

# Robotic technology in assisting mindfulness-based practices: an overview

## Abstract

Mindfulness means focussing on the present, and in the here and now of situations that has myriad benefits for both normal and abnormal population. These include: reduction in levels of stress, anxiety and depression, better emotional regulation and reduction in heart rate and blood pressure. It has also been found to be beneficial in developing a healthy and more resilient immune system and cultivating better personal and social relationships. Since, technology and AI has become an integral part of our lives, keeping in mind the above cited benefits of mindfulness-based practices, robotic engineers have well capitalized the well-being aspects of mindfulness through robotics and AI to benefit people through a rather innovative approach. Keeping this in mind, the aim of the present paper is to highlight and discuss as to how robotic technology is assisting in using mindfulness-based practices both in real life and for therapeutic interventions.

**Keywords:** robotic technology, mindfulness, practices & overview

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## Introduction

*“Be happy in the moment, that’s enough. Each moment is all we need, not more”*

Mother Teresa

Mental is a domain that remained quite undervalued till the onset and effect of COVID-19 till it shook the world with its disastrous consequences. It taught us the importance of cultivating relationships and having a good mental health, reminding us that mental health is not just a luxury, rather a necessity if we are to live a fulfilling life. One way to lead a rather healthy, happy and enriching life is through the art of practising mindfulness, which means focussing on the present and in the here and now of situations.

The concept of mindfulness derives its roots from the Buddhist concept of Vipasana, Hindu Yogasutras, Chinese Daoism, Islamic Sufism and Jewish Qabbala. However, the credit of refining the concept and using it as a stress reduction technique known as Mindfulness-Based Stress Reduction Technique (MBSR) that has had myriad benefits on varied population both normal and abnormal goes to Jon-Kabat-Zinn in 1979.

According to Jon-Kabat-Zinn,<sup>1</sup> “Mindfulness is awareness cultivated by paying attention in a sustained and particular way: on purpose, in the present moment, and non-judgementally”. It is one of the many ways of meditation, if you think as any way in which we engage in (1) systematically regulating our energy and attention, (2) thereby influencing and possibly transforming the quality of our experience, (3) in the service of realizing the full range of our humanity and of, (4) our relationships to others and the world (Jon-Kabat-Zinn, 2012).<sup>1</sup>

Mindfulness can be cultivated and practised keeping the seven main attitudes in mind given by Jon-Kabat-Zinn in his book Full Catastrophe Living Revised Ed (2013) which are as follows:<sup>2</sup>

1. Non- Judging-Become aware of the constant stream of judging and reacting to inner and outer experiences that we normally are caught up in-observe it, and step back from it.<sup>2</sup>

2. Patience- Accept the fact that sometimes things must unfold in their own time.<sup>2</sup>
3. Beginners Mind- Look at things as if it is the first time seeing them allowing yourself to be receptive to the new possibilities to prevent us from getting stuck in the rut of our own expertise.<sup>2</sup>
4. Trust- Develop trust in yourself and your feelings as an integral part of meditation training. It may be better to trust your intuition and your authority, even if you make some mistakes, than constantly looking outside yourself for some guidance.<sup>2</sup>
5. Non-Striving- Meditations only goal is for you to be yourself.<sup>2</sup>
6. Acceptance- We often waste a lot of energy denying and resisting what is already a fact. Rather we should accept things the way they are and be in the moment of it.
7. Letting Go- Letting go is a way of letting things be, without grasping and pushing away. If you have difficulty in picturing pushing away, picture holding on Kabat-Zinn, 2013.<sup>2</sup>

Research conducted across the globe indicates that practising various mindfulness-based techniques such as voicing positive self-talk and affirmations, making use breathing techniques, meditation techniques and various visualization based techniques have found to have myriad benefits for both normal and abnormal population such as reduction in levels of stress, anxiety and depression, better emotional regulation and reduction in heart rate and blood pressure. It has also been found to be beneficial in developing a healthy and more resilient immune system and cultivating better personal and social relationships.

According to Jon-Kabat-Zinn as cited in his book “Mindfulness for the Beginners”, Mindfulness as a practice provides endless opportunities to cultivate greater intimacy with your own mind and to tap into and develop your deep interior resources for learning, growing, healing, and potentially for transforming your understanding of who you are and how you might live more wisely and with greater well-being, meaning, and happiness in this world.<sup>1</sup>

Since, technology and AI has become an integral part of our lives, keeping in mind the above cited benefits of mindfulness-based practices, robotic engineers have well capitalized the well-being aspects of mindfulness through robotics and AI to benefit people through a rather innovative approach.

