IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 4, April 2024

DOI: 10.17148/IJARCCE.2024.13498

IMPLEMENTATION OF EMOTIVE RESPONSE ROBOT IN HOME HEALTHCARE

Mrs.Bhagya[1], G P Bhumika[2], Gagana S[3], Kavya K S[4], Kavyashree M C[5]

Professor, Department of ECE, East West Institute of Technology, Bengaluru, India[1]

Student, Department of ECE, East West Institute of Technology, Bengaluru, India[2-5]

Abstract: In response to the growing demand for innovative solutions in elderly care, this work endeavors to bridge existing gaps by introducing an Emotive Response Robot. Building upon the limitations of current home health care systems, which lack a unified approach to both health monitoring and emotional support, this work integrates cutting-edge sensor technologies and advanced natural language processing. Leveraging the outcomes of previous research, our Emotive Response Robot aims to provide a comprehensive care giving experience, ensuring real-time health monitoring while establishing empathetic voice-to-voice interactions. By combining these features, this work aspires to redefine elderly care, fostering not only physical well-being but also emotional fulfillment within the home environment.

Keywords: Health monitoring, Voice-voice-interaction, Emotional support

I. INTRODUCTION

Nowadays, the aging situation is deepening more and more rapidly. With the development of society and the improvement of economy, the more important problem for the elderly is whether they are mentally healthy. The low quality of life has become a problem for the modern elderly, and the mental health is also an increasingly prominent problem. Through the elderly care service platform of nursing homes, the elderly can enjoy professional elderly care services at home and realize the connection between demand and supply. For the elderly's nursing home security, intelligent monitoring equipment can monitor the physical condition of the elderly in real time. Facial expression is the common signal for all humans to convey the mood. There are many attempts to make an automatic facial expression analysis tool as it has application in many fields such as robotics, medicine, driving assist systems, and lie detector. Facial expressions are the vital identifiers for human feelings, because it corresponds to the emotions. Most of the times (roughly in 55% cases), the facial expression is a nonverbal way of emotional expression, and it can be considered as concrete evidence to uncover whether an individual is speaking the truth or not. The current approaches primarily focus on facial investigation keeping background intact and hence built up a lot of unnecessary and misleading features that confuse CNN training process. The current manuscript focuses on five essential facial expression classes reported, which are displeasure or anger, sad or unhappy, smiling or happy, feared, and surprised or astonished.

In an era marked by technological innovation, our Raspberry Pi-based robot embodies a groundbreaking fusion of cutting-edge advancements in artificial intelligence, health monitoring, and interactive communication. Designed with a compassionate purpose, this multifunctional robot aims to enhance the well-being of elderly individuals through a sophisticated emotion detection system powered by a Keras model. By interpreting facial expressions and gestures, the robot intuitively tailors its responses to provide therapeutic support, such as playing soothing music corresponding to the detected emotional state Beyond emotional care, the robot integrates a comprehensive health monitoring system equipped with temperature and SpO2 sensors, ensuring real-time health assessments. Additionally, the robot facilitates seamless voice-to-voice communication through speech recognition, fostering meaningful interactions and companionship between the elderly and the robot. This holistic approach aims to redefine elderly care by leveraging state-of-the-art technology to promote emotional, physical, and social well-being.

1.1 MOTIVATION

As there is an increase in elderly population, there is a rapid growth in the desire for personal home health care solution whereas the health caring assistant is not available throughout the day or all the time to overcome this scenario we are using this multipurpose robot which can also be assisted through voice-to-voice interaction. They majorly need a friendly attitude who can care them and spend some time with not a typical robot which can complete the given task. As the robot aim to creates more engaging and meaning interaction by responding to their emotions.

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 4, April 2024

DOI: 10.17148/IJARCCE.2024.13498

1.2 OBJECTIVES

The main goal of this work is to enhance the emotional well-being of individuals by recognizing and responding to their emotions and to provide companionship and social interaction to reduce feeling of loneliness and isolation through voice to voice communication .Next to monitor health and safety, alerting health care professionals when necessary . By achieving these objectives the robot seeks to improve the quality of life for elderly individual and alleviate the burden on care giving, ultimately creating a more supportive and inclusive environment for aging populations.

