Hampel filter as medical signal filter with doctor's assistance system for Clinical investigation

P.Saravanan,[1]
1-Associate professor
Department of Electronics and
Communication Engineering,
Sri Sai Ram Institute of Technology,
saravanan.ece@sairamit.edu.in

Ramprasad maharana,[2]
2-Associate professor
Department of Electronics and
Communication Engineering,
Sri Sai Ram Institute of Technology,
ramaprasad.ece@sairamit.edu.in

N.Oralroberts,[3]
3-Associate professor
Department of Electronics and
Communication Engineering,
Sri Sai Ram Institute of Technology,
oralroberts.ece@sairamit.edu.in

R.Prakash,[4]
4-Associate professor
Department of Electronics and Communication Engineering,
Vellore Institute of Technology,
Prakash r @vit.ac.in

K.Srinivasan,[5]
5-Associate professor
Department of Electronics and Communication Engineering,
Sri Sai Ram Engineering College,
srinivasan.ece@sairam.edu.in

Abstract –The medical signals should be free from unwanted noise and should be transmitted easily with less time to doctor for making clinical investigations.. This paper is a small work on our part in that track. ECG Electrocardiogram signal is most commenly known familiar and used medical signal, the ECG signal is very responsive in nature, and still if small noise combined with actual signal the different properties of the signal changes. Augmented reality is the Combination of artificial information to one or more senses so that handlers can accomplish tasks more effectively. We have projected a system in which significant digitally filtered information, such as ECG, is displayed on semi-transparent Doctors glasses.

Keywords—: FIR filter design; Hampel filter; augmented reality*; ECG*

1. INTRODUCTION

In medical applications we may use the filter to avoid unwanted components from the signal, similar to random noise and also to extract the significant parts of the signal like characteristics within a selected range of frequency (Quan et al., 2009)[1]. The design of the filters for specific application includes the coefficient calculation according to various criteria including sampling frequency, pass band and stop band frequency, filter order etc.

Human bodies are continuously providing messages about fitness. This message may be observed through body-structure-related devices that evaluate heart speed, blood stress, oxygen infiltration levels, blood glucose, nerve transmission, brain movement and so forth. Bio-medical signal processing includes the study of these observations to offer helpful message upon which doctors can make conclusions. Engineers are finding new techniques to prepare these signals by means of a range of mathematical formulae and sets of computer commands. functioning with conventional bio-measurement tools, the signals can be figured out by software-commands and provides the doctors, idea about what happening or viewable at present.

In Medical field, the sensors used to gather patient data's and display it in the display unit. In cases where doctor perform a critical operation, it is difficult for them to note the patient's data. So, to monitor the patient's data they get distracted easily causing accidents. One clear advanced expansion in medication over the most recent couple of decades has been imaging invention, which has further profited by progresses when all is said in done PC innovation. The constant point by point pictures we can deliver now have changed the act of medication in many territories.

AR has the ability of providing a heads-up show, giving indispensable data to specialists overlaid on the patient. In any event this takes into account getting to data without moving away from the working field. As the invention advances it is likewise simple to envision 3-D anatomical data really overlaid on head of the patient. Presently join this with misleadingly keen calculations that can picture the sick persons continuously, and associate the functioning field with past imaging just as anatomical data. Our Objective is to create a doctor's assistive system using augmented reality. We are monitoring the health status of the patient and displaying the status in the AR glass.

In this project, the real time data of sick persons in hospital gathered by the sensors fixed to patients, once the sensor estimated the values then it is managed and send to doctors augmented reality glass by wireless and alert if irregular state occurs. The doctor can take proper action based on the patient's existing health state.

2. BACKGROUND.

An extensive literature review was carried out on existing digital filters model and the method that are used for enhancing the performance of the digital filters.

Yamada & Nishihara, (2001)[7] demonstrated quick and complicated FIR digital filter on FPGA. Multipliers in the channel whose coefficients are communicated as canonic signed digit (CSD) code are acknowledged with wired-shifters, adders and subtractions. The basic way is lessened by addition of pipeline registers and is equivalent to the spread deferral of a summer. The quantity of pipeline registers is restricted by utilizing a comparable transformation on a signal flow diagram. The cost paid for the 100% speedup is 5% expansion in the range. The maximum sampling frequency is 78.6MHz.

