Connected Doctor Bot: An IoT-based solution

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Abstract: The Connected Doctor Bot is an advanced healthcare solution integrating telemedicine, IoT, and robotics to enhance patient care through remote monitoring and virtual consultations. It continuously measures vital health parameters such as heartbeat, blood pressure, oxygen levels, and body temperature, transmitting the data securely to a cloud-based platform for real-time monitoring by healthcare professionals. The robot operates autonomously or via remote control, allowing it to navigate hospital rooms, clinics, and home care environments to assist patients. Additionally, there will be a live video feature to the bot which allows patients to talk directly with their doctors, making it easier to get advice and evaluations without needing to be in the same place. This technology is especially helpful for people in rural or underserved areas, as it helps monitor their health continuously and ensures they receive timely care, which can reduce crowding in hospitals. The use of AI driven analytics helps in spotting the health issues early, leading to quicker treatment and better outcomes for patients. By bridging the gap between doctors and patients, the Connected Doctor Bot makes healthcare more efficient, available, and responsive.

Keywords: IoT Healthcare, Remote Patient Monitoring, Virtual Consultation, Real-time Health Data, Autonomous Robot, Cloud-based Monitoring.

INTRODUCTION:

Doctors play a vital role in hospitals and emergency departments. Yet, it is not possible for them to be physically available at more than one place at a time. To overcome this problem, we have created a Connected Doctor Bot, an advanced health monitoring system which monitors important signs like hear rate, oxygen levels and blood pressure. This data is used for providing individualized medical consultation and for informing healthcare personnel of any sudden changes in the status of a patient. Not being able to walk between wards of a hospital or properly monitor patients in operating rooms is one of the greatest challenges faced by doctors. Our Connected Doctor bot solves this issue by enabling remote travelling and interaction with patients in other parts of the region. There are also several advantages like smooth movement between hospital rooms, smooth operating room mobility, remote monitoring of medical reports as video consultations, and smooth visits between different rooms according to needs, enhancing healthcare efficiency and accessibility. Doctors can operate the robot from a distance using an easy online control system, ensuring everything runs smoothly. Recent technology changes in healthcare, such as robotics and telemedicine, have shown promise in making care more efficient and reaching patients in need.

[1-8] explored the integration of IP cameras in IoT-based virtual healthcare systems, highlighting the importance of real-time video communication in telemedicine. This study emphasizes the role of video-enabled healthcare robots in providing virtual consultations and remote patient monitoring, forming the foundation for our Virtual Doctor Robot and addressed the challenges of telemedicine in rural healthcare, emphasizing the need for remote medical support. [9-12] analyzed smart wearable devices for remote health monitoring, emphasizing the role of IoT in improving healthcare efficiency. These studies provide direct

support for the development of our Virtual Doctor Robot, which integrates similar technologies and explored wireless health monitoring and virtual doctor consultation using IoT, reinforcing the importance of wireless connectivity in virtual healthcare robots. By integrating these ideas, our Connected Doctor Bot aims to make doctor movement easier, lower barriers to healthcare access, and provide quick medical help through smart technology.

METHODOLOGY:

