RURAL HEALTH CARE MONITORING AND EVALUATION USING

MOBILE CLOUD COMPUTING ARCHITECTURE

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ABSTRACT: In the world of wireless technology, rural public health care can be managed and monitored by using mobile (peer to peer) cloud architecture. All the government hospitals situated for a particular village can store the information or data about each and every person of that village. For the management of public health, we propose a mobile cloud architecture, under which we have the patient details which will be monitored and evaluated by VHN (Village Home Nurse). All the information is stored in the cloud database, which can be retrieved at the time of requirement by the VHNS. All the VHN'S will be controlled by one HVHN (Head Village Home Nurse).And all the neighbouring villages and VHN'S will be directly linked to the cloud database situated at the hospital. The patients can use the telephonic services or they can contact via sms at time of emergencies. The patients can also access the information easily through their mobile devices.

Keywords- Cloud, Architecture, Nurses, Mobile devices, Patients

1. INTRODUCTION:-

Peer to peer mobile cloud computing is a modern form of wireless technology. By using this we can serve in a much better way in the field of health care as compared to our existing system. This system provides a direct monitoring and evaluation of all the patients by the VHN'S on daily basis. The patients can contact to the

VHN'S in case of normal health check-up through mobile cloud computing. In this all the details of the patient's medical history would be stored in advance in the cloud database present at the hospitals. At the time of check-up the VHN'S can retrieve all the information from the cloud database. All the details of the medication offered to the patient along with the appointments, disease diagnosed and medicines offered will be stored in the database. The patients also don't need to travel far for doctor's consultancy. The patients can also directly take the medicines as per the prescribed dosages from the nearest government chemist shop, by showing them the online cloud receipt of the respected patient. All the patients will contact via telecalls or sms to the VHN'S. If the VHN'S feel that they need personal assistance then only particular VHN'S would be sent to a particular place. At time of emergencies they can directly avail the emergency services present at the hospital by telecalling them. The ambulance along with VHN'S would be sent as soon as the complaint is received.

2. RELATED WORKS:-

This paper includes a wireless healthcare monitoring solution based on a secure technology in hospital context. Actually, radio frequency (RF) networks can present electromagnetic disturbances in hospital environments. The authors thus investigate an alternative solution based on infrared (IR) technology. As patient mobility is inevitable, they focus on mobile IR communications considering line-of-sight (LOS) propagation between the transmitter coupled with medical sensors and the receiver. In this paper, the authors study different mobility scenarios, one in two dimensions (2D) for a fixed transmitter height and another in three dimensions (3D) by considering transmitter height variations. In each case, they analyse the distributions of channel gain state to find the statistical model of the mobile IR channel for a given distribution of the patient locations within the room (uniform or Gaussian). **[1]** This paper presents a proof of concept that has been developed to monitor, record, and analyze heart rate through digital stethoscope. The design enables a physician to develop custom analysis and monitoring to collect key indicator or set alerts without a need for infrastructure implementations to store or transfer the data. **[2]** In this paper, the research efforts have targeted the idea of using open-source cloud computing technologies as the mechanism to build an affordable, secure, and scalable platform that supports billing as well as EHR operations. The platform is known as Med Book, and in this paper they have presented the architecture and implementation status of this system. Med Book provides patients, health care providers, and health care payers a platform for exchange of information about EHR, billing activities, and benefits inquiries. Med Book is a Software-as-a-Service (SaaS) application built on top of open source technologies and running on an Infrastructure-as-a-Service platform. The client applications are mobile apps run from iPhone and iPad devices. **[3]** In this paper, a role-based intelligent mobile care system with alert mechanism in chronic care environment is proposed and implemented. The roles in their system include patients, physicians, nurses, and healthcare providers. Each of these roles represents a person that uses a mobile device such as a mobile phone to communicate with the server setup in the care centre such that he or she can go around without restrictions. For commercial mobile phones with Bluetooth communication capability attached to chronic patients, we have developed physiological signal recognition algorithms that were implemented and built-in in the mobile phone without affecting its original communication functions. It is thus possible to integrate several front-end mobile care devices with Bluetooth communication capability to extract patients' various physiological parameters

