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## I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

Collaborating closely with my scientific coordinator Prof. Deepti Mishra (Department of Computer Science (IDI)), has been a truly fulfilling experience. Our joint efforts on various projects have enriched my understanding and instilled a sense of accomplishment and satisfaction. I was engaged in the following research projects:

### Projects

- **Synergy between Speech Recognition system of Humanoid Robot and Whisper**  
I investigated the limitations of robot's speech recognition system with the aim to observe the effect of distance, age, gender, and complexity of statements. The outcomes of the experiment hold the potential to illuminate that the integration of speech-to-text conversion with Whisper can effectively comprehend the capacity of humanoid robot.
- **Exploring the potential of Speech Recognition in Humanoid Robot: Online vs. Offline Settings**  
This research aims to evaluate how effectively robots can be used in classrooms for online and offline teaching. The focus was to understand how humanoid robots can be seamlessly integrated into the pedagogical framework, enhancing the learning experience for students.
- **Assessment of capabilities of social robots and their comparison**  
The various capabilities of social robots such as navigation, speech, object detection, and face detection have been explored in this research. The comparison of speech recognition system of Pepper and Nao robot was also done.
- **The relationship between the presence of humanoid social robots and participants' emotional responses using eye tracking glass**  
This initiative revolves around the utilization of cutting-edge eye-tracker glasses, which facilitate the collection of precise eye movement data from participants. We wanted to understand how having companions—both humanoid robots and humans—affects participants' emotions and performance. The analysis of this experiment's data aims to unveil the effects of companions on learning and cognitive engagement.
- **Integration of social robot and AI for stress management**  
The objective of the project is to evaluate the effectiveness of remedies provided by social robot NAO. Before starting the experiment, participants were asked to fill the pre-observation and big5 personality forms. The experiment was conducted with two scenarios: non-stressful and stressful. In each scenario, the social robot NAO and smartwatch emphatic were employed to capture facial images and physiological parameters, respectively. The multimodal data was transferred to the local system for further analysis. AI algorithms were applied to predict the stress. In case of stress, the robot was prepared to provide suggestions to participants. Further, participants were interviewed to understand their experience with social robots as a remedy provider.

### Supervision and Mentoring

**Master Thesis Co-Supervision:** I am honored to have been entrusted with the co-supervision of a master's thesis of Bhavana Nachenahalli Bhuthegowda (June 2024). The thesis work was related to stress detection through multimodal AI approaches and innovative stress management by humanoid robot.

**Mentoring:** I was also involved in mentoring master students in distinct impactful projects. I also mentored Master students in writing a research papers.



### Session Chair

- Co-chaired the session titled "Empowering Education and Wellness: The Rise of Social Robots" at the 'HCI International Conference 2024' in Washington, DC, USA.
- I am co-organizer of the similar session, going to be organized in HCI International Conference 2025.

### Outreach Programs

- I played an active role in the Catch IDI events (2023, 2024) that took place in Gjøvik. During this event, I took on the responsibility of presenting the ongoing activities and initiatives of the Educational Technology Laboratory. The event provided an excellent platform to not only share our lab's endeavors but also to interact with fellow participants, experts, and enthusiasts. It was an opportunity to demonstrate the significance of our ongoing work.
- We also showcased our work with robots to children at a Science Center (2023, 2024), with the primary goal of inspiring young minds to delve into the world of science and technology. Through interactive demonstrations and hands-on activities, we aimed to spark curiosity and excitement among the kids, encouraging them to imagine the possibilities within the fields of robotics, engineering, and scientific exploration.

### Apply research projects

I, along with my scientific coordinator, have written various research projects related to AI and social robots and applied for internal (NTNU) and external research funding from the Research Council of Norway and European Funding Agencies.

