

INNOVATIVE PROPOSAL OF CARDIAC HAWK EYE TECHNOLOGY

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SOURCE

The increase in death rate due to heart diseases is the main motivation for us to choose the cardiac field and propose a instrument which is easy to use and of low cost which helps in early detection of such diseases

ABSTRACT

Proposal mainly concentrates on the core problem on the early screening of cardiovascular diseases. With presently available instruments diagnosis of the heart diseases is possible, but the constraint that idea is focusing on, is the cost-effective method to be implemented in rural sector. The diagnosis method presently available is ECG, which cannot give the prior information of the disease but only depicts the present status and also for the analysis of the ECG signal a specialized doctor is required. Taking into consideration of disadvantages in the current instruments, a new proposal of module, which can overcome these problems being portrayed.

KEYWORDS

ECG, Cardio Vascular, Ultrasound, Doppler Effect.

INTRODUCTION

We are mainly concentrating on the core problem on the early screening of cardiovascular diseases. With presently available instruments diagnosis of the heart diseases is possible, but the constraint that we are focusing on, is the cost-effective method to be implemented in rural sector. The diagnosis method presently available is ECG, which cannot give the prior information of the disease but only depicts the present status and also for the analysis of the ECG signal a

specialized doctor is required. Taking into consideration the disadvantages in the currently present instruments we propose a new module, which can overcome the problems being faced.

Dybrid technology: The ECG is related to electrical activity of the heart any prominent changes can be observed only when heart is abnormal. In Doppler technology we can detect even minor blockages even before heart reaches abnormality. Based on the above facts we have decided to concatenate the above two working principles in our module which provides a better confirmed report based on the artificial intelligence algorithm.

The added advantage of this module is that we are able to bring in the history of the subjects status (thro' ECG) and also the present scenario (thro' Doppler image mapping) together which makes the database more stable for predicting the future.

EXISTING SOLUTIONS/PRIOR ART

For the detection of Cardiovascular diseases, the existing solutions being Electrocardiogram(ECG), Echocardiogram, Cartogram, Computerized Tomography Scan, Magnetic Resonance Imaging, CT Angiogram & Biomedical tests. (Most of these higher end systems use gamma rays, which are ionizing radiations that are very much harmful to the cardiac cells) ECG provides the net effective electrical activity of the heart.

Cardiogram, Cartogram, CT scan, MRI and others are imaging techniques used to obtain the topology of the heart. The implementation of these above mentioned sophisticated technique needs a specialist and highly skilled doctor who also needs a well equipped infrastructure in multi specialty hospitals.

PRIOR ART

Doppler Ultrasound (Echocardiography)

Hardware Type: Imaging Systems, Measurement Devices, Cardiovascular.

Hardware Description: An echocardiogram is a test that uses high-frequency sound waves (ultrasound) to create an image of the heart. Doppler is a special part of the ultrasound examination that assesses blood flow (direction and velocity). In contrast, the M- mode and 2-D Echo evaluates the size, thickness and movement of heart structures (chambers, valves, etc.). During the Doppler examination, the ultrasound beams will evaluate the flow of blood as it makes its way through and out of the heart. This information is presented visually on a monitor.

PROBLEM DEFINITION

When we look to the market statistics for technology the instruments are virtually unaffordable by common man. Nearly 1.2 million people lose their life suffering to cardiovascular diseases according to WHO statistics. In 2001 alone, some 7.1 million deaths were attributed to ischemic heart disease, 80% of which were in relatively poor countries. Medical and public health professionals expect that in developing countries, there will be a 137% and 120% increase in the disease for males and females, respectively, whereas these predictions lie in the 30% to 60% range for developed countries.

