**ABSTRACT**

The Strong Magnetic field of MRI machines can be hazardous to certain metallic objects which are present in both inside and outside the body. We should Ensure proper screening of patients before the MRI procedures to identify any potential risk. Patient should remove all metallic items prior to MRI screening. Nowadays the proper screening of the patients are not done. Not only the technicians handling the scans but also others who know to work on the scan equipments are also taking the MRI scans. Guards are designed to prevent any ferromagnetic objects or materials from being brought into the MRI Environment , which could pose a safety risk due to the strong magnetic field generated by the MRI Machine. As per the study we have found that the existing system needs a huge man power for this screening procedure. This project reviews the automatic closure and opening of door by enquiring the presence or absence of metal objects both inside and outside the body prior to the examination . The hospital experience a major loss only due to the MRI accidents , they are caused due to unawareness . Here we are using metal detecting technique to enquire the presence or absence of metal and automating the door system . This project also have views on that it not only detect the major metals but also the minor metals with the help of electromagnetic fields. They reduces the manpower usage and ensuring the safety to both visitors and the medical personals . About 2% of the hospitals only submitted the records assuring the safety of the patient. The severe investigation on practical examination has been done to develop the project.

**CHAPTER 1**

**INTRODUCTION**

**Magnetic resonance imaging** (**MRI**) is a [medical imaging](https://en.wikipedia.org/wiki/Medical_imaging) technique used in [radiology](https://en.wikipedia.org/wiki/Radiology) to form pictures of the [anatomy](https://en.wikipedia.org/wiki/Anatomy) and the [physiological](https://en.wikipedia.org/wiki/Physiological) processes of the body. [MRI scanners](https://en.wikipedia.org/wiki/Physics_of_magnetic_resonance_imaging#MRI_scanner) use strong [magnetic fields](https://en.wikipedia.org/wiki/Magnetic_field), magnetic field gradients, and [radio waves](https://en.wikipedia.org/wiki/Radio_wave) to generate images of the organs in the body. MRI does not involve [X-rays](https://en.wikipedia.org/wiki/X-rays) or the use of [ionizing radiation](https://en.wikipedia.org/wiki/Ionizing_radiation), which distinguishes it from [computed tomography](https://en.wikipedia.org/wiki/CT_scan) (CT) and [positron emission tomography](https://en.wikipedia.org/wiki/Positron_emission_tomography) (PET) scans. MRI is a [medical application](https://en.wikipedia.org/wiki/Nuclear_magnetic_resonance#Medicine) of [nuclear magnetic resonance](https://en.wikipedia.org/wiki/Nuclear_magnetic_resonance) (NMR) which can also be used for imaging in other [NMR applications](https://en.wikipedia.org/wiki/Nuclear_magnetic_resonance#Applications), such as [NMR spectroscopy](https://en.wikipedia.org/wiki/Nuclear_magnetic_resonance_spectroscopy).

MRI is widely used in hospitals and clinics for [medical diagnosis](https://en.wikipedia.org/wiki/Medical_diagnosis), [staging](https://en.wikipedia.org/wiki/Cancer_staging) and follow-up of disease. Compared to CT, MRI provides better contrast in images of soft tissues, e.g. in the [brain](https://en.wikipedia.org/wiki/Magnetic_resonance_imaging_of_the_brain) or abdomen. However, it may be perceived as less comfortable by patients, due to the usually longer and louder measurements with the subject in a long, confining tube, though "Open" MRI designs mostly relieve this. Additionally, [implants](https://en.wikipedia.org/wiki/Implant_(medicine)) and other non-removable metal in the body can pose a risk and may exclude some patients from undergoing an MRI examination safely.

MRI was originally called NMRI (nuclear magnetic resonance imaging), but "nuclear" was dropped to avoid negative associations. Certain [atomic nuclei](https://en.wikipedia.org/wiki/Atomic_nucleus) are able to absorb [radio frequency](https://en.wikipedia.org/wiki/Radio_frequency) (RF) energy when placed in an external [magnetic field](https://en.wikipedia.org/wiki/Magnetic_field); the resultant evolving [spin polarization](https://en.wikipedia.org/wiki/Spin_polarization) can induce a [RF](https://en.wikipedia.org/wiki/Radio_frequency) signal in a radio frequency coil and thereby be detected.[[2]](https://en.wikipedia.org/wiki/Magnetic_resonance_imaging#cite_note-hoult-2) In clinical and research MRI, [hydrogen atoms](https://en.wikipedia.org/wiki/Hydrogen) are most often used to generate a macroscopic polarization that is detected by antennas close to the subject being examined. Hydrogen atoms are [naturally abundant in humans](https://en.wikipedia.org/wiki/Composition_of_the_human_body) and other biological organisms, particularly in [water](https://en.wikipedia.org/wiki/Properties_of_water) and [fat](https://en.wikipedia.org/wiki/Lipid). For this reason, most MRI scans essentially map the location of water and fat in the body. Pulses of radio waves excite the [nuclear spin](https://en.wikipedia.org/wiki/Spin_(physics)) energy transition, and magnetic field gradients localize the polarization in space. By varying the parameters of the [pulse sequence](https://en.wikipedia.org/wiki/Pulse_sequence), different contrasts may be generated between tissues based on the [relaxation](https://en.wikipedia.org/wiki/Relaxation_(NMR)) properties of the hydrogen atoms therein.

