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MediCareBot: Better Healthcare Services

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Abstract : *The COVID-19 pandemic has shown that there is a lack of healthcare facilities to scope with a pandemic. This has also underscored the immediate need to develop hospitals capable of dealing with infectious patients and to rapidly change supply lines to manufacture the prescription goods (including medicines) that are needed to prevent infection. There is a danger of Hospital-acquired infections (HAIs), Tuberculosis (TB), and many more which are the leading causes of mortality and pessimism. In this scenario, there is a need to reduce person-to-person contact in hospitals. The role of delivery robots is evolving to prevent infection from doctors and medical staff by various viruses (coronavirus, monkeypox, Nipah virus). In this paper, we proposed a robot named MediCareBot with some functionality of providing medicine as well as measuring vital parameters (Heart rate, Temperature, Pulse rate) of the patient. In the project, a line-following robot is a device programmed to follow a specific path. Line tracking robots that monitor patient parameters at given times or transport medication and equipment to patients whenever needed based on predefined routes. finding the path to the patient's position using Line follower and RFID.A proximity sensor also has been attached to the robot, allowing the robot to detect obstacles in its path and trigger an alert. This technology focused on the delivery of safe, timely, efficient, effective, patient-centered, and equitable health care. Measured parameters are stored in the cloud using the Internet and Send this data to the respective doctor when he/she is busy or not at the hospital and also for the hospital record system.*

Keywords *- IR Sensor, Line Following Robots, Medicine Delivery, Patient Monitoring System, RFID.*

I. INTRODUCTION

As technology advances day by day, people's life expectancy gradually increases, and the population grows, it becomes necessary to monitor the health of patients for a healthy lifestyle. Improving healthcare has become one of the most important factors in the medical industry. Without quality monitoring, it is impossible to monitor a patient's condition. With millions of medical centers around the world, it is difficult and very stressful to care for individual patients for all frontline workers, especially those suffering from contagious diseases such as Covid-19 and hepatitis. A shortage of medical staff and facilities has made the COVID-19 epidemic worse than ever. The demand for medical staff is increasing significantly every day they have to work under stressful conditions without PPE and are at constant risk of exposure to critical events. Due to the fear of infection, it is very difficult to monitor the condition of these patients [1].

Thousands of patients have died worldwide because they did not monitor properly. A study found that patients died due to the lack of trained healthcare workers. Nurse Shortage “kill thousands of lives each year”: patient in overburdened hospitals develop fatal complications that could otherwise have been cured. The most important application in these infection scenarios is robotics. The robot can obtain a record of several important physical parameters of the patient (body, temperature, pulse rate, blood oxygen saturation, etc.) without direct contact with the doctor or nurse. It can greatly reduce the patient's troubles.

MediCareBot is a simple robotic patient support system. The aim is to develop a system that can be used in hospitals and at home for a variety of assistive tasks. This system would like to achieve the following goals with this project to reduce the risk of infections from person to person diseases in hospitals:

a. To provide better & faster service to patients and doctors.
b. To reduce Human Errors.

c. To reduce the burden on Health Care Sector Workers.

II. LITERATURE SURVEY

We searched for different types of medical service robots on the market. Since robots not only reduce the workload of healthcare workers but also help them complete the complex tasks they have to perform, the service is doing useful work for people and equipment and does not contribute to the industrial production of the product. "Service robots can help medical staff with their daily activities, reducing their burden and allowing them more time to focus on more important tasks."

Finally, research the different types of service robots available on the market. There are several service robots on the market. Here is a brief of commonly used service robots with a literature survey based on their field of use.

Table 1: market research[2]

ROBOTS	YEAR OF DELIVERY	KEY FEATURES	COSTING
1) Carebot	2014	Screening of patients in healthcare facility and measuring vital signs	$10,000 - $20,000
2) iWard	2016	remote physical condition monitoring for patients.	60 Lac
3) Panasonic	2004	Delivery of medical supplies in the hospital.	$100,000
4) Diligent Robotics	2016	Fetches suppliers and materials for nurses	9 Lac
5) AIMBOT	2019	temperature measurement, public address system, mask detection, automatic disinfectant.	