Cardiovascular disease is the world's leading killer, accounting for 16.7 million or 29.2 per cent of total global deaths in 2003. In India in the past five decades, rates of coronary disease among urban populations have risen from 4 per cent to 11 per cent. The World Health Organization (who) estimates that 60 per cent of the world's cardiac patients will be Indian by 2010. India lost more than five times as many years of economically productive life to cardiovascular disease than did the U.S., where most of those killed by heart disease are above retirement age. Cardiovascular diseases are not like spurs that suddenly emerge. They are the result of prolonged encroachment of heart territories by anti-cardiac materials.

Hence a prior knowledge of degree of encroachment can help in predicting future implications and also can guide us with precautionary measures. For all these early screening and regular monitoring of the subject is very much essential.

In problem statement for screening of cardiovascular diseases, the present existing technologies being blood tests, Stethoscope & blood pressure, ECG recorders are commonly available tools with practitioners by which we cannot come to the perfect conclusions so as to which part of the heart is affected. So as to find out the perfect infected mapping, sophisticated design tools are used in super specialty hospitals in urban area, whereas the implementation of these techniques are mere impossible in rural areas (which constitute more than 50% of the population as of now!).

The reason being, modern well equipped instruments fail as it needs specialist doctors, well established infrastructure lab facilities, high power consumption & very expensive treatment. Problems like Myocardial infarction, Valves abnormalities, Arteries blockage, Ischemic conditions needs to be screened at early stages for saving life.

Cost effective, accurate, low skilled manpower, unreliable infrastructure, time restraining capability and future predicting facility are some of the pre-requisites that have to be considered while designing an innovative module to be implemented in rural sector. By achieving the above qualities early detection of infections will be possible. The existing Doppler module is capable of

scanning the whole body but for the problem under consideration an overview of heart is sufficient.

CASE STUDY

Through this case study we are trying to explain the problem encountered in the existing technology. This heart problem was diagnosed by ECG only when the patient complained about uneasiness, chest pain and breathlessness.

The report of this case is produced below:

From:-

Smt. Naganma, S. Rao.
Female 51 years

Dr. R. P. SAINATH, M.D. (D.M. 1982)
Consultant Physician & Cardiologist
BHAGY, PATHOLOGY LABORATORY
1503, Situmpet, Mysore-570 001

4/0 Palpitation
Chest pain
Headache
Breathlessness } Sudden onset like
1/2 hour
at 8.30 AM

Pt was a known case of Hypertension
since for 30 years who was taking
antihypertensive drugs regularly as an advice
of Cardiologist

4/0 Pt was oriented.
Dyspnoea. Pulse 150/min -- RR 180/100
C/S

R/L: Normal vesicular breath sounds
in both lung fields.
No adventitious sounds

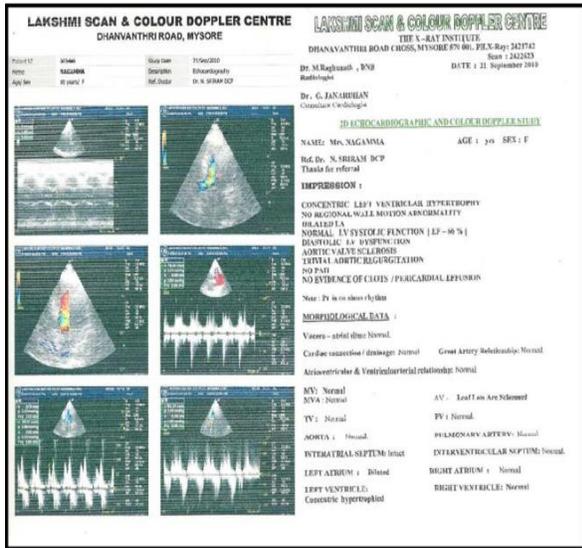
CVS: Tachycardia + S₁ Loud.

ECG taken at 10.00 AM suggestive
suggestive of Atrial fibrillation

ECG taken at 3 PM was within normal
limits

Conclusion:
This is a case of Paroxysmal Atrial
fibrillation which could only be diagnosed
exactly by ECG.





