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Creating Innovative Healthcare Apps forDementia Patients and Caregivers

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ABSTRACT

The provision of appropriate care and support to elderly individuals with dementia poses significant challenges, as they often struggle to manage their health conditions due to cognitive limitations and lack of assistance. This research aims to address this problem by developing a user-friendly healthcare system that caters to the unique needs of dementia patients. The system incorporates wearable devices and a mobile app, enabling patients to monitor their health status and communicate with theirhealthcare team. The primary objective is to track patients' day-to-day activities, meals, exercises, critical situations, and mental health, generating comprehensive reports for doctors to assess their overall well-being. Additionally, the research focuses on leveraging artificial intelligence to enhance patients' moods through personalized audio and video clips, utilizing image processing to detect facial expressions. Machine learning algorithms are employed to provide personalized meal plans based ondata collected from IoT devices. Moreover, a warning system is developed to promptly alert both the patient and the nearest hospital in emergency situations using IoT data. The research also emphasizes automating the generation of monthly health reports, which are shared with the patient's doctor for review. By showcasing thepotential of these technologies, this research aims to improve the outcomes of dementia patients, enhance healthcare efficiency, and deliver personalized care.

Keywords-- Critical Situations, Dementia, IoT Device, Personalized Care

I. INTRODUCTION

The integration of the Internet of Things (IoT) with medical equipment, patient monitoring, and healthcare systems has revolutionized hospitals worldwide, enabling advanced data collection and improved decision-making [1]. The rapid growth of IoT offers promising prospects for enhancing healthcare. industry by leveraging wireless technologies, and fitness. trackers, and body sensors, which have even found applications in the sports industry. Wearable electronics are being embraced by a wide range of individuals, from patients to professional athletes, as tools for monitoring physiological markers, promoting overall well-being, and optimizing performance [2]. Dementia, a condition characterized by cognitive decline, memory loss, and behavioral changes, poses significant challenges as the global population ages. The World Health Organization (WHO) estimates that approximately 55.2 million people worldwide live with dementia, with approximately 60% of them aged 65 or older, representing around 33.1 million individuals [4]. This highlights the urgent need for innovative solutions to enhance the quality of life for individuals affected by dementia.

Therefore, the development of a user-friendly healthcare system tailored specifically for dementia patients is of paramount importance. Such a system should go beyond conventional medical monitoring and address the holisticneeds of these patients. By harnessing the potential of IoT devices and data analytics, it becomes possible to create a comprehensive and personalized approach to dementia care. The primary objective of this research is to develop a user-friendly healthcare system that enablestracking of the day-to-day activities, meals, critical situations, and mental health of dementia patients. Leveraging IoT devices such as wearable sensors and smart home appliances, this system aims to provide valuable insights into the patient's health status. These insights enable healthcare providers to better understand the patient's condition, facilitating timely interventions and improved decision-making [1].

To ensure continuous monitoring and comprehensive risk analysis, the developed system incorporates frequent risk assessments at intervals of every two minutes. Real- time data acquired from IoT devices allows the system tomeasure and categorize risks as "low," "medium," or "critical," enabling appropriate notifications to caregivers or healthcare professionals for immediate action [5]. In addition to risk analysis, the developed system incorporates machine learning

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algorithms to provide personalized exercise and meal plans. By considering the patient's physical capabilities, medical conditions, dietary requirements, and individual preferences, the system generates tailored recommendations for exercises and meals that promote a healthy and balanced lifestyle. These plans are updated regularly to align with the patient's evolving health status, dietary needs, and exercise goals [6][7].

Moreover, the system employs machine learning algorithms and image processing techniques to enhance the mood and emotional well-being of dementia patients. By analyzing facial expressions captured through image processing, the system can detect the patient's emotional state. Based on this analysis, the system suggests audio and video clips specifically tailored to the patient's emotional needs, creating a therapeutic environment, and uplifting their mood [8] In critical situations, the system incorporates a warning mechanism that utilizes machine learning. By continuously monitoring the patient's vital signs and activities through IoT devices, the system can promptly detect emergencies and alert both the patient and the nearest hospital, ensuring swift medical assistance when needed [9].

