

# Improve Performance of FLASE Alarm Detection by using CFAR and Low Pass Filter

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**Abstract**— Cyber-Physical System (CPS) is an integration of physical systems with computation, communication and controlling. CPS has various applications such as power networks, transportation networks, healthcare applications, infrastructures and industrial process. CPS connects the virtual world with the physical world. Wireless Sensor Networks (WSN) are the vital part of CPS because they have the strong sensing capabilities. In CPS healthcare application various sensors are used to collect the data from patients. Many times these sensors generate a large number of false alarms. Due to these false alarms confusion is created and it reduces the efficiency of overall healthcare services. There are still a lot of challenges in healthcare such as interoperability, security and privacy, autonomy and device verifiability. In this paper, we improve the performance of false alarm detection by using CFAR (constant false alarm rate) and the low pass filter. Thus we are using low pass filter here because our actual values will be present in the lower frequency region. The noise has

higher frequency thus we tend to remove them by using a low pass filter.

**Keyword**— CFAR, CPS, WSN.

## I. INTRODUCTION

Cyber-Physical system is attracting a lot of attention in recent years but it is still consider as a nascent technology. CPS combines the physical systems with the information (cyber) systems. CPS was identified as a key research area in 2008 by the US National Science Foundation (NSF) and was selected as a number one research priority by the President’s Council of Advisors on Science and Technology. CPS have wide range of applications such as transportation, power management, healthcare, infrastructure, assisted living and monitoring network. The architecture of the CPS must contain the variety of physical information, reliable data analysis, event detection and security.

The architecture of CPS in healthcare is given below:-

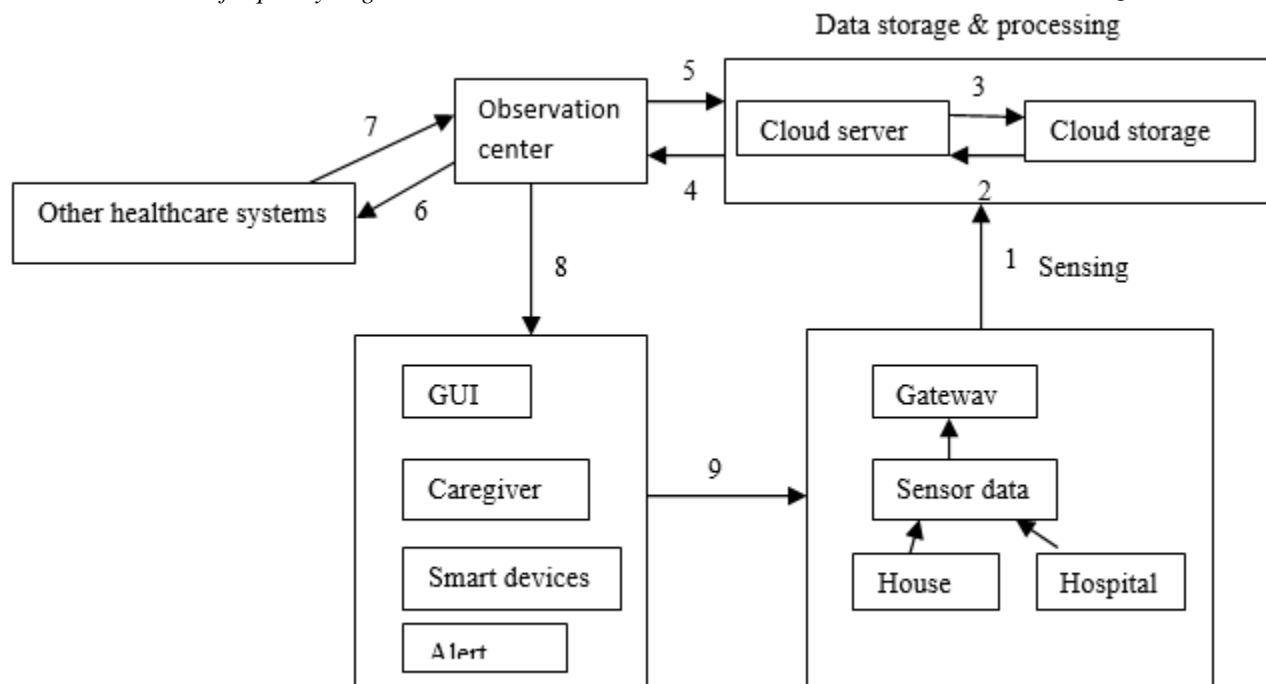


Fig.1: Architecture of CPS in Healthcare

In the above fig. we explain that how data is sensed and then transferred to the different units for the processing.