[such as blood pressure, pulse, saturation of haemoglobin (SpO2), and electrocardiogram (ECG)], to monitor multiple physiological signals without space limit, and to upload important or abnormal physiological information to healthcare centre for storage and analysis or transmit the information to physicians and healthcare providers for further processing. **[4]** In this article, they have provided detailed discussions on the privacy and

security issues in e-healthcare systems and viable techniques for these issues. Furthermore, we demonstrate the design challenge in the fulfilment of conflicting goals through an exemplary scenario, where the wireless body sensor network is leveraged, and a sound solution is proposed to overcome the conflict. **[5]** With the rise of mobile Internet and cloud computing new ubiquitous medical services will emerge coinciding with changes in demographics and social structures. In this paper, Mobile e-health and wellness applications can help relieving the burden of accelerating health care costs due to aging societies. In order to leverage these new innovations a holistic approach must be considered. Facilitating user centred design, acceptance models for user diversity and cultural as well as hedonic aspects can lead to development of services that improve therapy compliance and can even change the youth's lifestyle. An overview of such applications is presented and put into a cultural context.

[6] This system uses an auction mechanism based on trust to select an ambulance for emergency patient transportation. In this paper we see that a patient is shifted to a hospital, which is specialist in that cause i.e. if a person suffers heart attack then he will be shifted to a heart care hospital. **[7]** This paper covers a review of recent e-emergency systems, including the wireless technologies used, as well as the data transmitted (electronic patient record, bio-signals, medical images and video, subject video, and other). Furthermore, it also contains emerging wireless video systems for reliable communications in these applications are presented. We anticipate that in-health e-emergency systems will significantly affect the delivery of healthcare; however, their exploitation in daily practice still remains to be achieved. **[8]** This paper presents a cloud-based healthcare system that integrates a formal care system (DACAR) with an informal care system (Microsoft HealthVault). This system also provides us with high levels of security and privacy within a cloud environment, enabling sharing of both health records and the access rights, along the patient pathway. They also define a case study that can help in evaluating and in demonstrating the usefulness of a cloud-based integrated health care system.

[9] There has been a rapid development in mobile computing and cloud computing trigger novel computing paradigm. Mobile Cloud Computing. This paper reviews current research effort towards Mobile Computing. First, they present several challenges for the design of Mobile Cloud Computing service. Second, a concept model has been proposed by them to analyse related research work. Third, they have surveyed recent Mobile Cloud Computing architecture, application partition & offloading, and context-aware service. **[10]** In this, the proposed framework uses a Cloud Computing protocol management model which intends to provide multimedia sensor signal processing & security as a service to mobile devices. Their approach suggests that multimedia and security operations can be performed in the cloud, allowing mobile health service providers to subscribe and extend the capabilities of their mobile health applications beyond the existing mobile device limitations. **[11]** In this paper, the m-health is currently bringing together major academic research and industry disciplines worldwide to achieve innovative solutions in the areas of healthcare delivery and technology sectors. From the wireless communications perspective, the cur- rent decade is expected to bring the introduction of new wire-less standards and network systems with true mobile broadband and fast internet access healthcare services.

These all will be developed around what is currently called the fourth-generation (4G) mobile communication systems. In this editorial paper, we will introduce the new and novel concept of 4G health that represents the long-term evolution of m-health since the introduction of the concept in 2004. In this, the special section also presents a snapshot of the recent advances in these areas and addresses some of the challenges and future implementation issues from the evolved m-health perspective. This will also present some of the concepts that can go beyond the traditional "m-health ecosystem" of the existing systems. The contributions presented in this paper's special section represent some of these developments and illustrate the multidisciplinary nature of this important and emerging healthcare delivery concept. **[12]** This paper takes a closer look at these applications, specifically with regard to the health care industry and their underlying link technologies. In this, the authors believe that the BlackBerry platform and the associated infrastructure (i.e., BlackBerry Enterprise Server) is a logical and practical solution for e-Health, m-Health, sensor and M2M deployments, which are considered in this paper. **[13]**

3. PRPOSED METHODOLOGY:-

The following diagram represents a proposed architecture for rural healthcare monitoring and evaluation using mobile cloud computing architecture. In this system, all the details of the patient-1 and patient-2 are already stored in the cloud database. Both the patients are monitored by VHN'S. The VHN-1 and VHN-2 are under the direct control of HVHN. Both the VHNS will first see the criticality of the case and accordingly they will respond to it. They will check the cloud database present at the hospital centre. This includes the entire medical history of the patients i.e. the disease detected, list of tests being performed and those which are yet to be performed, the time period for which medication was offered etc. After seeing the details and the criticality of patient the further course of action is decided either by the HVHN or a doctor.

