Design and implemetation Backscatter Detecter with Arduino System

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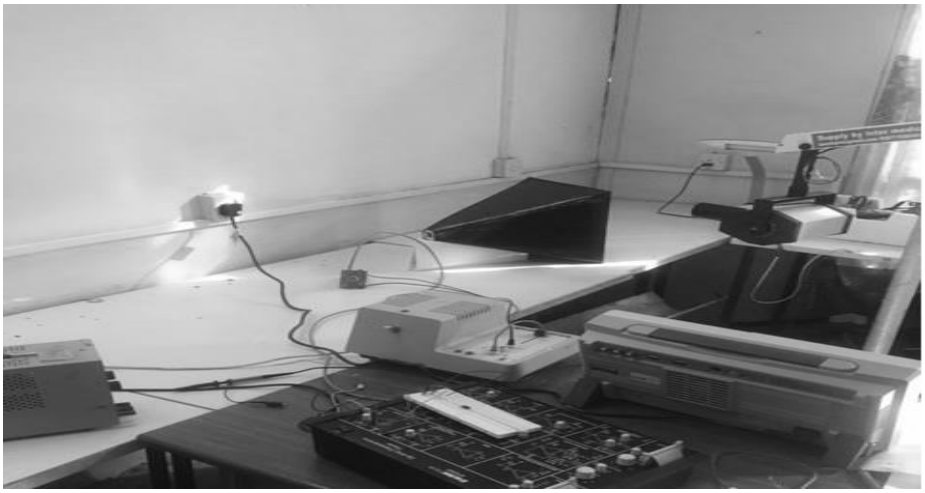
ABSTRACT:- Backscatter X-beam is used to obtain on X-beam imaging innovation. Conventional X-ray machines recognize hard and delicate materials by the variety in transmission through the objective. Conversely, backscatter X-beam identifies the radiation that reflects from the objective. It has potential applications where less-dangerous examination is required, and can be utilized if stand outside of the objective is accessible for examination The innovation is one of two sorts of entire body imaging advancements that have been utilized to perform full-body sweeps of carrier travelers to recognize shrouded weapons, apparatuses, fluids, opiates, money, and other stash. A contending innovation is millimeter wave scanner. These application can be very useful by detecting system specially in security system Purpose . At the point when The X-beams pass through the human body or whatever other Materials The item under X-beam will be absorb , penetrate or Scattered the X-beams bar. These beams which are scattered or launched out from the subject's body are detected by detector placed close to object . The sign delivered by this scattered X-beam detector then used to balance a picture show gadget to create a picture of the subject and any covered Objects conveyed by the subject The indicator get together is built in a setup to consequently and consistently improve the picture edges low nuclear number (low Z) hid articles to encourage their identification. A capacity means is given by which beforehand procured pictures can be contrasted and the present picture for dissecting fluctuations in similitudes with the present picture, and gives intends to making a nonexclusive representation of the body being inspected while stifling anatomical components of the subject to minimize intrusion of the subject's protection-beam imaging systems in view of Compton backscatter license review and screening of ocean compartments, a wide assortment of vehicles, baggage, and even individuals.. Potential applications in the paper will design the X-ray detector machine relay on new technique for image processing by using Arduino as control system with less dangerous assessment on the human body and Contrasts in the sort of data showed by backscatter pictures will be highlighted, between backscatter picture quality furthermore, interpretability, output speed, successful infiltration.

Keywords-; Scatter ; X-ray beam, Photo Multiplier Tube ,Image processing , Arduino