1.1 Literature Survey based on Navigation technology

The navigation technology is explained in the following papers: It uses the line follow method for navigation purposes and ultrasonic sensor for obstacle detection and edge detection [3]. This article provides an overview of current research on self-localization. In general, the first self-determination method used the concept of triangulation to determine the position of the robot. However, this method is less accurate because it usually does not pay attention to the noise. This method is improved by averaging multiple calculations [4]. Localization and mapping of mobile robots is a key technology for implementing autonomous navigation systems. Over the past decade, many efforts have demonstrated that simultaneous localization and mapping (SLAM) is theoretically and practically possible [5]. Autonomous navigation of robots in uncontrolled environments is a challenging task as many subsystems must work together. They can mark your environment, place robots on this map, create movement plans according to the map, execute these plans on the controller, and perform other tasks [6].

1.2 Literature Survey based on Patient Monitoring Technology

The patient monitoring technology is explained in the following papers: summarized the use of IoT in health monitoring systems. Early identification of health problems can help patients take necessary immediate action that can potentially save lives. An IoT-based health monitoring system can track patients in real-time and alert patients when something goes wrong[7].The goal of proposed system the framework is to develop new products for medical systems that can provide high-quality, low-cost patient healthcare services using this combination of big data analytics, cloud computing, and computer technology [8]. the system monitors body temperature, heart rate, room humidity, and temperature using sensors that are also displayed on the LCD. These sensor readings are sent to the medical server via wireless communication. This data is received by a certified personal smartphone with an IoT platform.[9].This article provided an overview of the service robot configured as the ARNA robot's functional subsystem, PHRI's mobile manipulator. Among the novelties of this robot are its neuro-adaptive control system and interfaces, as well as the sensor protocol. ARNA can also be used to fetch, transfer and manipulate parts in a manufacturing environment[10]. MedRobo delivers medications to patients and checks patient vital signs to replace nursing services. The robot finds a path of travel and identifies the patient's location with Line followers and RFID tags [11]. They used heart rate monitors and blood pressure monitors to monitor patients' health [12]. This article has presented the system in the context of an IoT environment. The system provides continuous health monitoring anywhere for patients in intensive care units or bedridden at home. The ECG sensor and digital thermometer are two sensors that can monitor the ECG signal and patient temperature in real time [13].

1.3 Literature Survey based on Sanitization Technology

The research on various disinfection systems led them to choose to develop the disinfection robot. This is not an autonomous device and must be manually controlled. The robot's built-in light and agility can inactivate microbes for specific time intervals. Based on the built-in sensor and camera, the device has high utility [14]. This article presents a prototype of an Arduino-controlled HSRV. The prototype was successfully tested by remotely manipulating to sanitize a room without requiring the operator to touch nearby objects. This prototype implementation will prevent the spread of the deadly virus and ensure the safety of his life fighting on the front lines[15]. They have developed sanitary devices that disinfect objects, floors and more. Ultraviolet disinfection is a modern disinfection technology that is growing in importance. It can be used in clinics and other commercial applications to improve your lifestyle. A major benefit of this project is the support of medical professionals [16]. This proposed system is an intelligent automatic that helps people keep their surroundings clean easily, safely, and cleanly. The purpose of this system is to meet the current requirements emerging worldwide following the covid pandemic. The system self-sanitizes and prevents infections from spreading between individuals [17].

III. METHODOLOGY

2.1 Overview of Methodology

The MediCareBot ROBO is designed to the monitoring of the patient and also to provide delivery services and many more that can be given in the below diagram.