If required, then the ambulance is sent to required spot along with a VHN or a doctor. After this the patient is immediately admitted to the hospital for proper medication and observation under the supervision of the doctor. All the primary or preliminary tests are conducted. After that according to the reports the further course of action is decided by the team of expert doctors and immediate necessary actions are taken. This method ought to serve our country in the field of healthcare in a much more efficient way as compared to our present healthcare system. In the era of fast moving technology this method can prove to be a boon for us and can surely take rural healthcare to the next levels.
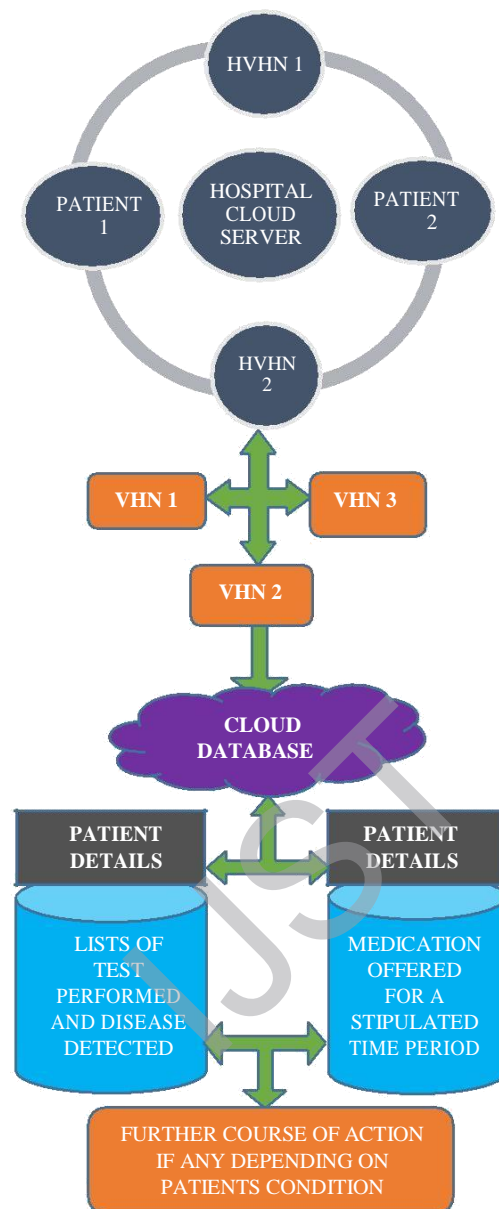
Figure-1 Process Flow Chart

The following diagram represents a cloud setup, which includes the each and everything varying from patient's mobile network to expert panel of doctors sitting at the hospital and watching patient's condition. In this they are using cloud network and base station network to watch the live video streaming of patient. They are making use of the systems present at remote location along with signal boosters.
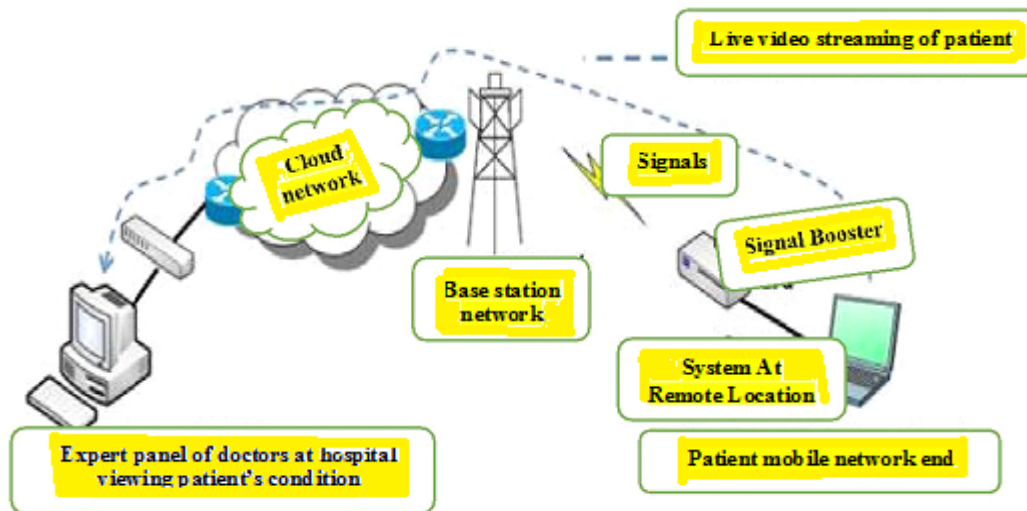
Figure-2 Cloud Setup For Rural Healthcare System