- The data is collected from the houses and hospitals via sensors and sent to the data storage and processing unit via gateway.
- In data storage and processing unit the cloud server calls the data which is stored in cloud storage and then again stored it on into cloud storage.
- Stored data is then sent to the observation center for processing.
- If it is required physicians approach other healthcare systems for consultation.
- The observation centre then sent the decision to the actuation components.
- Necessary actions are taken on the patients.

In health care application, a wide variety of sensors are used. Sensors can be heterogeneous as well as homogenous. There can be multiple sensors for a person and a single parameter sensing system for a group of people .The medical data is vital for saving patients life, all data must be readily available and accessible to the authorized medical persons and healthcare center. The sensors must alert the clinical in any emergency case. Many times the sensors generate a lot of unwanted false alarms. Due to presence of noise signals the actual alarm are missed. In this paper, we use the CFAR (constant false alarm rate) and low pass filter (trapz filter).By using this low pass filter we get only actual alarms.

### Literature Review

In this section we have discuss the previous work .

- [SHAH AHSANUL HAQUE,et-al]He proposes the anticipated configuration a way to ensure the location configuration. It means to blend the edge alert procedure with various classifiers in call set. Moreover, the anticipated configuration intends answer some nonreciprocal questions like culmination, cautioning discovery and right caution era.

The configuration proposes to use various classifiers and contrast those and essential wellbeing data from patients for location cautioning of medicinal sensors. He proposes a structure that is relied upon to perform higher with respect of exactness, power and great cautioning gadget. But this approach does not guides us the exact location or the configuration to be cured.

- [TIANBO LU, et-at]He proposes a security system consoling the wellbeing of digital physical systems and examine fundamental colleges and organizations figuring out CPS security and their relations in 3 levels: CPS security targets, CPS security methodologies and security in particular CPS applications. The most security methodologies on location digital physical assaults and consoling CPS security are recorded and dissected.

There are still a few difficulties confronting planners, administrators and scientists. This is regularly unacceptable, and ideally, by giving an outline of the writing endeavors done; the synopsis can contribute in giving reference to research laborer inside of the space of CPS security.

- [LU-AN TANG, et-at] He proposes a route alluded to as True Alarm that discovers dependable alerts. Genuine Alarm evaluates the areas of articles delivering alerts; builds an article alert diagram and completes attribute surmising upheld coupled data inside of the Graph. Inside and out trials demonstrate that True Alarm sift through commotions and false data quickly and ensures not missing any deliberate alerts. This paper concentrates on the matter of attribute examination in digital physical systems. The creators propose the caution and item trust models of finder system. Inside of the True Alarm structure, the system builds an article caution diagram and does the attribute illation on the connections of such chart. Inside and out analyses are directed to show the quantifiability and pertinence of anticipated ways.

## II. PROBLEM STATEMENT

In CPS healthcare application doctors and physicians play an important role. They have to observe the patient from anywhere and anytime .The patient data must be access by them accurately. False alarm detection is a very important in healthcare monitoring. In CPS healthcare application, various type of medical sensors are used, however these sensors produce a larger than average mixture of false alerts. It depends on Probability of false alarm and Probability of detection. According to previous work probability of detection is low, that means system is not able to detect false alarm and it is passing to the receiver. So that means as the SNR (signal to noise ratio) get increase the Probability of false alarm detection get low.

**III. PROPOSED METHODOLDY**

Here we have proposed CFAR in CPS where using threshold filtering, remove the unwanted noise and regain for our required output. We can observe the change in detected and ghost bits on basis of required SNR for various systems. We are also introducing trapz filter function. Thus we are using low pass filter here because our actual values will be present in the lower frequency region. The noise has higher frequency thus we tend to remove them using a low pass filter. According to proposed methodology probability of false alarm detection is getting increase. System is more able to get false alarm detection. By the proposed system PD is getting increase and the PFA is decreasing that means system is more perfect to detect false alarm system.

