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EMBEDDED BASED WEARABLE SENSING TECHNOLOGY FOR DETECTION AND MONITORING OF CORONA VIRUS PANDEMIC

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Abstract: Corona virus disease (COVID-19), a scourge with severe clinical signs and symptoms, is now lethal. A global catastrophe like COVID-19 puts unheard-of demands on health systems worldwide, causes misery for vulnerable communities, and presents a new type of catastrophic threat to international society. It's important to look at the technologies and mechanisms for preventing disease from emerging, slowing its spread, and particularly the plan for illnesses prevention. While significant efforts are being made to find the virus, develop treatments, and create vaccines, it's also very important to look at these. In a pandemic situation caused by viruses that spread illness, such as COVID- 19, it is required to identify persons who have been infected by those viruses, track them continually, segregate them at the appropriate moment, and acquire them for physical observations and treatment. Follow those who have been infected in real time because they may be at danger of spreading the virus to others even though they won't show symptoms for more than a few days. Additionally, a large number of medical professionals are required to keep an eye on patients and manually take measurements like their temperature, blood oxygen level, pulse rate, etc. This technique is time consuming and hazardous. The proposed project work introduce a image processing technique and the embedded technological advancements that replace human services needs as way as doable, the image processing technique accurately checks and confirms the presence of the infection and the embedded system part provides the mandatory readings from the infected person to the medical workers and helps them to supply the mandatory aid with less burden. Hence the entire system can together detect as well as monitor the infected people.

IndexTerms - Embedded System, Image Processing, Raspberry Pi Pico, CNN - Convolutional Neural Network, Corona.

I. INTRODUCTION

210 countries may be impacted by the 2019 Corona Virus Disease (COVID- 19) outbreak worldwide. With average case fatality rates in the most impacted countries allegedly ranging from 6.2 percent to 7.2 percent, COVID-19 is a serious public health risk. According to data recently released by the World Health Organization (WHO), the outbreak has resulted in the deaths of over 238,000 people worldwide and the infection of over 3,349,000 more. Because the number of verified COVID-19 cases as of third May 2020 is approximately 400 times higher than the previous corona virus, which induced Severe Acute Respiratory Syndrome (SARS) eruption in 2002-2003, it is anticipated that more people will contact the virus. The COVID-19 eruption not only threatens the health of the entire world's population, but also has an effect on many other aspects of daily life, most notably the world economy.

The COVID-19 and SARS-CoV-2 viruses most usually presents as Acute Metastatic Distress Syndrome (ARDS), malignancy, or shock as metastatic symptoms. A recent study found that SARS-CoV-2 is highly effective at spreading from person to person and frequently causes silent infections, despite the fact that SARS-CoV-2 and SARS-CoV share similar clinical signs. Clinical deterioration will occur rapidly, typically during the second week of illness, and may result in admission to the intensive care unit and a high fatality rate. The severity of COVID-19, in particular, can range from asymptomatic infection to severe or fatal sickness.

One of five categories—asymptomatic, mild, moderate, severe, or critical— describes the majority of COVID-19 cases. Between 15 and 20 percent of COVID-19 cases in China, according to data, require hospitalization, with about 15 percent displaying severe symptoms and 5 percent necessitating both medical assistance and invasive mechanical breathing. Between 40 and 50 percent of COVID-19 cases in Italy and other European nations are 7–12 percent of patients who are hospitalized need to be admitted to ICUs.

The COVID-19 pandemic has posed enormous hurdles for global health care systems due of its severity and rapid spread. Health care systems will quickly become overburdened with COVID-19, making it challenging for them to care for both individuals who are suffering from the disease and those who are not, specifically.

In order to combat this type of infection, this project suggests a wearable embedded technology with multiple sensors connected. It uses image processing technique for accurate detection and enables treatment and helps in monitoring of the afflicted individuals and medical personnel without coming into direct contact with them, lowering the risk of contacting the infection.