4. EMERGENCY SITUATION:-

The following diagram represents an accident scene in which a person had a collision with a car while he was walking on the road. The nearby people who came for the rescue called the hospital for the ambulance. Here all the three people i.e. PERSON-1, PERSON-2 AND PERSON-3 called the hospital through their mobile by using mobile based cloud architecture.
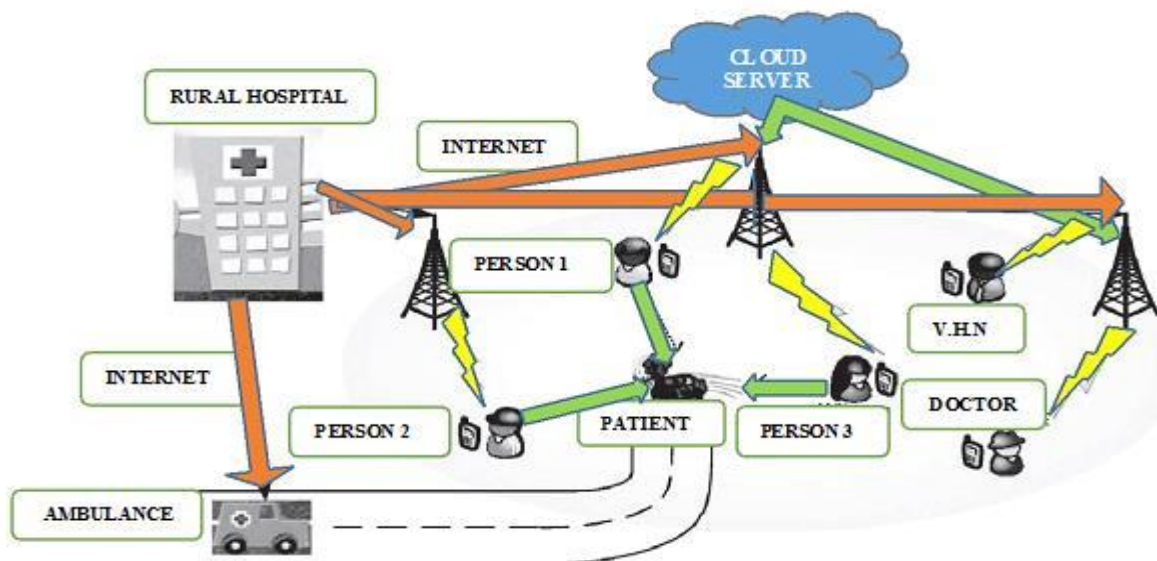

**Figure-3 Emergency setup for accident scene**

In this the VHN'S received the call and by seeing the criticality of situation and consulting a doctor, they immediately send a message through cloud to the ambulance van patrolling in that area. The ambulance reaches the accident spot within time and takes the victim to the hospital. At the hospital the victim is given the entire treatment and medical aid as per requirement. Now in such cases CLOUD SERVER seemed to be helpful because it is necessary for a doctor to know the medical history of the patient before he/she is offered further doses. Now we all know that during the time of emergency no one is carrying such documents. And moreover, it becomes very difficult for the people to preserve these records for a long period of time. In the cloud database of every rural hospital the entire patient history which include tests conducted, medication offered and disease detected for every patient. It also includes the doctor details under whom medication was offered. The details of dosages of all medicines are available so that the patient can directly view them and take the medicines as per instructions and requirement. The patients can return back to their home after initial treatment and they can be monitored by VHN'S by using mobile cloud computing. All these VHNs are reporting to their HVHN (Head Village Home Nurse). This saves space time and money for both doctors and patient and helps us in serving in a better way.