Shahramian et al., (2012)[8] proposed Decision feedback equalizer (DFE) architectures with changing quantities of discrete-time taps and continuous time IIR filters are thought about for use in filters. For every situation, the DFE coefficients are enhanced to minimize a cost capacity. Notwithstanding when a few reflections are available persistent time IIR taps can be successful if their channel coefficients are appropriately enhanced. Utilizing a DFE engineering with just two IIR channels gives satisfactory outcomes to both a 26-dB misfortune persuade link and a 16 FR-4 back-plane channel at 10 Gb/s while keeping the DFE intricacy low. Moreover, the usage and exploratory aftereffects of a DFE with different (three) IIR channels is accounted for. Generated in a 0.13

μm CMOS handle, the DFE uses17.3 mW from a 1.2 V supply. A BER of $10{-}12$ was accomplished at an information rate of 3.7 Gb/s.

C.Dai (2010)[10] proposed new shunt FIR filter architecture, which are valuable to symmetric coefficients as far as the equipment cost, under the condition that the quantity of taps is a multiple of 2 or 3. The proposed parallel FIR structures exploits the innate way of symmetric coefficients lessening a large portion of the quantity of multipliers in sub channel segment to the detriment of extra adders in preprocessing and post handling squares. Trading multipliers with adders is favorable in light of the fact that adders weigh not as much as multipliers as far as silicon region;

Benjamin etal(2018) presents a totally consistent regulator handle for use in virtual and increased reality situations. The regulator handle changes between two static expresses: a semi-inflexible, enormous width state when pneumatically pressurized and a delicate, compressible, littler breadth state when depressurized. We incorporated the regulator with an altered form of NVIDIA's VR Funhouse utilizing the two regulator states to reproduce the physical feel of two virtual articles. We utilized limited component displaying to down select an inside elastomer grid inside the regulator that controls disfigurement upon swelling. At long last, we show a case of utilizing the consistence of the handle as an association contribution by structuring a calculation to recognize fast compressions of the handle as a sign to trade objects in the virtual condition.

R. Velazquez etal (2015), pointed that, human fingers and hands are as often as possible harmed in light of the fact that they are fragile, complex, and utilized continually. In excess of 3 million individuals in the US experience the ill effects of hand or lower arm inabilities, and, around the world, hand wounds represent 33% of all work wounds. Because of the significance of hands and the predominance of hand issues, there is an expanding exertion toward creating hand orthotics. These endeavors have brought about dynamic hand orthoses that have been utilized for restoration preparing and reestablishing halfway hand work. To guarantee security and to decrease control multifaceted nature, some orthoses utilize mechanical compliances, for example, underactuated linkages or low-firmness materials and structures (e.g., rubbers and adaptable wires)

3. IMPLEMENTATION OF SYSTEM;

3.1 HAMPEL FILTER:

Digital-filters regularly acts on a large rate stream of data. They depend on the time decisive constraints, likely to be arithmetically concentrated and create intense use of multiply-combine calculations. ARM Cortex M4 processor has an extremely superior set of multiply-combine commands that can execute more than one integer multiply-combine operation in one clock period (e.g. SMLAD), which leads them to perform better in digital signal processing.

Hampel filters obtained by applying the median filter extensions: weighted Hampel filters, recursive Hampel filters, and their cascades. An important concept introduced here is that of an implosion sequence, a signal for which

generalized Hampel filter performance is independent of the threshold parameter t. These sequences are important because the added flexibility of the generalized Hampel filters offers no practical advantage for implosion sequences. Partial characterization results are presented for these sequences, as are useful relationships between root sequences for generalized Hampel filters and their median-based counterparts. To illustrate the performance of this filter class, two examples are considered: one is simulation-based, providing a basis for quantitative evaluation of signal recovery performance as a function of t, while the other is a sequence of monthly Italian industrial production index values that exhibits glaring outliers.