الخلاصة :-
يستخدم الأشعة السينية المرتدة من الاجسام التي تتعرض اليها للحصول على صوره ذات طبيعة محدده حسب الغرض من التصوير . علما ان أجهزة الأشعة السينية التقليدية تواجه صعوبة كبيره لتعرف على المواد الصلبة او الحساسة. على العكس من ذلك فان الأشعة السينية المرتدة من الاجسام يمكن ان يحدد نوع الجسم ونوع المادة التي مر من خلالها . لذلك فان التطبيقات المحتملة لهذا النوع من الأجهزة تكون أقل خطورة، ويمكن أن تستخدم من موقع خارج الجسم المطلوب الوصول اليه او الفحص .ان هذا الابتكار يقدم نوعين من التقدم الحاصل في تصوير الجسم و التي استخدمت تقنيات حديثه لتنفيذ عمليات تمشيط كامل الجسم في العديد من الاماكن مثل تعرض المسافرين لهذا النوع من اجهزه الفحص وذلك للتعرف على أسلحة والأجهزة والسوائل، والمواد الأفيون، والمال، وغيرها التي ممن الممكن ان تكون مخبأ . أن تكون هذه تطبيق مفيد للغاية في الكشف والتحقق وخصوصا في الأنظمة الأمنية. يعتمد عمل الجهاز من خلال تعرض الجسم الي الأشعة السينية عندما تصل إلى النقطة تمرير-أشعة X من خلال جسم الإنسان أو أي مواد أخرى فان الشعاع السيني سيكون اما امتصاص ، اختراق أو ارتداد. نقوم بالكشف عن هذه الأشعة المرتدة و التي تتناثر أو أطلقت خارج من الجسم هذا الموضوع من خلال الكاشف عن وضعها بالقرب من الجسم . حيث ان تصميم كاشف اللاقط للأشعة المرتدة من الاجسام المسلط عليها الاشعاع وبالتالي تحليل هذا الاشعاع للحصول على صوره رقميه تبين لنا محتويات والمواد الرئيسية للجسم المرتد منه الاشعاع علما ان سقوط الاشعاع على الجسم يودي الى اما امتصاص الاشعاع من قبل الجسم او نفاذيته او ارتداد او انعكاس هذا الاشعاع . ان اللاقط او الكاشف المصمم له القدرة على التقاط الأشعة المرتدة من الجسم وتحويلها الى اشارات كهربائية باستخدام الكتر وده الضوئية PHOTO MULTIPLIER TUBE PMT التي بدورها تحول الاشعاع المرتد الى اشارات تتناسب مع طبيعة الجسم ثم تحول هذه الاشارات الي اشارات رقميه من خلال Analogue to digital converter والتي تقوم بحفظها على شكل مصفوفات داخل الذاكرة الكي يتعامل معها فيما بعد وتحويلها الى صور قابله للمعالجة والتعديل من خلال برنامج الماتلاب والمعالج الرئيسي هو اردينو Arduino .

I. Introducation

This paper will introduce new method to develop an X-ray detector system less dangerous on the human body or any object . Detectors with integrated phosphor scintillation , conductive, or metallic fiber can have a good conductivity for X-rays Photon and transmitted to Photo multiplier tube[3] . Highly conductive Phosphor scintillation have been proposed in the past to pick up the signal which reflected and scatter from the human body to Photomultiplier tube (PMT). Photomultiplier tubes (photomultipliers or PMTs for short), one of type the vacuum tubes, and more consider sensitive materials used as detectors of light in the ultraviolet, visible, and near-infrared ranges of the electromagnetic spectrum [4]. These devices can amplify current when the incident light pass on the PMT can be amplify more than 100 million times ,During the amplify stages, enabling photons need to be detected when the incident light is very low[4.5].



Fig(1) Backscatter X-ray system with Arduino

As Show in Fig(2) The Photomultiplier tube has large area of collection , high gain, low interference noise, high bandwidth frequency response, and has maintained photomultipliers an essential medical diagnostics such as blood tests, medical imaging, telecine, radar jamming, and high-end image scanners known as drum scanners[3]. Photomultipliers can be used in different application such as to detect light high-sensitivity detection of light that is imperfectly collimated [1]. Connected the PMT to Arduino . Arduino is an open-source PC equipment and programming organization, undertaking and client group that plans and produces microcontroller-based packs for building computerized gadgets and intuitive articles that can sense and control objects in the physical world[4].the task depends on microcontroller board plans, fabricated by a few merchants, utilizing different microcontrollers. These frameworks give sets of advanced and simple I/O sticks that can be interfaced to different extension sheets ("shields") and different circuits. the Arduino gives an improvement environment in the image Processing, which incorporates support for the C and C++ programming dialects. Now day useing the Arduino in our application to enhancements and collect all the data from detectors . The benefits of Detectors - construct movement sensors in light of x-beam photon are their high affectability and trademark and the likelihood of coordination in Microcontroller framework, for example, Arduino[3]. X-beam backscatter finders cathodes to quantify and recognize parameters, for example, distinctive metals , show awesome guarantee because of the simplicity of coordination of identifiers ,Arduino , and conductive. Arduino framework and weaving is generally used to acknowledge picture . Inaccessibility of x-beam picture handling innovation and confinement in the quality components plan posture challenges in creating X-beams picture framework based indicators. In this segment we will exhibit the convention to build up our recognizing framework to get