In December 2019, the novel corona virus 2019 (COVID-2019), which initially appeared in a Chinese city, It became a disease after rapidly spreading around the globe. The public health has suffered as a result, which has a negative impact on the global economy. To halt the spread of the pandemic and begin treating those who are ill, it is crucial to identify positive cases as soon as practical. Since there are no correct machine-controlled tool kits available, the requirement for supplemental diagnostic instruments has raised. Research using radiology imaging methods suggests that these images offer important information about the COVID-19 virus. Tomography imaging combined with the application of advanced AI algorithms may help in the accurate diagnosis of this condition and even assist in resolving the issue of a doctor shortage in rural areas. In this work, a model is used in place of the primary chest X-ray/Computed Tomography images that were used for automatic COVID detection. The project model is designed to generate accurate diagnostics for multi- class classification (No-Findings vs. COVID vs. Pneumonia) and dual classification (No-Findings vs. COVID). In instances involving many classes, the model produced classification accuracy for binary categories of 98.08 percent and other is 87.02 percent. Every layer now includes convolutional layers and completely new filtering. The model with improvements can even be used via the cloud to immediately assess patients. Radiologists can use it to corroborate their first screening.

Since late December 2019, a corona virus illness outbreak (also known as COVID-19) has been reported in city, China. This illness then spread globally. Despite being an illness that requires immediate medical attention, COVID-19 has a death rate of 4.03 percent in China and 13.04 percent in Africa and 12.67 percent in Italy.

As a result of severe alveolar damage and advancing metabolic failure, the start of a serious illness may result in mortality. Despite being the gold standard for clinical diagnosis, techniques used in laboratories, the findings of some tests, such RT-PCR (Reverse Transcription Polymerase Chain Reaction), maybe misinterpreted as negative. Furthermore, a lack of RT-PCR testing resources during pandemic conditions can further postpone the subsequent clinical call and treatment. As a result, together with the embedded system, chest CT imaging has emerged as an important tool for the identification and prognosis of COVID-19 patients.

II. OBJECTIVES

Embedded device suitable for monitoring and detecting the virus from the patients hence helps in evaluating the health status of infected people, care-givers for easing triage procedures for hospital admissions, management staff, and with less human intervention. accurate detection of COVID-19 in patients using the image processing technique for Computed Tomography Scan images. This aids in the identification of healthy individuals as well as those with COVID-19 and pneumonia and thus helps the medical staffs to give the required treatment. It can be employed in any public places and is intended in less time. Deploying CNN Network for Infection Classification. The overall project is designed to be more effective at minimum cost. The appliance needs less housing space and it's dynamic and user friendly. This method is more effective than other current systems.

III. LITERATURE SURVEY

Some of the related works are described below:

Nuraisyah Hani Zulkifley, Mohd Asyraf Zulkifley, and Siti Raihanah Abdani. [1] Discuss the possibility of a portable deep learning model that is highly accurate in COVID-19 detection. It is vital to have a lightweight model so that it may be used on many different platforms, including desktop, tablets, and mobile phones, without having to worry about memory space.A redesigned spatial pyramid pooling module and 14 layers of convolutional neural networks make up the desired model. Some tests, including RT-PCR's (Reverse Transcription Polymerase Chain Reactions), can produce results that are misunderstood as negative, which allow it to detect COVID-19 sickness at varying severity levels. There are only 862,331 parameters in all, only 4 Megabytes of RAM are used. The model can be utilized for quick screening jobs so that more accurate diagnoses can be produced to maximize efficacy and efficiency.

Eylul Azra Yildirim, Muhammad Talo, and Tulin Ozturk. [2] outline a methodology designed to produce precise No Findings diagnostics against COVID for binary classification. This method's classification accuracy for scenarios with numerous classes was 87.02 percent; for binary categories, it was 98.08 percent. This project developed a classifier for the real-time item recognition system You Simply Look Once using the Darknet idea (YOLO). There were 17 convolutional layers used, and each one had its very own filter. A deep learning model to classify cases of COVID-19 in X-ray pictures. With an end-to-end framework and complete automation, this approach does away with the necessity for human feature extraction.

Silvio Brusaferro, Giovanni Rezza, G. Eason, and G. Onder. [3] The epidemiology and behaviour of the initial COVID-19 cases in Italy while they were still being actively controlled are described in this study. Up until March 31, 2020, all COVID-19 cases

with RT-PCR confirmation were reported to the national integrated surveillance system, estimates the basic and net reproduction numbers by region and provides a descriptive epidemiological overview. We are all susceptible to contracting illnesses brought on by viruses and bacteria. At some point in our lives, all of us have endured a cold or the flu.The goal of ongoing medical research is to discover effective treatments because a one-stop answer is not practical.The medications we are taking now help to lessen the symptoms, but it also depends on the individual.