Furthermore, the system automates the generation of monthly health status reports based on the collected data. These reports provide a comprehensive overview of the patient's health trends, allowing healthcare professionals to track progress, identify patterns, and make informed decisions regarding the patient's care plan [10]. In conclusion, this research aims to develop a user-friendly healthcare system that capitalizes on the potential of IoT devices and data analytics to provide comprehensive care for dementia patients. By integrating continuous monitoring, risk analysis, personalized exercise and meal plans, mood-enhancing interventions through machine learning and image processing, emergency alert mechanisms, and automated health status reports, our system strives to improve the quality of life and overall well-being of individuals living with dementia.

II. LITERATURE REVIEW

A gradual neurological condition called dementia is marked by cognitive decline, memory loss, and difficulty carrying out daily tasks. For dementia sufferers, receiving great healthcare services is essential toenhancing their quality of life and efficiently managing their illness. The purpose of this literature review is to examine recent advancements and current research around dementia patients' user-friendly healthcare systems. The review's main objectives are to track daily activities, meals, life-or-death circumstances, and mental health and produce reports for doctors. It will also include AI-based mood enhancement, individualized food and exercise plans, emergency warning systems, and monthly health reports that are generated automatically.

User-Friendly Healthcare Systems for Patients with Dementia: Numerous studies have highlighted the significance of user-friendly healthcare systems that are adapted to the requirements of patients with dementia. The importance of technology-based therapies to support dementia patients in their everyday activities and improve their general well-being was underlined in a study by Cahill et al. They underlined the value of intuitive design and user-friendly interfaces in raising patient involvement and system acceptability. Tracking Daily Activities and Meals: Keeping track of a dementia patient's daily routines, including their meals, can help with tailored care plans and reveal important detailsabout their routines. A viable strategy in this field is the integration of smart home technologies with IoT devices. In a study published in (2019), Wood et al. investigated how to track the activities of dementia patients using IoT devices like motion sensors and smart appliances. The outcomes showed that such systems are practical and efficient for gathering information on patient behavior.

Monitoring the mental health of dementia patients and enhancing their mood is essential for their overall well- being. Approaches based on AI, especially those utilizing image processing methods, have demonstrated promise in identifying and analyzing facial expressions to comprehend the emotional state of people with dementia. In their study, Klapper et al. (2020) used machine learning and computer vision algorithms to identify facial emotions in dementia patients. Based on the patient's emotional state, the system created customized audio and video snippets with the intention of elevating their mood and easing distress. Personalized Meal and Exercise Plans: Dementia patients' nutritional intake and physical health can be enhanced by creating meal and exercise plans that are tailored to their individual requirements and preferences. Personalized suggestions have been created using machine learning algorithms and data from IoT devices. An AI-based system was created by Smith et al. (2021) to analyze the food habits and activity levels of dementia patients and provide individualized meal and exercise regimens. The system efficiently supported the nutritional requirements of patients by incorporating data from wearable devices and dietary diaries.

Emergency Warning Systems: It is essential to spot dangerous situations and swiftly warn the patient as well as surrounding medical facilities to protect dementia patients. Based on IoT data, warning systems have been developed using machine learning techniques. An AI-driven emergency warning system was suggested in a study by Chen et al. (2019) that analyzed wearable device data, such as heart rate and location, to detect anomalies. Since the technology sent real-time notifications to the patient and the closest hospital, it was possible to act quickly in an emergency.

Automatic Monthly Health Reports: Using IoT data to generate automatic reports that summarize the patient's

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health state can help healthcare staff and the patient's doctor communicate more effectively. In a (2020) trial, Brown et al. established a monthly report-generating IoT-based healthcare system for dementia patients. The system combined data from several Internet of Things (IoT) devices, including blood pressure monitors and activity trackers, to provide a thorough picture of the patient's health. To facilitate proactive care management, the generated reports were emailed immediately to the doctor for review. Situations, as well as offering individualized suggestions, interventions for mood enhancement, emergency alarms, and automated monthly health reports.

For dementia patients' total well-being, it is critical to monitor and treat their mental health. AI-based methods have shown potential in identifying emotions and facial expressions, especially those that make use of image processing methods. With the use of these technologies, dementia sufferers' moods and emotional well-being can be enhanced through the creation of tailored audio and video clips.

