

# Medical Image Transmission over GSM

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## ABSTRACT

Advancements in data transmission has allowed radiologists at a given workstation anywhere in the world to send and manipulate any digital information. The technology proposed uses wireless network for the transmission of medical images to radiologist. Transmission of various imaging modalities like Computed Tomography (CT), and Magnetic Resonance Imaging (MRI) are considered. The input DICOM medical image is converted to JPEG form by extracting some of the necessary patient details and processing the extracted details. The processed data is transmitted over GSM network. Transmitted image is received by smart phone of radiologist. After image diagnose and interpretation, text message is retransmitted to the source location by addressing patient disease. Medical images are transmitted to radiologist smart phone over wireless network such as GSM. Thus application may be hosted from a single system accessed by many others.

## Keywords

DICOM image, Raspberry PI, GSM/GPRS, Linux, DCMTK

## 1. INTRODUCTION

In present situations, medical images (mainly of radiographs - e.g. X-rays) become compulsory in all the health centers to diagnose the diseases in the human body. Tele radiology (the transmission of Radiographs using communication networks) is useful in places where the population is widely scattered over a large geographical area so that access to health centers is difficult. This technique is also useful in situations when the time of diagnosis is critical as an emergency in hospitals.

The demand for medical image interpretation services in radiology is developing rapidly all over the world. This is because of the lack of adequate staff for providing specialty expertise. These problems can be overcome by utilizing communication to draw on the expertise of distantly located radiologists [1]

Some of the current goals of tele radiology include making radiological consultations available in medical facilities without on-site radiological support, enhancing educational opportunities for practicing radiologists and providing timely availability of radiological images and its interpretations in emergent and non-emergent clinical care areas [4].

There is a necessity of enable the proper interpretation and advice of the radiologists about the disease to the remote, rural and unserved population. Medical image transmission to the specialized doctors is one of the approaches in the form of improved access and reduced cost to the rural patients. This

enables the specialist doctor to assess the physical and psychological state of the patient and suggest treatment. This remote consultation and treatment is much more valuable in case of post operation (Post Surgery) follow up since the patient is not required to travel unnecessarily and hence saving money and time.

The different medical imaging modalities are X-ray radiography, magnetic resonance imaging, ultrasonography, endoscopy, elastography, tactile imaging, thermography etc. These images can be utilized for timely interpretation and also provide greater access to Physicians about the patient condition. Also allows specialists to view medical images in various locations and they provide service. The standard technologies such as GSM/GPRS module, Raspberry PI processor are used. GSM/GPRS is a third party dependent mode of wireless communication. It has a recurring cost and depends on public wireless communication domain though it is less cost. By utilizing GSM and GPRS technology we can achieve wireless communication up to far greater distances as compared to point to point communication with a very low competitive cost. Quality of the medical image should be good otherwise it may end up with erroneous result. The necessity of secure transmission is vital in the medical world.

## 2. RELATED WORK

The wireless devices have advances the medical world with a wide range of capability by providing the quality of life of patients. Wireless technology enables clinicians to monitor patients remotely and give them timely health information, reminders, and support potentially extending the reach of health care by making it available anywhere, anytime. The use of wireless technologies in medical environments is bringing major advantages to the existing healthcare services.

75% of doctors are practice in the urban areas as mentioned above so that in rural area people will not get timely consultation and advice of especially radiologists. X-rays scanning facility can be provided but the consultation of radiologist is quite difficult task [5]. If rural and remote area people want to consult a doctor it may be expensive and sometimes they could not reach them according their requirement. As we seen in the day today life there will be a fake doctors around us who do not held the proper degree and cheating the people for money. In order to overcome these problems the wireless transmission and reception of the medical image using GSM/GPRS technology can be used. By taking the doctor advice people can be careful with the health issues by asking the second opinion of specialized radiologist in their own place with less cost.

Some of the advanced technologies in the medical field are, a real time health monitoring system of remote patient developed is a wearable device. This device will be wearied by the patient and parameters such as Temperature, Heart Beat and ECG will be continuously transmitted and monitored through wireless technology ZigBee [10]. The radiographic images can be viewed from any workstation within its network. The basic functions carried out by PACS are image retrieval, image transfer, viewing and networking [1]. In medical imaging, the fast delivery of medical reports to referring medical practitioners is a major component of cooperative patient care. Recently, active involvement of smart phones brought effectiveness in telemedicine applications. The phone is a best medium to carry through faster delivery of information to the medical practitioners. An electronic medical report delivery system from a medical imaging department to the mobile phones of the referring doctors. The system which contains both text summary of medical report and a medical image in JPEG format, which are transmitted to 3G GSM mobile phones [12].

