# IoT Based Smart Medical Assistive Robot

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**ABSTRACT**

This paper highlights the growing significance of robotics in the healthcare industry, specifically focusing on ensuring the safety of healthcare workers such as doctors and nurses by minimizing direct person-to-person contact. The core objective of this project is to introduce a robotic system designed to operate within predefined paths, providing a versatile solution for various healthcare settings. The robot's movements and actions are pre-programmed and executed through an Arduino nano board, guided by signals received from RFID tags. Its primary functions include dispensing medication and collecting medical waste from infected individuals. To enhance its capabilities, this prototype incorporates a Node MCU unit that enables real-time monitoring and display of patients' physiological parameters, such as pulse and temperature, on a dedicated webpage. Through the integration of robotics and advanced technology, this research aims to revolutionize healthcare practices, ensuring improved safety and efficiency for both patients and healthcare professionals.

**Keywords:** Healthcare, Arduino Nano, NodeMCU

## 1 Introduction

The continuous improvement of living standards and medical standards has been a crucial factor in driving innovation in healthcare [1]. As populations age and healthcare needs become more complex, healthcare systems around the world are facing unprecedented challenges in providing efficient and effective care [5]. Nurses, doctors, and other healthcare workers are often overburdened with large patient loads, and the quality of care can suffer as a result. To address these challenges, the concept of medical assistive robots has emerged as a promising solution [3]. Medical assistive robots are designed to assist healthcare workers in various tasks, including patient care, monitoring, and medication management [9]. They can provide 24/7 monitoring and personalized care, reducing the workload of healthcare workers and ensuring that patients receive immediate attention if there is a sudden change in their condition. As technology continues to advance, medical assistive robots are becoming increasingly sophisticated [10]. For example, some robots can interact with patients using natural language processing, allowing them to provide personalized care and respond to patient questions and concerns. Others can perform complex surgical procedures with greater accuracy and precision than human surgeons.

Moreover, medical assistive robots can offer more consistent and accurate care than humans. These robots can administer medication precisely on time and in the correct dosage, reducing the risk of human error [2],[4]. They can also provide complete data about a patient's health parameters, such as temperature and pulse rate, for medical reference, allowing doctors to make more informed diagnosis and treatment decisions. These data are being displayed over a webpage using basic IoT principles [6]-[8].

This paper is structured in the following manner: Section 2 provides an explanation of the proposed system.

## 2 Proposed System

The medical field has witnessed significant advancements in recent years, with the development of medical assistive robots being one such innovation. Medical assistive robots can offer many advantages, including the ability to ease the workload of healthcare workers and provide timely assistance to patients. The



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proposed prototype is one such medical assistive robot that is fabricated by wirelessly controlled moving robot technology. The robot is controlled using a Radio Frequency Controller, with an Arduino Nano board used as the controller. The program is written in Arduino code with the Arduino software Arduino IDE tool, which is supported by Python and C programming languages for control system operations and end-user requirements.

