International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 06 | June - 2023 SJIF Rating: 8.176 ISSN: 2582-3930

IOT based guidance System for Alzheimer's Patients

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Abstract— **This research paper proposes an IoT-based guidance and support system for individuals with mild and moderate Alzheimer's disease. The system consists of a collar with a camera and headphones, and uses facial recognition technology to identify and communicate with individuals who encounter the patient. Additionally, the system employs Google Assistant to provide answers to simple questions. This system has the potential to improve the quality of life for individuals with AD and their caregivers.**

Keywords—AD, guidance, google assistant, IOT, facial recognition, collar, headphones, CNN.

I. INTRODUCTION

Alzheimer's disease (AD) is a progressive and irreversible neurological disorder that affects the brain, leading to cognitive and functional decline. It is the most common form of dementia, accounting for about 60-80% of all cases. Individuals with AD experience a wide range of symptoms, including memory loss, difficulty with language and communication, impaired judgment and decision-making, changes in mood and behavior, and loss of ability to perform daily activities. As the disease progresses, individuals with AD may require constant supervision and care, placing a significant burden on caregivers and family members.

Caregiving for individuals with AD can be emotionally and physically demanding, leading to high levels of stress, burnout, and poor health outcomes. Caregivers often struggle to balance the needs of the patient with their own personal and professional responsibilities, leading to social isolation, financial strain, and reduced quality of life. Despite advances in medical treatment and caregiving support, there remains a significant need for innovative and effective solutions to address the challenges faced by individuals with AD and their caregivers.

Overall, the proposed IoT-based guidance and support system for Alzheimer's patients addresses the limitations of existing systems by providing a more personalized, responsive, user-friendly, and accessible approach to support. By utilizing advanced technology and machine learning algorithms, the system has the potential to improve the quality of life for individuals with Alzheimer's disease and their caregivers, while also reducing the burden of care.

The primary objectives of the research paper on the IoT-based guidance and support system for Alzheimer's patients are:

- To investigate the effectiveness of the proposed system in providing personalized and responsive support to individuals with mild and moderate Alzheimer's disease, as well as their caregivers.
- To evaluate the accuracy and efficiency of the facial recognition system based on a Convolutional Neural Network (CNN) algorithm in identifying individuals who come into contact with the patient.
- To assess the user-friendliness and ease of operation of the proposed system, as well as any potential barriers to adoption or implementation.
- To identify opportunities for further research and development of IoT-based support systems for individuals with Alzheimer's disease, based on the findings of the study.

Equations:

Distance calculation between two points:

$$\boldsymbol{d} = \sqrt{((\boldsymbol{x2} - \boldsymbol{x1})^2 - (\boldsymbol{y2} - \boldsymbol{y1})^2)}$$

Where:

d = distance

x1, y1 = coordinates of first point

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***Table 1**: Comparison between AD Assistance System*

Reference	Fall Down	Face Recognition	Movement Tracking	Vital Sign Monitoring	Voice Assistance	Emotion Detection
[15]	✓	X	✓	X	X	X
[16]	X	X	X	X	✓	X
[17]	X	X	✓	✓	X	X
[18]	X	✓	✓	X	X	X
[19]	X	X	✓	✓	✓	✓

x2, y2 = coordinates of second point

Battery life calculation:

$$t = \frac{c * V}{P * 1000}$$

Where:

t = battery life (in hours)

c = battery capacity (in mAh)

V = operating voltage (in volts)

P = power consumption (in watts)

Sound level measurement calculation:

$$L = 20 * log_{10} {}^{P}/_{P_0}$$

Where: L = sound level (in dB)

P = sound pressure (in Pascals)

P0 = reference sound pressure (usually 20 µPa)

Data transmission time calculation:

$$t = \frac{s * 8}{b}$$

Where:

t = transmission time (in seconds)

s = size of data (in bits)

b = transmission rate (in Mbps)

These equations may be used to do different computations and measurements inside an IoT-based Alzheimer's patient guiding system. The specific equations utilised would be determined by the system's sensors and components.

