cm diameter wheels on the rotating shaft of motors. An acrylic sheet of dimension 1ft x1.5 ft is placed on the top of the structure for proving base for placing supplies above it. On the top of the lower wooden base NodeMCU with 2 Motor drivers and a battery is fixed and all the boards are wired with motors battery according to the schematic. The whole structure is then covered with an acrylic sheet for preventing the circuit from any water, humidity or corrosive damage.



Schematic Diagram for robot

VI. WORKING

For controlling the robot a button is pressed on the app in the cell phone which sends a key corresponding to that button from cell phone to Node MCU's serial monitor through wi-fi. The key received in Node MCU serial monitor is then matched with the task specified in code. If any task is found then digital signal according to that task is sent from Node MCU to Motor driver. The digital signal received in the motor driver is then used to supply the power from the battery to motors making robot move in the required direction.

SOURCE CODE FOR THE MICROPROCESSOR:

```
int L1  15
int L2  4
int L3  5
int L4  14
#include <ESP8266WiFi.h>
#include <WiFiClient.h>
#include <ESP8266WebServer.h>

String key;
const char* ssid = "robot";
ESP8266WebServer server(80);

void setup() {
pinMode(L1, OUTPUT);
pinMode(L2, OUTPUT);
pinMode(L3, OUTPUT);
pinMode(L4, OUTPUT);
Serial.begin(115200);
WiFi.mode(WIFI_AP);
WiFi.softAP(ssid);

IPAddressmyIP = WiFi.softAPIP();
server.on ( "/", HTTP_handleRoot );
server.onNotFound ( HTTP_handleRoot );
server.begin();
}

void forward(){
digitalWrite(L1, LOW);
digitalWrite(L2, HIGH);
digitalWrite(L3, LOW);
digitalWrite(L4, HIGH);
    }

void backward(){
digitalWrite(L1, HIGH);
digitalWrite(L2, LOW);
digitalWrite(L3, HIGH);
digitalWrite(L4, LOW);
  }

void right(){
digitalWrite(L1, HIGH);
digitalWrite(L2, LOW);
digitalWrite(L3, LOW);
digitalWrite(L4, HIGH);
  }

void left(){
digitalWrite(L1, LOW);
digitalWrite(L2, HIGH);
digitalWrite(L3, HIGH);
digitalWrite(L4, LOW);
  }

void pause(){
digitalWrite(L1, LOW);
digitalWrite(L2, LOW);
digitalWrite(L3, LOW);
digitalWrite(L4, LOW);
 }

void loop() {
server.handleClient();
    key = server.arg("State");
```

```
    if (key == 'F' ) forward();
    else if (key == 'B') backward();
    else if (key == 'L') left();
    else if (key == 'R') right();
    else if (key == 'S') pause();
}

void HTTP_handleRoot(void) {

if( server.hasArg("State") ){
Serial.println(server.arg("State"));
  }
server.send ( 200, "text/html", "" );
delay(1);
}
```

VII. CONCLUSION

In this paper, the ergonomic study was done on the structure of the robot in order for it to carry a weight of around 44lbs or 20 kgs. A Node microcontroller unit with inbuilt wifi helped us in interfacing the robot from a longer distance.

The robot designed and fabricated here could serve as an important tool to deal with the current pandemic situation. It could help in mitigating the problem of paramedical and medical staff getting infected by the virus. The use of robot will decrease the contact risk by a huge factor.

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