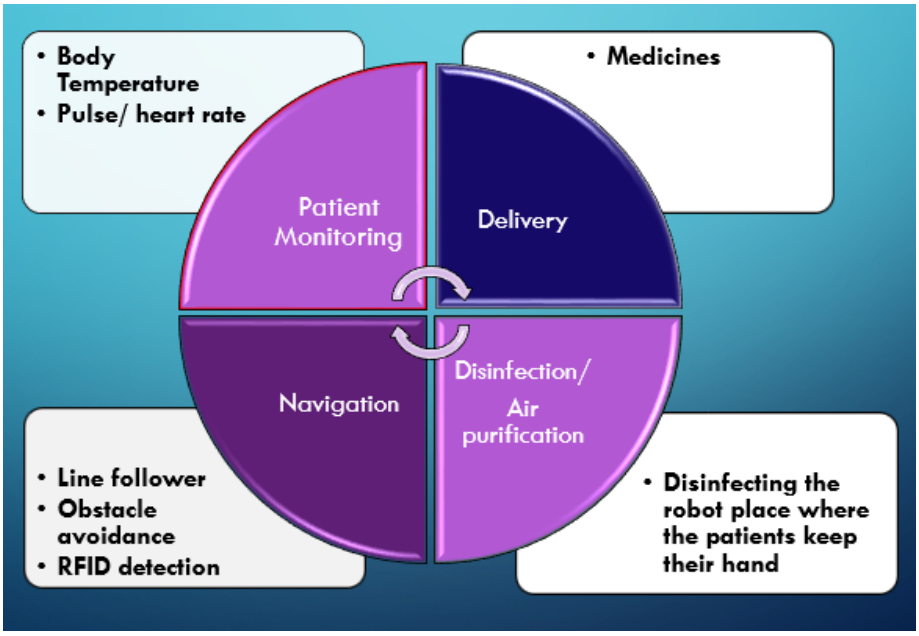

Fig 1:features of the MediCareBot

2.2 Block Diagram of the MediCareBot:

MediCareBot consist of Microprocessor Arduino Mega used as the decision-making device. Arduino mega is used to control the system's operations. It is the brain of the system. It has digital/analog IO pins from which we can interface different sensors like Temperature sensor, IR sensor, Heart beat sensor/ pulse sensor for measuring the vital parameters of the patient. Also at input we can interface the RFID card. RFID tagging is an ID system that uses small radio frequency identification devices for identification and tracking purposes. We are using RFID for bed identification purposes. At output ports we can interface sanitizer mist spray for the atomize sensitization and air purification circuit for better respiration of the patients. The values measured by the different sensors we can also display it through the display. The data collected by different sensors is stored in the cloud for the hospitals record.