CFAR (constant false alarm rate) identification alludes to a typical type of adaptive algorithm utilized as a part of radar systems to recognize target returns against a foundation of interference, clutter and noise

In radar receiver returning echoes are commonly gotten by the antenna, amplified, down converted and after that went through detector circuitry that concentrates the envelope of the signal (known as video-signal). This video-signal is relative to the force of the got echo and involves the needed echo-signal and the undesirable power from external clutter, interference and internal receiver noise.

The part of the circuitry of constant false alarm rate is to focus the threshold power above which any arrival can be considered to presumably start from an objective. On the off chance more targets is then recognized for low threshold to the detriment of expanded quantities of false alarms. On the

other hand, fewer targets is recognized for too high threshold, however the quantity of false alarms will likewise be low. Most radar-detectors, threshold is situated with a specific end goal to accomplish an obliged probability of false alarm (or comparably, false rate alarm or the time in between false-alarms.

In the event that the foundation against that targets are detected is then constant with the space and time, and then an altered threshold level can be picked that gives a predefined probability of false alarm, represented by probability-density-function of noise, that is generally thought to be a Gaussian. Detection Probability is then functions of target return SNR. Notwithstanding, in most fielded systems, interference sources and undesirable clutter imply which the noise-level changes both temporally and spatially. For this situation, a changing threshold can be utilized, where the threshold level is raised and brought down to keep up constant-probability of a false-alarm. It is known as CFAR detection.

**Proposed False Alarm Detection Architecture:-**

The proposed architecture in CPS healthcare application integrates physical and virtual systems by sensing, computation and communication. New technologies are advance in integration and miniaturization of sensors, microcontrollers and radio interfaces on one chip. Wireless networking and micro fabrication generates the wireless sensor networks which are suitable for many applications [2]. Many wearable medical devices and sensors are playing an important role in application of healthcare [2,3, 12-14].

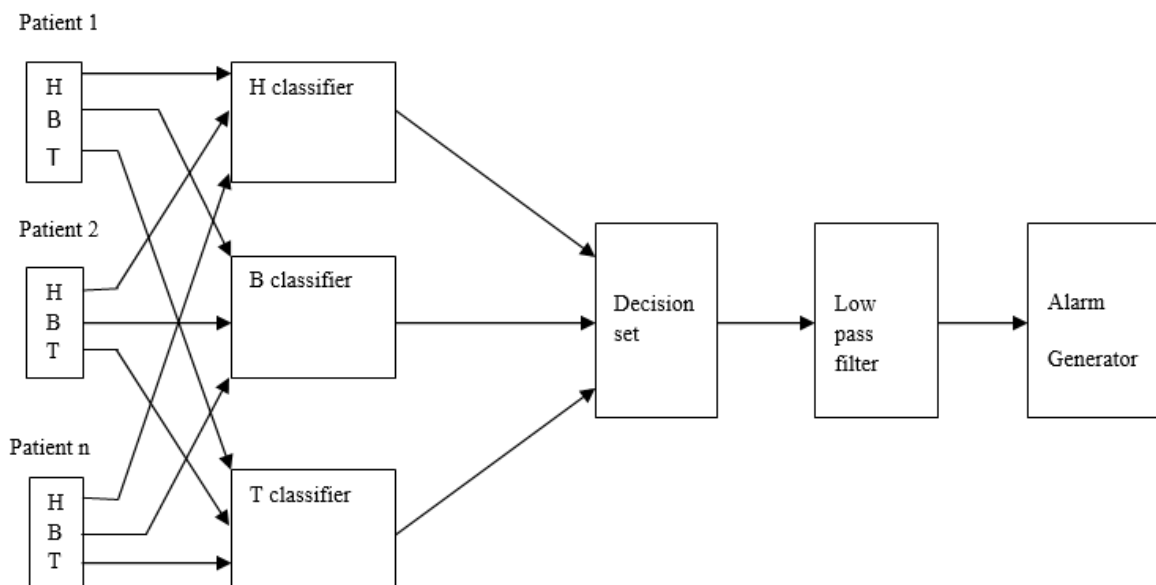


Fig.2: Proposed alarm architecture.