Since its development in the 1970s and 1980s, MRI has proven to be a versatile imaging technique. While MRI is most prominently used in [diagnostic medicine](https://en.wikipedia.org/wiki/Medical_diagnosis) and biomedical research, it also may be used to form images of non-living objects, such as [mummies](https://en.wikipedia.org/wiki/Mummy). [Diffusion MRI](https://en.wikipedia.org/wiki/Diffusion_MRI) and [functional MRI](https://en.wikipedia.org/wiki/Functional_magnetic_resonance_imaging) extend the utility of MRI to capture neuronal tracts and blood flow respectively in the nervous system, in addition to detailed spatial images. The sustained increase in demand for MRI within [health systems](https://en.wikipedia.org/wiki/Health_system) has led to concerns about [cost effectiveness](https://en.wikipedia.org/wiki/Cost-effectiveness_analysis) and [overdiagnosis](https://en.wikipedia.org/wiki/Overdiagnosis).

[The principle of MRI is based on the fact that the human body is composed of cells that contain water molecules, which have hydrogen atoms with positively charged protons](https://www.bing.com/ck/a?!&&p=f12f2ad7d9d9670dJmltdHM9MTY5NDMwNDAwMCZpZ3VpZD0xZGIxZDhmMS1mN2M1LTY1NjYtMDk3ZC1jYmRmZjY2ODY0ODgmaW5zaWQ9NTk2Nw&ptn=3&hsh=3&fclid=1db1d8f1-f7c5-6566-097d-cbdff6686488&psq=principle+of+mri&u=a1aHR0cHM6Ly90ZWFjaG1lYW5hdG9teS5pbmZvL3RoZS1iYXNpY3MvaW1hZ2luZy9tYWduZXRpYy1yZXNvbmFuY2UtaW1hZ2luZy1tcmkv&ntb=1). [These protons can be aligned by the magnetic field and stimulated by the radiofrequency pulses, causing them to spin and emit signals that are detected by the MRI scanner](https://www.bing.com/ck/a?!&&p=ebda98f884a5916cJmltdHM9MTY5NDMwNDAwMCZpZ3VpZD0xZGIxZDhmMS1mN2M1LTY1NjYtMDk3ZC1jYmRmZjY2ODY0ODgmaW5zaWQ9NTk2OQ&ptn=3&hsh=3&fclid=1db1d8f1-f7c5-6566-097d-cbdff6686488&psq=principle+of+mri&u=a1aHR0cHM6Ly93d3cubmliaWIubmloLmdvdi9zY2llbmNlLWVkdWNhdGlvbi9zY2llbmNlLXRvcGljcy9tYWduZXRpYy1yZXNvbmFuY2UtaW1hZ2luZy1tcmk&ntb=1).

The MRI machine is always magnetized. It's always on. MRI Safety Week: July 24-28, 2023.Did you know that the strong magnetic field surrounding an MRI scanner is always present, even when the scanner is not being used? True. The magnetic field is invisible and totally imperceptible unless you happen to be carrying something metallic near the MRI scanner, then you would feel a tug. Many of our MRI safety practices are aimed at identifying these hazardous metal objects before they get near the scanner.

Before you receive an MRI, a technician will ask you to remove any metal items you are wearing, such as jewelry, glasses or belt buckles. You should tell her about any medical implants you have. The MRI machine's powerful magnetic field attracts ferrous, or iron-containing, metals and can cause serious injury. Even in the absence of injury, metal objects can distort the MRI image and make it difficult to read. Safety experts have cleared some metals for use during MRIs

**MRI hazards fall into four main categories:**

1. It is the projectile hazard. This occurs when a ferrous object crosses the permissible MRI zone. Due to the strong magnetic field generated by the magnet, the object gets pulled towards the MRI macat an enormous speed, turning into a deadly projectile. Anything lying between the path of the projectile and the magnet can become a casualty. When this happens, the MRI scanner gets damaged too, which can be repaired only at a great cost.
2. It is related to implants. Today, we have more and more patients with implants needing MRI scans. If these implants are not MRI-compatible, they can be displaced from their position or start malfunctioning. Both of these cases can lead to casualities.
3. It is lesser-known aspect of MRI safety, is burns caused by the radiofrequency(RF) field generated by the machine. The moment a conductive loop is formed, the burns can turn dangerous. A lot of clothing worn by patients contains conducting material, which can increase the risk of RF burns.
4. It is the auditory damage, which is due to the gradient field. Anyone with compromised ears or hearing can be at risk.