PROPOSED IDEA

Considering the pre-requisites highlighted in the problem statement a new model is proposed here. Dual technology of Image processing and Signal processing is the best fit Engineering idea for this problem statement. This technology provides an accurate method for the early screening of cardiovascular diseases. A handy module which processes on the simpler artificial intelligence algorithm, estimates the output based on the supportive methods of image and signal processing, this makes the analysis of heart more accurate.

THE MODULE DESCRIPTION

The module is embedded with a gigahertz processor which handles the signal computation of both domains and can make the comparative analysis of the infected heart with the regular condition by using the artificial intelligence algorithm implementation. The lateral tube in the module is provided with a gel fluid for the frictionless scanning process. Backside of the module is mounted with 3-Dimensional color Doppler sensors which can scan the heart within few seconds by physically moving on the chest region. Simultaneously the 6 wireless chest leads and 4 wireless limb lead electrodes are used to collect the net electrical activity of the heart and blood pressure.

The parallel analysis computing of image and electrical activity of heart will come to an accurate conclusion by the processor. The result is compared with the regular normal heart parameters by

implementing it through artificial intelligence algorithm. The response of AI software will point the exact problem location in the heart and it will be displayed on the flip screen monitor.

THE PROPOSED IDEOLOGY OF THE MODULE SHOWN AS ALGORITHM

Step1: Image acquisition using 3D image color Doppler sensor (Transducer) providing input signal to the processor for computation.

Step2: Simultaneously Net electrical signal acquisition using wireless electrodes, parallel computing as one more input signal for the processor.

Step3: Comparative study of acquired signals with regular standard patterns and processing of the signal by the gigahertz processor.

Step4: Artificial intelligence comparative processing and followed by simple yes- no questioning based on the history, physical features, habits of smoking and alcoholism, appearing on the flip monitor.

Step5: Based on the percentage infection of cardiac in early screening method is displayed on the screen which is in the regular understandable format for the layman.

Step6: Up gradation of this scheme on to the going forward plan is extension of making the output transmitting it to the nearest cardiac care centers (Telemedicine) and help for further treatment.

THE PROPOSED IDEOLOGY OF THE AI ALGORITHM

Step1: The processed signal is the input feed for the simulation AI logic.

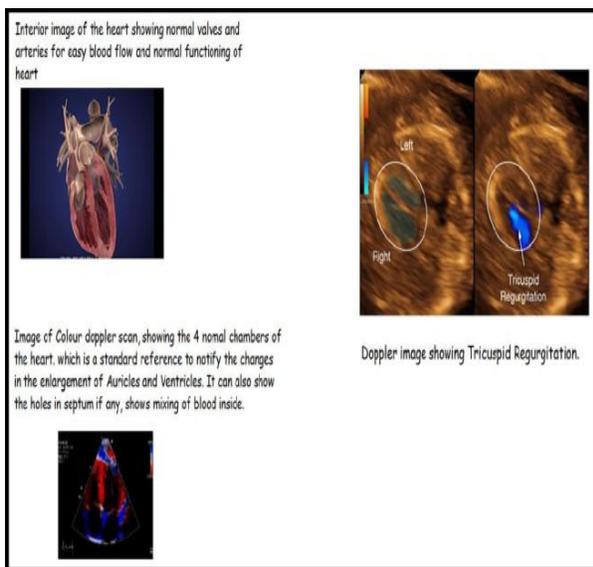
Step2: The data comparison between the processed data and the standard pattern, giving the conclusion of response based on the major abnormalities declaring it as a ‘Critical Cardiovascular disease’.