In the above architecture we consider n no. of patients having their heart rate(H), brain signal(B),body temperature signals provided by sensors respectively. These signals are then passes to their respective classifiers. After this the signals are transferred to the decision set. Decision set passes the signals only which crosses the threshold value to the low pass filter. In low pass filter the noise signals (high frequency signals) are rejected and the signals with low frequency are passes. Then the alarm is generated for actual signals.

**Mathematical calculations:-**

Probability of detection is calculated by

$$PD=ND/NS$$

Where

ND= No.of detected bits

NS=total no. of signal bits

Probability of false alarm is calculated by

$$PFA=NG/Nn$$

Where

NG=No. of ghost bits

NnS=total no. of noise bits

**IV. RESULTS**

MATLAB simulations have been conducted to calculate the approximate threshold alarm generation. For samples 5, 10,100,500,1000,2000,5000,7500,10000 and 20000 incidents and the threshold level is variable. The probability of detection is increases and the probability of false alarm is decrease in comparison with previously calculated. It means that the result is improved. This can be easily understand by the given table:-

Fig.3: Table for SNR(db)=10

S.no	No.of samples	PD of base paper	PD of improved paper	PFA of base paper	PFA of improved paper
1.	5	0.667	0.750	0.000	0.000
2.	10	0.400	0.500	0.000	0.000
3.	100	0.481	0.686	0.000	0.000
4.	500	0.512	0.697	0.000	0.017
5.	1000	0.522	0.552	0.002	0.007
6.	2000	0.505	0.521	0.003	0.003
7.	5000	0.519	0.577	0.001	0.005
8.	7500	0.493	0.470	0.001	0.006
9.	10000	0.488	0.465	0.001	0.005
10.	20000	0.503	0.533	0.001	0.007

This table shows the results when the SNR (db)=10. Similarly we can calculate for different values of SNR.

The probability of detection is higher for less SNR(signal to noise ratio) and probability of detection is decreases for high SNR values.

The graph generated for SNR(db)=10 is given below:-

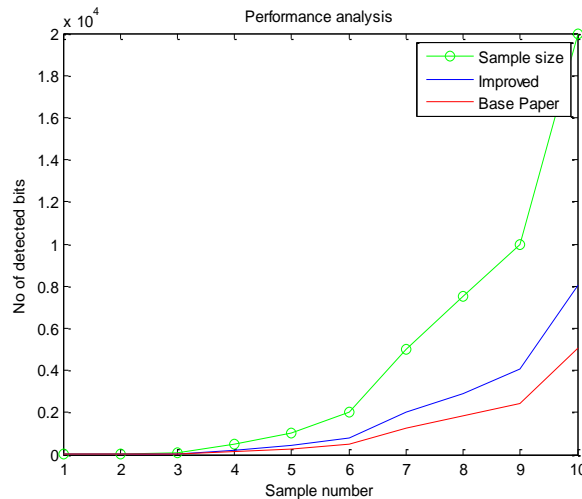


Fig.4: Comparison with previous results.

The graph with different values of SNR and the probability of detection is shown :-

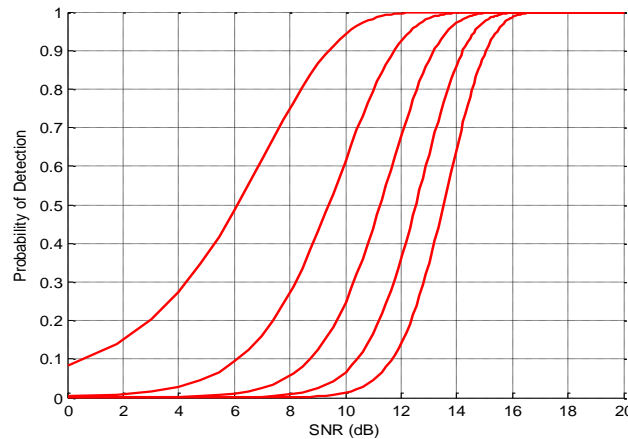


Fig.5: Relation between SNR and Probability of detection

**V. CONCLUSION AND FUTURE WORK**

False alert location plan for CPS health care application has been arranged. CFAR and low pass filter are able to detect more False alarms The Value of PD get increase according to the proposed methodology. In future we resolve to investigate the security issue and execute ideal model outline amid a health care situation.

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