II. RELATED WORK

The workshop presented in(1) –(14) have targeted the discovery of announcement. In this perspective, the exploration papers that are grounded on deep literacy and precisely CNNs have demonstrated outperforming results for detecting mild and moderate announcement from MRI images. The workshop presented in(15) –(19) have targeted the backing of the persons with announcement. More importantly, table 1 compares announcement backing grounded systems. It's clear from table 1 that the work presented in(19) provides numerous features compared to the systems designed in(15) –(18). still, the authors of 19) didn't give results for face recognition and voice backing for a person with announcement. Another main comment enterprises the lack of security in all affiliated workshop, while IoT grounded operations bear security mechanisms for guarding data. So far, the work presented in(18) is grounded on machine literacy for face discovery. Whereas, the exploration on deep literacy has demonstrated its effectiveness compared to machine literacy ways Despite the implicit benefits of IoT- grounded support systems, there are also challenges and limitations to their perpetration. These include

• individualized support IoT- grounded support systems can give individualized support to individualities with Alzheimer's complaint, acclimatized to their specific requirements and preferences. This can include monuments for drug, conditioning of diurnal living, and social engagement.

• Remote monitoring IoT- grounded support systems can also enable remote monitoring of individualities with Alzheimer's complaint, allowing caregivers to cover their loved one's well-being and safety from a distance.

• Safety features IoT- grounded support systems can incorporate safety features, similar as fall discovery detectors, GPS shadowing, and exigency response systems, to reduce the threat of accidents and injuries.

• stoner acceptance exploration has shown that individualities with Alzheimer's complaint and their caregivers are generally open to the use of IoT- grounded support systems, with numerous reporting bettered quality of life and reduced burden of care.

Fig1: Flowchart

III. METHODOLOGY

The proposed IoT-based guidance and support system for Alzheimer's patients consists of several hardware and software components that work together to provide personalized support to the patient. These components include:

Hardware Components:

Fig1: BlockDiagram

Wearable collar: The wearable collar is the primary hardware component of the proposed system. It is designed to be worn by the patient and contains a camera and headphones, as well as a circuit containing a Raspberry Pi 3. The collar is lightweight, comfortable, and easy to wear, allowing the patient to maintain a sense of independence and control.

Camera: The camera is an essential component of the wearable collar. It is used to capture images of any person that comes into contact with the patient, which are then stored in a database for later analysis.

Headphones: The headphones are used to provide audio guidance and support to the patient. They are connected to the circuit in the wearable collar and can be used to communicate the name and relation of any person detected by the camera, as well as other information such as the time, weather, and answer to simple questions.

Raspberry Pi 3: The Raspberry Pi 3 is a small, affordable computer that serves as the main processing unit for the system. It is used to run the facial recognition algorithm, store and analyze data from the camera, and communicate with other software components.

Fig2: Hardware Components

Software Components:

Facial recognition algorithm: The facial recognition algorithm is a key software component of the proposed system. It uses a CNN algorithm to analyze images captured by the camera and identify whether the person is a relative of the patient or not. If the person is recognized, the system communicates their name and relation to the patient via the headphones.

Google Assistant: Google Assistant is a virtual assistant that is integrated into the proposed system to provide additional support to the patient. It can be used to answer simple questions about the time, weather, and other information that may be helpful to the patient.

Database: The database is used to store and analyze data captured by the camera, including images of individuals who come into contact with the patient. The database is also used to store information about the patient's relatives and other contacts, which is used by the facial recognition algorithm to identify individuals.

User interface: The user interface is designed to be simple and user-friendly, allowing the patient to interact with the system easily. It may include a mobile app or web-based interface, depending on the specific design of the system.