II. METHODOLOGY

The primary task is to identify the hardware components which are suitable for this work. Block diagram consist of hardware components which are interconnected with each other to perform specific task raspberry pi is the main component which includes a wide range of application with 40 pins and 28 GPIO pins and also has a large community and plenty of online resource. Raspberry pi generation 3 (3 model) has a processor of 1.4 GHz speed and a 64- bit quad-core ARM Cortex processor

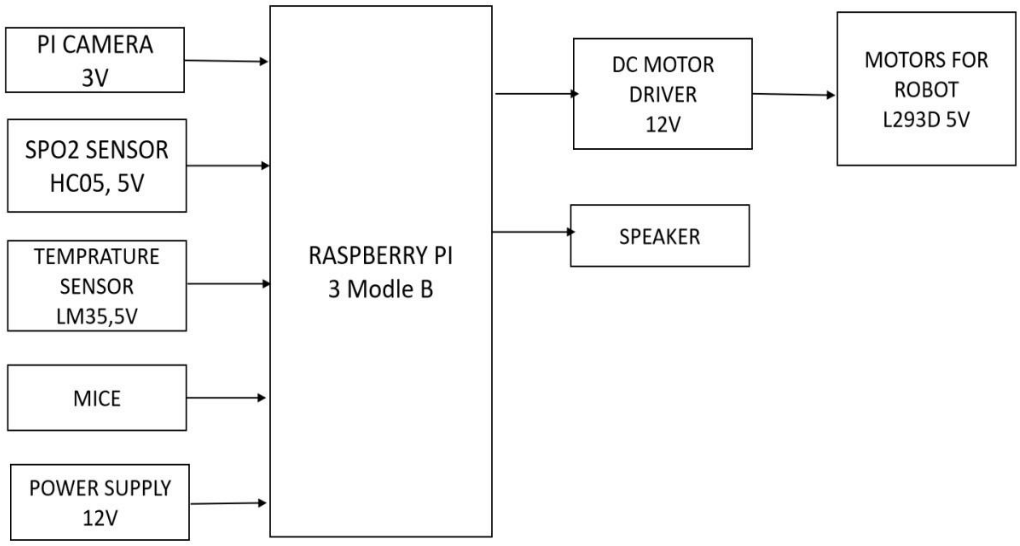

Fig: 1 Block diagram of emotive response robot in home health care

Raspberry Pi camera: It is specifically designed to be compatible with Raspberry Pi boards and offers features like easy integration, compact size, and low power consumption. It is used for computer vision, surveillance, or image/video processing.

SPO2 sensor: It also known as the HCO5 sensor, is a device used to measure the oxygen saturation level in your blood. It's often used to monitor a person's respiratory health and to check if they're getting enough oxygen.

LM35 a temperature sensor: It can be used to monitor body temperature, which is an important indicator of a person's health. By accurately measuring temperature, health care professionals can track changes in body temperature and detect any abnormalities. This can be particularly helpful in situations like monitoring patients with fever, assessing hypothermia or hypothermia, and ensuring the proper functioning of medical equipment.

L293D Motor driver: It is a popular motor driver IC that can be used to control DC motors in robotics projects. It allows you to control the direction and speed of the motors by providing the necessary power and control signals. The L293D is commonly used because it can handle higher currents and voltage levels, making it suitable for driving larger motors. It's a versatile and reliable choice for robotics applications.

A mike is used as the input so that the robot can receive the human voice and starts to respond.

Raspberry pie produces a 12 volts output for the dc motor for effective operation, whereas the speaker is the effective output of the robot which is used for the interaction between human and robot

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 4, April 2024

DOI: 10.17148/IJARCCE.2024.13498

III. IMPLEMENTATION

The proposed system has a user module which is the platform to the user to interact with the robotic module. The robot is equipped with raspberry pi camera and Keras algorithm .Through this the robot recognize the human emotions based on the facial expressions . After recognizing the human emotion, based on the emotion it responds to user by playing the suitable music providing therapeutic experience using the music module. Additionally the robot consists sensors such temperature sensor and SPO2 sensor. These sensors enable the robot to track the patients vital sign and well being and also gives trigger alters to the care givers in case of emergency. The Robot contains bluetooth module HC05 and a mic to capture voice commands from the user and the robot can converts textual responses into speech enabling real time voice to voice interaction between the user and the robot. The speaker was included on the robot to generate responses in the form of speech. This integrated approach addresses both emotional well-being and health monitoring, offering a comprehensive solution for elderly care and companionship.