the sign and changed over to picture for long time without creating any sort of meddling. In this section we will present the protocol to develop our detecting system to pick up the signal

and converted to image for long time without causing any kind of interfering , in addition to As shown in Fig(1) the Backscatter X-ray Imaging System Produce beam of X-rays to the Object which can be person , Vehicle, bags being examined. In the preferred embodiment, an X-ray generator 1, X-ray tube 2 connect to produce an X-ray beam source as is known in the art for scanning the pencil beam in a horizontal motion across the body, illustrated in Fig(1). X-rays that are scattered or reflected from the body are detected by X-ray sensitive detectors will be fixed on the same direction of scatter ray. The electronic sign created from the indicators and synchronization signals from the X-beam source are steered into Memory then will be move in by bass to control unit to generates an image display on a monitor at each point in the display corresponds to the relative intensity of the detected scattered X-rays. The detectors are mounted on two vertical shafts which are thus mounted on a base to control the movement of the locators as they are moved in a vertical bearing. The X-beam pencil shaft source is mounted on a carriage, which thus in upheld by two turn joints as show in fig (1).one associated with the finder, and the other to a vertical backing. As the locators show above are moved in a vertical heading, the X-beam pencil shaft is moved in a circular segment, such that it generally goes through the opening in the detectors[5] .

(II) Arduino System

Arduino is an open-source prototyping stage taking under consideration simple to-utilize instrumentation and programming As show in Fig(2)[13]. Arduino will scan all input in detector, you'll be able to check your board what to try to do and find out of directions to the microcontroller on the board[12]. The Arduino used the programming idiom (in lightweight of Wiring), and therefore the Arduino code (IDE)[13]. visible of process. Throughout the years Arduino has been the neural structure of a large variety of tasks, from regular articles to advanced experimental instruments. associate degree overall cluster of producers - understudies, specialists, craftsmen, developers, and consultants - has assembled around this open source , their commitments have import unbelievable} live of obtainable info which will be of incredible facilitate to beginners and specialists[9].

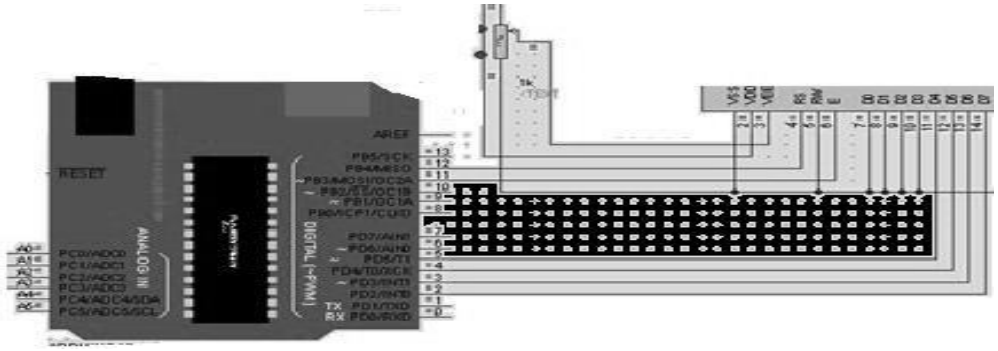


Fig (2) Arduino System [13]

