

Lightweight, Ultra-Fast, Next-Generation MRI Scanners

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New Delhi, April 09: During an MRI scan, the human anatomy is subjected to a strong magnetic field under the influence of which, water from within the human anatomy emits radio frequency (RF) signals that are detected and digitized to form an image. However, this process of detecting and digitizing radio signals has to be repeated many times over during a scan in order to acquire sufficient data to build a complete image. This is therefore a time-consuming process that presents a significant clinical limitation as the data acquisition rate during an MRI scan is not fast enough for real time, high resolution imaging of rapidly moving organs such as the heart. Additionally, a combination of the clinical, practical and financial limitations has currently limited the widespread adoption of MRI.

Several approaches have been proposed to address the clinical limitation imposed by slow MRI data acquisition rates. For instance, assumptions can be made about the intrinsic properties of imaged anatomy to exploit redundancies to minimize the volume of acquired data. Alternatively, approaches where multiple MRI RF signal detectors are employed in parallel during a scan can also minimize the volume of data that is acquired. Yet another recent approach is to acquire data partially during a scan and obtain an equivalent representation of the same through mathematical transformations that attempt to extract all relevant signal information from the partially acquired dataset. While these techniques have all helped make progress in addressing this clinical limitation, they still fall short of fully addressing the problem.

The solution to the clinical and practical limitations has been achieved through inventive imaging processes that have enabled the development of a lightweight, compact, ultrafast, full body MRI scanner developed by Voxelgrids Innovations Pvt Ltd supported under the National Biopharma Mission of DBT-India.

The following are the key benefits of this scanner:

- a.** It employs a high field magnet that is completely free of liquid helium and its accompanying cryogenics. Therefore, the resultant MRI scanner is now lightweight and extremely inexpensive.
- b.** The parallel acquisition of data enables a 3-4X acceleration in the data acquisition process above and beyond what current state of the art MRI scanners are capable of. For comparison, if an existing advanced MRI scanner can speed up data acquisition rates by a factor of 12, the proposed solution can enhance the same to a factor of at least 36.

The **Societal Impact** of the proposed solution is the following:

- a. The cost of an MRI scan for a patient is expected to become cheaper by a factor of 3-4. This will provide more people access to this Imaging modality, which at this point is prohibitively expensive for patients from lower income backgrounds.
- b. The 3-4X speed up factor can enable greater patient throughput and a higher Return on Investment for a hospital or Imaging center. Alternatively, the 3-4X speed up factor can be employed in real-time high-resolution Imaging of rapidly moving organs such as the heart. This will greatly enhance MRI's diagnostic utility beyond its traditional application areas.



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