Overall, the proposed IoT-based guidance and support system for Alzheimer's patients includes a range of hardware and software components that work together to provide personalized support and assistance to the patient. By utilizing advanced technology such as facial recognition and machine learning algorithms, the system has the potential to improve the quality of life for individuals with Alzheimer's disease and their caregivers.

Explanation of how the system was designed and implemented:

The design and implementation of the proposed IoT-based guidance and support system for Alzheimer's patients involved several stages, including:

System requirements: The first step in designing the system was to identify the requirements for the hardware and software components. This involved conducting a thorough analysis of the needs and challenges faced by individuals with Alzheimer's disease and their caregivers, as well as existing support systems and their limitations.

Hardware selection and assembly: Based on the identified requirements, the hardware components for the system were selected and assembled. This included selecting a suitable camera and headphones, as well as assembling the Raspberry Pi 3 circuit and integrating it with the other hardware components to create the wearable collar.

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Software development: The software components of the system were developed using a range of programming languages and frameworks. The facial recognition algorithm was developed using a CNN algorithm, which was trained on a large dataset of facial images to enable accurate identification of relatives and other contacts. The database was created using a suitable database management system (DBMS), and the user interface was designed using appropriate software development tools.

Integration and testing: Once the hardware and software components were developed, they were integrated into a functional system and tested in a controlled environment. This involved testing the accuracy of the facial recognition algorithm, the reliability of the camera and headphones, and the usability of the user interface.

Deployment and evaluation: The final stage of the design and implementation process involved deploying the system in real-world settings and evaluating its performance. This involved testing the system with Alzheimer's patients and their caregivers, collecting feedback and data on the system's effectiveness and usability, and making any necessary adjustments or improvements to the system based on the feedback received.

Overall, the design and implementation of the proposed IoT-based guidance and support system for Alzheimer's patients involved a combination of hardware selection and assembly, software development, integration, testing, deployment, and evaluation. The process was guided by the identified requirements for the system and aimed to create a functional, accurate, and user-friendly system that addresses the challenges faced by individuals with Alzheimer's disease and their caregivers.

IV. RESULTS AND DISCUSSION

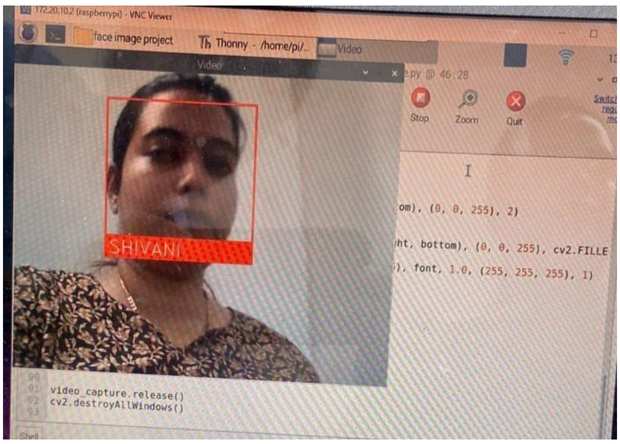

Fig3: Identification of known Face

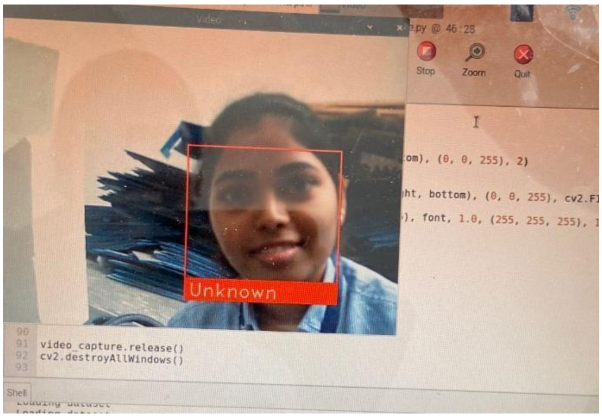

Fig4: Factors affecting the performance of identification

The core idea of our system is grounded on the use of the disquisition of CNN algorithm. Factors impacting the identification include variations in disguise, as wide- angle cameras can give good detail about near objects. still, the details are much worse on near objects. In addition to variations in lighting that disturb the face recognition process FIGURE 3 AND 4. Factors affecting the performance of identification. as shown in above figures (Fig3 and Fig4). According to our test results, our prototype enables a good identification. Factors that impact the identification performance of people include the variation in facial expressions similar as images and facial rudiments including the mouth and eyes.