3.1 Hardware Setup:

Assemble the robot chassis, motors, wheels, Raspberry Pi, and any additional sensors like spo2,temperature sensor ,heart beat sensor etc , we plan to use.

3.2 Programming:

We have to write code to control the robot's movements and to process input from sensors. we'll also need to implement algorithms for generating emotive responses based on input data. Some algorithms are shown below

3.2.1 Algorithm for Emotion Recognition :

The algorithm outlines the process of loading the emotion detection model, capturing frames from a webcam, detecting faces, predicting emotions for each detected face, and then based on the predicted emotion, taking certain actions such as playing music if stress-related emotions are detected. The algorithm also includes decision points to check which emotion is detected and whether to play specific music or print a message indicating stress detection.

3.2.2 Algorithm for Health monitoring:

The algorithm illustrates the key steps and decision points within the SENSOR_READ() function, including the heart rate measurement process, checking GPIO input for heart rate sensor, calculating heart rate values, and sending notifications via Telegram bot based on heart rate conditions. The main loop continuously executes SENSOR_READ() and controls the flow of sensor readings and heart rate monitoring. The algorithm also highlights the initialization of GPIO, bot, and function definitions before entering the main loop. Each function and decision point is shown as a separate step in the algorithm to visualize the control flow.

3.2.3 Algorithm for Robot Movement:

The algorithm shows the structure of the provided code. It begins with initializing GPIO pins and defining motor control functions. Inside the main loop (while True), it repeatedly calls the FORWORD() function to set the motor GPIOs for forward motion, waits for 2 seconds using time .sleep(2), then calls the STOP() function to stop the motor by setting all GPIOs to False, and again waits for 2 seconds before repeating the loop.

The algorithm demonstrates a simple motor control sequence where the motor moves forward for 2 seconds and then stops for 2 seconds, continuously looping. Each function call (e.g., FORWORD(), STOP()) represents a step in the control flow of the motor.

3.2.4 Algorithm for Voice to voice communication:

The algorithm outlines the control flow. It starts with initializing the serial port and GPIO, followed by entering a continuous loop (while True) to read from the serial port. Each iteration of the loop involves reading and decoding the received data, printing the received command, and then checking the command against predefined strings.

Depending on the received command ('hello', 'play music', 'bye'), specific actions are taken:

- If the command is 'hello', a TTS response saying "how can i help you" is generated, saved as an MP3 file, played using Pygame, and then Pygame is stopped after the audio playback finishes.
- If the command is 'play music', the 'happy.mp3' file is played using Pygame, and then Pygame is stopped after the audio playback finishes.
- If the command is 'bye', a TTS response saying "good to see you, take care" is generated, saved as an MP3 file, played using Pygame, and then Pygame is stopped after the audio playback finishes.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 4, April 2024

DOI: 10.17148/IJARCCE.2024.13498

This algorithm provides a visual representation of the sequential execution and decision-making process within the main loop of the provided code, demonstrating how commands received via serial communication trigger different audio responses. The loop continues indefinitely, handling commands as they are received.

3.3 Emotion Recognition:
Integrate emotion recognition software or hardware to detect human emotions, such as facial expressions or voice tone.

3.4 Emotion Generation: Design algorithms to generate appropriate emotional responses based on the detected emotions. This could involve changing the robot's facial expression, tone of voice, or movement patterns.

3.5 Feedback Loop: Implement a feedback loop to continuously adjust the robot's responses based on new input and its effectiveness in eliciting the desired emotional response.

3.6 Testing and Iteration: Test the robot in various scenarios to ensure it responds appropriately to different emotional cues. Iterate on the design and algorithms as needed.

3.7 User Interaction: Consider how users will interact with the robot and design interfaces or behaviors that encourage positive emotional engagement.

3.8 Safety and Ethical Considerations:
Ensure the robot's behavior is safe and ethical, especially when interacting with humans.

By following these steps and leveraging the capabilities of the Raspberry Pi platform, you can create a robot that can recognize and respond to human emotions in a meaningful way.

IV. RESULTS

As discussed above initially the proposed model will be helpful in automatic emotion recognition . The result of emotive response robot has been displayed in the fig 2,3and 4.

The main intention is to recognize the emotion and respond to it by playing music based on detected emotion and monitor the vital signs and well being.