### 3. PROPOSED WORK

The medical images can be obtained from the X-ray or scanning centers but the appointments of radiologist are difficult and costly for rural and financially backward people. The DICOM is a medical standard to aid the distribution and viewing of medical images, such as CT scans, MRIs, and ultrasound etc. A single DICOM file contains a header which stores information about the patient's name, the type of scan, image dimensions, etc. and also the image data. This is different from the popular analyses format, which stores the image data in one file (\*.img) and the header data in another file (\*.hdr). Another difference between DICOM and analyze is that the DICOM image data can be compressed (encapsulated) to reduce the image size. The size of medical images normally is the range of Megabytes in DICOM standard. Files can be compressed using lossy or lossless compression techniques and also converted into various formats such as TIF (Tagged Image File), JPEG (Joint Photographic Experts Group), BMP (Bitmap), WMF (Windows Metafile), EMF (Enhanced Metafile), PNG (Portable Network Graphics)files.

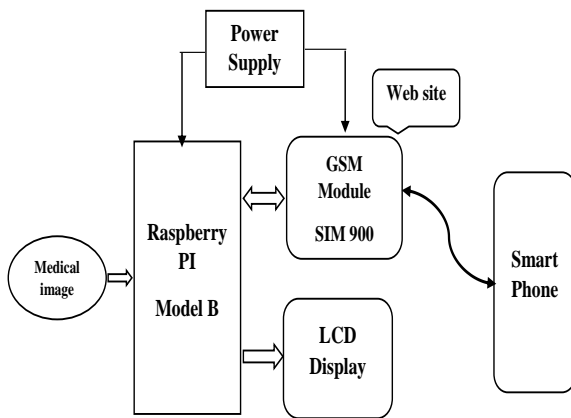


Figure 3.1: Proposed block diagram

The proposed technology is as shown in figure 3.1 in the form of block diagram. The proposed method is explained as follows the

input medical images in DICOM format from the patients which can be stored in the temporary storage device like pen drive. The DICOM images cannot be seen in all the platform like mobile phone, computers etc. so it is necessary to convert the DICOM form because of its popularity and also it consumes less space. The image stored in the temporary storage device is recognized by USB (Universal Serial Bus) of the processor Raspberry PI which is having Linux as an operating platform. C++ is one of the popular and general-purpose programming language. It has imperative, object-oriented and generic programming features, while also providing facilities for low-level memory manipulation. C++ programming language is used to convert DICOM image into the JPEG format with extracting some of the patient details. The converted image will reduce to Kilobytes from Megabytes range. These converted image is send to the GSM 900 module for transmission. At the reception end image will received by the smart phone of the radiologist. The received image is undergo diagnosis and the interpretations are sent back to the remote location as a text message with the help of LCD display the text messages can be viewed.

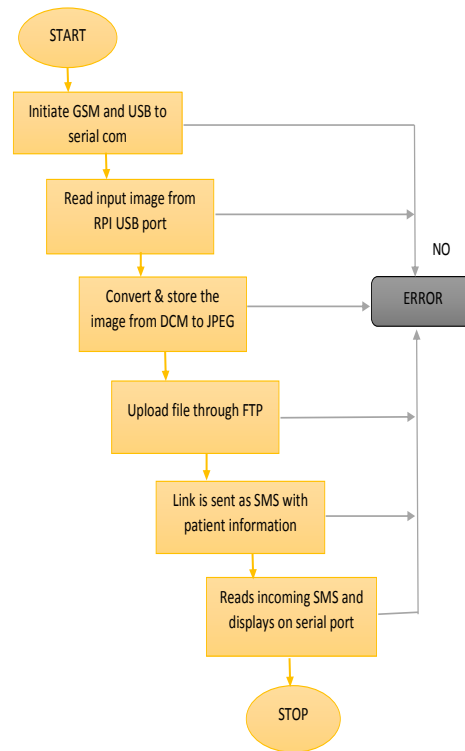


Figure 3.2: Flow Chart of the proposed work

The above figure 3.2 shows the pictorial representation of the operation flow of the proposed electronic gadget in the remote place. Which is placed in the government hospital for the benefit of the rural people so that the system can be access by the many users by placing it in the public place with the very less and affordable cost. All the functions shown in the flow chart executed one after the other, if any of the function fails it encountered with error and the system needs to restart for the new transmission.