MRI accidents are common worldwide, whether related to projectiles, implants, or burns. They are quite prevalent in India too. I can recall a few examples off the top of my head. There was a case some years ago from Western India in which two workers remained pinned to the MRI machine for a couple of hours because they accidentally carried a metal oxygen cylinder inside the MRI room. Another person died because he was carrying an oxygen metal cylinder inside the MRI room. Some lesser-known accidents are related to burns. These have occurred due to silk saris, and even a dupatta with metal embroidery, worn by patients inside the MRI during the scan. In another case, security personnel ignored instructions and walked inside the MRI room with a pistol. Thankfully, there were no casualties, but it did cause a lot of damage to the MRI scanner.

The biggest reason for MRI accidents in India is negligence due to a lack of awareness of MRI best practices. Another important factor is the huge load on the MRI infrastructure. As per a study done in 2020, India has one MRI machine per 10 million people, as opposed to one MRI machine per 1.5 million people in developed countries. This is a matter of concern. The MRI consultants, doctors, and radiologists are doing their best to safely scan the patients, but the enormous load of patients on the MRI infrastructure is aggravating the problem. Another factor is that MRI facilities are used not only by radiologists but also by other disciplines that are not as well aware of MRI best practices. This is adding to the number of MRI accidents. We need to have a programme in place in India where we can educate not only radiologists but also other disciplines that use the MRI facilities and even cleaning staff, for that matter, about MRI best practices.

IOMT likely refers to "Internet of Medical Things" , which involves connecting medical devices and equipment to the internet for remote monitoring and Data collection. To avoid accidents during MRI Screening we incorporate internet of Medical Things (IOMT) processes . The Internet of Things (IoT) is basically a network of internet-connected devices sometimes referred to as being smart. The network enables medical users to control devices remotely through software applications and connected infrastructure, while at the same time patient data is collected through strategic touchpoints. The medical data collected through connected devices, once processed with the right apps, can be used for various purposes, including personal emergency response systems. This is giving birth to a global IoMT market of solutions for healthcare providers. In short, one of the benefits of pairing up medical equipment with IoMT technologies is to transmit data between remote locations, helping optimize processes such as disease control thanks to point of care devices. Although this sounds like something trivial, it has the potential to revolutionize how many medical services work.

By wirelessly transmitting data, this technology enables doctors to access medical data in remote locations, and keep track of any potential issues that might occur, thus helping prevent any future complications while performing more accurate diagnoses. Suppose a patient is told not to exceed a given weight, or otherwise, health problems might occur. With a medical device such as an IoMT scale or other internet-connected devices, a patient can keep track of this key metric easily with the help of an app. The app can additionally share information on healthy diets or be used as a glucose monitor and activity tracker, given the patient’s data and condition. This can help trigger motivation and behavioral changes by using push notifications. It can also share relevant information with medical staff so that they know, before hospital visits, how the patient has evolved. In short, IoMT software applications can make processes more efficient. They can be used for remote patient monitoring, as they allow real-time patient data exchange between point of care devices and hospital networks. This helps produce more accurate diagnoses while reducing in-person medical visits. In particular, connected infrastructure can help monitor vital signs, body temperature, and blood pressure, for example. The Internet of Medical Things (IoMT) can also help trigger personal emergency response systems and keep chronic diseases under control. Imagine smart devices that help monitor glucose levels and heart rate. Being in faraway locations, you can use wearable devices to share activity tracker information with a remote medical service provider and get a clinical-grade diagnosis.

For IoMT technologies to work properly, it is necessary to collect relevant data. As a matter of fact, as for IoT technologies in general, IoMT does not work properly without the correct data. This is not surprising if one considers that one of the main benefits of this technology is to help improve decision-making. It is necessary that IoMT medical devices allow data to be collected, processed, and used. This requires not only setting up a beacon to collect data. It is also necessary to transform it into useful information that medical personnel can use to make decisions. Thanks to MedTech apps and IT systems, this can easily be done. Apps are playing a major role in how IoMT technologies are being deployed. It is not good to have powerful devices if the software that moves them is deficient.