The model employs the Hampel filter block to filter two sine waves of various frequencies as indicated in Figure 1.
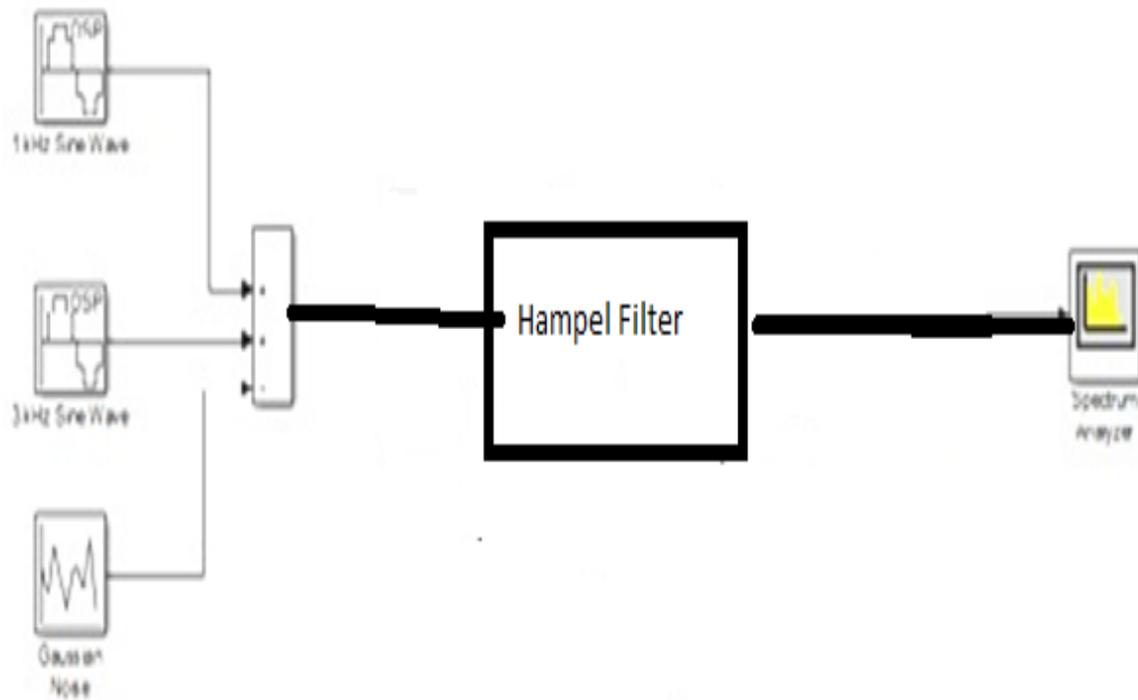

Figure 1: Implementation of Hampel Filter.

