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# PAIRADS: Hybrid Interaction Between Humans and AI in Radiology

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**Abstract.** This article describes an ongoing research project that aims to develop a hybrid AI system for aiding radiologists in diagnosing prostate cancer. Through our qualitative research including contextual inquiries and interviews, we analyzed the current workflow and context of use in German radiology centers. Based on that, we explore the potential benefits and challenges of using AI for detecting and diagnosing prostate cancer in medical practice in a hybrid human-AI interaction.

**Keywords.** Human-centered AI, Human-in-the-loop, Healthcare, Radiology

## 1. Introduction

Prostate cancer continues to be the most common cancer in men in Germany, and previously it was predicted to remain so in 2022 with an estimated 70,100 new cases [1]. Early detection and diagnosis of prostate cancer are crucial for improving the chances of successful treatment. Radiologists typically use imaging techniques such as multiparametric MRI (mpMRI) to detect anomalies in the prostate gland and classify them according to a PI-RADS scheme [2,3], but this can be a complex and time-consuming process considering the scarcity of radiologists in Germany (2.29% of all doctors [4]). AI has the potential to aid cancer diagnosis for radiologists because it can help improve the accuracy, efficiency, and consistency of prostate cancer detection. However, despite the significant recent developments in AI in healthcare, just a limited number of AI systems have successfully transitioned into medical practice [5] because of the failure to include humans in the development loop [6]. This suggests that a more human-centered AI (HAI or HCAI) is required to transform AI from purely technological to also humanistic [7].

In our ongoing project, we are focusing on HAI design to investigate human attributes and identify medical appropriateness barriers to foster an impactful human-AI collaborative environment in radiology. We are developing an AI-powered demonstrator which can assist radiologists in analyzing mpMRI images for diagnosing prostate cancer. This can help radiologists to make more accurate and timely diagnoses, which can ultimately improve patient outcomes. Our goal is to enable humans to understand and interpret the output generated by AI algorithms via Explainable AI with the help of visu-

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alization, and ultimately take the final decision which ensures human intelligence rather than replacing it, resulting in hybrid intelligence [8].

## 2. Methodology

We conducted qualitative field research in four different radiology centers (RC) in Germany using contextual inquiry [9] over a five-month period, with eight inquiry sessions enhanced by five interviews with radiologists. Each observation session lasted three to five hours, and each semi-structured interview was 40 to 80 minutes long. The main goal was to gain a thorough understanding of the radiologists' current workflow, to learn about their professional experiences and interactions with various artifacts and other stakeholders, to recognize the challenges they face on a daily basis at work, and to perceive their viewpoints on AI collaboration for cancer diagnosis. We have performed thematic data analysis [10] on our interviews to retrieve insights regarding our research domain. We are highlighting some of the important observations in the next section.

## 3. Findings and Discussion

We observed that the radiologists' workflow and artifacts varied across different RCs, with a crucial difference being whether the diagnosis was done individually or through double analysis. Due to time constraints in RCs with two radiologists, the first radiologist provides a summary to the second, leading to a biased perspective as the second radiologist may not thoroughly analyze the images. In many cases, only one radiologist completes the prostate diagnosis due to limited resources, violating the recommendation for double analysis [11]. Decision conflicts between radiologists led to longer examination times to reach a consensus. Moreover, different RCs produced varying results for the same patient, revealing decision discrepancies due to the subjective interpretation of imaging findings, potentially leading to variability in diagnosis and treatment recommendations. Besides, current practice involves numerous manual tasks and redundancies, including manual calculations of prostate size, volume, and PSA (prostate-specific antigen) density, and redundant work steps in reporting and data transfer. These tasks not only take up extra time but also raise serious concerns about human errors, data loss, and faulty diagnosis. Interestingly, when radiologists were asked about the need for a possible AI system in their current workflow and its trustworthiness, they responded positively, stating that there is scope for automation and that it will help them in their daily work, and that they will trust the system if it can prove its accuracy and efficiency.

As our empirical work suggests, radiologists may benefit from using a decision support system (DSS) to aid in their diagnosis by providing additional information and analysis of medical images, hence ensuring the importance of our work in the current practice. Our envisioned tool, PAIRADS will address the above-mentioned issues through AI. Since AI will be able to reduce the risk of human error and increase the consistency of diagnosis across different radiologists, this tool will be particularly important for prostate cancer, where the interpretation of imaging data can be subjective. Our system focuses on locating and segmenting the prostate in the MRI images, detecting abnormalities and localizing them in the prostate, performing different calculations automatically, and providing the final result to the end users. By receiving a visual representation of the results, users will be able to identify patterns, trends, and anomalies in the data, and make informed decisions based on the output of the algorithm easily and quickly. Moreover, we are including radiologists in the active learning process of AI through a human-in-the-loop approach, because it helps to ensure that the model is learning from relevant data, correcting errors, identifying biases, utilizing domain expertise, and building trust with users. By involving humans in the process, the AI model can improve its performance and be more effective in real-world applications with the use of human intelligence. However, to foster a revolutionary hybrid human-AI collaboration we need to address some crucial trade-offs among explainability, accuracy, and trust in AI.

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