A New Approach Design of Micro Control Unit of Encrypted Model for WBSNs

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Abstract: This project presents a very large-scale integration (VLSI) circuit design of a micro control unit (MCU) for wireless body sensor networks (WBSNs) in cost-intention. The proposed MCU design consists of an asynchronous interface, a multi-sensor controller, a register bank, a hardware-shared filter, a lossless compressor, an encryption encoder, an error correct coding (ECC) circuit, a universal asynchronous receiver/transmitter (UART) interface, a power management, and a QRS complex detector. A hardware-sharing technique was added to reduce the silicon area of a hardware-shared filter and provided functions in terms of high-pass, low-pass and band-pass filters according to the usages of various body signals. The QRS complex detector was designed for calculating QRS information of the ECG signals. In addition, the QRS information is helpful to obtain the heartbeats. The lossless compressor consists of an adaptive trending predictor and an extensible hybrid entropy encoder, which provides various methods to compress the different characteristics of body signals adaptively. Furthermore, an encryption encoder based on an asymmetric cryptography technique was designed to protect the private physical information during wireless transmission.

Keywords*:* WBSNS, MCU, ECG, UART, QRS.

I. INTRODUCTION

Presently days, uses of remote body sensor systems (WBSNs) have turned out to be more extensive and more extensive. These applications give a viable answer for supported observing, versatile wellbeing, self-wellbeing administration and organic examination in home-mind framework. Later on pattern of advancement, for example, remote sensor framework for breaking down irresistible ailment hubs and effectively ensuring touchy individual information in organize security, and so on., the utilization of WBSNs method is enhanced quickly. As the request of light-weight for wearable and compact applications, advancement of a proficient gadget to screen physical signs by means of the VLSI strategy has turned into a critical pattern. Some superior sensors have been proposed for physical signs. Lee et al. proposed an effectiveness correlative metal-oxide-semiconductor (CMOS) sensor for body temperature recognition. The circulatory strain can be distinguished by a magneto flexible skin ebb and flow sensor proposed. The pH esteem can be measured by an ISFET sensor proposed. A wearable ECG sensor was proposed. In spite of the fact that these sensors gave productive gadgets to catch the different physical signs, the WBSNs experienced the confinement of remote transmission data transfer capacity, figuring asset and vitality in batteries. A few concentrated concerned equipment arranged design for WBSNs have been exhibited as of late. So as to spare more power utilization and keep longer utilizing time, a versatile power controller and versatile fluffy controller outlines were proposed for WBSNs. A multichannel lossless body-signals compressor was exhibited for convenient observing frameworks. In addition, to be good with dealing with different bio-flags and handling physical flags in WBSNs, a multi-sensor smaller scale control unit (MCU) was created. A bio-flag preparing method was utilized to enhance flag quality in therapeutic applications effectively. By utilizing particular scientific operations, the physical signs can be examined with various sorts. Lossless information pressure methods are valuable in biomedical applications since none of data will be lost amid the pressure and de-pressure forms. The vast majority of low-many-sided quality lossless pressure calculations created a forecast and entropy coding forms. The blends of the forecast and entropy coding strategies incorporate a first-arrange expectation with a Huffman coding, a moment arrange forecast with a two-organize Huffman coding, a fluffy choice forecast with a crossover entropy coding, and a molecule swarm streamlining agent (PSO) forecast with a Huffman district coding Although the compressors diminish the information of the physical signs, the compacted information are likely lost amid remote transmission. Thus, a mistake adjust coding (ECC) system was utilized to diminish transmission blunder rates. Chen et .al proposed an equipment expectation ECC plan, which was effectively incorporated into a MCU outline. What's more, a general offbeat recipient/transmitter (UART) interface configuration was likewise incorporated into the MCU plan.

A continuous epileptic seizure controller configuration was incorporated into a CMOS System on a chip (SoC). Above of those, the information transmission experienced stolen emergency by remote transmission module, along these lines it is important to build up an encryption technique to ensure individual information. Since the physical signs are critical private information for individuals, the security of body signals is imperative. Henceforth, it is an intriguing issue to examine how to ensure the data recognized by WBSNs. Symmetric encryption coding utilized a same key to secure or open information remote sensor systems (WSNs). This technique will come up short on the off chance that one of two sides were broken. In this way, Thomas et al. proposed an adaptable design and an uneven encryption encoding utilized as a part of a close field correspondence (NFC). Uneven encryption is appropriate in the field of WBSNs because of two keys, an open key and a private key. The general population key is just used to encode the plaintext and the private key just works when Fig.1 message should be decoded. Likewise, some data of physical signs is vital for WBSNs, for example, the QRS focuses being critical for ECG signals. C. F.