The filtered output from the proposed Hampel filter based system is given in figure 2,
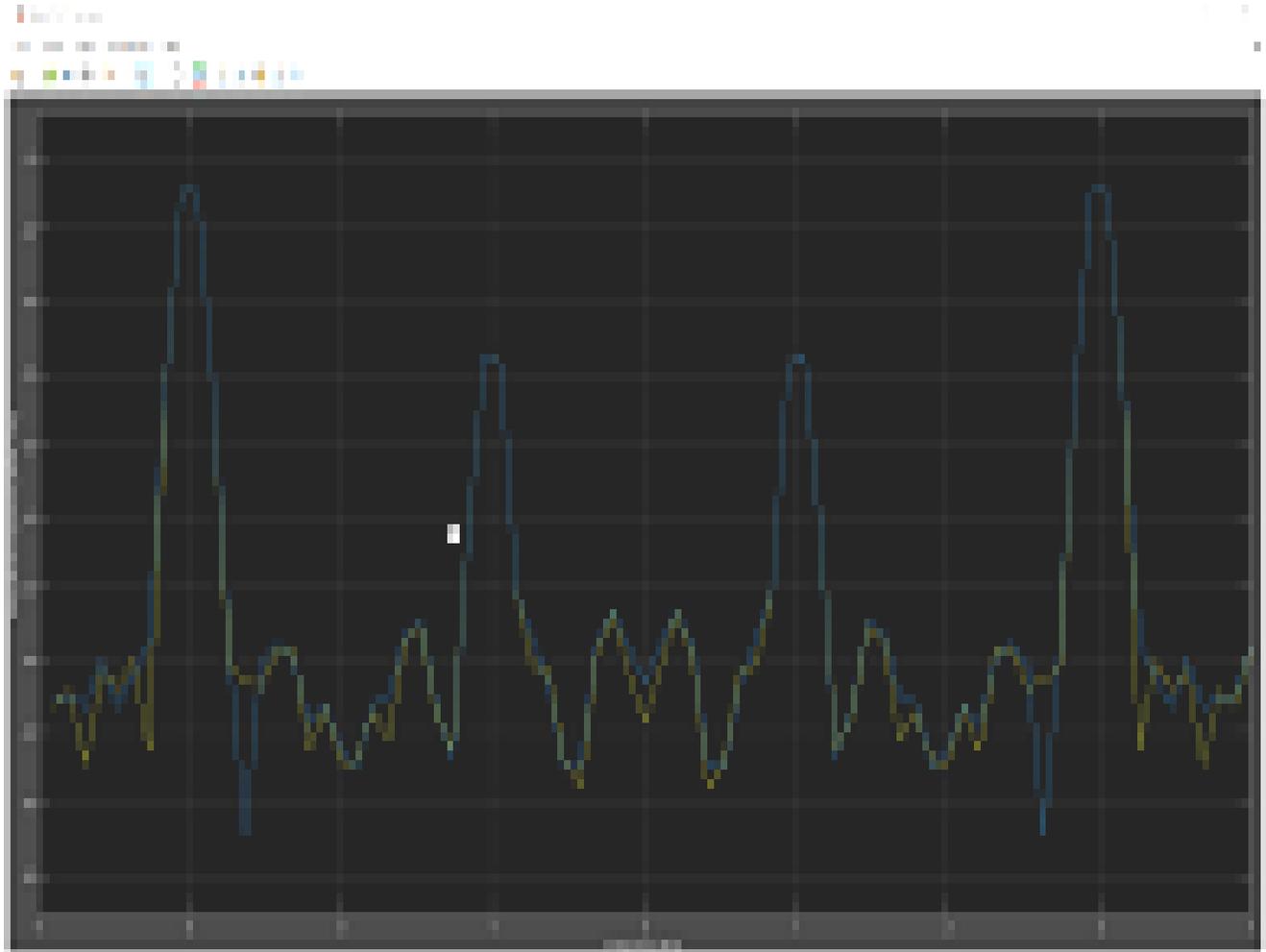

Figure 2. Output signal from Hampel filter..

3.2 MEDICAL SIGNAL DISPLAY AND TRANSMISSION.

If this proposed method is used in medical applications like filtering of ECG and other medical signals, with the presence of ARM controller some other measurement, control, display and transmission of the signal to some other remote location also can be done with ease.

The inputting and the handling of EMG signal is completed using LPC-2103 microcontroller unit. The LPC- 2103 is 32-bit ARM-7TDMIS processing unit, using on-time emulation that associates the microcontroller unit

with 32 KB implanted quick flash memory. Owing to unit's miniature dimension and little power utilization, the LPC -2103 is perfect in areas wherever dimension is main constraint.

For observing heart movement, the ECG signal is utilized. Our framework is partitioned into three subsystems 1.ECG Procurement 2. Preparing in ARM7 3.GSM.This is continuous framework. In this undertaking we will plan for checking of ECG information utilizing ARM7 LPC2148 and GSM module. Here first information is procured utilizing ARM7 which is additionally sent remotely utilizing GSM. The gadget will be efficient. It will be useful for the patient and specialist for simple Observing. It will be less perplexing when contrasted with other innovation. Less Force is required for its activity and control of the gadget. This gadget is utilized in Medical clinic, Military, Homecare Unit, and Sports Preparing.