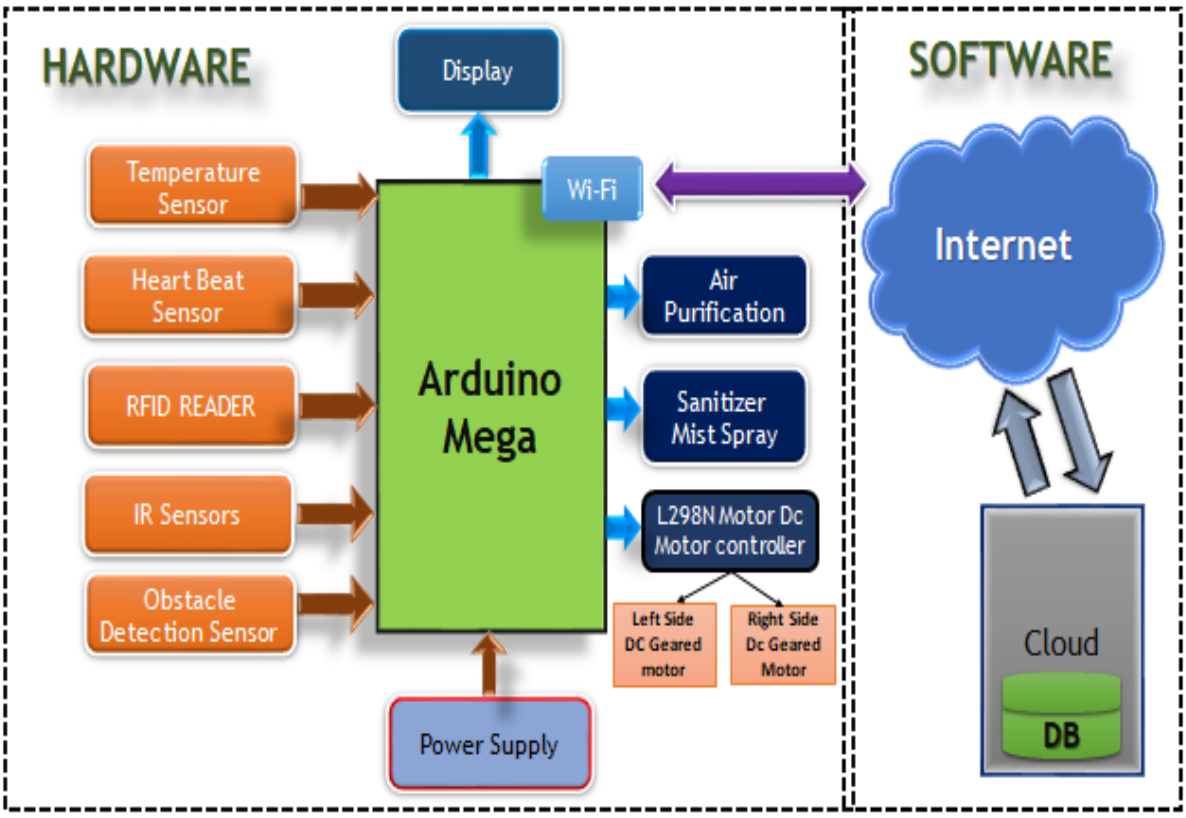

Fig 2:block diagram of MediCareBot

2.2.1 Navigation System:

MediCareBot ROBO consists of a Battery, a motor driver circuit, and four dc motors for driving the bot. The navigation part is built using a microcontroller Arduino Mega, and motor driver L298n. As a control signal has come from the Arduino Mega, it is given to the motor driver circuit. The motor driver circuit consists of a motor driver L298 which can drive two motors at a time. At the input port, we can interface two IR sensors for line detection. When infrared rays fall on a white surface, it's reflected back and caught by photodiodes which generate some voltage changes. When IR light falls on a black surface, light is absorbed by the black surface and no rays are reflected back, thus photodiode does not receive any light or rays.12V Lithium-Ion rechargeable battery is used to provide a power supply to the motor driver circuit. Now according to the control signal which has come from the IR sensor the motor driver circuit will turn on the motors forming various movements like forwarding Reverse, Left, Right, and Stop concerning the corresponding control signal.

2.3 Working of MediCareBot

When the system initializes the system will first choose the mode of operation. After that, it navigates through the following line and identifies the bed using an RFID reader. There are basically two modes of operation. If the assigned mode is MODE 1 then the MediCareBot is checking the patient's parameter. after checking the system sanitizes the place where the patient kept their hand for avoiding infections. the check parameter displays through the LCD and for hospitals records and to reduce paperwork the values measured will store on the cloud. If the as assigned mode is MODE 2 the robot will deliver the goods like medicines etc. to the patients and after that, it will return to the position.