The Arduino board will ever-changing to adapt to new wants and challenges, differentiating its supply from easy 8-bit boards to product for Io T applications, wearable, 3D printing, and embedded environments[9]. the item detection rule has been developed on MATLAB platform by the mixture of many image process algorithms. victimization the speculation of Image Acquisition and Fundamentals of Digital Image process, the item has been detected in real time. varied options of associate degree object like the form, size and color is wont to sight and track the item. The variation in vertical and horizontal axis of detected object is tempered by serial communication port and victimization serial information communications, the state of Arduino board pin has been controlled[9]. MATLAB programming develops a laptop vision system within the real time for object detection and pursuit victimization camera as a picture acquisition hardware. Arduino programming provides associate degree interfacing of a hardware model with management signals generated by real time object detection and tracking[12]. Arduino programming provides associate degree interfacing of a hardware model with management signals generated by real time object detection and pursuit. The revolutionized computers open up the probabilities of victimization pictures associate degreed video frames as an input signals of the signal process. Such signal process is known as as image process. Image process transforms varied sets of characteristics of image parameters into output as management signals[13]. The constant revolution within the field of digital image process release a large number of application in varied areas, during which innovative technologies may are developed. the most effective platform on that several image process algorithms are developed to date is MATLAB. Major advantage of victimization MATLAB as a picture process rule development surroundings is its in-built image process functions and its compatibility with hardware like cameras [9].

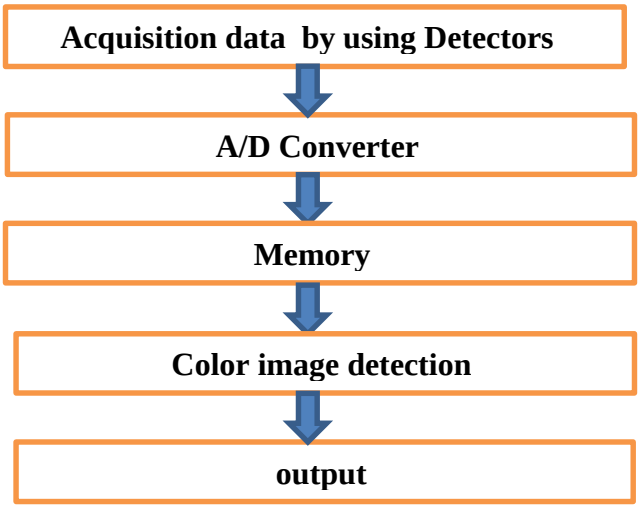


Fig (3) Flowchart of proposed prototype system

Software includes MATLAB and Arduino software whereas hardware includes Detectors ,Camera, Arduino board with Converter Adapter.The goal of this work is to visually detect and track an object in a region and send the data to the Arduino board to glow LEDs connected with the microcontroller's digital output port. The most challenging issue raised while developing the object detection algorithm is that of selecting the feature to use for segmenting the object[10]. Here, using approach based on object's shape is very difficult and less efficient with the system in real time constraints. So, rather using the segmentation by shape, the color of an object has been taken into consideration. The color of an object is a subject of its lightning condition. Working of the proposed prototype system can be understood by the above flowchart.

(III) Detector collection area

To design new detector which able to detect X-ray from known source with range from 50 kv to 170 kv as in fig (4) which represents the principle of the X-ray backscatter system As Show below consist of the following :-

1- X- Ray Generator

2- Detectors

3- A/D Converter

4- Memory

5- Control Unit (Arduino)

6- Display system

Each part was explained separately and The present system consists of an electronic detector can be built by adding a photomultiplier. These kind of detector scintillation or "scintillation

counters". The main advantage of using we can get on required image with low energy and an area sensitive to X-rays and pyramid shape with the total size are 45 cm width , 50 cm height and 55 Cm length As show in Fig (4) below . X-ray detectors are equipment used to detect the spectrum or the properties of X-rays .there are two main purpose of detectors for imaging and dose measurement. in this study we focus on use the Imaging detectors for X-ray backscatter devices were originally imaging plates and photographic but most of them replaced by different kind of computerized methods such as image plates or flat panel detectors. Usually detector place between the body and X-ray generator which as show Fig(3):