The below fig 2 shows the prototype of emotion recognition robot

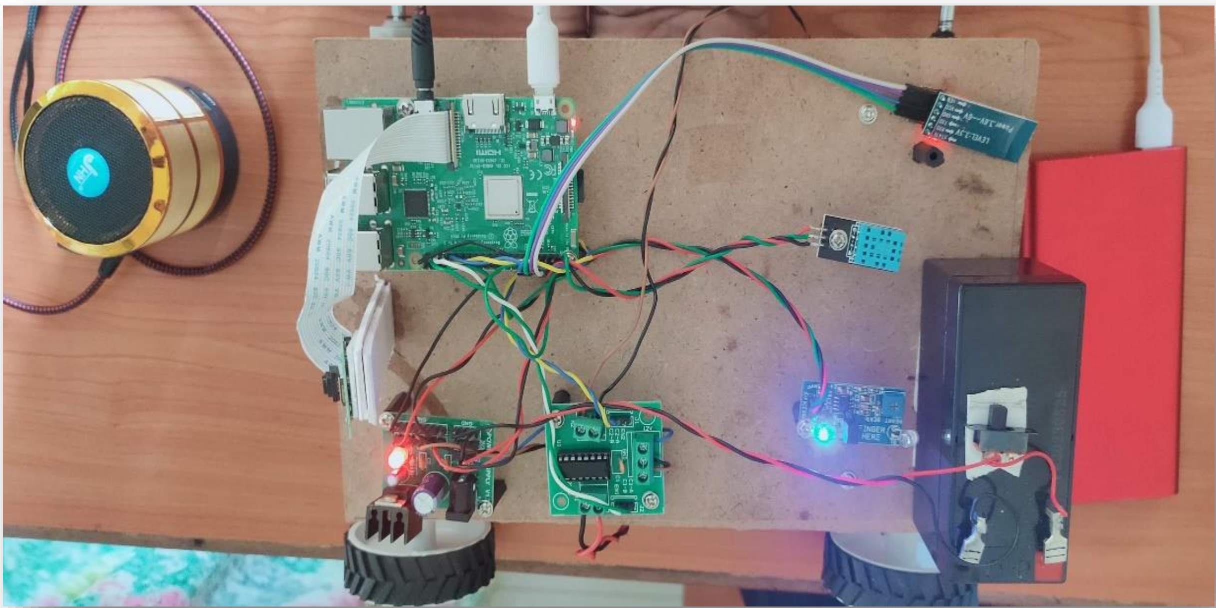

Fig . 2 Prototype of model

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁙ Peer-reviewed & Refereed journal ⁙ Vol. 13, Issue 4, April 2024

DOI: 10.17148/IJARCCE.2024.13498

The emotion is classified as happy, Angry, Disgusted, Sad, or Fearful, the robot will recognize and code prints or display the emotion detection and plays an audio file (happy.mp3) using Pygame to provide a stress-relieving response.

Fig 3. Emotion detection

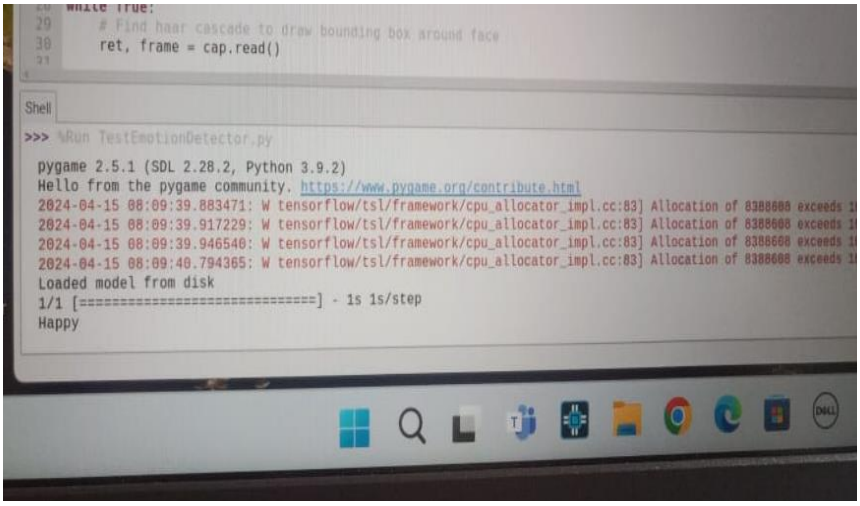

Fig 4. Displaying the emotion detected

Health monitoring system using some sensors are used to detect vital signs like heart rate, blood pressure, temperature, humidity etc .