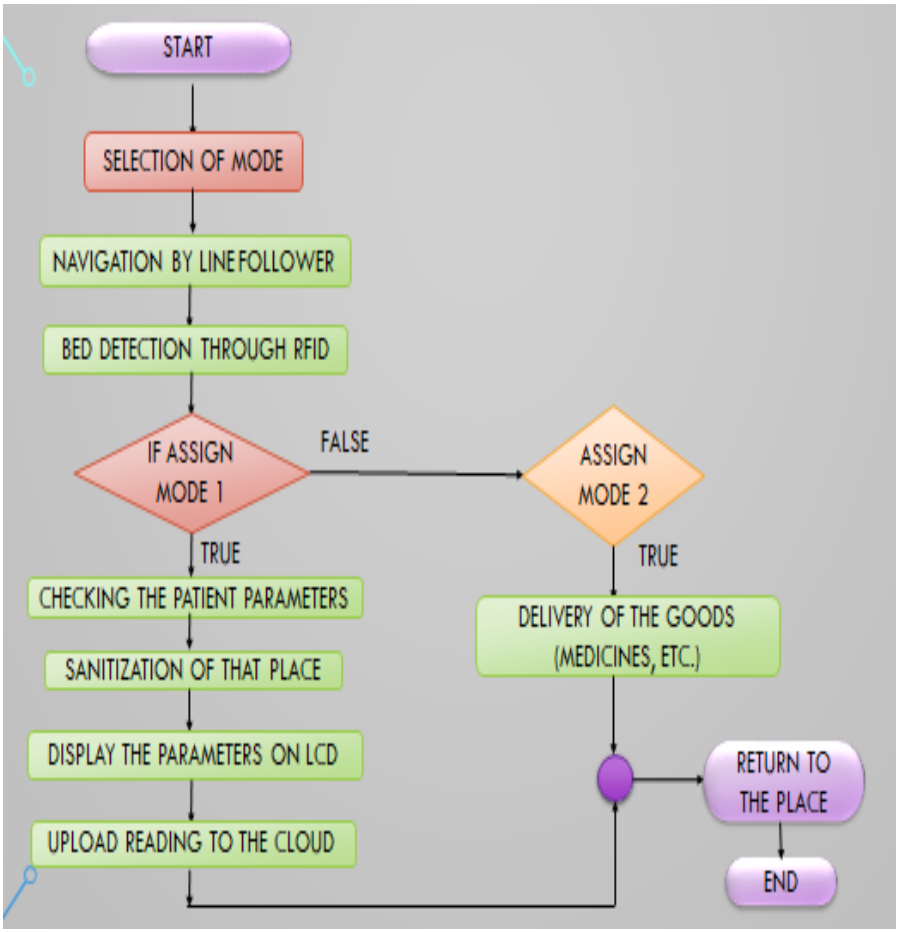

Fig 3: flow chart of MediCareBot

2.4.1 Working of Navigation System

A line-following robot is a self-operating robot that detects and follows a line drawn on the floor. The path to be taken is indicated by a black line on a white surface. The robot moves forward if the sensors don't detect black as well as robot turns according to the black line and stops when both sensors detect black.
The flow chart of the line-following robot consists of mainly four conditions that are given below

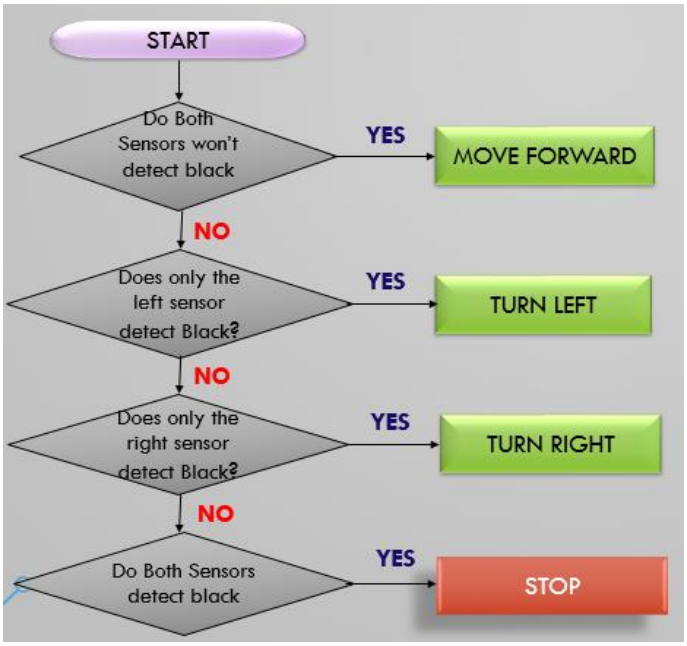

Fig 4: flow chart of the Navigation

IV. RESULT AND DISCUSSION

The MediCareBot having features of Navigation, Medicine Delivery and Patient Monitoring System. The navigation part includes the line follower technology. The prototype of the project is given below