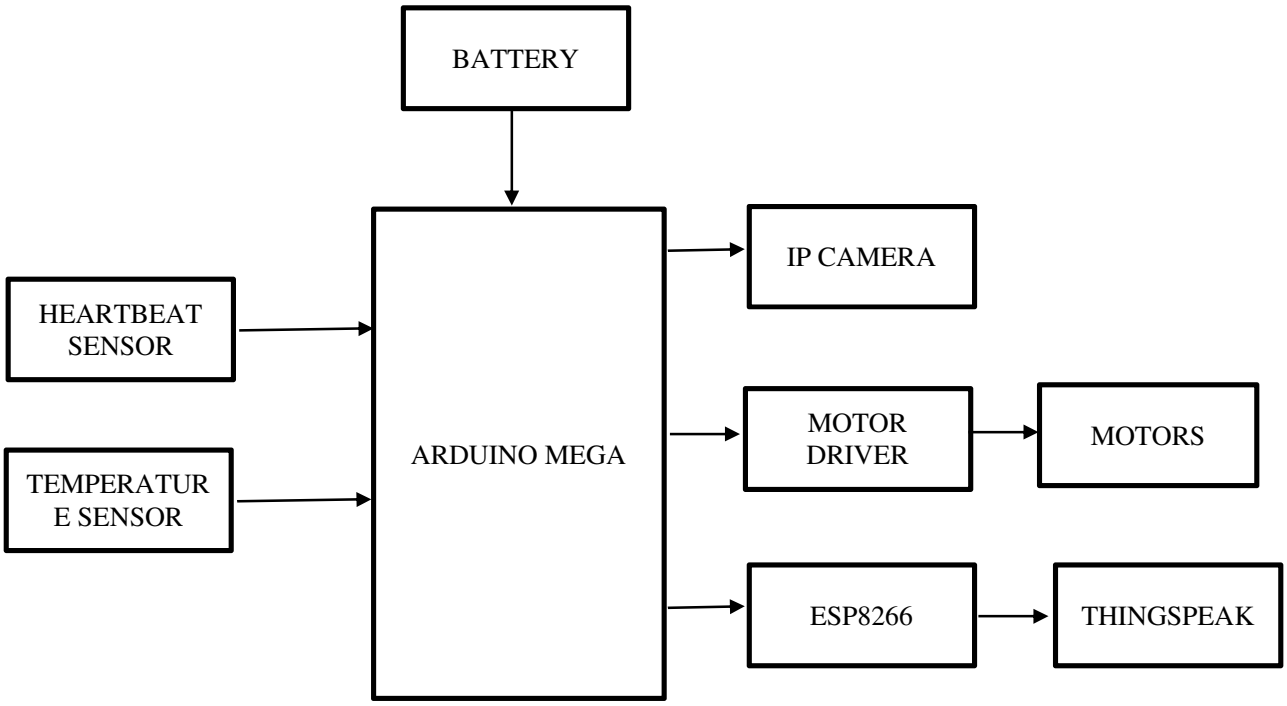


Fig1: Block Diagram with components

This system is built around an Arduino Mega microcontroller,a major component which acts as the brain for all its functions.It has two sensors named heart beat sensor and temperature sensors to detect the important signals ,making it useful for health related tasks.The system uses a battery which is portable.It also consists of an IP camera that is used in live streaming of video calls for easy monitoring. The speed and movement of the camera is controlled by motors using a motor driver which could be useful for robotics or surveillance applications.The data can be sent to the cloud over ESP8266 using ThingSpeak, a cloud based tool that helps users to visualize data and keep track of data in real quick. This system will allow you to live stream data, control things automatically, and access everything from anywhere.

Working Principle:

Connected Doctor bot is web of things; a bot that benefits healthcare from a remote location. The mobile robot comes with sensors that check important health signs like heart-rate, body temperature, and sends it in real time to the doctor for analysis. This robot can walk around by itself or can be controlled from other

places. It helps the healthcare worker to reach the patient in different areas of the hospital. Also, it can reach the remote patient. This mobile robot sends various vital indicators like heart rate, body temperature and other measurements continuously to a central location. The robot can walk around the hospital independently or can work against the remote control through the NodeMCU, WiFi module, which is given commands through an Adafruit interface.This robot helps doctors talk to patients through video chats. With the camera in the robot, the doctor can see how the patient is doing, apart from getting other vital datas. This helps doctors give better advice, diagnostics and even quick decisions for emergency care without actually being in the same room.By using this robot, we can reduce the number of trips patients need to make to hospitals, lower their risk of catching infections, and provide help quickly where it's needed most. Overall, the Connected Doctor bot offers a smart and efficient way to deliver healthcare, especially in areas that lack resources.As a whole, this system not only enhances convenience but also greatly improves patient care by facilitating timely and educated decisions on the part of physicians.