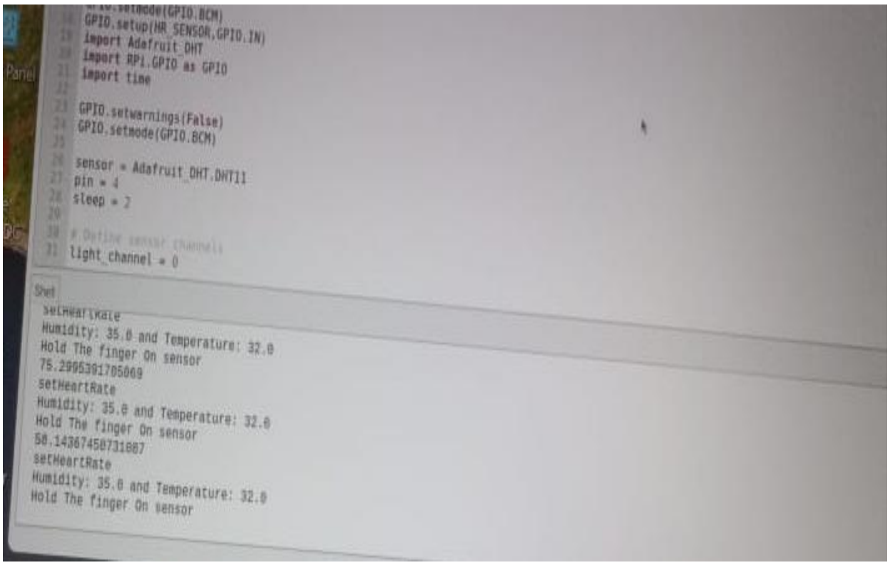

Fig 5. Temperature and heart beat detection

International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 4, April 2024
DOI: 10.17148/IJARCCE.2024.13498

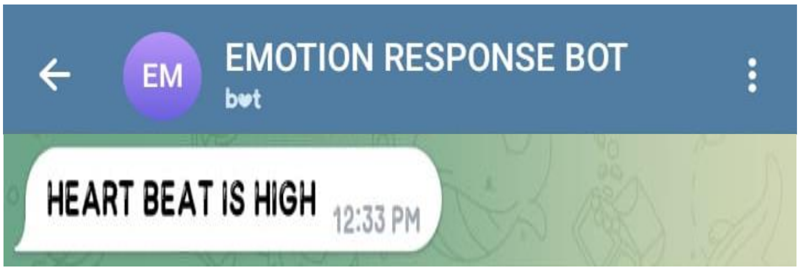

Fig . 6 Trigger alert

V. CONCLUSION

The Raspberry Pi-based robot designed for elder care integrates cutting-edge technologies to provide a holistic and innovative approach to health and well-being. The incorporation of an emotion detection system using a Keras model not only allows the robot to assess the emotional state of elderly individuals but also enables personalized therapeutic interventions, such as playing soothing music tailored to their emotions. The inclusion of health monitoring through temperature, ECG, and SpO2 sensors further enhances the robot's capabilities, allowing for real-time health assessments. Additionally, the implementation of voice-to-voice communication facilitates seamless interaction between the robot and the elderly, fostering companionship and enabling immediate response to their needs. This multidimensional system represents a significant advancement in elder care, combining technology and empathy to enhance the quality of life for the elderly population.

FUTURE SCOPE

Furthermore, if a patient requires reminders for specific medications or exercises, the robot can be programmed to provide those reminders at the appropriate times**,** the physical appearance of the robot can be customized to create a more comfortable and relatable experience for the patient.