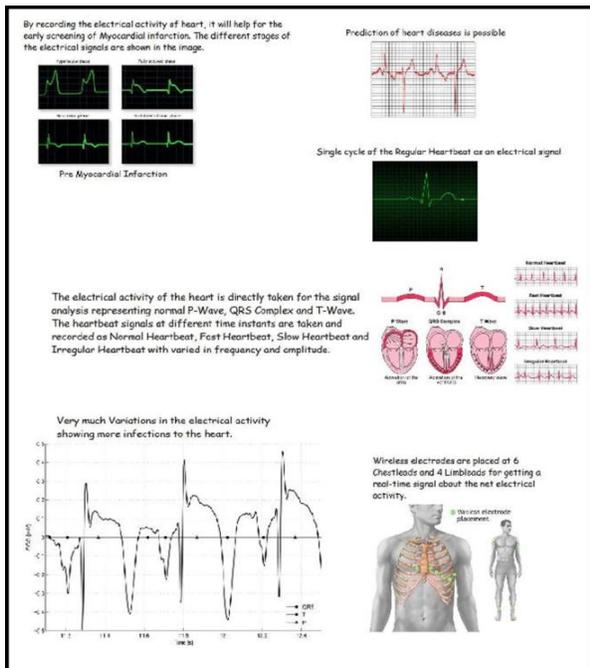
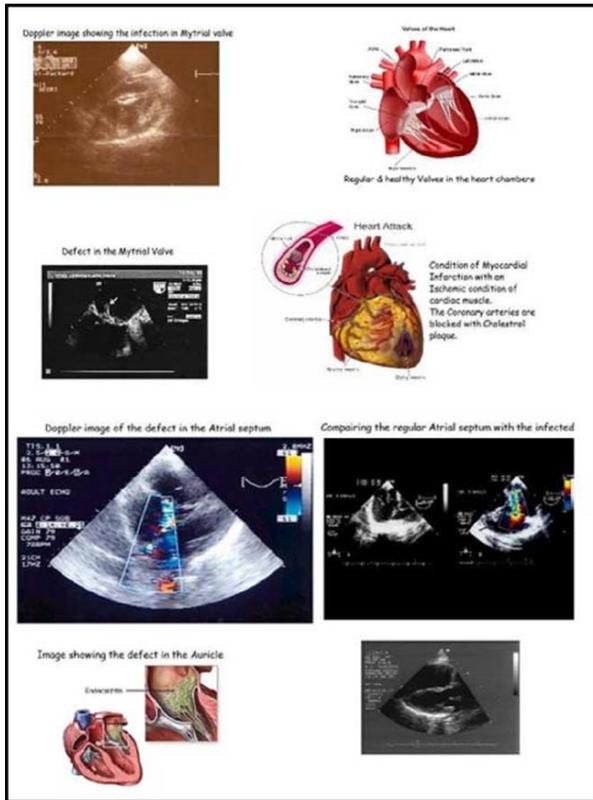
Step3: If there are limited section variations with the parameters of heart signals, continuing the logic with simple yes-no questionings related to history of person, Body mass index, blood pressure, stressful life, symptoms based, geographical area.

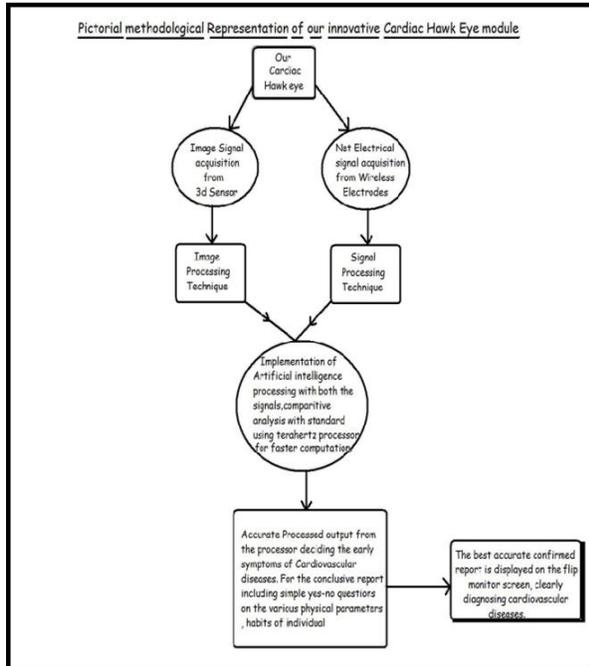
Step4: Based on the reasoning's of the individual the final report is proposed by our AI algorithm.

