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SURVEY ON HEALTH NAVIGATOR

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Abstract: The growing need for efficient healthcare has driven the advancement of intelligent robotic systems. This project describes a Health Navigator Robot that uses automation, artificial intelligence, and IoT to enhance patient care. The robot's core consists of a Raspberry Pi and ESP8266 microcontroller, allowing it to interact with patients autonomously and track heart rate, SpO_2, and body temperature in real-time. It features sensors like MAX30102 and VL53L1X, along with a camera module for precise data collection and navigation. The robot's AI capabilities include facial recognition, emotion detection, and fall detection, leveraging computer vision and deep learning. A voice-controlled interface enables hands-free interaction, making it user-friendly for patients. The system also integrates with Firebase for logging health data and sending emergency alerts. The robot responds to emergency signals, initiates voice interactions, and conducts real-time health assessments, offering comprehensive support for patient-centered care.

Keywords: Health robotics, AI in healthcare, IoT, patient monitoring, Raspberry Pi, voice assistant, real-time systems, emergency response.

I. INTRODUCTION

The rapid evolution of healthcare requires integrating advanced technologies to improve service delivery, reduce errors, and enhance patient outcomes. Hospitals face increasing patient loads and staffing shortages, particularly during crises like pandemics, making reliable automated support systems critical. The convergence of robotics, AI, and IoT offers transformative solutions to optimize hospital operations and facilitate patient-centered care. This project introduces a Hospital Assistance Robot, a multifunctional platform designed to aid healthcare professionals and elevate patient service quality.

The robot navigates clinical environments autonomously, responds to patient-initiated emergency signals, and interacts using natural language voice commands. It tracks heart rate, SpO_2, and body temperature through integrated medical sensors. The system uses a Raspberry Pi platform with ESP8266 for wireless connectivity and Firebase for secure health data storage.

The robot features AI-driven capabilities like facial recognition, emotion detection, and deep learning. A voice assistant module enables hands-free communication, improving usability for patients with physical disabilities. This robotic solution aims to augment hospital workflows, support staff, and contribute to smart healthcare delivery.

II. LITERATURE SURVEY

The **"Hospital Assistance and Patient Monitoring Robot"** is a developed system intended to support healthcare environments by performing functions like delivering medication and observing patient conditions. It navigates using Wi-Fi and employs a camera module to identify patients and administer medication as needed. The robot is also fitted with sensors capable of tracking vital health indicators, such as body temperature and oxygen saturation (SpO2) levels. Designed as a semi-autonomous unit, it offers prompt support and monitoring, contributing to improved patient care and assistance.[1]

The **“AI-Driven Personal Care Robot Assistant for Hospital Medication Delivery”** is an advanced robot assistant particularly developed for use in healthcare settings. Built around the Raspberry Pi 3 B+ and running Ubuntu with the Robot Operating System (ROS), the platform supports efficient motor control, seamless sensor integration, and effective data management. It includes precise movement capabilities, a wide array of sensors for real-time monitoring of its surroundings, and external interfaces for expanding functionality. To enhance safety, the robot is equipped with an emergency stop feature and a specialized power control unit. For interaction with both patients and medical staff, it makes use of a microphone array that enables voice communication and improves environmental awareness.

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This robot streamlines the process of medication delivery and promotes smarter interaction, ultimately enhancing hospital operations and patient care.[2]

The paper **"Smart Robot for Health Assistance"** introduces the development of a health-assistance robot that employs the ESP8266 microcontroller as its primary controller. The robot is equipped with an infrared (IR) sensor to detect obstacles and navigate along predefined paths. An LCD display is integrated into the system to showcase real-time data, while a buzzer is activated whenever an obstacle is detected, prompting the robot to stop. The robot also includes a DHT11 sensor to keep track of temperature and a SpO_2 sensor to calculate heart rate and oxygen saturation. The health parameters are displayed on the onboard LCD screen and can be accessed remotely via the Blynk application, enabling users to monitor their health data in real time.[3]

"Automated Medical Assistant" focuses on utilizing a line-following robot to deliver medication to patients. The robot is equipped with two infrared (IR) sensors, a microcontroller, and dual motors for movement. It operates on a flat surface, using the IR sensors to detect a line drawn on the floor for navigation. In addition to delivering medication, the robot can transport medical specimens and support remote healthcare services through an interactive touchscreen interface. By leveraging the contrast between black and white surfaces, the robot effectively follows a path to perform tasks, showcasing its capability for use in healthcare and other industries.[4]

The **"Health Assistant Bot"** project leverages machine learning to improve healthcare support services. Developed using Rasa—an open-source framework tailored for building intelligent chatbots—the system offers features such as automated medication reminders, emergency SOS alerts, and the ability to locate nearby medical facilities via map integration. With support for multiple languages, the bot is designed to be accessible and user-friendly for a diverse range of users. In addition to these capabilities, it helps organize patient data, manage medication plans, and deliver first aid guidance, ultimately addressing everyday health concerns while reducing the burden on medical staff.[5]

The **"Robotic Patient Monitoring and Medicine Delivery"** system is designed to automatically dispense medication to patients while simultaneously monitoring key health indicators such as body temperature, heart rate, SpO_2 levels, and blood pressure. This contactless approach minimizes the necessity of direct physical engagement with patients. The robot analyzes the collected health data by comparing it with predefined normal ranges and flags any irregularities for further evaluation. Through an IoT-enabled platform, the data is transmitted to medical professionals for remote monitoring. If abnormal values are detected, a GSM module triggers immediate alerts to notify the healthcare team. In addition to medication delivery and health assessments, the system presents the information on an LCD display. Its compact and efficient design ensures smooth operation within clinical environments.[6]