## 4. IMPLEMENTATION

- DICOM medical image is inputted by USB port of Raspberry PI Model B through temporary storage device like pen drive.
- Inputted DICOM image is converted into JPEG form in order to reduce the size and also to see in the image in the smart phone.
- This conversion processes is done in the Raspberry PI in the raspbian which is one of the type of Linux operating system using C++ programming language.
- DCMTK tool kit is used to convert .dcm file to .jpeg and resulted image is uploaded to the web site which is created previously.
- The uploaded URL (link) and the patient's data like name, gender, modality, date of birth, hospital name etc. are extracted by processor from the DICOM image.
- These information's are send to the radiologist smart phone in the form of SMS through GSM/GPRS module which is interfaced with RPI.
- At the destination part radiologist will diagnose the image and send back the interpretations in the form of SMS only.
- These messages are received by the GSM module and can be seen in the LCD display which also connected to the RPI as shown in the block diagram.
- The communication between the processor and display is done by using the serial communication port of the computer and RealTerm software is used for serial communication.

## 5. RESULT

The DICOM input images are acquired and processed. The image is sent over wireless network to radiologist location using GPRS module. Once the image reaches to smart phone in the form of SMS which contains the link of the image to be diagnosed as well as extracted patient details Image will undergo diagnoses and interpretations are sent back in the form of SMS this can be viewed in LCD display which is connected to raspberry PI. The image shown above is converted image and its size is reduced to 520kb to 23.8kb so that usage of bandwidth will be less and fast delivery of the medical images.

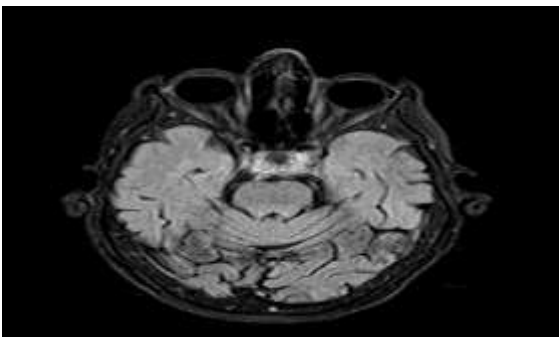


Figure 5.1: DICOM to JPEG converted image

It also provides cost effective medical services which costs 3 Rupees per SMS sent from the remote place because it also consist of the link which always uploads the new image every time to the website by overlapping older image. The SMS in the

radiologist smart phone from the remote place consist of link of a medial image followed by patient details. The image can be seen by clicking the link the image is shown in the figure 5.1 and the message from the doctor's phone to the remote place which can be seen in the display. The electronic gadget successfully sent medical image over wireless network and specialist response can be obtained as soon as the doctor diagnosed the patient disease.

## 6. CONCLUSION

In this study development of a medical image delivery system and exploring the advantages of mobile phone as a fast deliver platform in telemedicine. Our electronic gadget will accept and convert the DICOM image to jpeg image and successfully delivers the patient image with some extracted patient details. Also doctor's interpretations are received by the device and displayed. The system is expected to improve quality and efficiency of patient service thanks to fast delivery of medical images. Our electronic gadget can make drastic change in rural healthcare practice by bringing world class medical facilities to remote and rural villages. People who are suffer of poor rural healthcare facilities will be able to access those facilities at their door step. It can provide specialist advice and counseling via use of information and communication technologies at patient's home or nearest possible site eliminating need of unnecessary travelling. It helps in providing healthcare facilities at remote villages. It is very helpful for medical professional in exchanging information and consultation. It can be used to save life of injured people at war or disaster effected areas and also help in the education of medical healthcare professionals. The system design is expandable, and further improvement is feasible. We believe that this system is a valuable next step forward in the development of state of the art telemedicine applications in clinical practice.

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