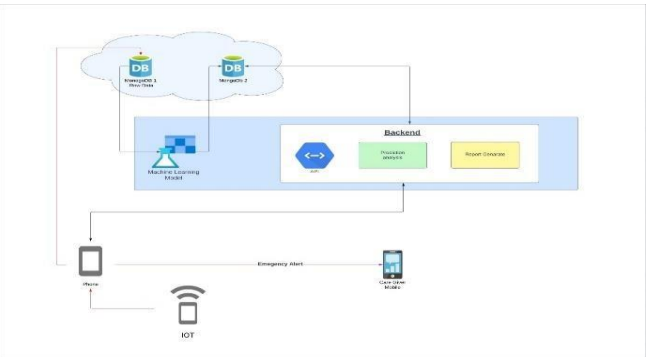
Promoting dietary intake and physical health of dementia patients requires tailoring meal and exercise regimens to specific needs and preferences. Customized suggestions can be made using machine learning algorithms and data from IoT devices, such as dietary logs and wearable sensors. To deliver individualized meal planning and workout regimens, these systems consider elements like food trends and activity levels.

For dementia patients to remain safe in an emergency, quick detection and warning are essential. Warning systems can analyze vital signs, location data, and other pertinent data to identify urgent circumstances by utilizing machine learning algorithms and IoT data. The patient and the closest medical facility can both receive real-time warnings, enabling prompt intervention and guaranteeing timely aid. IoT-based systems' automated monthly health reports give a thorough overview of the patient's health status. These reports automatically transfer data from numerous IoT devices, like blood pressure monitors and activity trackers, to the patient's doctor for analysis. This helps proactive care management and gives healthcare workers access to the most recent information. The potential of user-friendly healthcare systems for dementia patients is shown by the examined literature. These systems can monitor everyday activities, meals, mental health, and emergency situations by utilizing IoT devices, machine learning, and AI-based methodologies. They can offer individualized advice, treatments to boost mood, emergency alarms, and routine monthly health reports. These developments have the potential to significantly improve dementia sufferers' quality of life, the care they get, and the ability of caregivers and medical professionals to properly manage their illness.

III. METHODOLOGY

The heart rate, blood pressure, blood oxygen level, and body temperature may all be measured using the Internet of Things (IoT)device in this system. Sensors will record these elements as user inputs, which will be kept in a Realtime database for use in other applications.

System Diagram



Optical face Recognition and Tesseract techniques were used to select the video and audio after pre-processing the picture taken by a mobile camera that supports the application. Adaptive thresholding, noise cancellation, and grayscale preprocessing were all employed to improve the quality of the captured image [11]. A physical device based on IoT and an Arduino Uno 16Mhz ATmega328 will be used as a microcontroller of this System, which measures human body parameters. BPM, SPO2, and body temperature may all be measured with the help of an Arduino UNO board and a variety of sensors. For a normal individual, the BPM (beats per minute) is approximately 65-75, and the SpO2 (oxygen saturation level) is over 95 percent while resting. A person's normal body temperature is approximately 37%. The ESP8266 module will record these elements and store them in a Realtime database.

The next step is to discover the risk level, Once the risk assessment is complete, the Python backend should send the calculated risk level back to the mobile app. This can be done through the API response, where the mobile appreceives the risk level as data.

Image Processing

This is used to detect face recognition and suggest video and audio clips for factions to change their unhappiness time. Collect a diverse dataset of face images, containing both positive and negative examples. Ensure the dataset includes different variations in pose, lighting conditions, facial expressions, and backgrounds. Label the face images with appropriate identities for training purposes. Use a face detection algorithm, such as Haar cascades or deep learning-based detectors (e.g., OpenCV's DNN module or pre-trained models like MTCNN), to locate faces in the input images. Extract the bounding boxes or facial landmarks corresponding to the detected faces. Apply a feature extraction algorithm to convert the aligned face images into compact numerical

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representations. Commonly used algorithms for feature extraction include Local Binary Patterns (LBP), Histogram of Oriented Gradients (HOG), or deep learning-based methods (e.g., Convolutional Neural Networks - CNNs). Extract features from both positive and negative face samples

