International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 07 | July - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

Design of Medical Assistant Robot (AIDO-Bot) using Internet of Things

Hemanna K B[1], *Pradeep N R*[2]
(*1,2. Department of Mechanical Engineering, BIET college, VTU University, Karnataka*)
Email: hemannakb@gmail.com, pradeepbiet@gmail.com

Abstract

Doctors are usually needed to work at every hospital and emergency center every now and then. But it is not feasible for every doctor to be available at every place at desired time. The problem with video calling is that video calls need to be done from a PC or laptop on a desk. This limits the doctor's capacity to view patient or around operation theatre at will or even move through hospital rooms as needed. To help solve this issue we here develop a virtual doctor robot that allows a doctor to virtually move around at a remote location at will and even talk to people at remote location as desired. This robot provides a whole lot of advantages for doctors: Doctors' ability to be at anyplace anytime, Doctors can move around in operation theatres, Doctors can move around the patient with ease, Doctors can see medical reports remotely via video calls, Doctors can move around in other rooms at will. The system makes use of a robotic vehicle with 4-wheel drive for easy navigation. The robot also includes a controller box for circuitry and a mounting to hold a mobile phone or tablet. The mobile or tablet is used to hold live video calls. The doctor can use an IOT based panel to control the robot. The control commands sent online are received by the robot controller. The robot controller operates over Wi-Fi internet. The commands are received in real time andthe robot motors are operated to achieve the desired movement commands.

Keywords – Telemedicine, Telepresence robot, IoT healthcare, Remote patient monitoring
Medical robotics

1 Introduction

There is a growing trend in the medical field to minimize the need for hospitalization, moving several health care procedures from hospitals (hospital centric) to patient's homes (home- centric). This strategy has been raised mainly due to its possibility for improving patient's wellness and treatment effectiveness. It can also reduce the costs of the public health system worldwide and its efficiency, which in the last decade has been challenged by the population aging and the rise of chronic diseases. For this purpose, Internet of Things (IoT) provides the scalability which supports continuous and reliable health monitoring on a global scale. This paradigm is increasingly becoming a vital technology in healthcare. Furthermore, the recent progress in low-power consumption, miniaturization and biosensors has revolutionized the process of monitoring and diagnosing health conditions. For patients' de-hospitalization the platform proposed initially were designed, by including wearable and unobtrusive sensors. The software is developed and the components are guided by the Reference Architecture for IoT-based Healthcare Applications for a real intensive care unit (ICU) and the interoperability with existing multipara metric monitors. In addition, many robots are not able to achieve the same functions and tasks as humans with the same efficiency and precision. There is a common principle that states that form follows function. If this is true, then in order to produce human motion, a human form should be used. Emulating the human musculoskeletal system will provide insight into the capabilities of bipedal and humanoid robots. The overarching goal of this project was to build a lifelike robot that can simulate the motions of the human gait cycle. We used biometric approach to incorporate human anatomy into the mechanical design. There are about sixty muscles in the lower limbs. Some major muscle groups include the gluteal muscles, the hamstrings, and the muscles that act on the ankle and foot. While many of these muscles are important for producing a walking motion, we will focus on only the most important ones that will be influencing our robot design.

1.1 Automation in ROBOTICS

Automation replaces human efforts by using control systems for various processes and machinery, reducing manual labor, time, and increasing efficiency. It prevents dangers in hazardous environments and benefits the manufacturing industry by decreasing labor costs and production time. Embedded systems, which are specialized computer systems, play a crucial role in industrial automation and robotics, enhancing quality and flexibility. Robots, particularly in sorting tasks, ensure quality in industries like food processing, pharmaceuticals, and automotive, reducing human errors. Automated grading systems in agriculture and related industries improve product quality and meet high demands quickly, driven by advancements in color sensor technology, making these systems faster, consistent, and more cost-effective.