Step5: Confirmed report is displayed on the screen.

Interpretation of artificial intelligence algorithm:





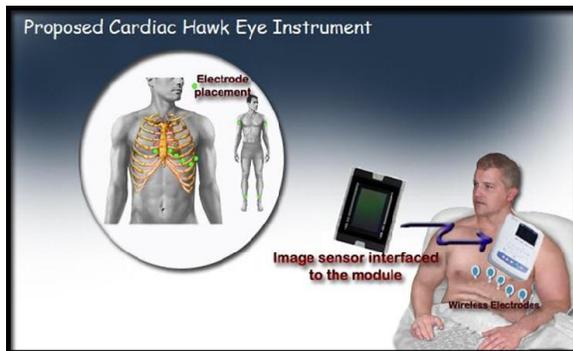


NOVELTY OF IDEA

The response of the existing technology instruments fails as signal needs backend processing consuming more time to give its analysis report, and also result needs to be certified by a cardio specialist. These disadvantages of existing systems stacks up as major failure, finds very difficulty in implementing in rural sector with limited set of facilities or even no facility sometimes. The proposed model can be a replacement for all impediments mentioned above. The need for fewer infrastructures, accurate results within no time, cost effectiveness makes the module novel from the existing modules. Cardiac Hawk Eye Instrument is a customer friendly device which discards the need of a skilled technician for its operation. This aspect of the module enhances its novelty.

DIFFERENCES BETWEEN PROPOSED SOLUTIONS AND EXISTING SOLUTIONS

Parameters	Proposed Solutions	Existing Solutions
Domain analysis	Combinational method of image and signal processing.	Any single domain analysis.
Early screening of cardiovascular diseases	It is designed for the same purpose.	It is designed for later stage purpose.
Time efficient	It's very much fast as it uses gigahertz processor, very much time saving.	It needs more time for the diagnosis.
Reliable screening for large population	As it is a hand held device, which is reliable to screen large population.	As the device structures are complex, not possible to screen large population.
Cost effective	The module is handy and simple, which is cost effective to be implemented in rural sectors.	The module cost is very much expensive to afford and meet the requirements of rural.
Skilled Manpower	No need of specialist skilled people. Low-skilled manpower is sufficient.	Expertise and specialist Manpower is very much essential.
Infrastructure (Electricity, Lab facilities)	Low infrastructural facility. The module is battery operated, and no need of much equipped lab facility.	High sophisticated infrastructural facility is needed.
Equipment design	Simpler module design.	Complex module design.
Rural sector implementation	Best fit solution for implementation in rural.	Difficult for rural implementation as of now.
Accuracy in early screening of diseases	More accurate result for the early symptoms.	Most accurate for the whole treatment process.



ADVANTAGE OF OUR INNOVATIVE MODULE USING A COLOR DOPPLER IMAGE ACQUISITION TECHNIQUE OVER EXISTING

A Doppler sensor (transducer) evaluates BP as it scans through the blood vessels. It helps consumer to evaluate blood flow through the major arteries and veins of heart. It can show blocked or reduced blood flow through narrowing in the major arteries. It also can reveal blood clots in veins that could obstruct and block blood flow. Doppler test may be used to look at blood flow in an unborn baby as well.

During Doppler test, a handheld instrument (transducer) is passed lightly over the chest region. The transducer sends and receives waves that are amplified. The waves bounce off solid objects, including blood cells. The movement of blood cells causes a change in pitch of the reflected waves (called the Doppler Effect). If there is no blood flow, the pitch does not change. Information from the reflected waves can be processed by a processor to provide graphs or pictures that represent the flow of blood through the blood vessels of heart, which also take parameters such as size of heart chambers, septum defects, bundle blockages, abnormal backward flow of blood through valves.