5. EVALUATION AND MONITORING:-
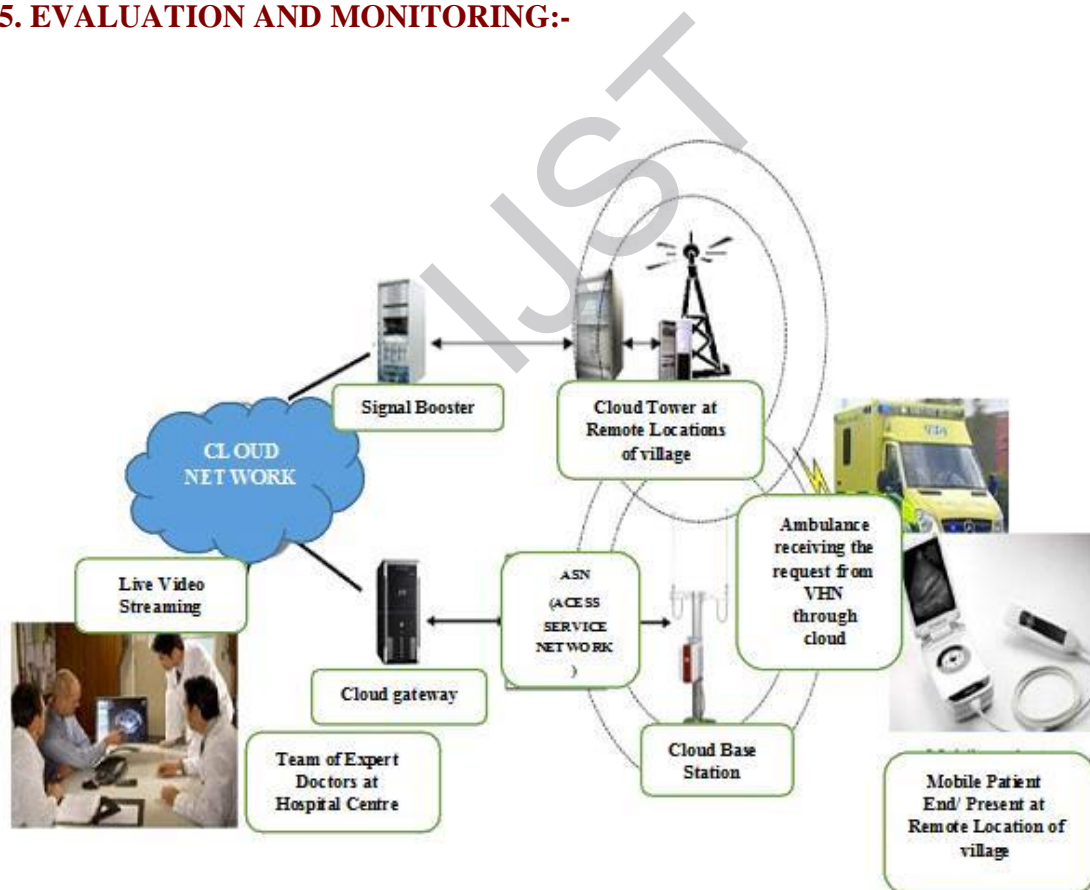
Figure-4 Monitoring Patients Via Cloud Based Healthcare Approach

The given diagram represents or depicts the monitoring of the patients by expert team of doctors present at the hospital. The team of doctors are seeing the patient present at the mobile end through cloud network. In this network we have signal boosters to boost the signals from the patients end. We also have cloud towers present at various remote locations to strengthen the signals. The cloud network provides us a cloud gateway to access all the emergency services as fast as possible like ambulance services, immediate first aid etc. In this the team of doctors will discuss and monitor the patient's condition along with HVHN (Head Village Home Nurse) and