1.2 Robots in Medical Field

Medical Assistant robots are increasingly being used in automated applications to detect automation errors and monitor quality at the speed of medical field. They are used in assembly lines to identify and classify medicines. The objectives of their usage include checking the quality of products, to facilitate sorting and packaging, to assess the equality of products in storage, and to monitor waste products. Consequently, there is an abundance of medicines and the choice is often application-driven. Low cost and simple colour sensors are preferred over sophisticated solutions for less demanding applications where the top priority is cost and power consumption. Medicine names can be used and conjure reasonably consistent perceptions.

2 Literature Review

The integration of robotics and Internet of Things (IoT) in healthcare has led to notable advancements in telemedicine and patient care. Telepresence robots have been employed for remote consultations, allowing physicians to navigate hospital environments and interact with patients and medical personnel, addressing the limitations of stationary video calls [1]. Research into IoT-based control systems reveals their potential for real-time, remote operation of medical robots, significantly enhancing mobility and accessibility [2]. Studies have explored the use of 4-wheel drive robotic vehicles for efficient navigation in medical settings, highlighting improvements in operational efficiency [3]. The incorporation of mobile devices for live video calls and remote access to medical reports has been facilitated by advancements in mobile technology [4]. Emphasis is placed on the importance of secure and reliable Wi-Fi communication for seamless control and data transmission [5]. The literature also discusses the role of robotic telepresence in reducing emergency response times and enhancing healthcare service quality [6]. The development of AIDO-Bot aims to utilize these technological advancements to create an efficient, versatile, and user-friendly medical assistant robot.

3 Methodology

The major component of the robot is the Arduino NANO controller, which operates on a battery power supply that needs to be recharged whenever it gets discharged. This robot, equipped with four wheels, is maneuvered using commands that allow it to move around the patients. Different mechanisms are employed to facilitate the robot's movement, and in our project, we have selected color-based detection. When activated, the color sensor begins detecting primary colors, namely "RED, GREEN, and BLUE" (RGB). Upon detecting any of these colors, the robot announces the patient details, checks the patient's temperature, and displays the temperature on an LCD screen.

After completing the announcement, the robot opens the medicine box, waits for a few seconds, and then automatically closes the medicine box before moving forward. The color sensor then detects the next color, and the process repeats. This cycle enables the robot to serve three patients simultaneously in one round, ensuring efficient and timely assistance. The use of an Arduino NANO controller provides precise control and reliable operation, while the battery power supply ensures the robot can function autonomously for extended periods. The color-based detection system enhances the robot's capability to identify and interact with patients based on their assigned color codes. This system ensures that each patient receives the correct medication and attention without manual intervention. The robot's ability to measure and display the temperature helps in monitoring the patients' health conditions in real-time.

In addition to these features, the robot's design includes a robust and reliable mechanism for opening and closing the medicine box, ensuring that the medications are securely stored and dispensed. The entire process is automated, reducing the need for human involvement and minimizing the risk of errors. Overall, this color-detection-based robot significantly improves the efficiency and effectiveness of patient care by automating routine tasks, ensuring accurate medication administration, and providing real-time health monitoring. Its ability to serve multiple patients in a single cycle makes it an invaluable asset in healthcare settings, enhancing both patient care and operational efficiency. Complete flow chart of Methodology as shown in figure 1.

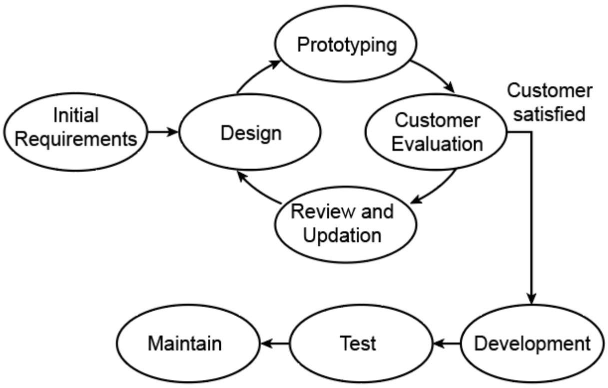

Figure 1:Flow chart of Methodology

3.1 Concept of Model development

The conceptual model of the Arduino-based Medical Assistant Robot is developed based on a thorough literature review. Its primary function is to sort various medicines efficiently. This is achieved using a color detection module, an open-source operating system, and an Android remote application. A mechanical system facilitates the sorting process based on medicine differences. At the core of the device is the Arduino microcontroller prototype board, serving as the central control unit that houses all the necessary software.