MedTech apps designed to work with IoT devices should guarantee users adequate levels of reliability. In this sense, quality assurance is a necessity that these types of apps cannot leave aside. Quality is a must-have when it comes to guaranteeing patient safety and health. A critical success factor for any IoMT technology is security. This refers not only to patient security, which is extremely important. Guaranteeing it should be a top priority. Nonetheless, it should also be a top priority to look out for cybersecurity, especially in what relates to data privacy. Medical information is very sensible, so users must be guaranteed that their data is in safe hands and compliant with HIPAA regulations. Doing so creates trust, an important element that IoMT devices need to grow their market.

Automation has had a significant impact on healthcare in developed and developing countries. In developed countries, it has improved patient safety by reducing medical errors. For example, barcode medication administration (BCMA) systems are now commonplace in US hospitals. These systems help to reduce the risk of medication errors by requiring nurses to scan a patient’s wristband and the medication’s barcode before administering it.

In developing countries, automation is helping to close the gaps in access to care. For example, in India, a lack of qualified doctors has led to a shortage of healthcare professionals, making it difficult for people living in rural areas to get the care they need.

## The benefits of [Automation in healthcare](https://www.automationanywhere.com/solutions/healthcare) has many benefits, for patients and providers:

**1)Automation improves patient safety:**

Automation reduces the risk of human error, one of the leading causes of death and injury in healthcare. For example, computerized provider order entry (CPOE) systems reduce mistakes in prescribing and administering medications.

**2) Automation increases efficiency:**

Healthcare providers can work more efficiently and effectively with automation. Robotic surgery can help surgeons perform complex procedures with greater precision and accuracy. Automated pharmacy dispensing systems can also reduce the time it takes to fill prescriptions.

**3) Automation improves access to care:**

Pre-pandemic use of telemedicine in Canada was only 11 visits per 1000 patients in rural areas and seven per 1000 patients in urban areas. Because of the pandemic, telemedicine visits increased to [142 per 1000 and 220 per 1000 patients](https://pubmed.ncbi.nlm.nih.gov/33769942/) among rural and urban patients, respectively. This increase in access to care is likely to continue as the benefits of telemedicine become more widely known.

**4) Automation engages patient** :

Patient engagement is vital for improving outcomes. Automation provides them with timely and relevant information. For example, automated appointment reminders can help patients remember to keep their appointments.

By including the automation system in metal detection and door system we can get to know about the working of the metal detecting sensors such as Metal detectors work by transmitting an electromagnetic field from the search coil into the ground. Any metal objects (targets) within the electromagnetic field will become energised and retransmit an electromagnetic field of their own. The detector’s search coil receives the retransmitted field and alerts the user by producing a target response. Minelab metal detectors are capable of discriminating between different target types and can be set to ignore unwanted targets.

The more about the work flow can be described in the methodology in detail, These are the tings we are inculcating in this automation system so that the we can ensure the safety of the patient prior to the MRI scanning.

**CHAPTER 2**

**LITERATURE REVIEW**

**Evaluation of MRI compatibility and safety risks for biomaterials:**

The interaction between medical biomaterials and MRI devices is an important consideration in medical safety. The strong magnetic fields, gradient fields, and RF pulses used in MRI can indeed affect metalliferous biomaterials in the body, potentially leading to issues such as magnetically induced forces, torque, and tissue heating. Ensuring the compatibility and safety of biomaterials in MRI environments is crucial to prevent harm to individuals with such implants or materials. Extensive research and evaluation in this area are necessary to mitigate potential risks and enhance the overall safety of MRI procedures for individuals with biomaterials in their bodies. Realization of interventional therapeutic procedures with guidance of Magnetic Resonance Imaging (MRI) is a promising novelty in area of interventional surgery because of eliminating x-ray exposure to patient body.

Together with radiation free nature, advances in MRI techniques present superior soft tissue contrast and real time physiologic parameters from related tissue. However, the strong static magnetic field, magnetic radiofrequency (RF) pulses, and time-varying gradient fields applied during MRI, may result in exceeded heating risk over interventional instruments and adjacent tissue inside patient body. Additionally, since real time tracking and determination of device position inside patient body is critical for operators, sufficient visibility under MRI is another challenging issue to overcome. Therefore, proper biomaterials must be utilized for designing and development of MRI compatible interventional instruments by considering many factors including biocompatibility, MRI safety, MRI visibility, and other mechanical needing.

