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Advaya Bot - Radiologist assistant robot development & its usage in healthcare applications

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Abstract
In this paper, the Advaya Bot - Radiologist assistant robot development & its usage in healthcare applications is presented. The final year project undertaken by us involves the design and development of a bot that can assist the healthcare professional, specifically in the Department of Radiology. It is a growing concern among the community of radiologists that radiation exposure, even under protocol scenarios, is causing harm to them in the form of cancers, tumors, cataracts, dry eye syndrome, etc. Also, in departments like that of Ultra Sonography imaging, the manual use of a transducer is something not looked forward to by the patients. We aim to build a bot that can reduce radiation exposure, workload, and uncomfortable interactions for the doctors in the department of radiology imaging. The use of such bots is strictly domain-specific. For the purpose of our final project, we have chosen the domain to be that of an Ultrasonography (USG). We aim at eliminating the manual use of the transducer and replacing it with a bot. The bot shall be capable of greeting the patient and adjusting the location of the end-effector with the help of a radiologist or specialist from a distance. The end-edge of the bot will also be capable of placing the transducer with the required pressure on the required area of the patient's body. In developing countries like India, the ratio of doctors to the number of patients is very low. We aim to unburden healthcare professionals and free them from harmful working conditions. The work carried out is the seventh semester main-project by the students of Electronics & Communication Engineering under the guidance of the faculties supervision (guide).

Introduction
We were motivated by a strong understanding of the difficulties present in this crucial area of healthcare. In their pursuit of precise diagnosis, radiologists and other healthcare professionals face a number of urgent issues. The foremost among them is the ongoing threat of radiation exposure, which carries long-term health hazards like cataracts and cancer. Due to physical equipment handling during radiological treatments, patients also feel uneasy and anxious. This robot not only helps radiologists by lowering their exposure to radiation, but it also exemplifies efficiency and compassion by calming patients, establishing a calm environment, and deftly placing the transducer device under the USG chamber and X-Ray chamber. Our Radiologist-Assist bot increases patient comfort while also easing the workload for our healthcare professionals, enabling them to concentrate on providing top-notch care. It leverages the power of AI, ML, and robotics to reduce

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radiation exposure, enhance efficiency, alleviate patient discomfort, and support healthcare professionals in delivering more accurate diagnoses [1]-[10].

Objective

Our project, the Radiologist-Assist Bot, seeks to lower radiation exposure for medical staff, improve diagnostic effectiveness, increase patient comfort, and assist radiologists in providing more precise diagnoses while adhering to safety standards and ensuring cost-effectiveness [11]-[20].

Aim

The aim of the project work is focused on the specific domain of Ultrasonography (USG),aims to develop, and implement an innovative Radiologist-Assist Bot that significantly reduces radiation exposure for radiologists while optimizing efficiency, patient comfort, and diagnostic accuracy in USG procedures [20]-[30].