The **"Health Tracker Using IoT with Automatic Nurse Assistant Robot"** the purpose of the project is to support healthcare workers, particularly in emergency situations. This system facilitates continuous tracking of patients under critical care while upholding social distancing protocols between patients and medical staff. Each patient is provided with an RFID card that contains a distinct identification code along with detailed health information. Sensors integrated into the Automatic Nurse Assistant Robot (ANAR) collect data from the patient's body and upload it to a cloud platform, such as ThingSpeak. Once the data is successfully stored in the cloud, healthcare professionals and family members can access real-time updates on the patient's health status, facilitating better communication and timely interventions.[7]

The **"Multipurpose Medical Assistant Robot (Docto-Bot) based on the Internet of Things"** is designed to monitor various physiological parameters. It includes a sensor for monitoring body heat, which detects the patient's temperature using infrared technology and transmits the data to an Arduino Mega 2560. The Arduino subsequently processes this data and presents it on an LCD screen additionally on an Android app. If the patient's pulse rate falls outside the normal range—either above 130 BPM or below 60 BPM—the system triggers an alarm and sends an SMS notification to authorized personnel via a GSM module. Additionally, the SpO_2 level is showed on the LCD, and if the SpO_2 value drops below 90%, the alarm is activated, alerting the medical team to potential health concerns.[8]

The project titled **“Design and Implementation of an IoT-Based Medical Assistant Robot (Aido-Bot)”** introduces an intelligent, IoT-enabled robotic solution aimed at supporting patient care and easing the responsibilities of healthcare professionals, particularly in hospital environments. Aido-Bot is developed to reduce physical interactions between patients and medical staff—an especially critical feature during health crises like the COVID-19 pandemic. The robot is equipped with several core features, including a health tracking system that scales key vital signs such as body temperature, pulse rate, and oxygen saturation. It also includes a smart medicine dispensing unit with reminder functionality and a contactless hand sanitizer system to uphold hygiene standards.

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Aido-Bot can function in two operational modes: autonomous, where it navigates and avoids obstacles using sensors, and manual, where it can be remotely controlled via a Wi-Fi-connected Android application. Additionally, it houses an IP camera for video communication and supports real-time data transmission to cloud platforms, allowing for remote health monitoring. Built on an Arduino microcontroller and integrated with various sensors, the robot ensures accurate and consistent health data acquisition. Tests conducted with twenty individuals confirmed the robot's reliability, with its readings showing close alignment with those from traditional medical devices. The findings suggest that Aido-Bot holds significant potential in enhancing healthcare delivery, particularly in facilities facing staff shortages. While current limitations, such as restricted angular movement, exist, future developments involving machine learning and artificial intelligence are expected to further expand its capabilities.[9]

The **"Personal Assistant Robot"** introduces a multifunctional robotic system designed to assist elderly and disabled individuals in their daily activities, enhancing their independence and quality of life. Developed within the framework of smart home technology, the robot consists of three main components: a mobile robotic base, a central processing controller, and a tablet PC interface. The robotic base is responsible for movement and navigation, using motorized wheels and sensors to follow commands and avoid obstacles. The central controller, built on the Arduino-compatible ChipKIT Max32 board, processes input from sensors and manages communication between components. The tablet PC, running Android, serves as the user interface, allowing for voice control, internet access, and remote monitoring through video streaming. The robot is capable of performing tasks such as voice-activated movement, object avoidance, user tracking via the "follow me" function, and even basic conversation. It can also respond to health-related inquiries and, if needed, alert emergency services through online communication tools like Skype. With its modular design and real-time responsiveness, this personal assistant robot offers a practical, scalable solution for assistive care, especially in home environments where constant human supervision may not be feasible.[10]

III. PROBLEM IDENTIFICATION

- Semi-automation or no automation robots.
- Lack in Database management of the patients.
- Integration of LCD display for Representation of data.
- Lack in monitoring patients (Temperature, SPO2, Heart rate etc).
- No interaction with the doctors virtually.

IV. APPLICATION

- To minimize the risk of viral flue.
- To minimize the human interactions.
- Can be used in home for personal care.
- Can be used in Rural areas where the medical staff is less.

V. SUMMARY

This study provides the design and development of a Hospital Assistance Robot aimed toward improving affected person care, automating medical institution obligations, and supporting healthcare professionals. Built the use of Raspberry Pi, IoT sensors, and AI technologies, the robotic is designed to monitor vital signs (Pulse rate, SPO2, and ECG), deliver drug treatments, and provide voice-primarily based interplay the usage of Google Assistant. The robotic autonomously navigates clinic environments the usage of VL53L1X Time-of-Flight sensors for obstacle avoidance and room tracking. It also consists of camera-primarily based AI for detecting patient distress with the help of facial expressions.
Additionally, the robot enables remote medical doctor consultation via an included tablet, where sufferers can initiate video/audio calls. The information collected from patients is securely stored in Firebase Realtime Database for far flung get admission to and evaluation.

VI. CONCLUSION

The Health Navigator robot is a smart AI integrated solution designed to support hospital staff and enhance patient care. It combines real-time health monitoring, voice interaction, and AI based features like face recognition and distress detection all managed via Raspberry pi and IoT technologies. The robot are designed with autonomous navigation and firebase integration for data storage, the robot ensures timely patient assistance and efficient health data management.

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VII. FUTURE SCOPE

The Health Navigator Robot can be scaled up with several advanced technologies, such as:

- Indoor mapping with SLAM or Visual odometry.
- Voice and Language personalization.
- Automatic medicine dispensing system.

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