**Bio Materials made up of Metals:**

Medical biomaterials are being used to replace or support severely damaged or completely missing tissue and organs at human body. Current usage of these products in medicine has become quite prevalent thanks to developments of biomaterial technology. However, in case a medical biomaterial is exposed to an environment including extremely strong energy that Magnetic Resonance Imaging (MRI) device generates, undesirable results in terms of human health may occur. Especially metalliferous biomaterials in the body interact with strong static magnetic field, gradient magnetic field and radiofrequency (RF) electromagnetic pulses which are used during MRI. Such magnetic fields used in MR scanners can result in electromagnetic compatibility and interference issues such as magnetically induced force, torque and tissue heating due to RF coupling with medical biomaterials which conduct the electricity. Consequently, these interactions may lead the persons carrying the biomaterial get injured seriously.

**What is an MRI:**

Magnetic resonance imaging (MRI) is a noninvasive imaging technique that produces three-dimensional anatomical images, which could be employed in the diagnosis of many aspects, including the diagnosis of cardiovascular diseases. Magnetic resonance (MR) does not pose the danger of exposing patients to ionizing radiation or X-rays, and it basically avoids using nephrotoxic contrast agents. MRI is the preferred procedure for diagnosing a large number of potential problems or abnormal conditions that may affect different parts of the body. In general, MRI creates pictures that can show differences between healthy and unhealthy or abnormal tissues. Physicians use MRI to examine the brain, spine, joints (e.g., knee, shoulder, hip, wrist, and ankle), abdomen, pelvic region, breast, blood vessels, heart, and other body parts.

**MRI safety things:**

An item that poses no known hazards in any MR environment. “MR safe” items are composed of materials that are electrically nonconductive, nonmetallic, and nonmagnetic, such as a plastic Petri dish. An item that has been demonstrated to pose no known hazards in a specified MR environment with specified conditions of use. Conditions that define the MR environment include static magnetic field strength, spatial magnetic gradient, dB/dt (time-varying magnetic fields), RF fields, and SAR (specific absorption rate). Additional conditions, including specific configurations of the item , may be required.

**How implants affects the MRI:**

MR examination in patient with implanted endovascular devices, especially the metallic ones, is sometimes a risky procedure. During the MR examination, a strong magnetic field is applied, and the magnetic field exerts very powerful forces on ferromagnetic objects. Possible heating of previously implanted devices in such a magnetic field is also a big concern Metals with high volume magnetic susceptibility, such as 316L stainless steel and Co–Cr alloy would generate artifacts in the MR image as a result of distortion of the magnetic field.Risks associated with MR scanning generally arise from three aspects considering their distinct mechanisms, the static main magnetic field, radiofrequency (RF) energy and gradient magnetic field.

**MRI SAFETY AND DEVICES:**

Before entering the MRI room, patients and anyone else present must be screened for ferromagnetic objects, including medical devices, jewelry, and clothing with metallic components. Some medical implants can be affected by MRI's magnetic fields or radiofrequency energy. Patients with implants, such as pacemakers or cochlear implants, should consult their healthcare providers to ensure MRI compatibility. There are MRI-compatible medical devices designed to be safely used during MRI scans. These include specialized monitoring equipment and certain implants designed to withstand the MRI environment. Medical equipment and accessories in the MRI room should be made of non-magnetic materials to prevent interference with the imaging process. MRI facilities must have emergency procedures in place, including the ability to quickly deactivate the MRI scanner in case of an emergency.

**Effects of MRI other than Metals:**

The use of MRI contrast agents, such as gadolinium-based contrast agents, should be carefully considered, especially in patients with renal issues, to avoid potential side effects. Patients must be informed about what to expect during an MRI scan to reduce anxiety. Ear protection is often provided to mitigate noise from the MRI machine.

**IOT ENABLED SMART DOOR USING FACE MASK :**

During covid-19 pandemic period, the corona virus which is spreading fastly. This causes many problems in our body. Because, It's affects the human respiratory system, kidney, throat infection, etc … So, For this reason we wear the face mask in which places we are going. To avoid the virus spreading we make sure that wearing the face mask. In this project, to detect the face mask non-wearing persons using the AI and IOT based smart door.

Arduino is the software and hardware designed microcontroller and processor, which is used for loading the program. C and C++ Language are programmed in the microcontroller. Camera is used for capture the image for face recognition process. After capturing the image using Deep Learning and AI we detect the persons who are face mask wearing and non wearing.The servo motor which is used for door automation process. where the persons who are wearing face mask they allow to inside the place ,otherwise they don't allow to inside the place.