Chiachung Chen, Hsuan-Yu Chen, and Andrew Chen. [5] This paper proposes, conventional method will be replaced with temperature measurement based on infrared technology. Many varieties of thermometers are developed to live vital sign. Infrared IRT thermometers are rapid, practical, and simple to use. The membrane and forehead infrared thermometers are the two common types used to assess body temperature. Since the COVID-19 corona virus has spread, many people are being screened for the illness using forehead temperature activity.

Budimir Lutovac, Andrej Skraba, and Radovan Stojanovic. [6] The wearable gadget described in this study is a headset that can track Covid-19 symptoms such as body temperature, breathing problems, and respiratory system. As a result, it offers many benefits to individuals, and there are numerous ways it may be enhanced to maximize these benefits.

IV. PROPOSED METHODOLOGY

In this project the hardware consists of Raspberry Pi Pico microcontroller which is the heart of the model. All the sensors, LCD and Power Supply are connected to the microcontroller. The microcontroller is coupled to a temperature sensor and a SpO2 (Saturation of Peripheral Gas) sensor.

The temperature value in degrees celsius is provided by the temperature sensor. The oxygen levels are monitored by the optical SpO2 sensors using infrared light sensors. Furthermore, the heart rate is tracked. A configurable threshold is used to compare the temperature and SpO2 values and classify them as "high" or "normal.

When the temperature exceeds 40 degrees Celsius and the oxygen level is low, the symptoms of COVID are displayed. If not, it's typical. However, an image processing technique utilizing the CNN algorithm is employed to determine whether the patient has COVID or pneumonia. Here, more precise findings may be achieved because the scanned photos are processed to determine whether the person is healthy or whether they have COVID or pneumonia.

Electronic display modules called ALCDs are favored over 7-segment and other multi-segment LEDs because they are inexpensive, simple to control, and have no restrictions for showing unique and even unique character animation. It features a command register where the commands supplied to the LCD to perform predetermined tasks, including instantiating it and clearing its stream, establishing the cursor location, controlling the display, etc., are stored. A 16x2 LCD bit has two lines and can display 16 characters per line. But to know whether the person has covid or pneumonia the image processing technique using CNN algorithm is used. Here the more accurate results can be obtained as it detects that the person has covid or pneumonia or is he normal by using the image processing of the scanned images.

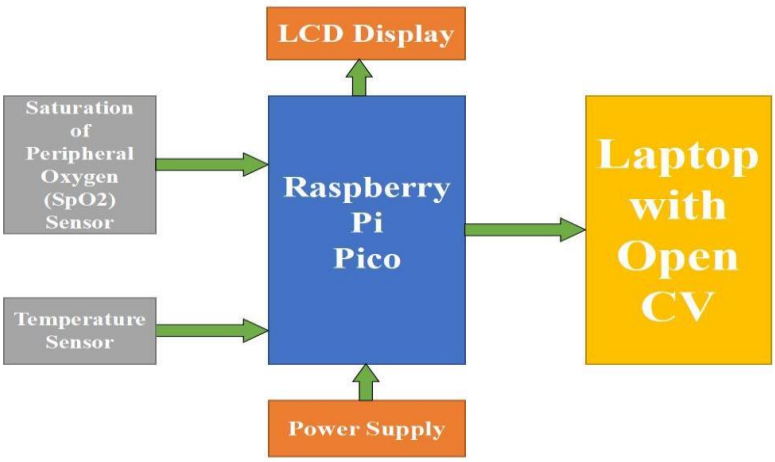

Fig 1: Block Diagram

Computed Tomography scan pictures based COVID detection will done. The scanned images among patients who have COVID-19 positive tests are accessible in a representative open-source data set. Using data set, developed sample "regular" (i.e., not infected) CT scan images from healthy patients train, a CNN to automatically spot COVID-19 in scanned images. Analyze the findings from a scholarly standpoint. Sensor data are analyzed with the data from the portable computer to provide the final prediction results.