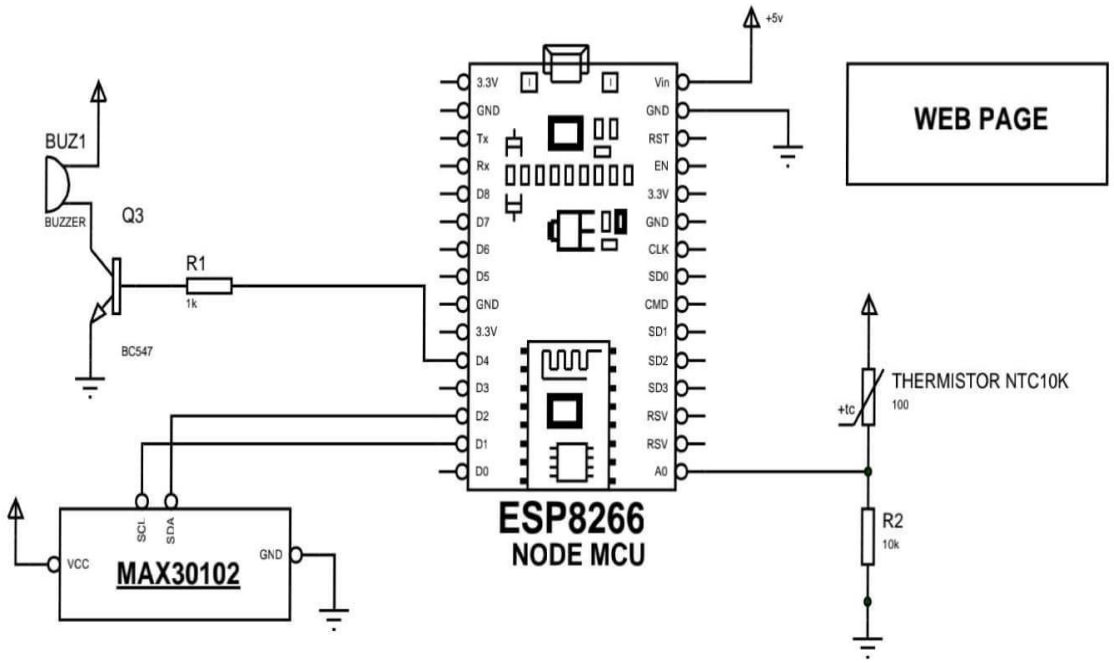


**Figure 1:** *Receiver system diagram*

The robot moves with the help of an 8.4v 7Ah Li-ion battery, which powers a motor at a speed of 60 rpm. The motor used is a 60rpm 12V DC gear motor, which is a permanent magnet DC motor. Additionally, a tray is used to help with the robot's movement, and it operates with the help of a Motor driver "L293D". To ensure the robot can move without any hindrances, two IR proximity sensors are installed - one on the front side and the other on the backside, to detect obstacles as shown in fig 2. The prototype is also equipped with a Node MCU unit, which allows the physiological parameters (Pulse and temperature) of the patient to be monitored and displayed through a 16*2 LCD matrix display module as shown in Fig 1. Also, a web page is created through which the patients from their rooms as well as the medical staff from the nursing station can access it.

This prototype can be particularly useful in healthcare facilities where the workload on healthcare workers is high, or in areas where healthcare services are inadequate. By using the proposed prototype, medical staff can provide patients with timely medication and assistance, while simultaneously monitoring their physiological parameters without human intervention. Nonetheless, the proposed prototype demonstrates the potential of medical assistive robots in the healthcare field and provides a foundation for further research and development of similar systems.

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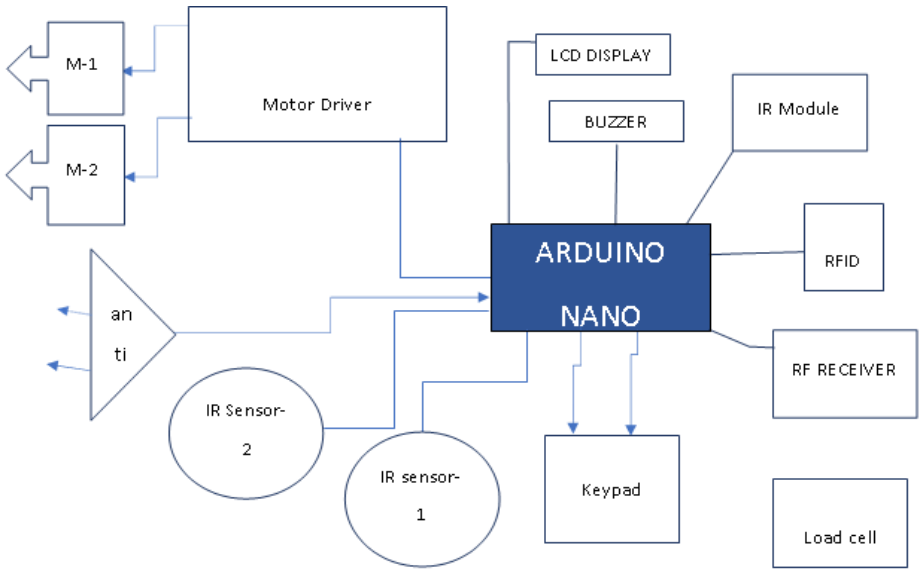


**Figure 2:** *Transmitter system diagram*

## 3 Software Description

The proposed system uses the Arduino IDE software to program two different microcontrollers, namely the Arduino Nano and the NodeMCU. The Arduino Nano is programmed using the C programming language, which is a popular high-level language used for embedded systems development. This microcontroller is used to control and manage various tasks within the system.