Block-diagram

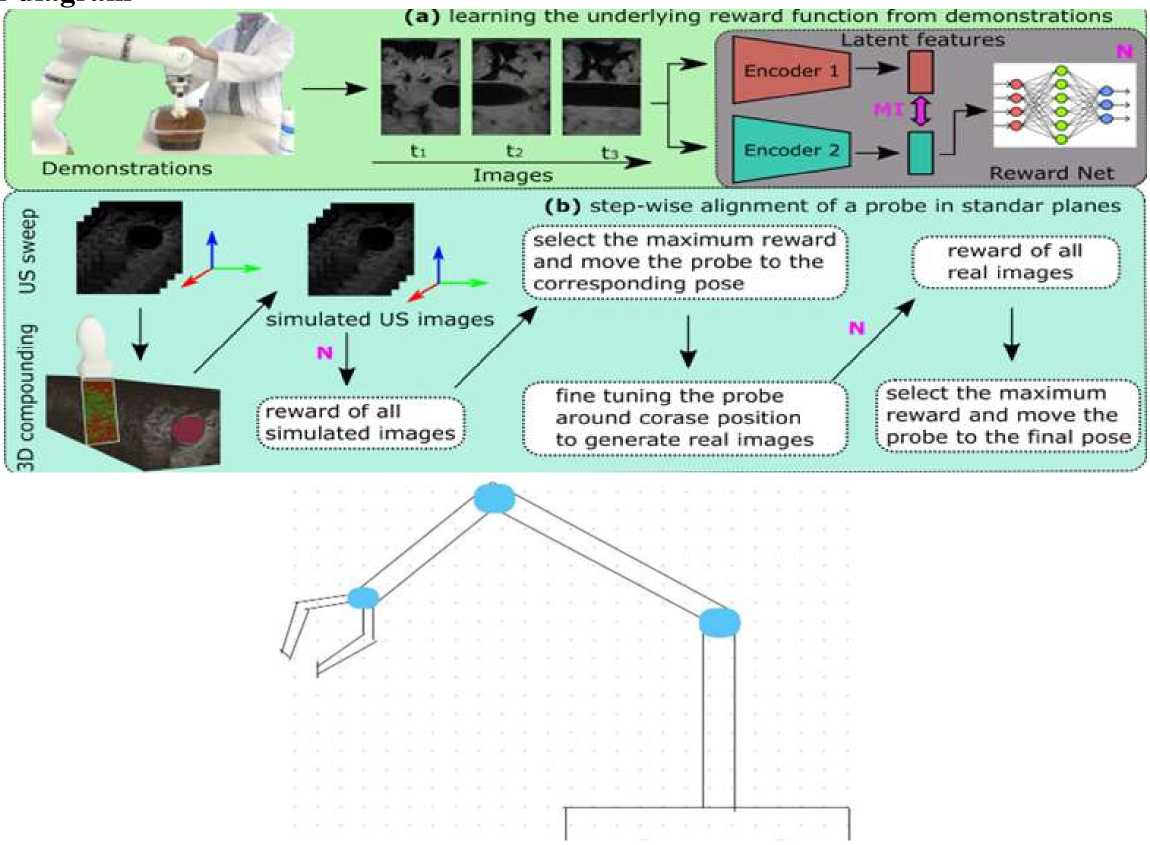

Fig. 1 : Proposed block-diagram to implement the robotic project

Proposed methodology

The figure no. 1 gives the proposed block diagram for implementing the bio-medical robotic project. The bot will utilize the power of actuators to move. The movements will be controlled by the handler (healthcare professional). Generally, the USG setup consists of a transducer and a monitor. With the help of this bot the distance between the monitor and transducer can be further increased. The transducer should be placed on the body of the patient at a required angle and at a required pressure that can be managed by the healthcare professional in charge. As the bot will also be the first point of contact between the patient and the facility, the bot will be able to interact with the patient for hospitality purposes or can even relay communication between the healthcare professional and the patient. This is to reduce workload on the professional and make the patient feel more comfortable. On an advanced approach the bot can also be implemented in X-Ray

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imaging to move the required body part (like arms and legs) for the purpose of proper imaging. X-Ray imaging creates more radioactive exposure for professionals thus putting their health at stake. With more implementation of such bots, we can safeguard our doctors and other professionals from ionizing radiation and decrease their workload. Simultaneously, the patients can feel more comfortable during their medical imaging procedure [1]-[10].

Working of the main project module

The main module will show movement about its various axes to go to the desired position and orientation. The sensors on the edge-effector will give the measurement for the pressure it applies [11-[20].

Tools used (hardware/software)

Raspberry Pi 3 Model B, Raspbian buster, Putty, VNC Viewer, Windows or IOS, Joints and Actuators, encoders for joint position feedback, force/torque sensors for detecting external forces, and proximity sensors for object detection, end-effector, power source Python IDLE, Flasher, SD Card Formatter, Adafruit IO [21]-[30].

Applications & Advantages

During an ultrasonography (USG) scan, the sonographer is in close contact with the patient, which puts them at risk of transmission of many diseases from patient. The less involvement of human will protect privacy of the patient’s personal information. A robot-assisted system that automatically scans tissue, increasing sonographer/patient distance and decreasing contact duration between them. Additionally, its adaptability allows for deployment in resource-constrained regions, addressing the global shortage of sonographers [1]-[10].

Expected Outcome

Robotic ultrasound has been evaluated in various environments including the operating room, remote clinics, and even space. Systems have been designed for abdominal, obstetric, vascular, and other applications. Sonologists need not be near the patient to rescan areas of interest. It considers the preferences of the sonographers in terms of how US scanning is done and can be trained quickly for different applications. Our proposed system automatically scans the tissue using a dexterous robot arm that holds USG probe (Transducer) [11]-[20].

Conclusions

In conclusion, the Advaya Bot project marks a groundbreaking development in the field of healthcare and medical imaging. By creating a Radiologist assistant robot, this project has demonstrated its potential to revolutionize healthcare applications. Advaya Bot streamlines the radiologist's workflow, enhances diagnostic accuracy, and reduces the time required for image analysis. The robot's ability to efficiently process medical images, assist in diagnostics, and provide support in healthcare settings has far-reaching implications for the medical field. It not only improves the quality of patient care but also aids healthcare professionals in handling the ever-growing volume of medical imaging data. As this technology continues to advance, Advaya Bot stands as a significant advancement in the quest for more efficient, accurate, and accessible healthcare solutions.

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