VHNS (Village Home Nurses) and will prepare the reports and further course of action (if any). This diagram represents a live ultrasound streaming of patient present at mobile end. The doctors will prescribe the further medicines and dosages on the cloud database itself and the patient can directly show the name of the medicines given by the doctor at the nearest government medicine shops through their mobile devices and avail them at very low cost. The patients can also get their various tests done in nearby clinic and can send the report through mobile cloud computing. This is a full proof system based on the mobile cloud approach. This method ought to serve in a much better and successful manner.
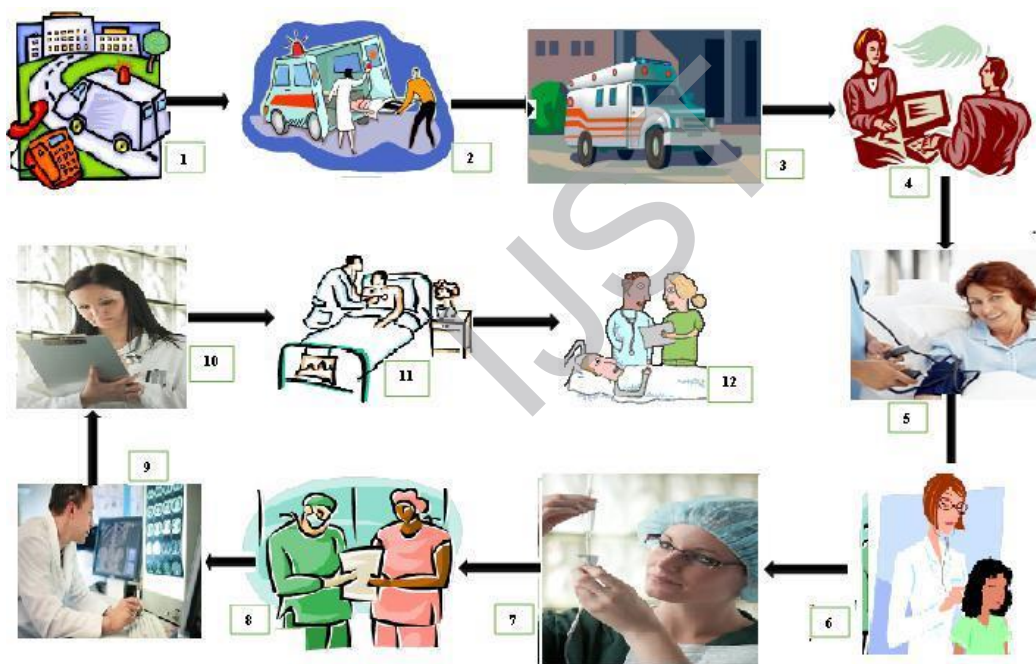
Figure-5 Functioning Of Cloud Based Rural Healthcare Architecture Using Mobile

The above diagram represents the complete functioning of the cloud based healthcare approach. In this picture-1 depicts the ambulance being called up for the patient. In picture-2 the patient is being put up in the ambulance. A VHN is also accompanying the patient. The picture-3 shows that the patient has been brought to the hospital.

In picture-4 all the formalities have been completed at the reception by patient's relative. In picture-5 the normal check-up of blood pressure and pulse rate is done. Picture-6 depicts that the doctor is also checking the patient so that it can prescribe the tests. In picture-7 the VHN is preparing the anaesthesia injection. Picture-8 shows that the doctors are ready for conducting the prescribed tests by the doctor. Picture-9 shows doctor evaluating the tests reports (X-ray). In picture-10, you can clearly see the HVHN is preparing the final report as instructed by the doctor. Picture-11, depicts the doctor checking up the patient and providing the necessary medication. Picture-12 shows that the doctor is checking the patient finally and the VHN is preparing the documents for discharging.

6. EXPERIMENTAL ANALYSIS:-

An experiment was conducted randomly for 5 patients by using mobile cloud computing architecture. The details of all the test along with the results is being displayed in the following table.

PATIENT ID	PATIENT ID	PATIENT ID	PATIENT ID	PATIENT ID	PATIENT ID
PAT019	SUGAR TEST	DIABETES	AVERAGE	PATIENT ID	DOC115
PAT035	PATIENT ID	PATIENT ID	NORMAL	TESTS	DOC149
PAT048	TESTS	TESTS	CRITICAL	CARDIOLOGIST	DOC003
PAT063	X-RAY	PATIENT ID	HIGH	ORTHOPAEDIC	DOC097
PATIENT			TESTS		

🟥 **CRITICAL**   🟩 **NORMAL**   🟨 **HIGH**   🟪 **AVERAGE**

Table-1 Experimental Details Of Mobile Based Cloud Healthcare

The given table shows the details of various patients whose name have already been registered in the cloud along with their patient ID's. The details of the entire tests been conducted, along with disease being diagnosed is shown in the table. The ID's of the various doctors consulting the patients have been displayed. In this the patients having red mark are considered critical and are provided with immediate medication. Those with yellow mark are considered less critical than red one's. The one's with green marks are normal and pink marks are average. The patients are seen according to their criticality levels by various consulting doctor.

The following bar graph shows a comparative study between present day healthcare system and cloud based approach. The patients who used to get treatment under normal case increased significantly from 29% to 73%. In the case of high it got increased from 62 % to 81%. In case of average it is increased from 53% to 85%. Whereas in case of critical it stood from 47% to 79%. This clearly shows the success of this cloud based healthcare approach.