The outline diagram of this framework is as appeared in the figure 3. The equipment framework comprises of ECG obtaining, ARM7 processor and GSM module. In this framework, ECG signal are procured utilizing 3 lead ECG anodes. This sign is given to ARM7 processor for enhancement and filtration
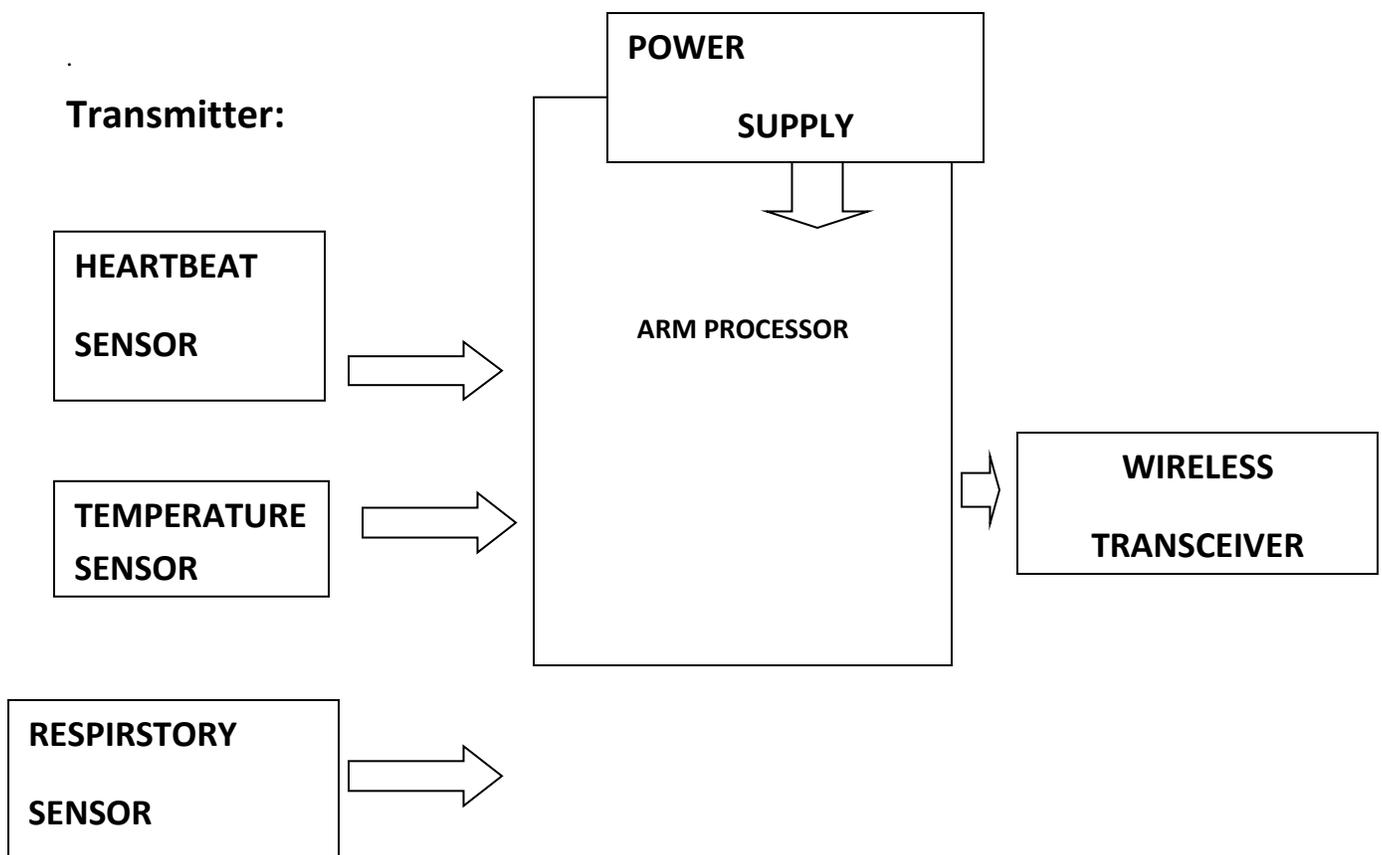
.