Components:

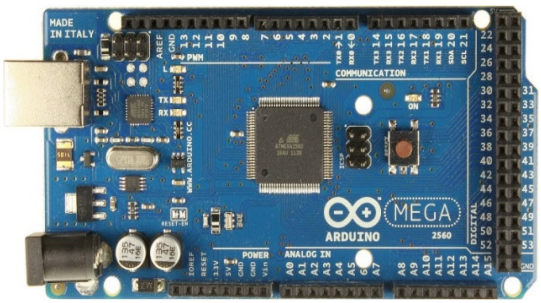


Fig 2: Arduino Mega 2560

Fig 3: Robot platform

Fig 4: DC Motors

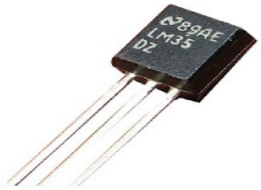
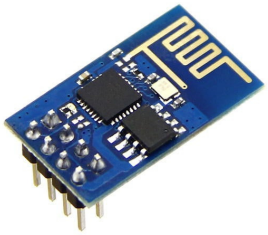


Fig 5: Temperature Sensor



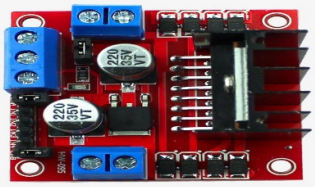


Fig 6: NodeMCU Wi-Fi Module

Fig 7: Motor Driver

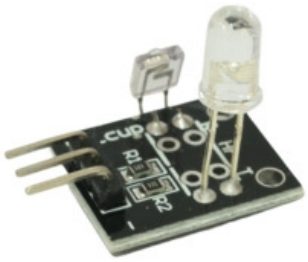


Fig 8 :Heartbeat Sensor

Fig 9:IP Camera

Fig 10: 12V Battery

Fig 2: Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital I/O pins, 16 analog inputs, and multiple serial communication ports, making it suitable for complex robotics projects.

Fig 3:Robot Platform is a base structure where all the components are mounted. It can be a chassis with pre-drilled holes for easy assembly of motors, sensors, and electronics.

Fig 4: DC Motors convert electrical energy into mechanical motion, helping the robot move. They are typically controlled using a motor driver.

Fig 5:Temperature Sensormeasures the ambient temperature and can be used for environmental monitoring, safety, or automation applications.

Fig 6:Node MCU Wi-Fi Module is a development board with an ESP8266 chip that enables wireless communication. It allows the robot to connect to the internet or a local network for remote control and data transmission.

Fig 7:Motor Driver is a circuit that controls the DC motors by regulating speed and direction using signals from the microcontroller.

Fig 8: Heartbeat Sensor is a bio-sensor that detects and measures the pulse rate. It can be used for health monitoring applications.

Fig 9: IP Camera is a network-based camera that streams live video, enabling surveillance or remote monitoring of the robot's environment.

Fig 10:12v Battery isa rechargeable battery is an energy storage device that can be charged again

after being discharged by applying DC current to its terminals.

Software Used

1. Arduino IDE: Arduino IDE is utilized to compose, compile, and upload code on the Arduino Mega 2560 for motor control, sensor processing, and communication with the NodeMCU Wi-Fi module. It offers a Serial Monitor for debugging and incorporates libraries for sensor and motor drivers. The IDE is essential for programming the robot for autonomous motion, health checking, and remote data transfer.

2.ThingSpeak : ThingSpeak is an IoT analytics service platform through which you can aggregate, visualize, and analyze live data streams in the cloud. You can push data to ThingSpeak from your devices, generate instant visualization of live data, and push alerts.