REFERENCES

[1]. Real-time Facial Emotion Recognition for Human-Robot Interaction Jelena Epifanic Comenius University Bratislava, June 2023 Vol. 17 No. 1 MEi:CogSci Conference
[2]. Emotion detection of elderly people in nursing homes based on AI robot vision Siyao Song, May 2023 Springer.
[3]. Understanding the acceptance of emotional artificial intelligence in Japanese health care system: A cross-sectional survey of clinic visitors' attitude Manh-Tung Ho, Ngoc-Thang B. Le, Peter Mantello, Manh-Toan Ho, Nader Ghotbi , Technology in Society Volume 72, February 2023
[4]. Robot with Speech Recognition, Sentiment Analysis, Object Detection Rubeena Rustum, Vaddepally Laxmi, Siripuram Navya, G. Naveena, V. Sravanya 2023 7th International Conference on Intelligent Computing and Control Systems (ICICCS) Year: 2023,Conference Paper Publisher: IEEE
[5]. Development of Health Monitoring Vest using Veloster M Kanimozhi, I Yamuna, B Srimathi, R Senthil Kumaran, November 2022 International Conference on System, Computation, Automation and Networking (ICSCAN).
[6].Real-Time Implementation of Face Recognition and Emotion Recognition in a Humanoid Robot Using a Convolutional Neural Network Suchi Dwijayanti ,Muhammad Iqbal, Bhakti Yudho Suprapto, August 2022 *IEEE Access*, vol. 10
[7]. A Social Robot for Autonomous Health Data Acquisition Among Hospitalized Patients, An Exploratory Field Study Daisy van der Putte; Roel Boumans; Mark Neerincx; Marcel Olde Rikkert; Marleen de Mul, september 2021,14th ACM/IEEE International Conference on Human-Robot Interaction (HRI)
[8]. Patient Identification using Facial Recognition Vinay Kumar Verma; Vanika Kansal; Pankhuri Bhatnagar, June 2021 International Conference on Futuristic Technologies in Control Systems & Renewable Energy (ICFCR)
[9]. A. Lambert, N. Norouzi, G. Bruder, and G. Welch, "A systematic review of ten years of research on human interaction with social robots," Int.J. Human Comput . Interact., vol. 36, no. 19, pp. 1804–1817, 2020
[10]. Y.-W. Cheng, Y. Wang, Y.-F. Yang, Z.-K. Yang, and N.-S. Chen,"Designing an authoring system of robots and IoT-based toys for EFLteaching and learning," Comput. Assist. Lang. Learn., vol. 34, nos. 1–2,pp. 6–34, 2020.
[11]. B. Johansson, T. A. Tjøstheim, and C. Balkenius, "EPI: An open humanoid platform for developmental robotics," Int. J. Adv. Robot. Syst.,vol. 17, no. 2, 2020, Art. no. 1729881420911498.

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⋇ Peer-reviewed & Refereed journal ⋇ Vol. 13, Issue 4, April 2024

DOI: 10.17148/IJARCCE.2024.13498

[12]. O. Nocentini, L. Fiorini, G. Acerbi, A. Sorrentino, G. Mancioppi, andF. Cavallo, “A survey of behavioral models for social robots,” Robotics,vol. 8, no. 3, p. 54, 2019.

[13]. L. Bishop, A. Van Maris, S. Dogramadzi, and N. Zook, “Social robots: The influence of human and robot characteristics on acceptance,”Paladyn J. Behav. Robot., vol. 10, no. 1, pp. 346–358, 2019.

[14]. A. Vulpe et al., “IoT security approaches in social robots for ambi-ent assisted living scenarios,” in Proc. 22nd Int. Symp. Wireless Pers.Multimedia Commun. (WPMC), 2019, pp. 1–6

[15]. E. Hertzfeld, Japan’s Hennna Hotel Fires Half Its Robot Work force, Hotel Management, New York, NY, USA, Jan. 31,2019.[Online].Available:https://www.hotelmanagement.net/tech/japan-s-henn-na-hotel-fires-half-its-robotwork force

[16]. C. Chen et al., “Equipping social robots with culturally-sensitive facial expressions of emotion using data-driven methods,” in Proc. 14th IEEE Int. Conf. Autom. Face Gesture Recognit . (FG), 2019, pp. 1–8.

[17]. Xianqun Huang ; Qixin Cao ; Xiaoxiao Zhu, “Mixed path planning for multi-robots in structured hospital environment” in the proceedings of The Journal of Engineering, 2019.

[18]. Azeta, Bolu, Abioye and Oyawale, “A review on humanoid robotics in healthcare” in the proceedings of MATEC Web of Conferences 153(5):02004, January 2018.

[19]. Seohyun Jeon ; Jaeyeon Lee “Performance analysis of scheduling multiple robots for hospital logistics” in the proceedings of 14th International Conference on Ubiquitous Robots and Ambient Intelligence (URAI) 2017

[20]. Seohyun Jeon ; Jaeyeon Lee ; Jaehong Kim Multi-robot task allocation for real-time hospital logistics, IEEE International Conference on Systems, Man, and Cybernetics (SMC), 2017.