On the other hand, the NodeMCU microcontroller is programmed using the HTML programming language, which is widely used for creating web pages. The NodeMCU is used to create a web page that allows medical professionals to monitor patient parameters, such as temperature and pulse rate. This web page can be accessed from any device that is connected to the same network as the NodeMCU as shown in fig 3.

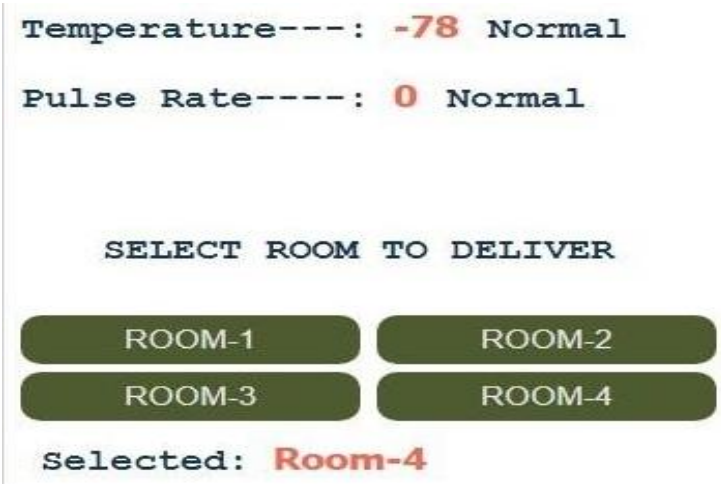


**Figure 3:** *Webpage Display*

The use of the NodeMCU in the proposed system enables the real-time monitoring of patient parameters. It is equipped with Wi-Fi connectivity, allowing for remote monitoring of patients in real-time. This makes it possible for medical professionals to monitor the health of their patients without having to be physically present with them.

## 4 Result and Discussion

In this prototype, we aimed to demonstrate the functionality of autonomous robots as smart medical assistive robots using a simulation. The results revealed that the robot can effectively function as a medical caretaker by collecting the patient's health parameters, providing timely medication, and collecting medical waste while moving along a designated path. The robot carries the required medication for a patient on its tray and, upon activation, moves along the predefined path. To ensure safety, we placed infrared sensors on the robot that can detect any obstacles in front of it. As the robot moves along the path, it scans RFID keys to identify the patient's key and deliver the required medication from its tray. Moreover, the robot records the patient's current health parameters for future reference. If the IR sensor detects any obstacles within a specific distance, the robot slows down or stops and alerts nearby personnel. However, if there are no obstacles, the robot moves seamlessly along the desired path without any interruption.
To improve accessibility, we have also created a webpage for both patients and medical staff to access. This webpage displays the number of rooms and allows healthcare workers to work according to each person's requirement present in each room. Furthermore, various parameters can be monitored using sensors in this webpage. Our simulation results indicate that the proposed robot is an efficient and effective medical assistive device that can assist healthcare workers in performing routine tasks such as collecting health parameters, delivering medication, and disposing of medical waste. These findings can serve as a foundation for the development of real-time machinery robots to assist healthcare workers in various medical facilities.

Some potential limitations of the medical assistive robot include

- **Limited flexibility:** The robot is programmed to move along a fixed path, which may limit its ability to adapt to changes in the environment or patient needs.
- **Limited obstacle detection range:** Although the robot has infrared and ultrasonic sensors installed to detect obstacles, their range is limited, and the robot might fail to detect obstacles that fall beyond this range.
- **Limited RFD key allocation:** The robot relies on RFID keys to identify patients and deliver their medication. However, if there are more patients than available RFID keys, or if the keys become lost or damaged, the robot may not be able to accurately identify patients.
- **Limited interaction with healthcare professionals:** While the robot is designed to assist healthcare workers, it may not be able to fully replace their role in patient care. The robot's ability to collect health parameters may be limited, and it may not be able to provide the same level of personalized care as a human healthcare professional.
- **Limited ability to handle complex tasks:** The programming and hardware capabilities of the robot may impose limitations on its capacity to carry out complex tasks such as responding to emergencies or administering injections.