FLOWCHART:

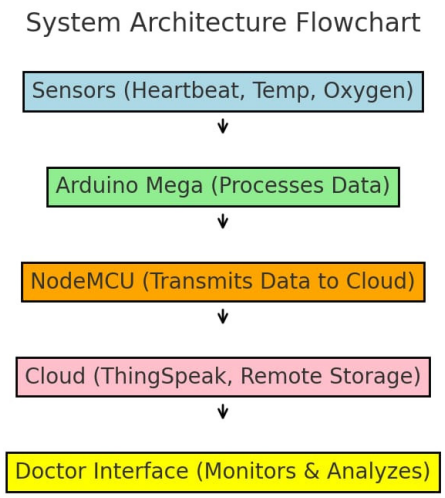


Fig 11: System Architecture Flowchart

WORKFLOW/WORKING:

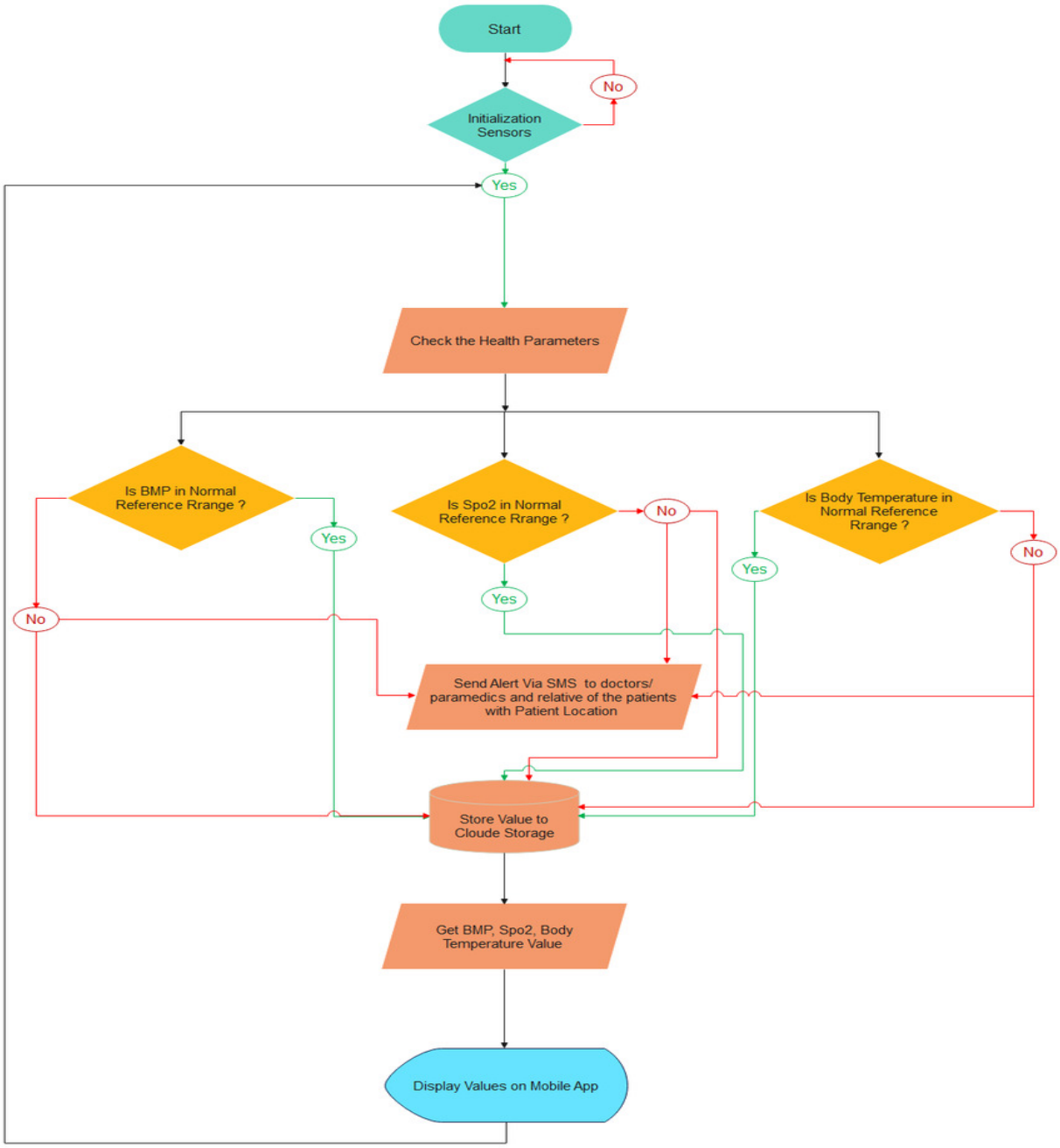


Fig 12: Working flow of the system

IMPLEMENTATION:

The Virtual Doctor Robot is an autonomous health-monitoring system that integrates various sensors and communication modules to assist in remote patient care. Built on an Arduino Mega 2560, the robot moves using DC motors controlled by a motor driver and powered by a 12V battery. A heartbeat sensor and temperature sensor continuously monitor patient vitals, sending real-time data via a NodeMCU Wi-Fi module to a remote server or web dashboard. An IP camera provides live video streaming for remote monitoring, allowing doctors or caregivers to assess the patient's condition. The robot platform is equipped with wheels, dummy shafts, and mechanical arrangements for smooth movement, controlled manually or

autonomously. A slide switch enables easy power control, and multiple connectors ensure seamless integration of components. The collected health data is accessible via a mobile or web interface, making this system an efficient tool for remote healthcare and emergency response.

Results and Discussion:

Fig 13: Communicating with virtual robot

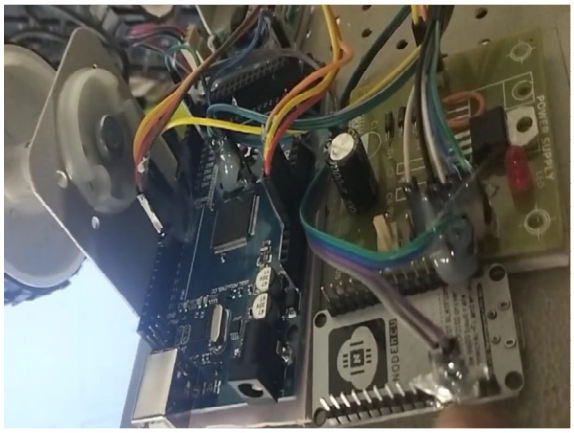


Fig 14: Components

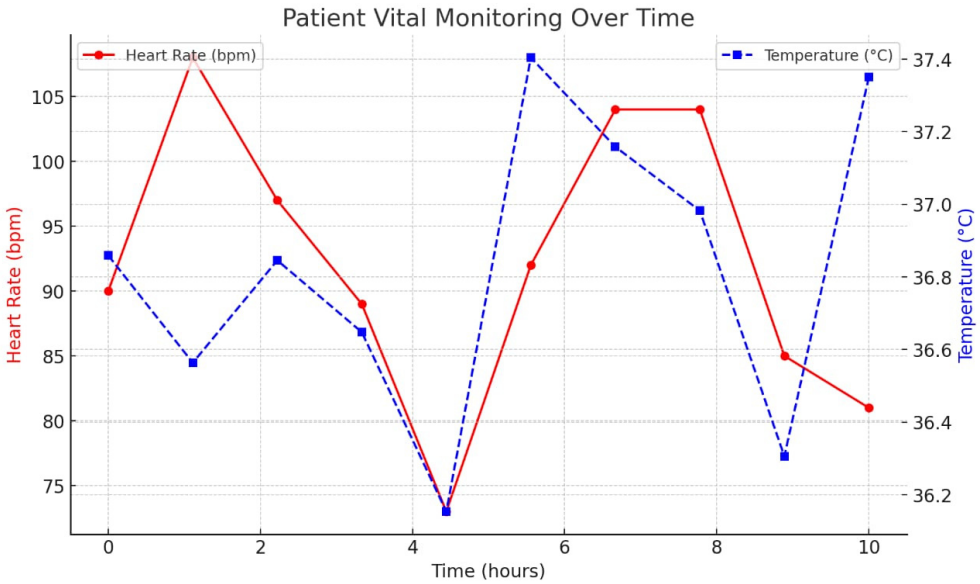


Fig 15:Patient Vital Monitoring Over time

The graph shows how the patient's vital signs change over time. The graph shows heart rate represented in red and temperature represented in blue. According to the graph, we can find that there is a large degree of variation in heart rate. However, the temperature remains more stable but will drop down when the heart rate rises. After few hours, both heart rate and temperature drop significantly before rising again. The way

the measurements change together helps diagnose all the things that can go wrong with the patient.