### Keeping this in mind:

#### Problem statement

The aim of the present paper is to highlight and discuss as to how robotic technology is assisting in using mindfulness-based practices both in real life and for therapeutic interventions.

#### Robotic technology in assisting mindfulness-based practices

Since technology has become a mainstay of our lives, fostering better mental health through mindfulness based AI remains no exception to it. Mindfulness can help ensure that AI is developed in a way that is aligned with human values and priorities. By fostering a greater sense of empathy and compassion, mindfulness can help developers create AI systems that are not just intelligent, but also ethical and responsible.<sup>3</sup>

Mindfulness based practices can encourage us to be more present and attentive in our daily lives, whether while interacting with others, engaging in work or leisure activities, or simply taking a walk outside. In other words, mindfulness can help develop a healthier relationship with technology by encouraging us to be more intentional in our use of technology.<sup>3</sup> This can help in avoiding pitfalls of addiction, distraction and cognitive overload, and instead assist in making use of technology in a way that supports holistic health and well-being.<sup>3</sup>

Research conducted by Jay Vidyarthi at the Mindful Society Global Institute, that Mentorful (AI technology) has the ability to analyse data from mindfulness based practices and provide personalized feedback and guidance that can be helpful in both daily life and for therapy.<sup>3</sup>

Furthermore, in another research conducted at the institute, platforms such as Woebot and Replika use AI to stimulate conversation and provide support and guidance to individuals who may be suffering from mental health issues providing an additional assistance to the traditional therapy and counselling techniques.<sup>3</sup>

Research conducted across the globe that Robots have been instrumental in fostering mindfulness based techniques having potential benefits which are as follows:

1. Robots have been found to increase the attention span of participants to help them remain more focussed and motivated during mindfulness-based interventions.
2. Robots have played a significant role in mapping neural activities of participants during mindfulness-based practices.
3. Robots have been found to be more objective and impartial towards gender during such interventions.
4. Robots have been successful in guiding people towards mindfulness-based techniques such as focussed breathing, loving-kindness meditation and walking meditation that can be practiced both at home and at work.

A study was conducted by Alimardani et al.,<sup>4</sup> that aimed to develop a robot assistant that facilitated mindfulness training by means of a brain-computer-interface (BCI) system. For this purpose EEG signals were collected from two groups of subjects that engaged in a meditative vs. non-meditative human-robot interaction (HRI)

and evaluated cerebral hemispheric asymmetry as an indicator of emotional states. Results indicated that like in earlier meditation studies, the fronto-central activations in alpha and theta frequency bands was not influenced by robot-guided mindfulness practice. However, there was a significantly greater right-sided activity in the occipital gamma band of the meditation group, which is attributed to increased sensory awareness and open monitoring. In addition, there was a significant main effect of time on participant's self-reported affect, indicating an improved mood after interaction with the robot regardless of the interaction type. Results suggested that EEG responses during robot-guided meditation held promise in real-time detection and neurofeedback of mindful state to the user. However, the experienced neurophysiological changes may have differed according to the meditation practice and recruited tools.<sup>4</sup>

Bodala et al.,<sup>5</sup> conducted a longitudinal research to study the use of social robots for delivering mindfulness based sessions. For this purpose a teleoperated robotic platform was created that enabled an experienced human coach to conduct mindfulness sessions in a virtual manner by replicating upper body and head pose in real time. The coach was also able to view the world from the robots perspective and to make a conversation with the participants by talking and listening through the robot. One group was given mindfulness sessions through a teleoperated robot and the other group was given sessions with the human coach for a period of five weeks. Results indicated that mindfulness sessions delivered by both types of coaching invoked positive responses for the participants for all the sessions. The sessions conducted by the human coach was rated consistently high in all aspects. However, there was a longitudinal change in the ratings for the interaction with the teleoperated robot for the aspects of motion and conversation. Furthermore, the results indicated that the personality traits of participants such as conscientiousness and neuroticism also influenced the perceptions of the robot coach.<sup>5</sup>