A. Algorithm Used For COVID-19 Detection in OpenCV

Convolutional Neural Network Layers:

A CNN has numerous layers. When these layers are applied multiple times, it produces a Deep Neural Network. The CNN is made up of three different sorts of fundamental layers:

Information: This layer holds the inaccurate pixel estimates for the image.
Convolutional Layer: The data district is produced which is connected to the neuron layer, are sent to this layer. Every channel might also be a 5x5 window with a slider for the picture element and access to the data.
ReLU Layer: This layer handles the picture data in a neighborhood-wise incitation manner. Prefer to appreciate that a CNN employs back increment in order to carry proportionate estimates of the pixels without being altered by the back beginning; this is how we typically use the ReLU work.
Pooling Layer: This layer performs a volume-achieving down-testing task on the spatial estimates.
Fully Connected Layer: This layer is used to determine which score categories have the clearest score manifestation in connection to the information digits.

Similar to a DNN, a Deep-CNN has several hidden layers, including convolutional, ReLU, pooling, and fully connected normalized layers. The convolutional layer's weights are shared by CNN, which decreases the memory footprint and improves network performance. CNN must possess the shared weights, shared connections, and 3Dvolumes of the neurons. A convolution layer creates a feature map by combining different input picture sub regions with a learnt kernel. Once the error is small, the convergence properties are then improved by applying a non-linear activation function across the ReLU layer. After selecting a portion of the picture or feature map, the pooling layer selects the representative pixel with the highest value among them or the average value. As a result, the sample size is over-sizely reduced. In the output stage, convolutional layers and Fully-Connected layers are occasionally combined. The layer of convolution and pooling are occasionally utilized in conjunction in CNN designs. Max pooling and mean pooling are two types of operations that the pooling layer occasionally performs. The average neighbourhood is calculated among the feature points in mean pooling, and among the majority of feature points in maximum pooling. The neighbourhood size limitation error is lessened and background information is retained through mean pooling. Max pooling decreases the mean deviation-related calculable error in convolution layer parameters, which results in significant texture retention information.

Data Set: The Lung Image Database Consortium (LIDC) and the Image Database Resource Initiative provided the training's data set (IDRI). 1000 CT scans in the Digital Imaging and Communications in Medicine (DICOM) format are available in the LIDC and IDRI.
Image Segmentation: Division of a optical image into various parts is known as segmenting an image. This ostensibly aids in identifying limitations and artifacts. The goal of segmentation is to change how a picture is interpreted into a concrete image that can be quickly and clearly captured.
Pre-Processing: By lessening the impacts of the deterioration that happened during capture, the median filter is utilized in the pre-processing stage to recover the image under review. Different methods of pre-processing and segmenting respiratory organ nodules have been mentioned. Every pixel value in the image is simply replaced by the median of its neighbors and of itself using the median filter. The values of the picture elements that are dissimilar from those of their neighbors are thus removed.

Training: The DCNN was trained to scan the respiratory system for irregularities using a CT image with a 52020 resolution. There are two phases to it. A CNN with in the initial stage, to extract meaningful volumetric features from input data, different layers of volumetric convolution, rectified linear units (ReLU), and max pooling are utilized. The second stage is the classifier. It has numerous FC and threshold layers,then a SoftMax layer to carry out the neural network's high-level thinking. The dataset's CT image's initial values were as closely as feasible kept without any scaling. From the training set of CT scans, random sub-volumes were chosen and normalized with an estimate.

B. Implementation Of Hardware

Requirements: System requirements, part of specification could be a well-organized collection of information that captures the needs of a system. It is a comprehensive explanation of the behaviour of the system that will be created. It lists hardware, software, and non- functional needs.

Functional Requirements: This section provides the list of useful functional requirements that are applicable to the system. Functional necessities are nothing however the services provided by the system to its user. Functional demand captures the ostensible system behaviour. This behaviour may also be described as a service, a task, or a set of requirements that the system must meet.
Hardware Interfaces: The customer's PC's serve as the external device interface for referring and looking.

Software Interfaces: Any window family can be used as a functional framework.

Prerequisites for Performance: The PC's being used must be at least have Windows XP/Windows 7 or higher that they can give perfect execution of the thing.

- System should process the data.
- System should segment the CT scan image.
- System should detect the Lung scan image.
- System should predict COVID using Lungs CT scan image.

Non-Functional Requirements: Non utilitarian necessities are the limits offered by the structure. It joins time objective and prerequisite on the headway system and models. The non helpful essentials are according to the accompanying:

Speed: The framework should be designed to ensure that the provided commitment will yield in a timely manner.

Usefulness: The product appeared to be simple to use and portable. It doesn't require much planning work by that point because the clients can use it effortlessly.

Reliability: If frustrations are occurring at a lower rate, the system is clearly becoming more robust.