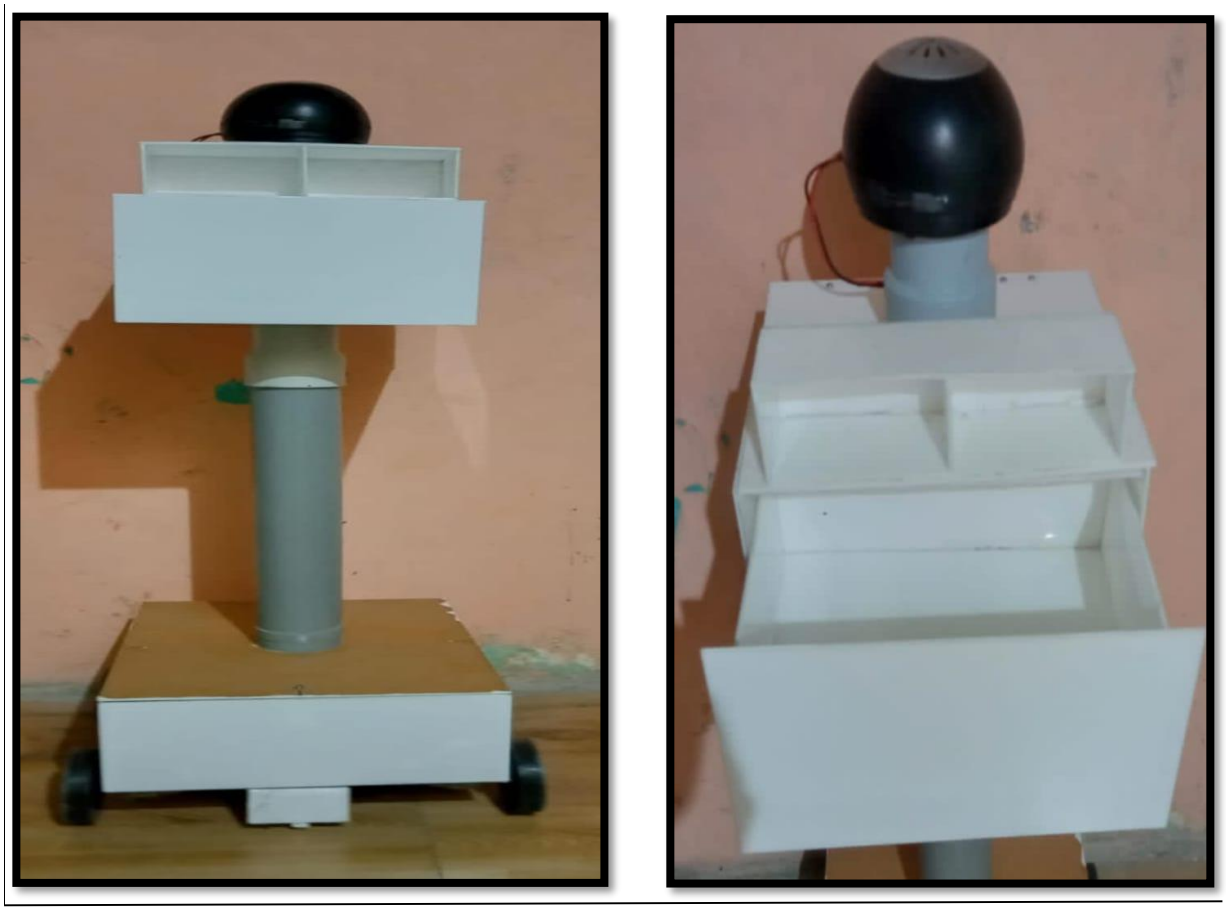

Fig 5: prototype of the MediCareBot

The navigation system is equipped with a motion algorithm which is explain as follows. So, when the left and right sensors get reflected signal back then the robot moves in forward direction. If one of those sensor don't get reflected signal so robot will turn according to that signal and when the both sensors signal get absorbed by black line. It's not receiving reflected signal. So robot will stop at this position.

Table 2:motion algorithm of MediCareBot

Left IR Sensor	Right IR Sensor	Movement
0	0	Move Forward
1	0	Left Turn
0	1	Right Turn
1	1	Stop