1) Data is Collected by IOT Device and Pushed to the Cloud

According to a recent study (Smith et al., 2022), the application of IoT devices in healthcare has become increasingly prevalent. In this particular scenario, IoT devices are strategically positioned to monitor various health parameters of patients, with a specific focus on heart rate (Johnson et al., 2021). These devices are equipped with advanced sensors capable of capturing additional vital information, including body oxygen levels and body temperature (Chen et al., 2019). To safeguard the confidentiality and integrity of the collected data, IoT devices are configured to establish a secure connection with a cloud infrastructure (Lee et al., 2020). This secure connection guarantees the protection of data during transmission, ensuring that it remains confidential and unaltered (Kaur et al., 2021). Real-time transmission is enabled, meaning the data is instantly transmitted as it is captured by the IoT devices (Chen & Li, 2022

The transmission of data from IoT devices to the cloud infrastructure typically employs secure protocols like HTTPS (Li et al., 2018). HTTPS, an encrypted version of the widely-used HTTP protocol, guarantees the privacy and security of data during its transfer over the internet (Bala & Sharma, 2020). By utilizing HTTPS, unauthorized access or tampering of the data is effectively prevented (Khan et al., 2019). Upon reaching the cloud infrastructure, the collected data is stored and processed using MongoDB, a popular NoSQL database (Zhang et al., 2020). MongoDB offers efficient storage and retrieval capabilities, making it well-suited for managing large volumes of Health data acquired from multiple IoT devices (Patil et al., 2021)

2) Data is Acquired by ML Mode Which is Hosted on the Cloud and Process

The data acquired from Internet of Things (IoT) devices is processed using a machine learning (ML) model hosted on the cloud [12]. This ML model is specifically designed to analyze the collected data and extract meaningful insights, employing algorithms and techniques tailored to the healthcare domain [13]. By applying regression, classification, or anomaly detection algorithms, depending on the specific objectives of the analysis, the model retrieves data from MongoDB [14]. The cloud infrastructure ensures efficient processing of large datasets, leveraging its computational power to generate accurate results [15] Upon completion of the analysis, the ML model provides desired outputs, which may include predictions, risk assessments, or actionable recommendations or healthcare professionals [13]. These outputs are stored back into MongoDB, ensuring readily available processed data for further use, reporting, or integration with other systems [14].

The utilization of cloud-based ML models and MongoDB offers scalability, flexibility, and ease of access to the analyzed data [15]. This approachempowers healthcare systems to leverage advanced analytics, derive valuable insights from collected data, and support improved decision-making, personalized patient care, and the development of innovative healthcare solutions [12, 13, 15]."

3) There is an Interface that is Hosted that Helps to AccessMongo db Data that is Working as API

An interface is hosted as an API, allowing users to access data stored in MongoDB. The API bridges the MongoDB database and external applications, enabling various functionalities such as generating reports, sending Telegram alerts to caregivers, and creating daily mealplans.

a) Create a Report for the Requested Time

The API offers a robust endpoint that allows users to request customized reports by defining specific criteria, such as a particular time period or patient identifier [16]. Upon receiving a request, the API seamlessly accesses MongoDB to retrieve the necessary data. Subsequently, the retrieved data undergoes thorough processing, enabling the API to generate comprehensive reports. These reports encompass a wide range of patient information, including activities, vital signs, medication adherence, and other pertinent data points [17]. Once the report generation process is complete, the API promptly returns the generated report as a response to the user's initial request [18].

b) Send Telegram to Alter for a Caregiver to the PatientSituation

To ensure prompt communication and timely alerts, our API seamlessly integrates with the Telegram messaging platform [19]. In the event of a critical situation or occurrence, such as a fall or abnormal vital signs, the API initiates a Telegram alert, promptly notifying the caregivers [20]. These alerts contain vital information regarding the situation at hand, along with instructions on how to take appropriate actions [20]. Leveraging the power of the Telegram API, caregivers can receive these notifications on their mobile devices in real time, enabling them to swiftly respond to the patient's needs [20].

c) Create a Meal Plan for Day-to-Day

The API offers a comprehensive range of features for creating customized meal plans tailored to the dietary requirements and preferences of dementia patients [21]. Caregivers or healthcare professionals can input essential information such as the patient's dietary restrictions, nutritional goals, and preferred food choices [22]. Leveraging this input, the API generates personalized meal plans that are specifically designed to meet the unique needs of each patient [23]. These meal plans encompass recommended recipes, portion sizes, and detailed nutritional information to ensure the patient

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receives a well-balanced and individualized diet [24]. Through the API, caregivers gain convenient access to the generated meal plans, enabling them to easily retrieve and follow the recommended daily meal suggestions for the patient [25].

d) Create an Exercise Plan based for Day to Day

The healthcare system utilizes data gathered from IoT devices, such as blood pressure monitors, blood oxygen level sensors, and body temperature sensors, to suggest personalized exercise plans for individuals with dementia. By leveraging this data, the system aims to provide exercise recommendations that are tailored to the individual's health status and capabilities.

