IoT BASED DECISION SUPPORT SYSTEM FOR TELEHEALTH MANAGEMENT THROUGH DATA MINING FOR BIOMEDICAL EQUIPMENT

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Abstract— Often, small clinics and hospitals using previous generation of Medical equipment do not have facility to transfer patient data to a remote location for analysis. As the ratio of doctors to patients is declining due to rise in health care issues, it is necessary to monitor patient data from a remote location, where qualified medical professionals are available. India counts to 1,85,505 Primary Health Centres in rural villages alone with approximately 371 crore worth medical equipment. Due to the cost ratio, the entire equipment replacement with modern technology would be myth. Rather, implementation of add-on equipment with the existing equipment will help provoke of a decision support system for telehealth enhancement. The proposed work includes a clip on camera supported with IoT to capture the screen continuously and transfer the data wirelessly to remote location. This will be a small add-on camera to every equipment. It is a portable, small clip on device which can be added to any biomedical equipment by clipping on it to the display monitors. The work proposes a system that consists of a camera that can be clipped onto the screen of the existing equipment and a data processing module and a data transmission module. The receiving end will be a wireless receiver module and a translator and display capable of receiving from multiple equipment. The development of camera based medical equipment is very helpful in the hospitals located in the rural areas. It includes data extraction, data storage and data visualization. This works under the basis of Optical Character Recognition and Application Programming Interface in Google Cloud Platform. This proposed work would be useful for patients in need of diagnosis and treatment who are remote from the doctors and using the existing older generation biomedical equipment itself.
Keywords— Telehealth, Optical Character Recognition, Application Programming Interface, Google Cloud Platform.

I.	INTRODUCTION

The following project is initiated mainly to transfer the medical data in realtime to the doctor who is far away from the patient. As the ratio of doctor to patient is dwindling due to raise in healthcare issues, it is necessary to monitor the patient data from a remote location where qualified medical professionals are available. The older generation equipments do not have data transfer capability but cannot be replaced due to enormous cost implications and is a difficult task for small clinics and hospitals to replace these equipments. It is difficult to interfere with hardware to tap the signals. 70% of India's Population live in Rural areas and 90% of Secondary and Tertiary care facility are in cities and towns. There were low penetration of healthcare services and lack of investment in health care in Rural areas along with inadequate medical facilities in Rural areas. There is a problem of Retaining doctors in Rural areas specially the Specialized Doctors. Patients with chronic conditions benefit from using telehealth technology to monitor their vital signs and gauge effectiveness of treatment plans. Often, telehealth devices connect to medical practices or hospitals via the Internet, which allows medical professionals to catch a drastic bodily change early on. This telehealth technology makes quick treatment easy, and can prevent a medical situation from escalating. This type of monitoring is especially helpful for diabetic patients. In a recent report the National Institute of Health found that 29.1 million Americans, or 9.3 percent of the population, have some form of diabetes.

Telemedicine defines specifically to remote clinical services. Telehealth refer to remote non-clinical services, such as provider training, administrative meetings and continuing medical education, in addition to clinical services. Research shows that the patients generally like telemedicine, but a new Cleveland clinic study delves deeper into why it's a hit. The study examines the patient, physician and medical encounter characteristics that have the greatest impact on the patient's overall satisfaction. Programmatic and the Realism with tools adapted to the context must remain the rule. India is a Booming economy. Telemedicine is a new emerging concept, with the good marketing and government approach.
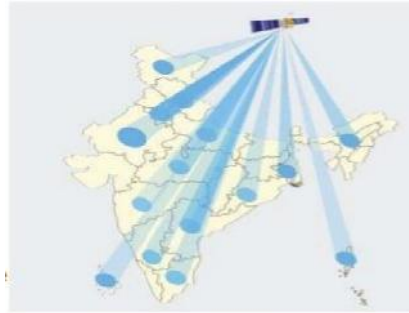
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Fig. 1. Telemedicine scope in India

Hence, an alternative is suggested to use a camera to capture the screen continuously and transfer the data wirelessly to remote location. This will be a small add on to every equipment. It will be clipped on to the display monitors of the existing biomedical equipment. It will capture the image of the display. Then the medical parameters that are displayed are extracted from the image. The extracted images are displayed in the text format with the help Google Vision API. The Google Vision API will detect and extract text from images. For the extraction of the parameters, Optical Character Recognition(OCR) and Application Programming. Interface are also used. Advanced OCR Technique is a highly recognition technique which is capable of generating more fonts. Since most of the fonts are now common, and with support for a variety of digital image file format input. An API is a coding language with programs that allow the user to transfer data from one software to another.