Portability: It thought to be anything besides hard to complete in any structure.

Availability: The projected system parts are obtainable for operation once it's intended by the user.

Interoperability: All the components used to develop the proposed system is systematically organized and can work along.

Extensibility: The projected system will be extendable by adding further options while not affecting the prevailing operating model.

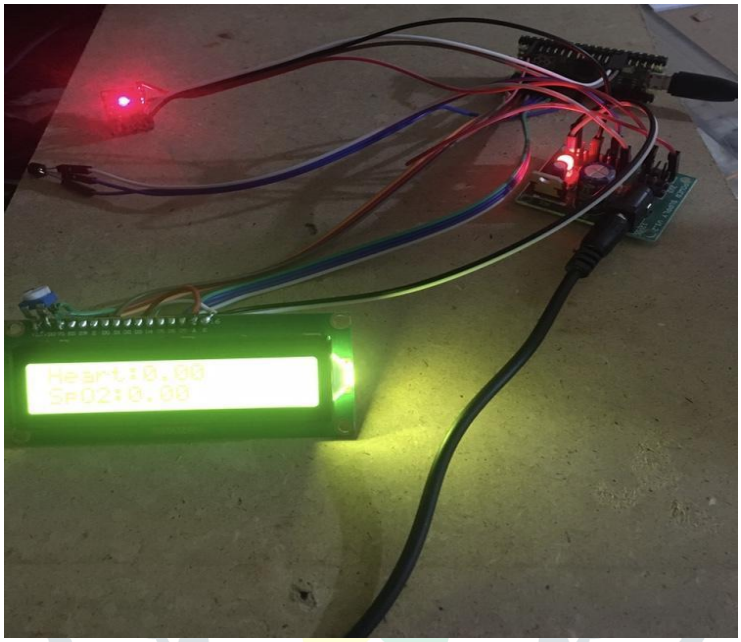

Fig 2 : Working Model

IV. RESULTS AND DISCUSSION

A convolution layer uses convolution to extract the options from the input images and then produces feature maps. Convolution kernels are a set of limited size filters that are used to execute convolution operations on image data in order to build feature maps. As a result, following image processing, the results of the identification of normal, Corona virus- infected, and Pneumonia-infected images are produced as shown below. Additionally, as illustrated below, the output from the embedded device can be observed.