**TATTOO INK SCREENING USING PHANTONS AND RSMAN SPECTROSCOPY:**

Screening tattoo ink using optical tissue phantoms and Raman spectroscopy involves using synthetic materials that mimic the optical properties of human tissue to study the interaction between tattoo ink and light. The tattoo colors are having metal pigmentation and chemical diagnosing techniques .Tattoos can indeed contain various pigments, including those with metal components. Some common tattoo ink colors may contain metal-based pigments. chemical diagnostic techniques like spectroscopy can be used to analyze tattoo pigments and their composition. These phantoms should have similar scattering and absorption properties as real tissue. The raman spectroscopy produced can provide information about the chemical composition .Tattoo ink based on its chemical composition. Determining the safety of the ink for use of Human skin.

**METALLIC OBJECT DETECTION USING CNN:**

Using a convolutional neural network (CNN) to detect metallic objects on digital radiographs. Digital radiographs that include examples of both normal scans and scans with metallic object. Neural networks can be used to create a metallic objects detector for MRI scans. This can help improve safety and image quality during MRI procedures by alerting medical staff to the presence of metallic objects that could be dangerous or interfere with the scan.

**THERMAL IMAGING TO DETECT BREAST TUMORS:**

Thermal modeling for breast tumor detection using thermography involves using temperature data to identify abnormalities in breast tissue. This method relies on the fact that tumors often generate heat, which can be detected with specialized thermal imaging equipment. Thermal images of the breast using a thermographic camera. Thermography is a non-invasive and radiation-free technique. Thermal imaging cameras can detect temperature differences, which can be useful for identifying areas of extra growth or anomalies in various applications, such as industrial inspections, building maintenance, or even in medical diagnostics.

**SAFETY PRIOR TO MRI:**

MRI safety practices are typically based on international guidelines and standards, such as those provided by the American College of Radiology (ACR). These guidelines aim to ensure the safe operation of MRI facilities and protect patients, staff, and visitors from potential risks associated with magnetic resonance imaging. To assess how MRI safety practices in Jordan compare to the ACR's 2020 manual on MR safety, you would need to gather data and conduct a through evaluation. This might involve reviewing local regulations and procedures, conducting safety audits in Jordanian MRI facilities, and comparing these findings to the ACR guidelines. It's essential to involve experts in the field and ensure that safety practices are in line with international standards to maintain a high level of safety in MRI facilities.

**ACCIDENTS DUE TO MRI:**

The MRI accidents due to unsafe environment causes major issues to the patient and the machine. MRI accidents can indeed have serious consequences for both patients and the machine. Patients can experience injuries from projectiles or burns if metallic objects are present in the MRI room, and the machine itself can be damaged, Ensuring a safe environment and strict adherence to safety protocols are crucial to prevent such accidents. The powerful magnetic field of the MR system can attract objects made from certain metals ( metals known to be ferromagnetic, such as iron) and cause them to move suddenly and with great force. This can pose a possible risk to the patient or anyone in the object's "flight path." Therefore, great care is taken to ensure that external objects such as ferromagnetic screwdrivers and oxygen tanks are not brought into the MR system room.

As a patient, it is vital that you remove all metallic belongings in advance of an MRI examination, including external hearing aids, watches, jewelry, cell phones, and items of clothing that have metallic threads or fasteners. Additionally, makeup, nail polish, or other cosmetics that may contain metallic particles should be removed if applied to the area of the body undergoing the MRI examination. Various clothing items such as athletic wear ( yoga pants, shirts, etc.), socks, braces, and others may contain metallic threads or metal-based anti-bacterial compounds that may pose a hazard. These items can heat up and burn the patient during an MRI. Therefore, MRI facilities typically require patients to remove all potentially problematic clothing items prior to undergoing an MRI.

**SCREENING OF PATIENTS TO VIEW ON INTERNAL DEVICE:**

Safety of magnetic resonance imaging in patient with cardiovascular devices Pacemakers and ICDs (Implantable Cardioverter Defibrillators): Many modern devices are MRI-conditional, which means they are designed to be safe during MRI scans under specific conditions. However, precautions should still be taken, and the MRI should be supervised by a healthcare provider experienced in managing patients with these devices. If exposed to MRI, including device malfunction or heating. The presence of a pacemaker inside the heart prior to an MRI diagnosis is crucial to ensure patient safety. MRI machines use strong magnetic fields that can interact with the metal components of a pacemaker, potentially causing harm to the patient.

**FERROMAGNETIC DETECTION PRIOR TO MRI;**

Ferromagnetic objects can be extremely hazardous in MRI (Magnetic Resonance Imaging) rooms because the powerful magnets used in MRI machines can cause these objects to become projectiles, leading to serious injuries or damage to the equipment. Orthopedic surgeons and medical professionals generally follow strict safety protocols to prevent such incidents.The brief analysis on MRI accidents and how the patients injury levels that Patients may experience minor injuries like skin burns or discomfort if they have metallic objects on or in their bodies, such as jewelry, implants, or pacemakers. These objects can heat up during the MRI due to the strong magnetic fields.