II. TELEHEALTH TECHNOLOGY

Telehealth technology is the digital platform, which transform information digitally and communicate with other devices digitally to access health care service remotely and manage the health care. These technology uses data from home or that your doctor uses to improve or support health care services.
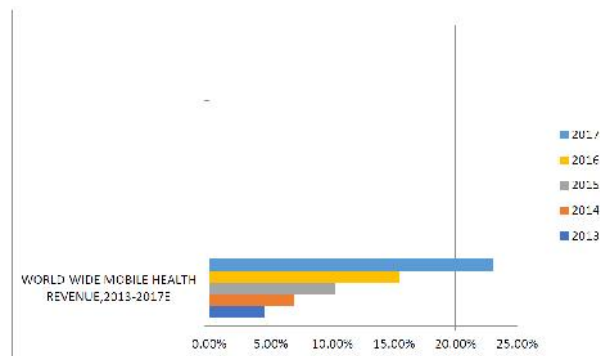

Fig. 2. Statics Of Telehealth Technology

A.   What is Telehealth Technology?

People often use the term "telehealth" interchangeably with "telemedicine," but telehealth doesn't always provide the same clinical services. Telehealth often refers to patient education resources, mobile apps, and other tools that engage people in their healthcare. Telemedicine is usually remote treatment by primary care providers or specialists. Telehealth may also refer to the sharing of digital images for a diagnosis, like x-rays and CT scans or pictures of skin lesions.

Patients with chronic conditions benefit from using telehealth technology to monitor their vital signs and gauge effectiveness of treatment plans. Often, telehealth devices connect to medical practices or hospitals via the Internet, which allows medical professionals to catch a drastic bodily change early on. This telehealth technology makes quick treatment easy, and can prevent a medical situation from escalating. This type of monitoring is especially helpful for diabetic patients. In a recent report the National Institute of Health found that 29.1 million Americans, or 9.3 percent of the population, have some form of diabetes. That's just one population that can benefit from widespread telehealth use
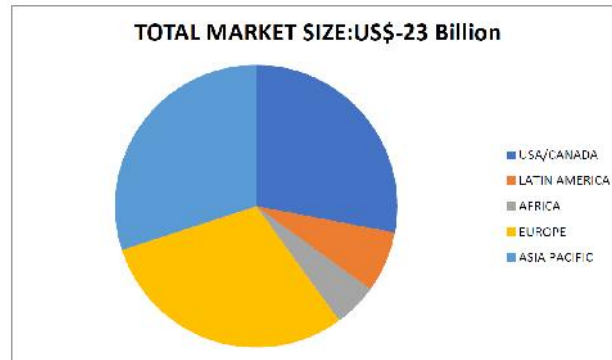
Fig. 3. Total Market Size

GLOBAL MOBILE HEALTH MARKET OPPURTUNITY BY REGIONS,US$ BILLION AND % SHARE OF OVERALL MARET,2017E

Telehealth often refers to patient education resources, mobile apps, and other tools that engage people in their healthcare. Telemedicine is usually remote treatment by primary care providers or specialists. Training can sometimes also be delivered via telehealth schemes or with related technologies such as eHealth, which make use of small computers and internet. The common example of telehealth technology is remote monitoring of vital signs, ECG or blood pressure, remote doctor patient and health education services.

Telehealth technology will play a vital role in meeting the healthcare needs of the US long into the future. It increases access, reduces costs and provides a more convenient delivery channel for patients and providers alike.
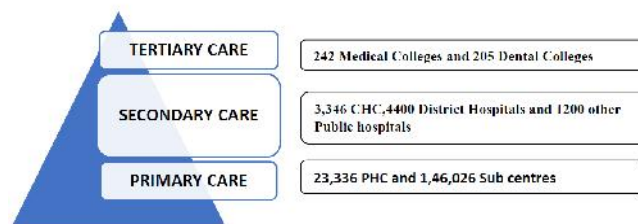

Fig. 4. Public Health Care Delivery Model

Telehealth technology uses Information and Communication system to deliver data over a long and short distance. It is about transmitting data, images, information and voice rather than moving care recipients, health professionals or educators. Specialists whose practices are using telemedicine the least to interact with patients are: Allergists/Immunologists 6.1%,Gastroenterologists-7.9%,Ob-gyns-9.3%.Inadequate medicare reimbursement, lac of EHR integration, and telemedicine parity laws, are among the top challenges faced by telehealth programmers to reveals a new survey from reach Health.