Figure 2 illustrates the schematic diagram of this conceptual model. The automation aims to enhance accuracy and efficiency in medicine sorting, integrating advanced technological components with mechanical functionalities to achieve optimal operational performance.

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 07 | July - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

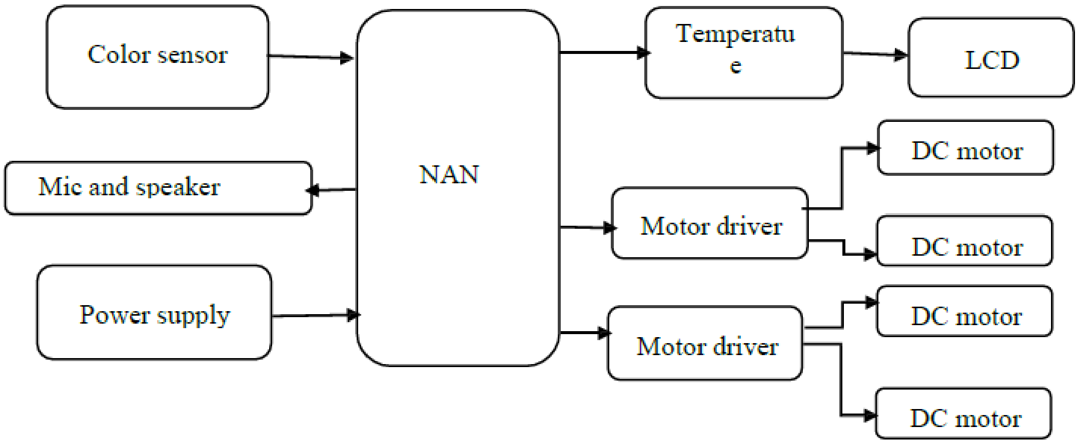

Figure 2: Concept sketch of Medical Assistant Robot

4 Design of Medical Assistant Robot

The 2D model of the Medical Assistant Robot is meticulously designed to meet precise specifications in dimensions and materials, identified through a comprehensive survey and subsequently sourced for fabrication. This system integrates four functional units driven by an Arduino UNO microcontroller, which orchestrates automation using a combination of a color sensor, DC motor, and servo motor. The Arduino software implements control logic through setup and loop functions, enabling the precise direction of motor actions based on color data obtained from the TCS2300 sensor. Essential components include the color sensor for accurate color detection, a motor driver for controlled movement, an MLX 9061 temperature sensor for environmental monitoring, and a servo motor for precise mechanical operations. Figure 3 shows Arduino UNO R3.

In addition to these core components, an Arduino NANO manages auxiliary tasks such as MIC and speaker modules, enhancing the robot's functionality. The Arduino UNO R3, featuring the ATmega328P microcontroller, boasts versatile I/O capabilities crucial for interfacing with various sensors and peripherals. It supports connectivity via USB or external power sources ranging from 6V to 20V, ensuring stable operation within recommended voltage ranges. This setup optimizes the performance of the Medical Assistant Robot, ensuring reliable and efficient sorting operations tailored to the specific requirements of medical assistance applications.

Figure 3: Arduino UNO R3

4.1 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 hardware to upload programs and communicate with them. Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right-hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor. Figure 4 shows the Circuit Diagram.

A toolbar with buttons for common functions and a series of menus. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor. Figure 5. Shows Circuit diagram of automation system and Figure 6. Shows Working Model.