## II – PUBLICATION(S) DURING YOUR FELLOWSHIP

### Published Research Papers

- **Pande Akshara**, Misha Deepti, Bhuthgowda Nachenahalli Bhavana, Inal Yavuz. Exploring the Use of Social Robots as a Game Associate in the Health Sector: A Systematic Review. ANTIC (accepted), 19-21 December, 2024. Proceedings will be published by [Springer CCIS](#).
- **Pande Akshara.**; Mishra Deepti. Assessment of Pepper Robot's Speech Recognition System through the Lens of Machine Learning. *Biomimetics* 2024, 9, 391. <https://doi.org/10.3390/biomimetics9070391>
- **Akshara Pande**, Deepti Mishra (2023). Humanoid Robot as an Educational Assistant – Insights of Speech Recognition for Online and Offline Mode of Learning. *Behaviour & Information Technology*, 2024: p. 1-18. <https://doi.org/10.1080/0144929X.2024.2344726>
- **Pande, A.**, Mishra, D., Nachenahalli Bhuthgowda, B. (2024). NAO vs. Pepper: Speech Recognition Performance Assessment. In: Kurosu, M., Hashizume, A. (eds) *Human-Computer Interaction. HCII 2024. Lecture Notes in Computer Science*, vol 14685. Springer, Cham. [https://doi.org/10.1007/978-3-031-60412-6\\_12](https://doi.org/10.1007/978-3-031-60412-6_12)
- Nachenahalli Bhuthgowda, B., **Pande, A.**, Mishra, D. (2024). Next-Gen Stress Monitoring: Social Robot and AI Integration. In: Kurosu, M., Hashizume, A. (eds) *Human-Computer Interaction. HCII 2024. Lecture Notes in Computer Science*, vol 14686. Springer, Cham. [https://doi.org/10.1007/978-3-031-60428-7\\_7](https://doi.org/10.1007/978-3-031-60428-7_7)
- Deepti Mishra, Guillermo Romero, **Akshara Pande**, Bhavana Nachenahalli Bhuthgowda, Dimitrios Chaskopoulos, Bhanu Shrestha. An Exploration of the Pepper Robot's Capabilities: Unveiling Its Potential. *Appl. Sci.* 2024, 14, 110. <https://doi.org/10.3390/app14010110>



- **Akshara Pande**, Deepti Mishra (2023). The Synergy between a Humanoid Robot and Whisper: Bridging a Gap in Education. *Electronics*. 2023; 12(19):3995. <https://doi.org/10.3390/electronics12193995>
- **Akshara Pande**, Bhanu Shrestha, Anshul Rani, Deepti Mishra (2023). A Comparative Analysis of Real Time Open-Source Speech Recognition Tools for Social Robots. In: Marcus, A., Rosenzweig, E., Soares, M.M. (eds) *Design, User Experience, and Usability. HCII 2023. Lecture Notes in Computer Science*, vol 14033. Springer, Cham. [https://doi.org/10.1007/978-3-031-35708-4\\_26](https://doi.org/10.1007/978-3-031-35708-4_26)
- Anshul Rani, **Akshara Pande**, Karen Parish, Deepti Mishra (2023). Teachers' Perspective on Robots Inclusion in Education – A Case Study in Norway. In: Kurosu, M., Hashizume, A. (eds) *Human-Computer Interaction. HCII 2023. Lecture Notes in Computer Science*, vol 14013. Springer, Cham. [https://doi.org/10.1007/978-3-031-35602-5\\_12](https://doi.org/10.1007/978-3-031-35602-5_12)

#### Under-review Research Papers

- **Pande Akshara**, Rani Anshul, Bhuthgowda Nachenahalli Bhavana, Misha Deepti. Human-Robot Interaction for Stress Mitigation: A Pilot Study with Social Robot.
- Claire Trinquet, Deepti Mishra, **Akshara Pande**. The Future of Libraries: Integrating Pepper and Computer Vision for Smart Assistance

### III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

1. Paper accepted in 4<sup>th</sup> International Conference on Advanced Network Technologies and Intelligent Computing (ANTIC 2024) (to be held on 19-21 December 2024).
2. 26<sup>th</sup> International Conference on Human-Computer Interaction (HCI International 2024 (HCII 2024)).
3. 25<sup>th</sup> International Conference on Human-Computer Interaction (HCI International 2023 (HCII 2023)).

### IV – RESEARCH EXCHANGE PROGRAMME (REP)

In Research Exchange Programme, I visited CWI Amsterdam (Netherlands) under the mentorship of Prof. Dr P.D. Grünwald (Head Machine Learning Group). The duration of REP was 1st August-10th August 2023. This experience was immensely enriching, offering valuable insights and discussions that greatly benefited my research. It also paved the way for future collaboration opportunities.