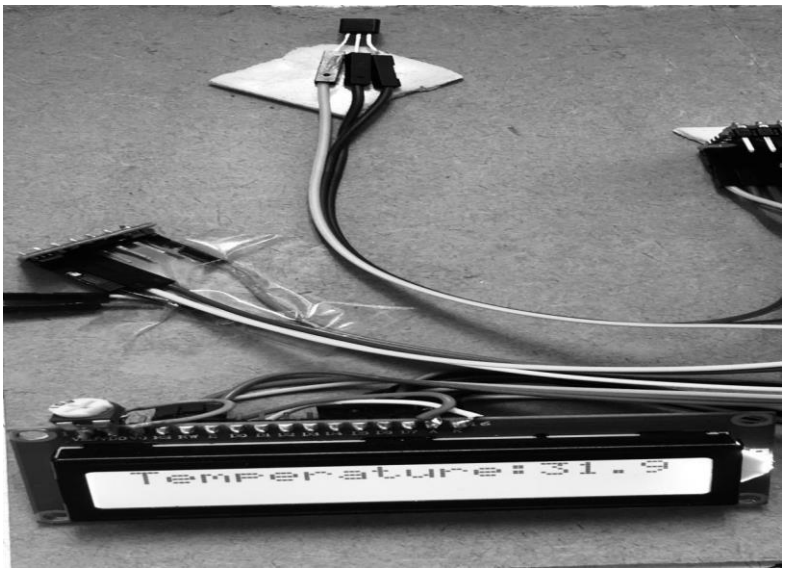

Fig 3: Output of Sensors Displaying on the LCD

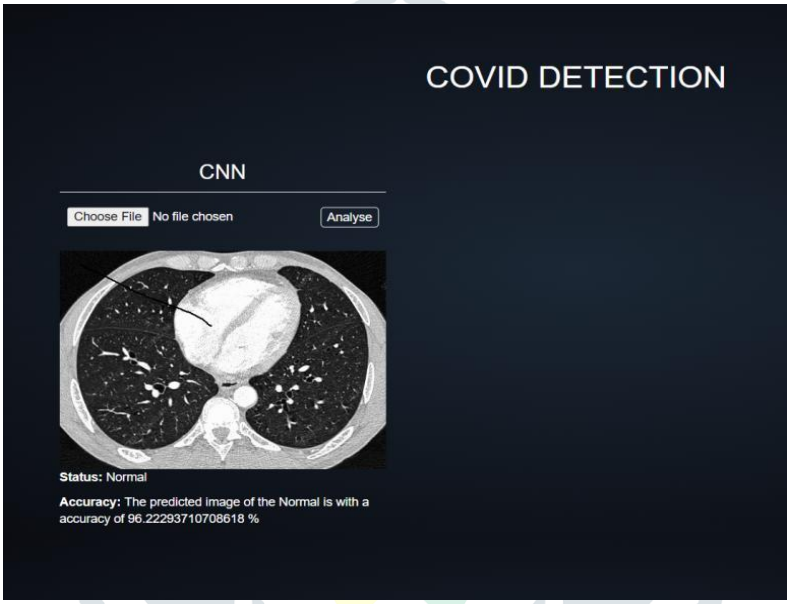

Fig 4: Image showing the Normal Status of Patients Report after Image Processing

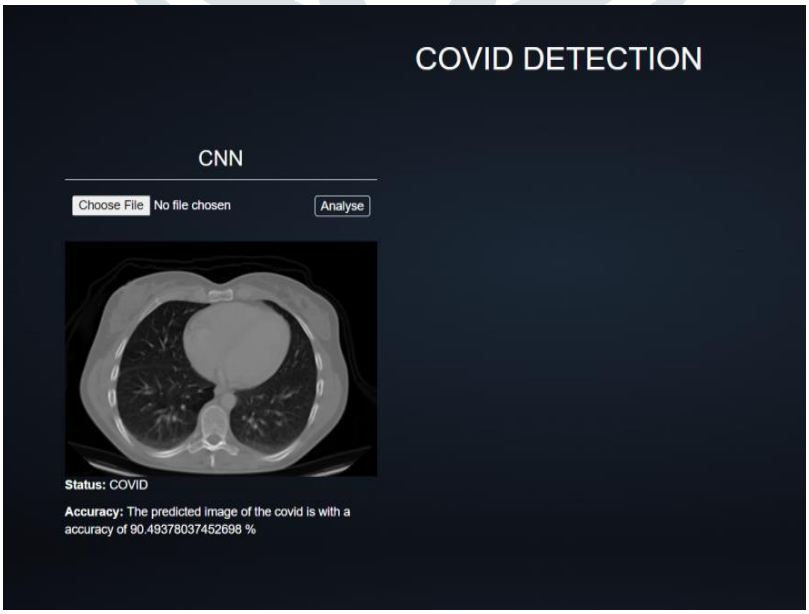

Fig 5: Image showing the COVID Detection of Patients Report after Image Processing

Fig 6: Image showing the Pneumonia Detection of Patients Report after Image Processing

In the above images the normal, COVID and pneumonia detection is made accurately and its accuracy is also displayed.

V. CONCLUSION

An overview of embedded wearable technology, picture processing methods, and retiring symptoms sensing are provided in this project, as well as details on potential applications in the struggle against COVID-19. These devices support more accurate detection and efficient monitoring. With the prompt adoption and deployment of these developing technologies during the spreading epidemic, the load on aid systems can be reduced. Early detection and treatment of cases are made possible by discovering relationships between nursing decline and exacerbation that are suspected but asymptomatic or pre-symptomatic, and reduced contact between medical staff and patients, are all possible ways to enhance clinical outcomes. As a result, they hold great promise for battling pandemics like COVID-19.

In future, this project aims to enhance different connected devices and numerous different sensors can be embedded that is successively used for sleuthing similar or completely different styles of diseases so creating the system rather more economical. More parameter like ECG, MEMS device, gas level indicator, invasive & noninvasive BP monitor, respiration device etc. can be added. The home based health observance applications bestowed which permit doctor to look at his patient's medical parameter remotely and dynamically in web content in real time, in an online access in future we are able to produce and save info of patients, in future if patients comes for routine medical examination the doctor will check info and treat the patient as he is aware of the history of patient. For accomplishment of system we are able to develop android and iOS devices to alert doctors and patient relatives.

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