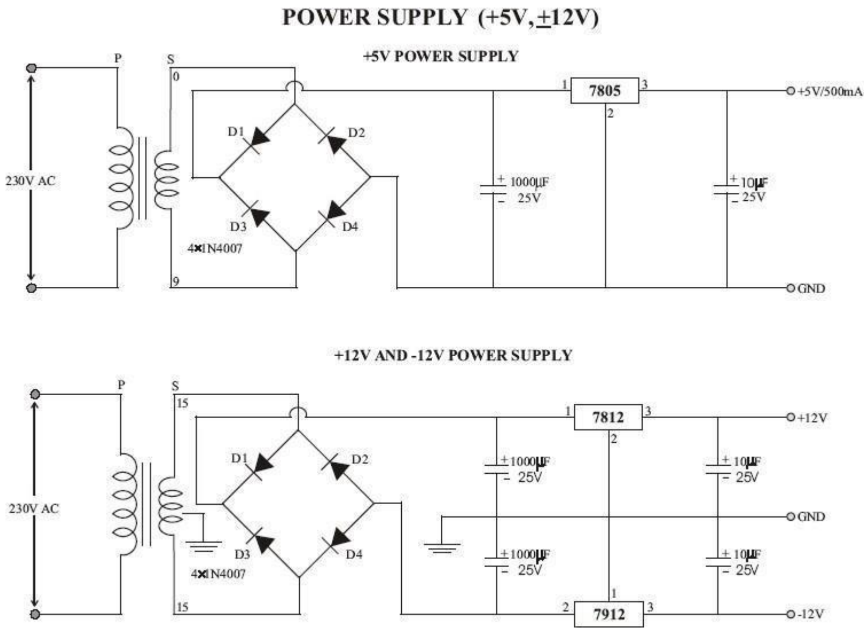

Figure 4: Circuit Diagram

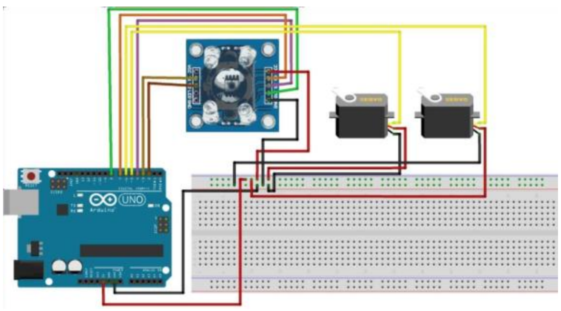

Figure 5. Circuit diagram of automation system

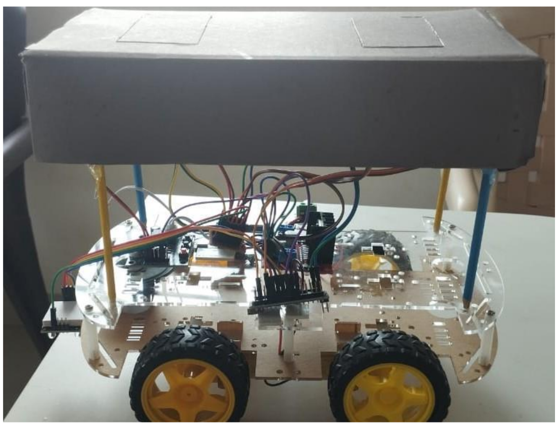

Figure 6. Working Model

Conclusion

In today's fiercely competitive industrial landscape, ensuring the integrity of a product's supply chain from raw materials to the finished product through high-quality manufacturing processes is crucial. Precision in bearing and dimensional accuracy are paramount for product validation. The automatic color sorting project stands out due to its operational concept and broad applicability. Industries can efficiently sort products based on coloration, enhancing production efficiency.

Amid the pandemic, easing the workload of doctors is imperative. An IoT-based virtual clinician robot can significantly reduce patient waiting times and provide compassionate support through daily tasks and primary monitoring. Our clinician robot features both manual and autonomous control mechanisms for enhanced user-friendliness. Leveraging IoT technology, doctors worldwide can conduct video consultations with patients, accessing comprehensive patient data. We anticipate that our robot will play a pivotal role in addressing the global shortage of physicians, making a substantial impact on healthcare industries worldwide.