COMPARITIVE STUDY BETWEEN PRESENT HEALTHCARE SYSTEM AND CLOUD BASED APPROACH

	CLOUD BASED HEALTHCARE APPROACH	PRESENT HEALTHCARE SYSTEM
NORMAL	73%	29%
HIGH	81%	62%
AVERAGE	85%	53%
CRITICAL	79%	47%
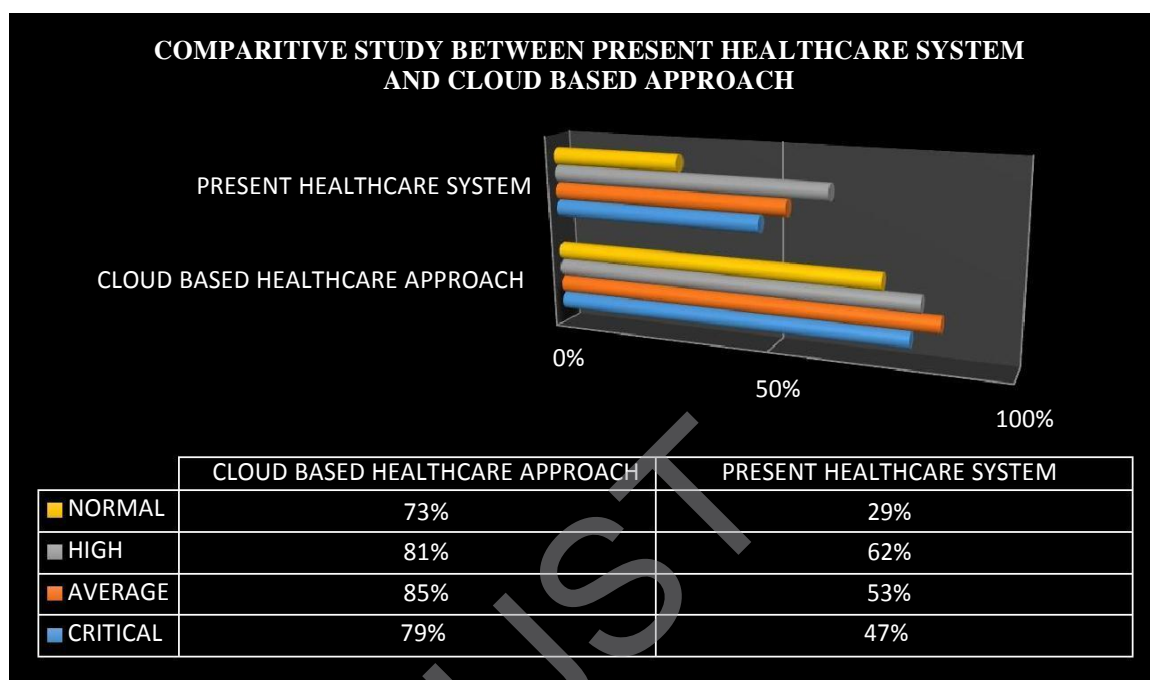
Figure-6 Graphical Interpretation Showing Success Rates Of Cloud Healthcare System

7. RESULT:-

The observations recorded were carefully analysed and critically viewed by the observers i.e. the patients, doctors, village home nurses etc. The above proposed mechanism is better than the current mechanism in our country. In the current mechanism more number of hospital staffs, nurses, doctors etc. are required and they are not able to serve the people in a better way or effectively due to over crowd and disorganised system. We think this proposed solution ought to solve all the problems in the field of rural health care.

8. CONCLUSION:-

The proposed solution can prove to be very efficient on its implementation. This cloud based solution provides us a better chance to serve the rural people in a much better way. This can prove to be a boon for those people who don't have adequate amount of money to travel to the hospital for medical aid. This mobile based cloud computing architecture provides us an opportunity to serve the people in a more efficient and appropriate manner at the time of emergencies. This is also a very cost effective system i.e. is economical system for the people. All the tests and experiments were performed and the outcomes were represented in the table which clearly shows its success. The proposed mechanism ought to be improved further in future with the intelligent and much more accurate and appropriate cloud based solutions.

9. FUTURE WORKS:-

Healthcare is a very big domain and it has lot of scope for its development and enhancement. Using the similar technologies like Cloud Computing etc. such as Green computing and Soft computing also it can be improvised and implemented. We hope that next mechanism will be furthermore beneficial for the development of rural healthcare system.

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