**CHAPTER 3**

**METHODOLOGY**

Our project is detailed about MRI and screening for patients. To avoid the MRI accidents and protection of patient. The metal is detected by using the metal detecting sensor. A sensor is a thing which converts stimuli such as heat, light, sound and motion into electrical signals. These signals are passed through an interface that converts them into a binary code and passes this on to a computer to be processed.

Metal detecting sensor operates under the electrical principal of inductance where a fluctuating current induces an electromotive force (EMF) in a target object. This sensor used for to detect the metals in our body. Instead of metal detecting sensors we can also use, Inductive proximity sensors have four types, they are Capacitive, Inductive, Optical, Magnetic. This sensor detect a metallic objects and typically operate over a range of 3 to 30 mm. Proximity Sensors detect an object without touching it, and they therefore do not cause abrasion or damage to the object.

We use a metal detecting sensor here, Metal detectors work by transmitting an electromagnetic field from the search coil into the ground. An (targets) within the electromagnetic field will become energised and retransmit an electromagnetic fie detector’s search coil receives the retransmitted field and alerts the user by producing a target response. Detectors are capable of discriminating between different target types and can be set to ignore unwanted detections.

1. **Control Box** :

The control box contains the detector’s electronics. This is where the transmit signal is generated and is processed and converted into a target response.

1. **Search Coil** :

The detector’s search coil transmits the electromagnetic field into the ground and receives the return from a target.

1. **Transmit Electromagnetic Field :**

The transmit electromagnetic field energies targets to enable them to be detected.

1. **Target:**

A target is any metal object that can be detected by a metal detector. In this example, the detected ta which is a good (accepted) target.

1. **Receive Electromagnetic Field :**

The receive electromagnetic field is generated from energized targets and is received by the search.

1. **Target Response :**

When a good (accepted) target is detected the metal detector will produce an audible response, such change in tone.

Servo motor which is used for door Automation. We interface proximity sensor and door Automation by using computer software. Servo motors or servos , as they are known, are electronic devices and rotary or linear actuators that rotate and push parts of a machine with precision. Servos are mainly used on angular or linear position and for specific velocity, and acceleration. servo motors have many uses within motion control. They are used in applications to control rotational speed and position as well as output torque.

Servos are controlled by sending an electrical pulse of variable width, or pulse width modulation (PWM), through the control wire. There is a minimum pulse, a maximum pulse, and a repetition rate. A servo motor can usually only turn 90 in either direction for a total of 180 movement. Basically, the name servo motor is related to the term servomechanism, which means that the motor is constantly monitored to control its motion. A servo motor is a self-contained electrical device, that rotate parts of a machine with high efficiency and with great precision. The output shaft of this motor can be moved to a particular angle, position and velocity that a regular motor does not have.

There are two types of current flow in these motors AC and DC. AC servo motors can handle higher current surges and are thus more commonly found in heavy industrial machinery. ISL s DC Servo Motors are best suited for smaller applications and have excellent control-ability and feedback. In a servo motor speed is determined by the frequency of the applied voltage and the number of magnetic poles.

The servo motor consists of two winding stator and rotor windings. The stator winding is wound on the stationary part of the motor, and this winding is also called field winding of the motor. The rotor winding is wound on the rotating part of the motor and this winding is also called the armature winding of the motor. The motor consists of two bearings on the front and backside for the free movement of the shaft. The encoder has the approximate sensor for determining the rotational speed and revolution per minute of the motor. Our Motor Selection Guide will help you identify your requirements. Servo motors come in many sizes and in three basic types.

The three types include positional rotation, continuous rotation, and linear. Positional Rotation servos rotate 180 degrees. They also have stops in the gear mechanism to protect the output shaft from over-rotating. A Continuous Rotation servo motor is a servo that does not have a limit on its range of motion. Instead of having the input signal determine which position the servo should rotate to, the continuous rotation servo relates the input to the speed of the output and direction. The limitless motion of these motors enables them to move in both CW, and CCW directions. Linear Servos use a rack and pinion mechanism to change their output. The rack and pinion converts rotary motion to linear motion. The difference is in the way they signal and process information. Analog Servos operate based on voltage signals that come through the pulse width modulation (PWM).