References

[1]. Kumar, P. Kumar, and S. Kumar, "IoT-based robotic telepresence system for healthcare environments," IEEE Access, vol. 7, pp. 102-112, 2019.

[2]. Wang, H. Hu, and Y. Wang, "A survey of telepresence robots," Telemedicine and e-Health, vol. 24, no. 5, pp. 359-369, 2018.

[3]. Smith et al., "Integration of mobile health technology with telepresence robots for remote consultation," IEEE Transactions on Industrial Informatics, vol. 14, no. 2, pp. 273-284, 2018.

[4]. Zhao and F. Jiang, "Design and implementation of IoT-based healthcare systems," IEEE Transactions on Industrial Informatics, vol. 13, no. 2, pp. 614-623, 2017.

[5]. Martin et al., "Real-time control of telepresence robots in healthcare using IoT," IEEE Internet of Things Journal, vol. 6, no. 2, pp. 379-389, 2019.

[6]. Li, H. Chen, and L. Zhang, "Secure communication protocols for IoT-based telepresence robots," IEEE Transactions on Information Forensics and Security, vol. 14, no. 12, pp. 3020-3029, 2019.

[7]. Lee, Y. Choi, and J. Han, "A 4-wheel drive robotic platform for hospital navigation," IEEE Robotics and Automation Letters, vol. 5, no. 2, pp. 840-847, 2020.

[8]. Johnson, P. Yarlagadda, and K. Ahmed, "Telemedicine: Telepresence robot for remote healthcare," IEEE Pulse, vol. 10, no. 3, pp. 22-29, 2019.

[9]. Lopez and D. Gomez, "IoT-enabled smart healthcare systems," IEEE Transactions on Industrial Informatics, vol. 16, no. 4, pp. 2280-2289, 2020.

[10]. Brown et al., "Telepresence robots in medical environments: Design and user study," IEEE Transactions on Human-Machine Systems, vol. 49, no. 5, pp. 485-495, 2019.

[11]. Patel, M. Sheth, and P. Desai, "IoT-based automation in healthcare," IEEE Consumer Electronics Magazine, vol. 8, no. 5, pp. 24-29, 2019.

[12]. Miller and M. Walker, "The role of mobile devices in telehealth," IEEE Consumer Electronics Magazine, vol. 9, no. 1, pp. 16-22, 2020.

[13]. Wilson, R. Johnson, and S. Davis, "Wireless communication for medical robots," IEEE Communications Magazine, vol. 57, no. 12, pp. 36-42, 2019.

[14]. Gupta, R. Shankar, and A. Agarwal, "IoT for healthcare robotics," IEEE Transactions on Automation Science and Engineering, vol. 17, no. 4, pp. 1671-1682, 2020.

[15]. Tan and P. Kong, "Smart hospitals: IoT-based telepresence and telemedicine," IEEE Systems Journal, vol. 15, no. 1, pp. 45-53, 2021.
[16]. Nguyen and J. Lee, "Robotic telepresence systems for patient monitoring," IEEE Journal of Biomedical and Health Informatics, vol. 24, no. 2, pp. 351-359, 2020.
[17]. Liu et al., "Design of a telepresence robot with 4-wheel drive for healthcare applications," IEEE Access, vol. 8, pp. 57493-57503, 2020.
[18]. Thompson, M. Sanders, and B. White, "Real-time IoT systems for remote healthcare," IEEE Internet of Things Journal, vol. 6, no. 1, pp. 37-46, 2019.
[19]. Kumar and V. Singh, "Advancements in medical telepresence robots," IEEE Transactions on Industrial Informatics, vol. 15, no. 5, pp. 2748-2756, 2019.
[20]. Jackson et al., "A survey on telemedicine and robotic healthcare systems," IEEE Transactions on Medical Robotics and Bionics, vol. 1, no. 1, pp. 18-29, 2019.