Some potential areas of improvement for the medical assistive robot include:

- **Integrating more advanced sensors:** While the current robot uses infrared and ultrasonic sensors to detect obstacles and measure patient parameters, future research could explore the use of more advanced sensors such as cameras, LIDAR, or radar to enhance the robot's capabilities.
- **Incorporating machine learning and artificial intelligence:** Through the implementation of machine learning and artificial intelligence, the robot could gain insights from patient data and adjust its conduct accordingly to offer more individualized care.

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- **Improving battery life and charging capabilities:** The current robot runs on a Li-ion battery, but there is potential for improvement in battery life and charging capabilities to allow the robot to operate for a longer period of time without needing to be charged.

- **Enhancing the robot's mobility:** While the current robot moves on a fixed path, future research could explore the use of more advanced mobility systems such as wheels or legs to allow the robot to navigate a wider range of environments.

The risk of spreading epidemic diseases like covid-19 can be prevented as well as the safety of the medical staff is ensured by this project.

The complete prototype is depicted in Fig 4 and 5.

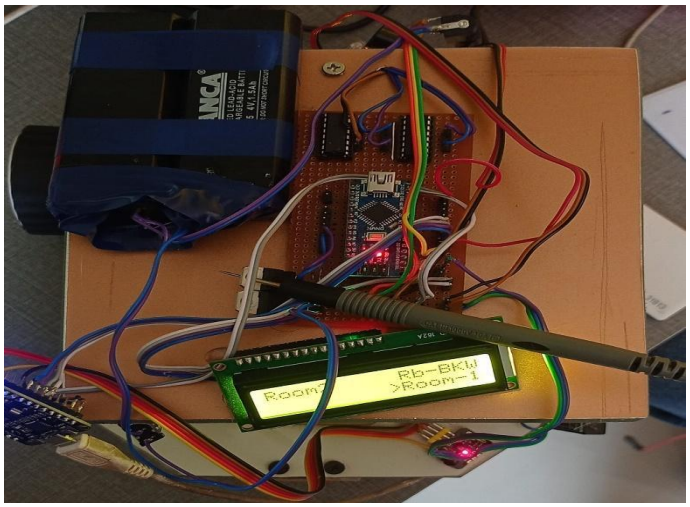


**Figure 4:** *Top View of prototype*

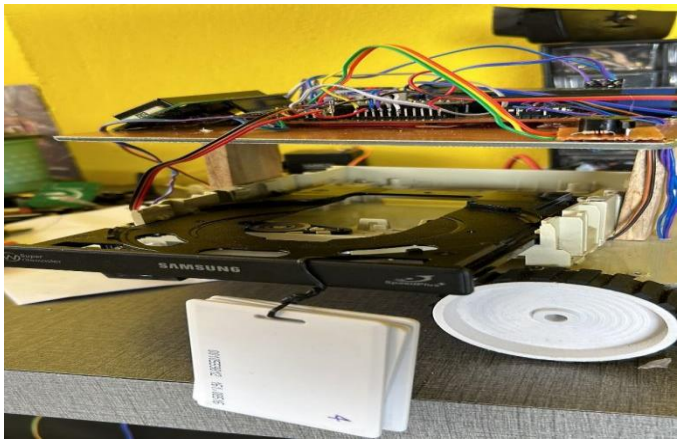


**Figure 5:** *Side view of prototype*

## 5 Conclusion

This paper emphasizes the importance of robotics in healthcare. The key intention of this paper is to bring a safe environment for all healthcare workers like doctors, and nurses by minimizing contact from person to person. The robot developed in this project moves in a particular path (e.g.: on a particular floor) as designed by the user. The movements and actions of the robot are programmed, and it is fed to the Arduino nano board. The controller senses the signals received from the RFID tags and the proposed robot moves accordingly to supply medicines or to collect medical waste from the infected person. This prototype is

equipped with a Node MCU unit, by which the physiological parameters (Pulse and temperature) of the patient can be monitored and displayed on the webpage.

## 6 Declarations

### 6.1 Acknowledgment

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## How to Cite

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