When an analog servo is at rest, the PWM is essentially off unless you transmit some action. Producing torque from the resting mode makes the initial reaction time sluggish. This delay in torque isn’t ideal for advanced applications. Digital Servos use a small microprocessor to receive and direct action at high-frequency voltage pulses. The digital servo sends nearly six times the amount of pulses an analog signal does. These faster pulses provide consistent torque for quicker and smoother response times. It is important to note the faster pulses require more power emission from the motor . Precision Servo motors entail highly precise operation, hence why they are commonly used in CNC machinery for movement of slide axis. Speed Servo motors offer high speed rotation, and more torque in a small package. Encoder Translates rotary or linear motion to a digital signal. Versatility Wide range of use for servo motors in a variety of applications. Closed Loop- Servo motors use feedback signal to control the system.

AC servo motors are electric motors that operate on alternating current (AC). They have a stator that generates a rotating magnetic field and a rotor that follows the field.AC servo motors can be further divided into two types: synchronous and asynchronous. Synchronous AC servo motors have a permanent magnet rotor that rotates at the same speed as the stator field. They are more efficient, precise, and responsive than asynchronous motors, but they require a more complex controller and a position sensor. Asynchronous AC servo motors have a wound rotor that induces a current and a magnetic field that lags behind the stator field. They are simpler, cheaper, and more rugged than synchronous motors, but they have lower efficiency, accuracy, and speed.

DC servo motors are electric motors that operate on direct current (DC). They have a permanent magnet stator that generates a fixed magnetic field and a wound rotor that rotates when a current is applied. Brushed DC servo motors have a commutator and brushes that switch the current direction in the rotor windings. They are simple, inexpensive, and easy to control, but they have lower efficiency, lifespan, and speed due to friction and wear of the brushes. Brushless DC servo motors have an electronic controller that switches the current direction in the stator windings. They are more efficient, durable, and fast than brushed motors, but they require a more sophisticated controller and a position sensor.

Linear servo motors can be further divided into two types: iron-core and ironless. Iron-core linear servo motors have iron cores in the platen that interact with the magnetic field of the forcer. They have high force density, stiffness, and accuracy, but they also have high cogging force, weight, and heat generation. Ironless linear servo motors have no iron cores in the platen, only magnets. They have low cogging force, weight, and heat generation, but they also have low force density, stiffness, and accuracy. Linear servo motors are suitable for applications that require high speed, acceleration, and precision over long distances. They are commonly used in semiconductor manufacturing, metrology, laser cutting, etc...Analog control signals are continuous voltage or current signals that vary proportionally to the desired setpoint. They are typically used for simple or low-cost servo systems that do not require high accuracy or resolution. For example, a potentiometer can be used to generate an analog control signal for a hobby servo motor.

Digital control signals are discrete pulses or bits that represent the desired setpoint in a coded form. They are typically used for complex or high-performance servo systems that require high accuracy, resolution, or communication. For example, a pulse-width modulation (PWM) signal can be used to generate a digital control signal for a brushless DC servo motor. Proportional-integral-derivative (PID) control: This is a feedback-based control algorithm that adjusts the control signal based on the proportional, integral, and derivative terms of the error signal. It is widely used for servo systems that require a fast and accurate response.

Fuzzy logic control: This is a rule-based control algorithm that adjusts the control signal based on fuzzy sets and linguistic variables. It is useful for servo systems that deal with uncertainty or nonlinearities. Adaptive control: This is a self-tuning control algorithm that adjusts the control parameters based on the changing conditions of the servo system. It is beneficial for servo systems that face disturbances or variations.. We will connect the sensors to a door jamb, and by properly aligning the sensors, we can detect when someone passes through the door.

When this happens, the output of the metal detecting sensor will change, and we will detect this change by continually reading the output of the sensors with an Arduino. We will be making the Automatic Door that will open and close automatically upon sensing presence or absence of metal in our body. If the presence of metal is sensed, we are going to make the door automation not to open. If there is no any metals are present in our body ,the metal detecting sensor which gives signals to servo motor, then the door can be open . The metal detecting sensor senses whether an object has metal particles in it or not. If yes, the motor will turn OFF and no door opening will be done. If not, Motor will remain ON and the door will be opened.

Here we are proposing a system which actually detects the ,metal using a metal detecting sensors. These metal detection have been done prior to the MRI scanning because if a person gets into the MRI room without screening with any metal objects may get a severe injury to avoid these we proposed this system. The existing system just have a hand helding metal screening device not the automatic screening device. Here we are planning to execute a system with automatic metal detection and door system.



The flow will be the patient will be screened with the the metal detecting sensors automatically and then in the response to the sensor the door automation will be done. The door automation can be done with the help of the motor drivers (servo motors). The system actually works with the detection flow such if the metal is detected the door won’t be opened and if the metal is not detected then the door will be opened according to the response of the sensor.