



CURRENT AFFAIRS



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“DEVELOPMENT OF AFFORDABLE MRI TECHNOLOGY ENHANCES DIAGNOSTIC ACCESSIBILITY IN INDIA”

THIS ARTICLE COVERS “DAILY CURRENT AFFAIRS” AND THE TOPIC DETAILS OF “DEVELOPMENT OF AFFORDABLE MRI TECHNOLOGY ENHANCES DIAGNOSTIC ACCESSIBILITY IN INDIA”. THIS TOPIC IS RELEVANT IN THE “SCIENCE AND TECHNOLOGY” SECTION OF THE UPSC- CSE EXAM. WHY IN THE NEWS?

Researchers have pioneered an innovative magnetic resonance imaging (MRI) scanner with significantly reduced costs compared to current models. This breakthrough promises to revolutionise access to this essential diagnostic tool. MRIs are invaluable for visualising intricate details within the human body, aiding in the diagnosis and treatment selection for many conditions, including brain disorders, cardiac issues, various cancers, and orthopaedic ailments. Operating on the principle of strong magnetic fields, measured in units known as tesla (T) and radio waves, these scanners produce detailed images of internal organs. Clinical MRI setups typically employ magnetic fields ranging from 1.5 T to 3 T, which are significantly more powerful—4 to 8 times—than the magnetic fields observed in sunspots on the Sun.

ABOUT MRI:

- MRI, short for Magnetic Resonance Imaging, represents a pivotal medical imaging technique renowned for its ability to generate intricate images of the body's interior.
- Understanding how MRI functions is essential, and here are some key insights:
- MRI machines, resembling large tube-shaped structures, house potent magnets.
- Upon entering the scanner, the strong magnetic field prompts hydrogen atoms within the body to align in a specific orientation.
- Targeted radio waves are then directed towards particular body regions, disrupting the alignment of these atoms.
- When atoms return to their original alignment, they emit radio signals.
- Sensitive receivers capture these signals, which are subsequently amalgamated to construct highly detailed images of the body's organs and tissues.

50 TIMES CHEAPER :

- AT A FRACTION OF THE COST, THIS GROUNDBREAKING MEDICAL TECHNOLOGY REMAINS BEYOND THE REACH OF MANY, PARTICULARLY IN LOW- AND MIDDLE-INCOME NATIONS LIKE INDIA.
- THE PROHIBITIVE EXPENSES STEM FROM NOT ONLY THE INITIAL PURCHASE OF THE SCANNER BUT ALSO THE INFRASTRUCTURE ESSENTIAL FOR ITS OPERATION.

- THIS ENCOMPASSES CONSTRUCTING SHIELDED ROOMS TO CONTAIN THE POWERFUL MAGNETS' EFFECTS, PROCURING LIQUID HELIUM TO COOL THE MAGNETS DURING OPERATION, AND MEETING THE SUBSTANTIAL ELECTRICITY DEMANDS OF THE SCANNER.
- MUKUL MUTATKAR, AN INTERVENTIONAL RADIOLOGY CONSULTANT FROM PUNE, ELUCIDATES THE STAGGERING COSTS INVOLVED, CITING FIGURES RANGING FROM 9 TO 13 CRORE RUPEES FOR A 3-T MRI MACHINE ALONE, EXCLUSIVE OF ADDITIONAL INFRASTRUCTURE EXPENSES.
- IN A CONCERTED EFFORT TO MITIGATE THIS ACCESSIBILITY GAP, A PIONEERING TEAM SPEARHEADED BY ED WU AT THE UNIVERSITY OF HONG KONG DEvised AND FABRICATED AN MRI APPARATUS EMPLOYING LOW-STRENGTH MAGNETS AND OFF-THE-SHELF HARDWARE.
- REMARKABLY, THIS STREAMLINED MACHINE CARRIES A PRICE TAG OF APPROXIMATELY \$22,000, EQUIVALENT TO ABOUT RS 18.4 LAKH. UNLIKE ITS CONVENTIONAL COUNTERPARTS, THIS INNOVATION OPERATES ON 0.05 T MAGNETS, OBTAINING THE NEED FOR SHIELDED ROOMS OR HELIUM COOLANT. FURTHERMORE, IT CAN BE EFFORTLESSLY CONNECTED TO STANDARD WALL-POWER OUTLETS.
- THIS LEAP IN TECHNOLOGY HERALDS THE ADVENT OF A NOVEL CATEGORY OF MRI SCANNERS—ECONOMICAL, ENERGY-EFFICIENT, AND COMPACT—POISED TO DEMOCRATIZE ACCESS TO THIS VITAL DIAGNOSTIC TOOL.

Innovation driven technology lead to affordability and accessibility.