Transmitter:

Figure 3.Transmitter and receiver section

GSM (Worldwide Framework for Portable correspondence or Groupe Special Versatile) interchanges, started by the European Commission, is the second-age versatile cell framework planned for creating. GSM is the world's most well-known 2G innovation. It was created to tackle the fracture issues of the principal cell framework in Europe. GSM guaranteed a wide scope of system administrations using ISDN. It additionally indicates advanced adjustment and system level models and administrations.

4.RESULTS AND DISCUSSION.

In this work we likewise anticipated and actualized a versatile channel for nonstop and distinct purposes. We decreased the equipment unpredictability by utilizing the computerized channel driven equipment engineering. As indicated by the exploratory outcomes, the proposed channel with ARM processor has lower computational multifaceted nature than other existing sifting calculations Figure3. System block diagramThe minimized number in hardware of this idea offers the benefit such as less consumption of space and power for overall system including signal transmission and display. As the ARM processor can also be used for signal transmission and display using Augmented reality, the overall cost, power consumption will be minimum and has better performance.

We have proposed a visualizing module in the following cases

Case 1: TEMPERATURE MEASUREMENT

In order to measure temperature of the body, we have included temperature sensor which senses the temperature of the body and displays it in the visualizing module in updated manner. Numbers of test runs were performed for assessment of proposed system.

Case 2: PULSE MEASUREMENT

In order to measure the pulse rate of the body, we have included heartbeat sensor which senses the pulse rate of the body and displays it in the visualizing module in updated manner. Numbers of test runs were performed for assessment of proposed system.

Case 3: RESPIRATION MEASUREMENT

In order to measure respiration or breaths per rate of the body, we have included respiratory sensor which senses the breaths per second of the body and displays it in the visualizing module in updated manner. Numbers of test runs were performed for assessment of proposed system.

This paper aims at bringing out time saving and money saving augmented reality glasses for the purpose of analyzing critical conditions of the patient during surgeries. This glass will become more common as of other surgical equipment in forthcoming years. With reduced size, it becomes more and more compatible, efficient, great useful product in the field of medicine.

Reference

1. Quan, Q., &Cai, K. Y. (2012). Time-domain analysis of the Savitzky-Golay filters. *Digital Signal Processing: A Review Journal*, *22*(2), 238–245. https://doi.org/10.1016/j.dsp.2011.11.004

2. Yamada, M., & Nishihara, A. (2001).High-speed FIR digital filter with CSD coefficients implemented on FPGA.Proceedings of the Asia and South Pacific Design Automation Conference, ASP-DAC, 2001–Janua(April), 7–8. https://doi.org/10.1109/ASPDAC.2001.913262

3. Shahramian, S., Yasotharan, H., &Carusone, A. C. (2012).Decision feedback equalizer architectures with multiple continuous-time infinite impulse response filters.IEEE Transactions on Circuits and Systems II: Express Briefs, 59(6), 326–330. https://doi.org/10.1109/TCSII.2012.2195055

4. .C. Dai, W. Chen, & Y. Zhu. (2010). Seeker Optimization Algorithm for Digital IIR Filter Design.IEEE Transactions on Industrial Electronics, 57(5), 1710–1718. https://doi.org/10.1109/TIE.2009.2031194

5. Benjamin C. Mac Murray, Bryan N. Peele, Patricia Xu,(2018), A variable shape and variable stiffness controller for haptic virtual interactions, IEEE International Conference on Soft Robotics (RoboSoft).

6. R. Velazquez, E. Pissaloux, J. Szewczyk, M. Hafez ed,(2015), A low-cost highly-portable tactile display based on shape memory alloy micro-actuators, IEEE Symposium on Virtual Environments, Human-Computer Interfaces and Measurement Systems

7. Dastjerdi, M. M., A. A. Kusha., and Pedram M., 2009, "BZ-FAD: A LowPower Low-Area Multiplier Based on Shift-and-Add Architecture," IEEE Transactions on VLSI Systems, 17 (2), pp. 302-302.

8. . Dwivedi, A. K., Ghosh, S., &Londhe, N. D. (2016). Low-Power FIR Filter Design Using Hybrid Artificial Bee ColonyAlgorithm with Experimental Validation Over FPGA. Circuits, Systems, and Signal Processing, (April), 1–31. https://doi.org/10.1007/s00034-016-0297-4