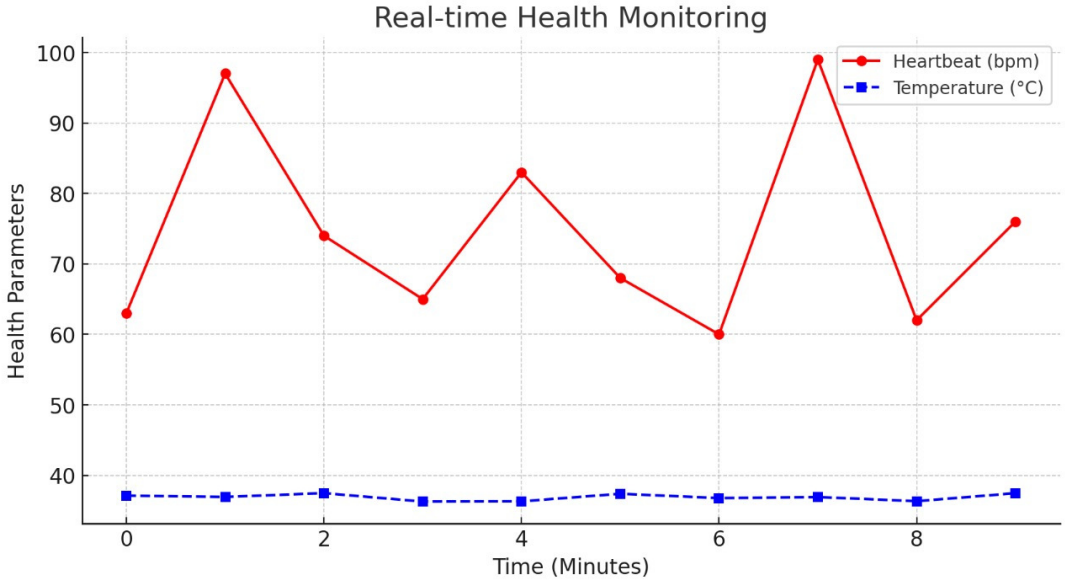


Fig 16:Health Parameters vs Time

The above picture is a graph that shows the heartbeat, time (in red) and temperature, time (in blue). For two minutes and seven minutes, there are peaks in the heartbeat and important flat lines are noted.The heart rate is racing for some reason, perhaps due to exercise or a change in settings. The temperature line is fairly flat with many little changes during the plot. This helps us find out how the body responds when thngs change. The heartbeat line changes rapidly but the temperature line is a gradual change and fairly flat through much of the plot.

Conclusion: The combination of real time heath tracking, the ability to move around and the virtual doctor visit all contribute to great improvement of remote healthcare by IoT based Virtual Doctor Robot. This robot collects all important health information such as heart rate, blood pressure and oxygen levels, securely send it to cloud via smart technology. This lets patients not have to go to the hospital to get help because they can talk to their doctor through a special camera from which they can see and hear each other. This allows the doctors to access and review patient data all from where they are, so that they can make quick and informed decisions that can generate better health outcomes. The robot can go to doctor's hospitals or people's home to give them both remote care and physical check-ins because of its ability to move. The phone includes a built in camera that allows for doctor and patient to video chat, giving them the feeling that they are talking to someone rather than a robot. This new way of caring for people is more convenient, it helps those those far away or in tough situations to receive help, and this technology is also very important for those in rural areas or when emergency situations require quick medical help. As a whole, the Connected Doctor Bot is a giant leap in the direction towards making healthcare more accessible, interactive and effective for all, based on treating people through technology, while being supported by caring individuals.

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