A research was conducted by Mesqi<sup>6</sup> to study the effect of personality on the effectiveness of a robotic mindfulness coach on a sample of 46 participants. The independent variable for the study was the personality of the robot and the dependent variable was mindfulness state of the participants, measured through a self-report. The research was conducted under four conditions, under which the personality of the robot was manipulated as dominant-extrovert, dominant-introvert, submissive-extrovert and submissive-introvert personality. Participants participated in mindfulness exercises for ten minutes. Results of the study indicated that mindfulness state of all the participants increased significantly after participating with the robotic mindfulness coach. However, the personality of the robot did not have any significant effect on the mindfulness state of the participants. Also no evidence was found for the stated hypothesis that a robotic mindfulness coach was more effective was more effective when its personality matches the personality of the user.<sup>6</sup>

Robinson, et al.,<sup>7</sup> conducted a pilot randomized controlled trail to explore the feasibility of an autonomous humanoid social robot to deliver a brief mindful breathing technique to promote information around well-being on 230 participants (mean age=29 years), 71% being higher education students. The study was conducted under two conditions: First under a brief technique training and second under control designed to represent a simple wait -list activity to represent a relationship-building discussion (simple rapport). This trial also explored willingness to discuss health related topics with a robot. Results indicated that there were moderate ratings of technique enjoyment, perceived usefulness and likelihood to repeat the technique again. It was also indicated that males with high distress

and females with low distress who received simple rapport activity reported greater comfort to discuss non-health topics than males with low distress and females with high distress.<sup>7</sup>

A research was conducted by Huang, et al.,<sup>8</sup> to investigate loving-kindness meditation (LKM) and walking meditation (WM) with a NAO robot, countering negative mood by stimulating creativity on a sample of 142 participants, aged between 18 years-34 years. Creative behaviour to reduce negative mood was stimulated through positive valence and state openness. The participants responded to two rounds of questionnaires, with a ten minute intervention guided by audio or NAO robot in between each round. A control group with participants with no intervention (ten minutes rest) was used for comparison. Results indicated that both audio-guided LKM and WM successfully evoked state openness, with the former also exerting a positive effect on valence. Furthermore, valence and state openness were positively correlated and were associated with higher convergent thinking and willingness to create.<sup>8</sup>

Patil, et al.,<sup>9</sup> proposed to conduct a study to investigate the potential of LLM's in supporting human mindfulness practices based on two human-robot mindfulness applications. The first application consisted of having a robot/voicebot lead spoken meditation first series occurred on new moon). The second application, proposed a compassionate listener robot to generate empathetic gestures (calming motions to reduce stress and anger detected through human speech) to promote relaxation and well-being through non-verbal signals. Thus so far Chat GPT has been utilized to generate a tailored mindfulness coaching text for delivery through Pepper robot's voice. The script guided the audience using Speechify's text to speech. In their ongoing work, Patil et al., would like to match speech to robot motion in both application cases, expanding the horizons of mindfulness-based activities.<sup>9</sup>

## Conclusion

It can be deduced from the above cited literature that even though AI based applications have their benefits in helping to foster mindfulness-based practices and mental health, however such interventions are not free from their psychological pitfalls, underlying challenges for the future of mental health in a technology driven world. These pitfalls are enlisted below:<sup>10</sup>

1. Automation Paradox- Indicates that though machines and robots give a good output for tasks that are repetitive and physically exhausting, but at times may not always lead to relief or satisfaction. On the reverse, many people may feel a loss of tasks that are tedious leading to the feeling of personal use or meaning.<sup>10</sup>
2. Intervention of robots can often lead to lack of compassion, empathy, social and emotional connect that otherwise play a very significant role in our daily lives.<sup>10</sup>
3. Over dependency of AI and robotic automation at workplace may lead to a significant drain of human resource based skills and competencies at workplace, that may further may exasperate

mental health issues such as stress, anxiety, depression, substance abuse and alcoholism.<sup>10</sup>

4. For robots to become an integral part of our daily lives, it may require significant psychological adaptation that may not be easy and may pose serious challenges for robotic engineers, psychologists and general population at large.<sup>10</sup>

Lastly, even though AI based technology has begun to have a significant impact on our daily lives whether it is at workplace or in the area of mental health, however, as a certified mindfulness meditation practitioner, I would like to end my article with a quote by Rodney Brooks, "Hands –on experience is still the best way to learn about all the interdisciplinary aspects of robotics".

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## Conflicts of interest

The author declares that there is no conflict of interest.

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