FEASIBILITY OF IDEA

The automatic comparative report study of the images and electrical activity of heart gives more justified accurate analysis. The image captured from the Doppler transducer is processed and compared with the regular, healthy heart parameters. These physical features comparisons will detect directly if there are any abnormalities such as; Enlargement of heart cavities, valves or arteries abnormalities, bundle blockages. The above impediments can be collectively depicted by the blood pressure and net electrical variations of heart. So both the image and signal

processing methods acts as a supportive accurate technology for detecting early symptoms of diseases.

The signal computation in the processor is based on the Artificial Intelligence algorithm, which will give directly confirmed report of early symptoms, if any. If there exists an ambiguity then passed on to the parameter questionings: history of person, Body mass index, blood pressure, stressful life, symptoms based, geographical area.

Based on the report of both the implementations a final confirmed conclusive report is obtained on the screen of the monitor. If the condition is more critical, all the heart parameters are transmitted wirelessly to the nearest cardiac care centers (implementation of tele-medicine), so easing for the early treatment of any such sensitive cardiac diseases.

The commercial risks for the time being are the success rate of the module design response and publicity features in rural sector. As the module design uses the lumped elements, replaceable processors with low-skilled can be achieved. The module is also easily replicable for the manufacturing so there is a less chance of service/maintenance risks.

POTENTIAL IMPACT

As mentioned the device is very much simple to handle and monitor, even a low- skilled person can operate on his own to check his own early diagnosis of his heart. The panel screen mounted on the top of the module will give all checked parameters in an understandable format for a common man so that he can contact the specialist doctors for his next stage of treatment. This is a “Life Saving” method which can be implemented in rural, so that he can change is diet and regular life style preventing him from suffering cardiovascular diseases in future. The technology supports “Prevention is better than Cure”.

CUSTOMER VALUE / COMMERCIALIZATION

As the module is implemented with the processor technology with more justified results of problem prone area of heart, the analysis is cost-benefit in the commercial point of view. On large scale production of this analysis module costs less, which is the basic equation of economics.

This medical instrument has replaceable processors, so maintaining the product/service is not at all a big task. Since the module uses a present technology gigahertz processor, manufacturing is same as other products. The module is operated with chargeable batteries and mounted on top

with a flip open monitor screen for the display of the response of analysis. The testing circuits are given for each stage of circuit design, so that it'll be easy for verifying the connectivity of each stage. The parallel processor, co-support is provided for standby condition and the processor is easily replaceable. Battery operated technique can be extended for solar charging.

FUTURE SCOPE

The implementation of this technology module can be extended for transmitting the processed signal to the nearest cardiac care centers or primary health care centers in rural for further treatment of the infection.

With slight modification in our module, interfacing with the printer is possible, by which the medical report having sophisticated parameters can be taken out for further reference (expert consultation). Key factor in implementation of this proposed technology for saving life within few minutes by early screening is justified. With the implementation of a buffer and a data base management system, customer's history can piled on. This can later be produced before the doctor for better interpretation of the symptoms. For security issue biometrics' can be incorporated.

The same module can be upgraded to diagnose defects throughout the entire body.

CONCLUSION

The key aspect of our module is early screening method of cardiovascular diseases which uses a dibrid technology and gives more reliable analysis.

The most important conclusion is that the instrument is handy, reliable, cost- effective, time restraining, accurate, low infrastructure which meets all the requirements to be implemented in rural sector. The fundamentals which we considered were ECG and echocardiography which had defects in their own domains were rectified to highest degree by our module. The proposed module design is especially designed for the premature diagnosis of the cardiovascular symptoms, which has a mapping quantified method particularly applicable for the chest region. "If wealth is lost, nothing is lost – if health is lost, everything is lost, Health is wealth". This innovative cardiac hawk eye is for "Helping and saving mankind and society".

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