30 VOLUNTEER TESTED WITH MORE PRECISION:

- IN THE 1970S, INITIAL EXPERIMENTATION WITH 0.05 T MACHINES FOR IMAGE GENERATION. HOWEVER, DURING THE 1980S, THE PREFERENCE SHIFTED TOWARDS 1.5 T MAGNETS DUE TO THEIR ABILITY TO PRODUCE HIGHER-QUALITY IMAGES.
- THE RELATIONSHIP IS CLEAR: THE STRONGER THE MAGNETIC FIELD, THE FINER THE RESULTING IMAGE. A 1.5-T SCANNER IS CAPABLE OF DETECTING TISSUE DAMAGE AS MINUTE AS 1 MM, WHEREAS THE MINIMUM DETECTABLE DAMAGE AT 0.05 T IS 4 MM.
- TO ADDRESS THE CHALLENGE OF LOWER RESOLUTION, EMPLOYED A SOPHISTICATED DEEP-LEARNING ALGORITHM. TRAINED ON DATASETS COMPRISING HIGH-RESOLUTION IMAGES OF HUMAN ORGANS, THIS ALGORITHM EFFECTIVELY MITIGATED BACKGROUND NOISE, ENHANCING IMAGE CLARITY.
- THEIR METHODOLOGY UNDERWENT RIGOROUS TESTING INVOLVING 30 HEALTHY ADULT VOLUNTEERS. IMPRESSIVELY, THE SCANS CAPTURED CLEAR IMAGES OF VARIOUS ANATOMICAL STRUCTURES, INCLUDING BRAIN TISSUE, SPINAL CORD, CEREBROSPINAL FLUID, LIVER, KIDNEYS, SPLEEN, LUNGS, HEART, AND KNEE CARTILAGE.
- NOTABLY, THE IMAGES OBTAINED FROM THE 0.05-T MACHINE COUPLED WITH AI DEMONSTRATED COMPARABLE QUALITY TO THOSE FROM A 3-T SCANNER.
- THE RESEARCH TEAM HIGHLIGHTED ANOTHER SIGNIFICANT ADVANTAGE: REDUCED OPERATIONAL NOISE OF THEIR MACHINE. THIS FEATURE RENDERS IT SUITABLE FOR USE WITH PEDIATRIC PATIENTS, EXPANDING ITS APPLICABILITY AND POTENTIAL IMPACT ON HEALTHCARE ACCESSIBILITY.

HOW WILL IT IMPROVE ACCESS AND EMERGENCIES:

- A MACHINE OF THIS NATURE PRESENTS NUMEROUS ADVANTAGES. ITS LIGHTWEIGHT DESIGN, PORTABILITY, AND RELIANCE ON STANDARD POWER SOURCES, SUCH AS A WALL SOCKET, MAKE IT A PRACTICAL SOLUTION FOR REGIONS WHERE ACCESS TO HIGH-POWER MRI MACHINES IS LIMITED.
- ACKNOWLEDGING THE POTENTIAL OF SUCH MACHINES WHILE ALSO RECOGNISING THAT THEY CANNOT ENTIRELY REPLACE STANDARD HIGH-FIELD MAGNETS DUE TO THE SUPERIOR RESOLUTION THE LATTER OFFERS.
- THE ULTRA-LOW FIELD SCANNER MAY NOT REPLACE HIGH-FIELD SCANNERS, BUT IT CAN EFFECTIVELY COMPLEMENT THEM WITHIN RADIOLOGY DEPARTMENTS, HIGHLIGHTING THE DISPARITY IN MRI COSTS, WHICH CAN RANGE FROM RS 7,000 TO RS 15,000, WITH SOME FACILITIES OFFERING SCANS FOR AS LOW AS RS 2,000 ALBEIT WITH EXTENSIVE WAITING PERIODS.
- THE UTILITY OF SUCH SCANNERS IN EMERGENCY SITUATIONS. BY ELIMINATING THE NEED FOR APPOINTMENTS, THEY FACILITATE SWIFT MEDICAL INTERVENTIONS, AIDING FIRST RESPONDERS IN MAKING WELL-INFORMED DECISIONS.
- IN CASES OF ACUTE EVENTS LIKE STROKES OR TRAUMATIC ACCIDENTS, LOW-COST SCANNERS CAN BE INSTRUMENTAL IN ASSESSING INJURIES PROMPTLY AT THE SCENE. THIS TIMELY EVALUATION ENABLES HEALTHCARE PROVIDERS TO DETERMINE THE APPROPRIATE COURSE OF ACTION, INCLUDING WHETHER IMMEDIATE HOSPITAL TRANSFER IS NECESSARY AND THE MOST SUITABLE MODE OF TRANSPORTATION.