Telemedicine refers specifically to remote clinical services and non-clinical services, such as provider training, administrative meetings and continuing medical education, in addition to clinical services. Research shows that the patients generally like telemedicine, but a new Cleveland clinic study delves deeper into why it's a hit. The study examines the patient, physician and medical encounter characteristics that have the greatest impact on the patient's overall satisfaction.

Telemedicine- Ideal for India:

1) Area: 32, 87, 26 sq.kms
2) Popuation: Over 1 Billion
3) There is a Urban and Rural Divide
4)There is a Inaccessible hilly regions,islands,deserts,coastal regions, tribal areas. It proves that the telemedicine is ideal for India as it has Strong fiber backbone with Indigenous Satellite communication technology. We also have IT trained Resource and we have Also Pilot Projects with successful outcomes.
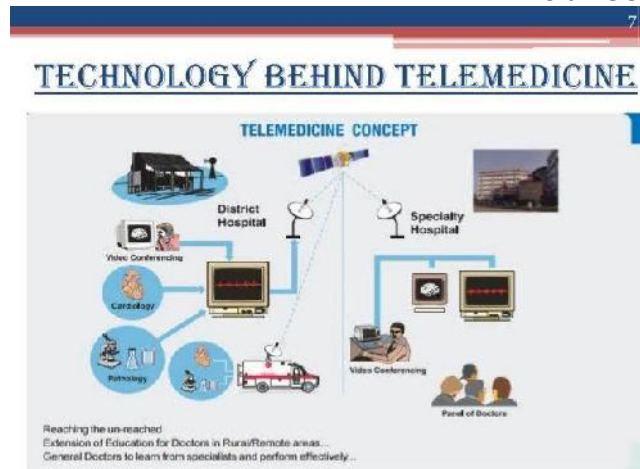
Fig. 5. Technology Behind Telemedicine

Consumers find telehealth valuable and convenient to have in the home. Here are just a few of the distinct benefits telehealth brings to patients and healthcare providers.

Dr.Vinod Khandhar MS(ENT),MS(GEN SURG),DIPOMA IN LASER SURGERY(SPAIN),LLB is the one who initiated the firstever Telemedicine Projects in India.
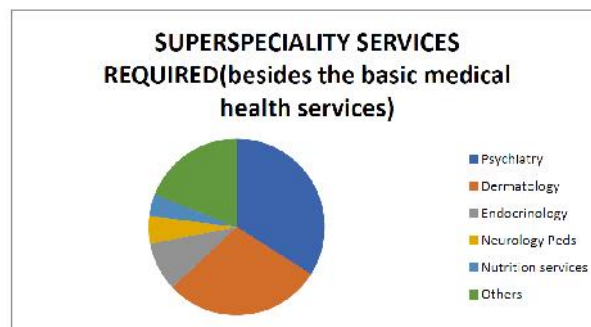

Fig. 6. Super speciality Services

70% of India's Population live in Rural areas and 90% of Secondary and Tertiary care facility are in cities and towns.There were low penetration of healthcare services and lack of investment in health care in Rural areas along with inadequate medical facilities in Rural areas.There is a problem of Retaining doctors in Rural areas specially the Specialized Doctors.
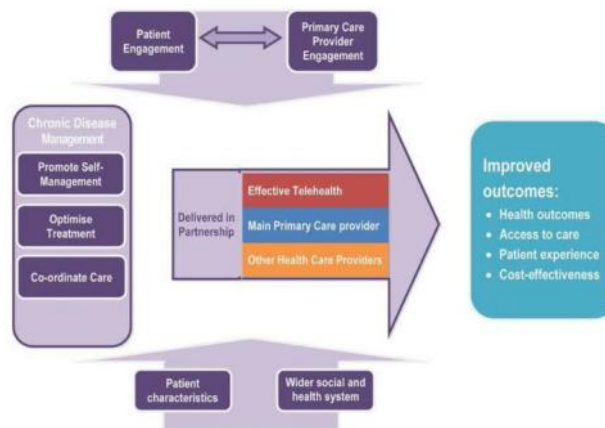

Fig. 6. View of Effective Telehealth

SUPPORT FOR TELEMEDICINE:

In India,Telemedicine Programs are being actively supported by:

• Department of Information Technology(DIT)
• Indian Space Research Organisation
• NEC Telemedicine program for North-Eastern states
• Apollo Hospitals
• Asia Heart Foundation
• State Governments
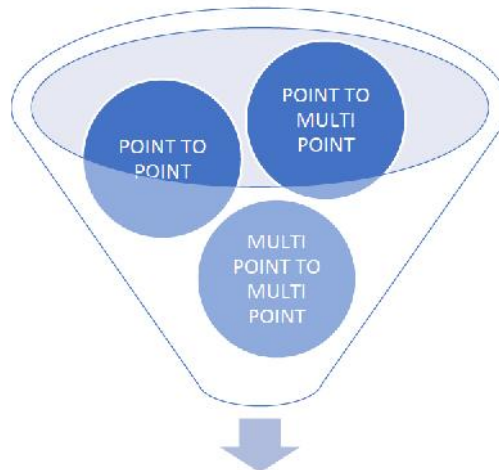• Telemedicine technology also supported by some other Private Organisations

Fig. 7. Telemedicine-Ways of Communication

III. OCR (OPTICAL CHARACTER RECOGNITION)

Optical Character Recognition (OCR) is an electronic device that helps computer to recognize text from images. It is also called as optical character reader (OCR), which reads text from image or document. OCR is a software based technique, which convert the physical paper content into electronic form. OCR is a field of research in pattern recognition, artificial intelligence and computer vision. There are different type of Character Recognition, they are

Optical character recognition (OCR), Optical word recognition, intelligent character recognition (ICR), intelligent word recognition (IWR).
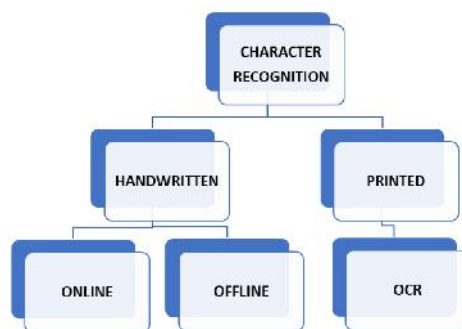

Fig. 8. Flow Chart of OCR

OCR is a software device that locally processes a data in digital form by locating and recognizing characters, symbols and numbers. Some of the OCR software will export text in a digital form. Some of the advanced OCR will convert the character to editable text.

IV. API (APPLICATION PROGRAMMABLE INTERFACE)

An application programming interface is an interface software that allows two application to communicate each other at a same time. The common example of API software is Facebook, WhatsApp, where we can send instant message immediately.

In other words, APIs serve as an abstraction layer between two systems, hiding the complexity and working details of the latter.

V. RASPBERRY PI BOARD

In this project we use the **RASPBERRY PI3 MODEL B+,** because of the revision of the original **Raspberry pi.** It has 512MB RAM, four USB ports, 40 GPIO pins, and an Ethernet port…it uses a 1.2GHZ 64 bit quad -core Arm cortex -A53 CPU, has 1GB integrated 802.11n wireless LAN, and Bluetooth 4.1.

Raspberry Pi is a developed in United Kingdom, which is a chain of tiny and affordable computer. The size of Raspberry Pi is small like credit card size which is plugged with computer monitor or television, keyboard and mouse are used for controlling the Raspberry Pi.
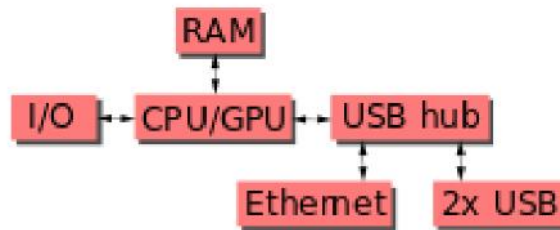

Fig. 9. Flowchart of Hardware

VI. WEBCAMERA

In this project we are using the **LOGITECHC270** HD Webcam. This device comes with easy installation process that offers a hassle-free set up. The design of Logitechc270 is compact; it helps in saving space and make it simple to install the webcam in PC or laptop. The designs of webcam is simple, easily adjustable one and make it to tilt as your needs.