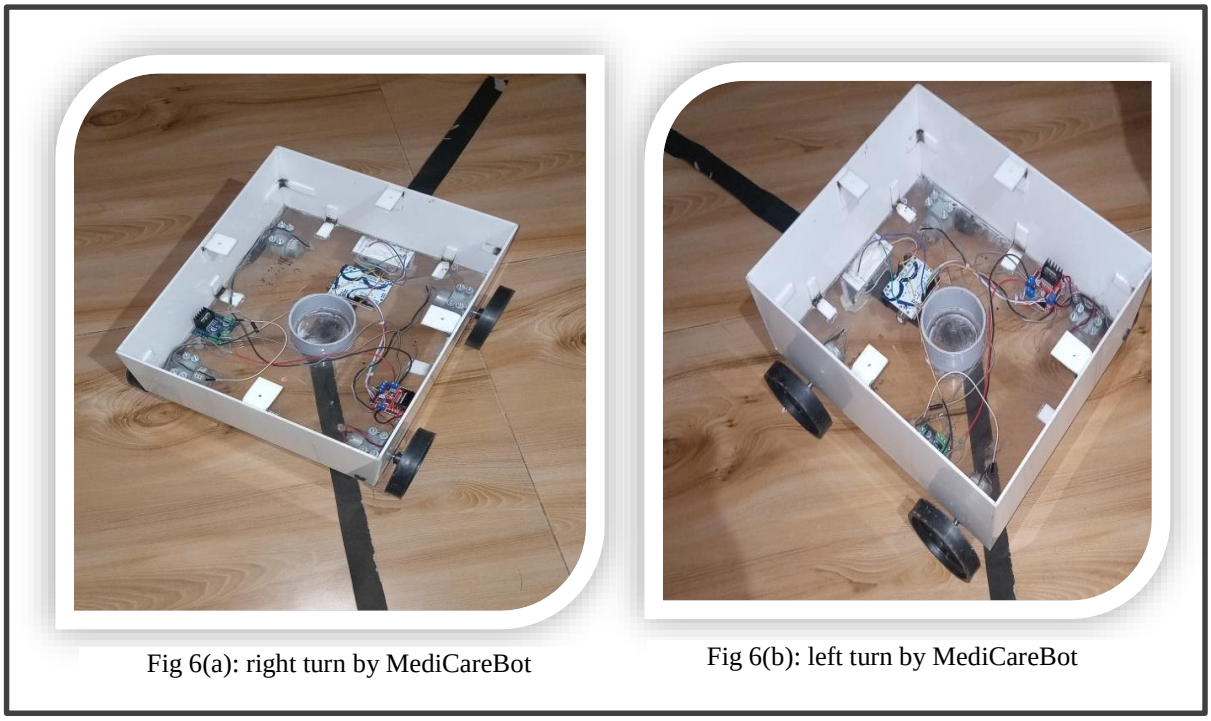

Fig 6(a): right turn by MediCareBot

Fig 6(b): left turn by MediCareBot

Fig 6: navigation system of MediCareBot

This the result of implemented navigation system of MediCareBot. The Patient Monitoring feature shown in below image by measuring Heartbeat in bpm, SPO2 in percentage and Temperature in Celsius as well as in Fahrenheit of the patient.

Fig 7: patient monitoring system of MediCareBot

In Patient Monitoring, the Heartbeat sensor and Temperature sensor are used to check the patient's parameters. The Heartbeat sensor measures the Heart Rate in bpm as well as SPO2 in percent of the patient. The Temperature sensor measures the temperature in Celsius and Fahrenheit and displays it on LCD which is shown in Fig no.7

This is the result of the system implemented to date. we have implemented a Patient monitoring system, navigation system, and delivery services. The further implementation includes the Sanitization function and Air purification module.

V. CONCLUSION

Currently, nurses face challenges in increasingly overburdened work environments. The multifaceted working of our model ensures the process is not cumbersome and does not require extensive human intervention. The literature survey on different methodologies including the navigation, patient monitoring and Disinfection reveals the advantages and disadvantages of previously designed systems. The main goal of MediCareBot is to deliver medicines and necessary supplements to patients, check the patients, and also have disinfect functionality with an air purification function. For this proposed idea we did a literature survey and in that, we understood the different methods that are executed in different types of robots. From this survey, gained practical knowledge and a little bit of the execution idea of a project. The system is implemented a project prototype with mentioned features. We are very excited to complete future work within the timeline. This research helps to reduce human-to-human contact in hospitals and thus prevents the doctors and medical staff from getting affected by a different virus also sheer the volume of types of tasks that are physically and emotionally stressful for nurses and all frontline workers in the hospitals. The idea of the patient monitoring system using MediCareBot is a contribution to the field of medical science and it will reduce health issues and unwanted deaths.

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