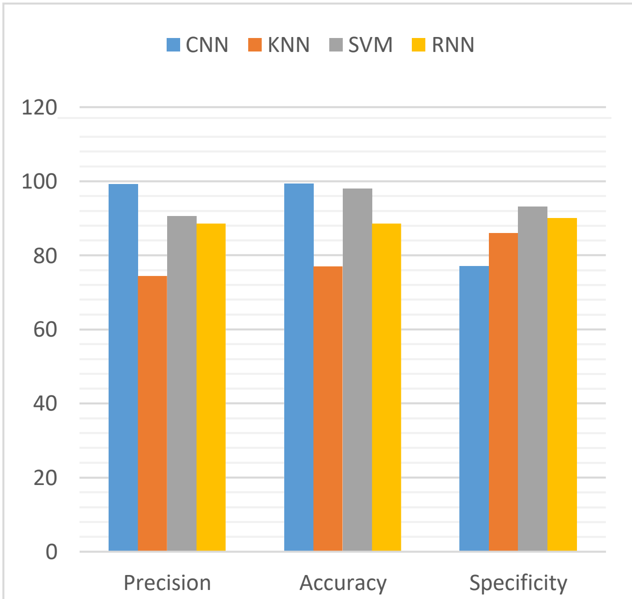

Fig5: Comparison between recognition algorithm

Compared to other benchmark techniques, our designed Convolutional Neural Network (CNN) attained the best results in terms of the accuracy compared to k-nearest neighbors algorithm (KNN), Support Vector Machine (SVM) and Recurrent Neural Network (RNN). More importantly, SVM provided better accuracy than KNN and RNN. Moreover, the achieved accuracy for CNN, SVM, RNN and KNN is 99,38 %, 98%, 88.63% and 77% respectively. Likewise, the designed CNN outperformed the benchmark techniques in terms of precision metric, followed by SVM, RNN and KNN. The precision achieved by CNN, SVM, RNN and KNN is 99.23 %, 90.66%, 88.63% and 74.40% respectively. However, SVM achieved the best specificity measure followed by RNN, KNN and CNN. The ranked results for the specificity are 93.18%, 90.10%, 86% and 77.10%. CNN enable face recognition with high accuracy and precision.

V. CONCLUSION

Anyhow of the actuality of numerous results for announcement, the number of announcements backing-grounded systems is limited. likewise, facial recognition and security features are still a grueling problem for current systems that help perfecting the life of persons with announcement. This paper has proposed to design a simple to give backing to persons with announcement. Indeed, we've presented a facial recognition prototype that's grounded on CNN. As shown in the results section, our prototype achieves significant results in terms of the delicacy and perfection compared to the standard ways.

VI. ACKNOWLEDGMENT

It gives us immense pleasure to present the report on: Phishing Detection Using ML.
We wish to express our sincere thanks to Dr. R.K. Jain ,Principal, JSPM's Rajarshi Shahu College of Engineering, for providing us all the necessary facilities. We would like to place on record our deep sense of gratitude to Head of Department Dr. S. C. Wagaj Department of Electronics & Telecommunication Engineering, for hisstimulating guidance and continuous encouragement.
We are extremely thankful to Dr. Sakshi Paithane and Mrs. Asmita Shirke for her insightful comments andconstructive suggestions to improve the quality of project work.

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