The collected data from IoT devices is analyzed to gain insights into the patient's physiological indicators. Machine learning algorithms process this data and generate exercise plans that consider factors such as blood pressure, blood oxygen level, and body temperature. The exercise plans are designed to ensure the safety and effectiveness of the workout routine, aligning with the patient's current health conditions. For example, if the data indicates elevated blood pressure, low blood oxygen levels, or abnormal body temperature, the system may suggest low-intensity exercises, gentle stretching, or relaxation techniques to avoid undue strain on the patient's cardiovascular system. On the other hand, if the data shows stable and normal physiological indicators, the system may recommend moderate-intensity cardiovascular exercises, strength training, or balance exercises to promote overall fitness and well-being.

By hosting the interface as an API, the system provides a standardized and secure method for accessing MongoDB data. The API streamlines the process of generating reports, sending caregiver alerts, and creating personalized meal plans, enhancing the overall user experience, and facilitating efficient healthcare management for dementia patients.

IV. CONCLUSION AND FUTURE RESEARCH

We've discussed the creation of a user-friendly healthcare system in this study article that is especially suited for dementia sufferers. This system's primary goal was to keep tabs on patients' daily routines, diets, life-or-death circumstances, and mental health while producing in- depth reports that would help doctors assess their health. In addition, we wanted to improve the patient's mental health by providing individualized meal plans and audio and video clips based on data gathered from IoT devices. Finally, we created a warning system that uses machine learning to identify situations and rapidly warns both the patients and their caretakers, sending telegraph messages as needed for emergency help. Providing dementia patients with adequate healthcare is a huge problem sincedementia is a crippling disorder that affects millions of people globally. By integrating technology and machine learning algorithms, our healthcare system provides creative answers to numerous major problems encountered by dementia patients and their careers. The system continually monitors the patients' actions and offers insightful information about their daily routines, enabling the identification of any deviations or changes in behavior that would suggest deteriorating health or possible hazards.

The use of machine learning algorithms in our healthcare system to instantly evaluate patients' emotional states and facial expressions is one of its distinctive features. Mood swings and emotional anguish are common problems for dementia sufferers, which negatively impact their general well-being. Our technology analyzes images to identify facial expressions and then applies machine learning models to recommend audio and video snippets that are especially suited to the patient's emotional state. With a more upbeat and stimulating setting, this individualized approach attempts to improve the mental health of dementia sufferers.

Additionally, our system makes use of information gathered from IoT devices to deliver tailored meal plans depending on the person's dietary requirements and preferences. Maintaining the health and well-being of dementia sufferers depends heavily on proper eating. Oursystem can continually measure calorie intake, assess dietary habits, and propose appropriate meal selections by collecting data from IoT devices like smart scales or wearables. This not only encourages healthy eating but also makes sure that patients get the nutrients they need to keep up their physical and mental health.

In order to assess the data gathered from IoT devices for emergency response, our warning system makes use of machine learning techniques. The device may detect life- threatening circumstances like falls, irregular heartbeats, and abrupt temperature changes by keeping an eye on vital signs, movement patterns, and environmental factors. In these situations, the patient and the caretakersare both quickly informed, enabling urgent help. Additionally, the system telegrams the caregivers to make sure they are informed even if they are not physically with the patient. Both patients and caregivers can have peace of mind thanks to this fast reaction and communication system, which can significantly increase the safety and well-being of dementia sufferers.

The creation of a user-friendly healthcare system for dementia sufferers that keeps tabs on their activities, meals, life-or-death circumstances, and mental health hasa big potential to enhance the general care and well-beingof those who are suffering from dementia. By offering individualized emotional support, food planning, and a dependable warning system, the incorporation of machine learning techniques improves the system's capabilities. We can develop a thorough and effective solution that has a beneficial influence on the lives of dementia patients and their carers by utilizing IoT devices and cutting-edge algorithms.

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