We really did not intend to spend way too much money, yet we wished to get a webcam with good specs and sensibly excellent video clips of high quality. We wound up on choosing a Logitech C270 Software. We've used it for a long time, and also after discovering all its ups and downs, we assumed it would certainly be a good concept to show you what we have actually located like a lot of Logitech's items, the Logitech C270 Software is available in a rather huge box. You don't have to open the bundle in order to see the webcam inside. When we linked the Logitech C270 Software to a Windows 8.1 computer, it was right away recognized. The OS immediately began to download and install its suitable vehicle drivers. When the procedure was done, we examined to see if any added software was installed. Next, to its drivers, the cam just adds a modern-day application called Logitech Video camera Controller. This is a really simple application that only uses a couple of links to some Logitech websites where you can do things like registering your device, gain access to support options or supply feedback. Nonetheless, if you want to have even more control over its setups, we suggest that you download and install the Logitech Webcam Software Application. It will certainly enable you to do things like capture photos and video clips, share them to Facebook, Twitter or YouTube, modification progressed camera setups, use face monitoring or activate activity detection. As we quickly pointed out earlier, the Logitech C270 Software merely functions out of the box. The photo top quality is more than suitable, the shades look all-natural and also the comparison is OK. These declarations are all true even in darker settings.

Fig. 10. Logitech Camera

VII. GOOGLE CLOUD

It is a suite of loud computing services that runs on the same infrastructure that google uses internally for its end-users products such as Google search, Gmail and You tube. Alongside it provides a set of management tools, it provides a series of modular cloud services including computing, data storage, data analytics and machine learning. Registration requires a credit card or bank account details. We used credit card for registration.
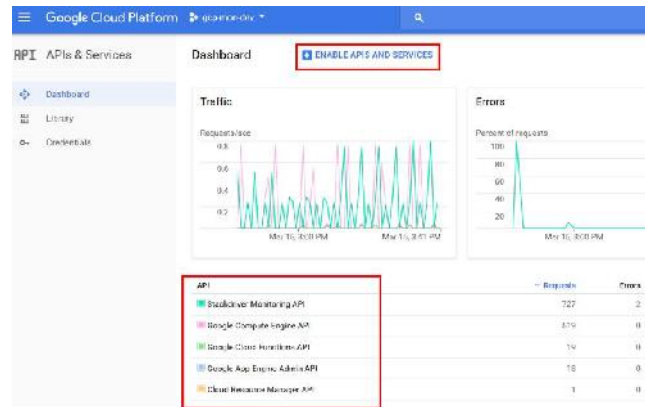

Fig. 11. Key Generation

VIII. CLOUD SHELL

Google Cloud Shell is an interactive shell environment for Google Cloud Platform that makes it easy for you to learn and experiment with GCP and manage your projects and resources from your web browser.

With Cloud Shell, the Cloud SDK gcloud command-line tool and other utilities you need are pre-installed, fully authenticated, up-to-date, and always available when you need them. Additionally, Cloud Shell comes with a built-in code editor, the ability to launch tutorials and open cloned repositories, and preview functionality to temporarily run web apps on a Cloud Shell virtual machine instance, and more.
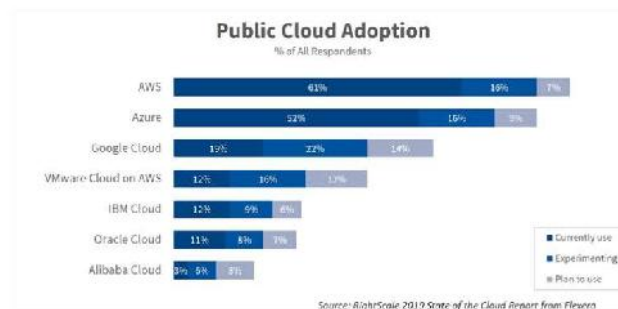

Fig. 12. Public Cloud Adoption

IX. RESULT AND CONCLUSION

The above connections are made to extract the texts from images captured using camera in any existing biomedical equipment. Here we used ECG machine for the trail session and we can do this in any biomedical equipment to extract any image of medical report. It would be useful in number of Remote areas for multiple patients hence Screen Capturing Technique is executed in the above explained method.

Fig. 13. Execution of Screen Capture Technique

As the ratio of doctors to patients is lesser in number due to rise in health care issues, it is necessary to monitor patient data from a remote location, where qualified medical professionals are available.The older generation of equipment do not have data transfer capability but cannot be replaced due to enormous cost implications and is a difficult task for small clinics and hospitals to replace these equipment.Hence an alternative is suggested to use a camera to capture the screen continuously and transfer the data wirelessly to remote location.The above method would definitely help the patients in Remote areas for further Diagnosis and Treatment.

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