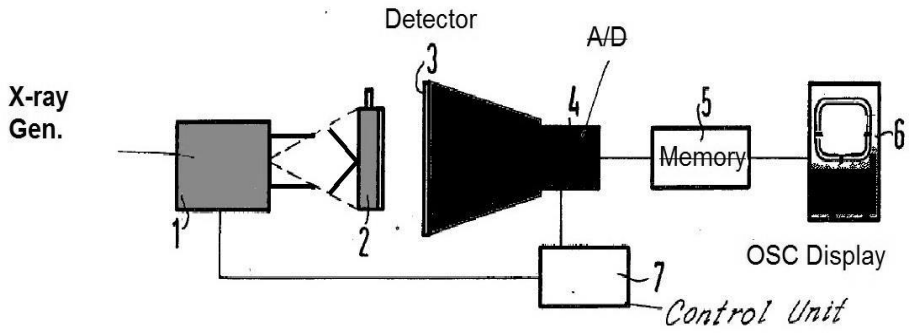


Fig (4) Basic Principle of image of X-ray system [7]

can be placed at the same distance from the subject. In the backscatter detectors will be pick up backscattered radiation when start a scan. We can determine the effective detection area at any given point in the scan is can be the same scan Detector , i.e., one-half the total detector area of the stationary detector configuration[5]. During our experiments we can notice the measurements show that the shape and located of detector receiving about more than fifty percent (50%) of X-rays as backscatter[6]. As indicated above, this is can be more than the transmission method. our detector consists of an active area 1 inch by 24 inches, or a total X-ray collection area of 24 square inches. This is a factor of approximately 40 lower than the 952 square inches of X-ray sensitive area provided in the present invention[3]. The increased collection area of the present invention is increased number of scattered X-rays allowing for reduction in dose compared with the backscatter system of the prior art.

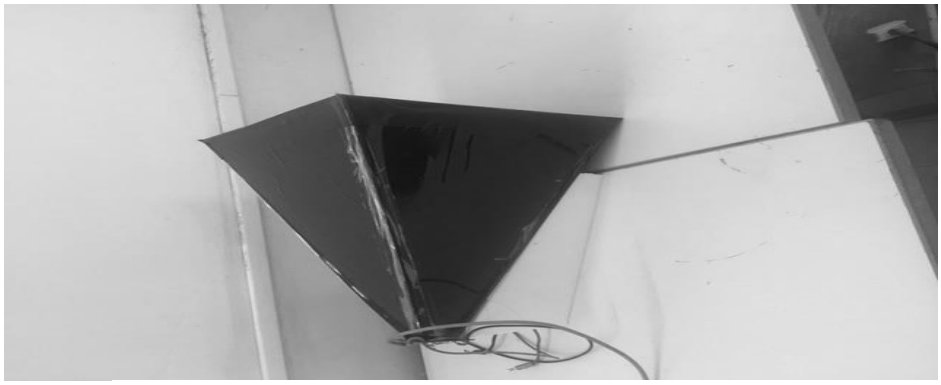


Fig (5) Design detector with Photo multiplier tube

Through our experiments and measurement that the detector must consist of an active area in the range of 150 to 1500 square inches and placed in the range of 9 to 20 inches from the person being searched so that at least 2% of the scattered radiation is detected. When system start work ,we got digital image of the subject. Our detection will concentrate on the part of photons scattered back towards the x-ray source[7]. This can be done with scintillators made out of materials such as sodium iodide. These materials which made up the Scintillators can "convert" an X-ray backscatter to a visible light; In order to gain energy spectrum information, we used A/D to separate the different photons.. These signals are amplified and then converted to digital signal for processing, as seen below [8].X-ray backscatter imaging can be used to see through objects. This can be done by subtracting a lower energy scan from a higher energy scan. The results of this can be seen in our simulation below when we upload in Matlab. This image is then processed by the digital computer to identify key features in the image. This library of human images is used to identify common anatomical features in the present subject so those anatomical features can be suppressed[2]. The library may also contain within its images certain common benign objects which can also be suppressed to permit more accurate detection of dangerous or illegal concealed objects. The location of detected features can be referenced to the absolute location in the image, or in relation to the body of the person being examined[10]. The latter method has the advantage of being insensitive to subject positioning within the imaging window and differing subject size.