HOW ARE BASIC THINGS DONE?

- THE IMPORTANCE OF EMPLOYING LOWER POWER MAGNETS FOR MRI MACHINES EMPHASISES THE CRUCIAL ASPECT OF SAFETY.
- UNLIKE CONVENTIONAL MACHINES, WHICH POSE A PERSISTENT RISK OF PULLING METAL ITEMS LIKE OXYGEN CYLINDERS, WHEELCHAIRS, AND STETHOSCOPES INTO THE MRI MACHINE, LOWER POWER MAGNETS MITIGATE THIS DANGER. WHILE SUCH INCIDENTS ARE RARE, THEY CAN RESULT IN HARM TO BOTH THE PATIENT AND THE MACHINE.
- ANOTHER ADVANTAGE OF MRI MACHINES WITH LOW-STRENGTH MAGNETS IS THE POTENTIAL REDUCTION IN ARTIFACTS CAUSED BY IMPLANTS OR PROSTHETICS IN THE FINAL IMAGE.
- THESE ARTEFACTS, OFTEN ARISING FROM MATERIALS LIKE TITANIUM, WHICH EXHIBIT WEAK PARAMAGNETIC PROPERTIES, CAN OCCASIONALLY MISLEAD DOCTORS REGARDING THE ORIGINAL TISSUE ANATOMY.
- THIS RISK UNDERSCORES THE IMPORTANCE OF OPTING FOR LOWER POWER MAGNETS, ENSURING GREATER ACCURACY AND SAFETY IN DIAGNOSTIC IMAGING PROCEDURES.

IMPORTANCE OF MRI:

DIAGNOSTIC VALUE:

- – MRI IS WIDELY USED TO DIAGNOSE A VARIETY OF CONDITIONS, INCLUDING BRAIN AND SPINAL CORD ANOMALIES, TUMOURS, HEART DISEASE, LIVER DISEASE, AND KIDNEY DISEASE.
- – IT IS PARTICULARLY VALUABLE FOR EXAMINING THE BRAIN AND SPINAL CORD, AS IT CAN DETECT ANEURYSMS, MULTIPLE SCLEROSIS, STROKE, TUMOURS, AND BRAIN INJURIES.
- – MRI IS USED IN THE DIAGNOSIS OF RECTAL AND PROSTATE CANCER.
- **TREATMENT PLANNING AND MONITORING:**
- – MRI IMAGES HELP DOCTORS PLAN TREATMENTS BY PROVIDING DETAILED INFORMATION ABOUT THE LOCATION AND EXTENT OF A DISEASE OR INJURY.
- – IT IS USED TO MONITOR THE PROGRESSION OF DISEASES AND THE EFFECTIVENESS OF TREATMENTS.
- – MRI IS USED IN STEREOTACTIC SURGERY AND RADIOSURGERY FOR THE TREATMENT OF INTRACRANIAL TUMOURS, ARTERIOVENOUS MALFORMATIONS, AND OTHER SURGICALLY TREATABLE CONDITIONS.
- **VERSATILITY AND ADVANTAGES:**
- – MRI CAN EXAMINE ALMOST ANY PART OF THE BODY, INCLUDING THE BRAIN, SPINAL CORD, BONES, JOINTS, HEART, AND INTERNAL ORGANS.
- – IT PROVIDES BETTER CONTRAST IN IMAGES OF SOFT TISSUES COMPARED TO CT SCANS.
- – MRI IS A NONINVASIVE PROCEDURE THAT DOES NOT USE IONISING RADIATION, MAKING IT SAFER THAN CT SCANS AND X-RAYS.
- **RESEARCH APPLICATIONS:**
- – MRI IS AN IMPORTANT RESEARCH TOOL FOR STUDYING THE MECHANISTIC UNDERPINNING OF BODY FUNCTION AND DYSFUNCTION.
- – MRI (FMRI) DETECT BRAIN ACTIVITY BY DETECTING CHANGES IN BLOOD FLOW, HELPING RESEARCHERS ASSESS BRAIN FUNCTION AND DETECT ANOMALIES IN ACTIVITY.

PRELIMS BASED QUESTIONS:

Q. Consider the following statement related to MRI:

1. MRI is run by the magnetic field produced by electricity.
2. Electrons are stimulated by radiofrequency current in the MRI.

Which of the following statement/s is/are correct?

1. 1 Only
2. 2 Only
3. Both 1 and 2
4. Neither 1 nor 2

Answer: D

MAINS BASED QUESTION:

Q. Innovation led to the origin of new-age technology to cater to the people better. How can we ensure the accessibility and affordability of health by open area in the Research & Development?

Vishal Yadav