(VI) Simulation by Using Matlab

The entire algorithm for object detection and tracking is a base on image processing. The proposed system uses MATLAB as a platform on which image processing algorithm has been developed and tested. As an image acquisition device , camera is used[8]. A camera can be an built in camera of laptop or it can be a USB camera as well. To get the detail of the hardware device interfaced with the computer, ***imaqhwinfo*** command of MATLAB is used. Entire

MATLAB programme for this algorithm can be divided in parts as follows. *A. Image Acquisition:*The first task in image processing algorithm is to get the live video feed from the camera connected[9]. This live video feed has further been converted into sequence of frames and these frames are used in order to apply further image processing algorithm. For that ***get snapshot*** command of MATLAB is used, which converts video feed into image array. Conditionally, ROI (Region of Interest) can also be defined for capturing specified area of the frame. Image acquisition toolbox of MATLAB can also be used for image acquisition purpose To perform the image, which is p_3_2.jpg, negative transformation, first we have to read the image p_3_2.jpg that shows the MRI of the brain by using command imread, let us name our image (brain). After we read the image, we use the command Size to determine the image's size (size of array). Using command double will help us to convert to double precision. I use command zeros to make a matrix that is N-by-N zeros. Next steps, I used the expression s=L-1-r that are given with question to perform the negative of the image, which is gray levels, with the range [0, L-1]. Then, I closed with the commands end and end. To be able to compare the original image with the image after perform, I used command imshow (brain) for original image; after that I used command figure to be able to see the image after performing negative transformation and imshow (f, [0 255]). We see that from two images. In the original image, around the brain image is the black level and the brain in the image with gray level. In the image after transformation, the brain has less gray level than the original and around the brain is more white level.

The program on MATLAB should be as the following:

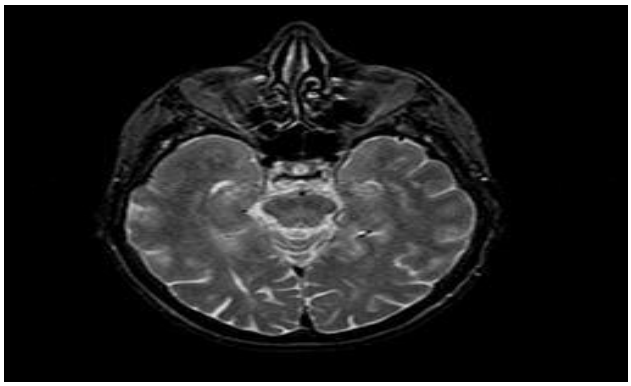
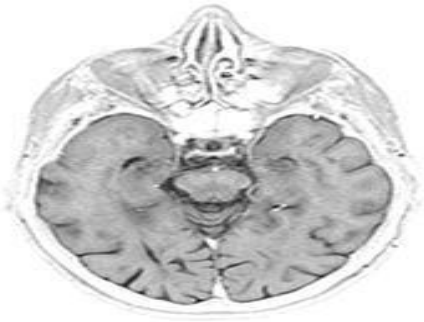


Fig (6)The original image of brain



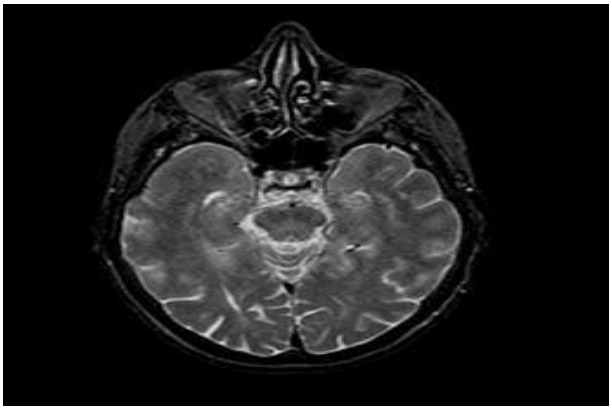
Fig(7) The image of the brain after negative transformation

In part B question 1, log transformation to the brain image. Part B in question 1 is close to part A. The difference will be in the expression. First we have to read the image p_3_2.jpg that shows the MRI of the brain by using command imread, the name of the image will be (brain). After we read the image, we use the command Size to determine the image's size (size of array). Using command double will help us to convert to double precision. I use command zeros to make a matrix that is N-by-N zeros. In the part B, I have to use a log transformation. The general form of the log transformation, which is given in the question, is:

$S = c \log (1+r)$ ----------(1)

The constant of c = 100 r is the original pixel value ; and s is the new pixel value ;

The program should be as the following:



Fig(8)The original image of the brain

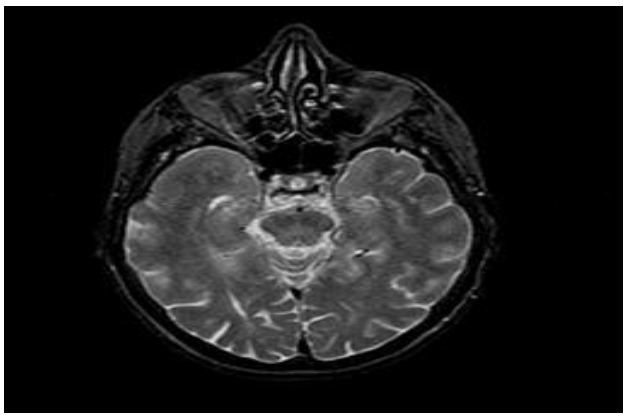
Fig(9) The image after the log transformation

The difference between two images is in the original image shows the brain image and the area around with different gray levels. In the image after log transformation, the image shows brain white and the area around the brain is black. In the part C, we have to do the power law transformation to the brain image. First we have to read the image p_3_2.jpg that shows the MRI of the brine by using command imread, let us name our image (brain) too in this transformation. After we read the image, we use the command Size to determine the image's size (size of array). Using command double will help us to convert to double precision. I use command zeros to make a matrix that is N-by-N zeros. The basic form of the power law transformation is:

$S=cr^{y}$ ----------(2)

Where C=1 and y=0.6, 0.3.

The program on MATLAB should be as the following:



Fig(10)The original image of the brain

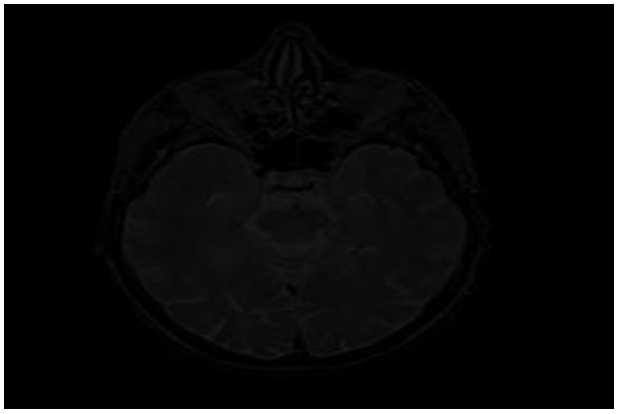


Fig (12) The image after power law transformation with 0.6

Fig(13) The image after power law transformation with 0.3

Three images have got after program, the first image is an original image of brain. The second image is the image of brain after the power law transformation; we can see in the second image that brain in the image is darker (we still able to see it) than original image due to 0.6 is considered a small number. In the third image, it shows the dark image (it is hard to see brain in the image) because of 0.3 which is really small number. So, the image is a dark (black) image.

(V) Conclusion

Now day there is increased concerns about security everywhere after all the relevant events , Image Using backscatter x-ray Detectors can used widely to implementation in around the world . These devices use Compton scattered x-rays to make the new connection to computerized to detect and recognize any explosives or weapons they might be carrying. However, there are concerns over the detector's abilities to always detect hidden explosives[4]. Also, There are concerns about Health effect by X-rays radiation when human body exposure for long time. The imaging impact is much the same as taking a photo of the compartment substance through the optically murky mass of the holder with picture shine exceptionally

corresponded with the normal nuclear number of the segments of the picture. Besides, these pictures can be taken at relative framework versus target object rates of 10 km/hour and that's only the tip of the iceberg. Such frameworks can be outlined with an extensive variety of tradeoffs between determination, check speed, and field-of-perspective and offer one of a kind uneven imaging abilities that are impractical with straightforward transmission X-beam frameworks. On the other hand, if fancied, transmission imaging ability can be included onto any backscatter framework. Various perspectives are likewise conceivable with appropriate framework plan, so that cargoes may be imaged from a few distinct bearings.

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