Zhang et al. exhibited a novel QRS finder in view of a scientific morphological strategy to distinguish the QRS waves inside the ECG signals. In spite of the fact that the equipment arranged examinations specified above accomplished the motivations behind superior and ease plans, it is important to build up another MCU outline with more capacities, higher execution, and high security for WBSNs.

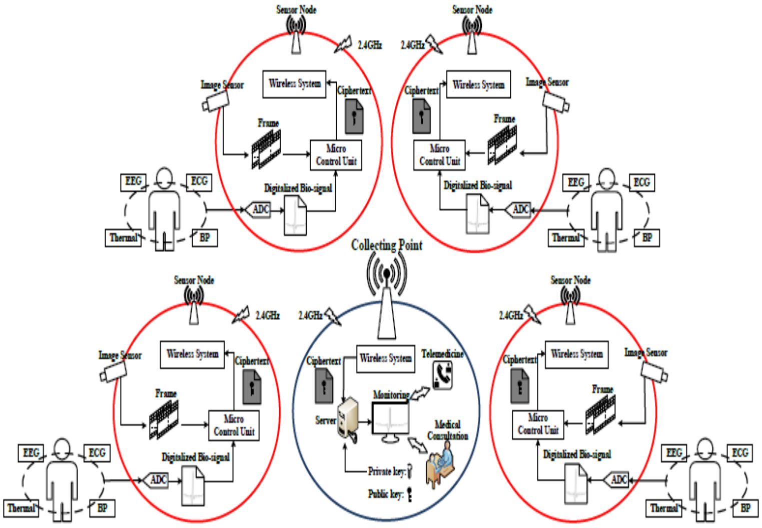

Fig.1. WBSNs system and the architecture of the wireless sensor nodes.

II. LITERATURE REVIEW

Security assaults in Wireless Sensor Networks ranges from Denial of Service Attacks, Sybil assault, Black gap/Sinkhole assaults, Hello surge assault, Wormhole assault and so forth. In spite of the fact that few encryption plans have been proposed to defeat information misfortune because of these assaults, the restricted assets of the sensor hubs makes it difficult to decide on complex encryption instruments and consequently multipath, randomized directing plans were investigated. The idea of multipath directing goes back to 1970s, when it was at first proposed to spread the movement with the end goal of load adjusting and throughput upgrade [Lee and Choi, 2006]. Afterward, the way disjoint multipath steering picked up prominence in view of its use in settling security issues. It likewise substantiated itself as a powerful calculation. A portion of the conventions incorporate, Split Multiple Routing (SMR) convention [Boukerche et al. 2004], multipath DSR [Khushvinder & Shuang, 2009], and the AOMDV [Zhanet al. 2009] and AODMV [Greenwald& Khanna, 2004] calculations that change the AODV for multipath usefulness. These conventions have been proposed early and henceforth do exclude the issue of security. Information encryption is generally used to guarantee security in open systems, for example, the web. With the quick advancement of cryptography research and PC innovation, the capacities of cryptosystems, for example, of RSA and Diffie-Hellman are lacking due the necessity of substantial number of bits. The cryptosystem in light of ECC is the current pattern of open key cryptography. [Watro et al. 2004] presents the execution of ECC by first changing the message into a relative point on the EC, over the limited field GF (p). Customary plans like RSA or ElGamal require impressive measures of assets. This fills in as a drawback because of the way that assets are restricted with regards to sensor systems. Subsequently, their utilization in sensor systems is constrained. Rabin's Scheme was presented in 1979 in [Karlof& Wagner, 2003]. It depends on the factorization issue of substantial numbers and is hence like the security of RSA with the same measured modulus. Rabin's Scheme has deviated computational cost. The encryption operation is to a great degree quick, however decoding circumstances are equivalent to RSA of a similar modulus. This asymmetry makes Rabin's Scheme particularly fascinating for our application. NtruEncrypt [Nachikethet al. 2003], was presented in 1996 by Hoffstein, Pipher and Silverman. NtruEncrypt is an open key cryptosystem where security depends on the hardness of the Shortest Vector Problem (SVP) in a high measurement lat-tice. Regardless it utilizes generally huge operands, yet it decreases the general asymptotic unpredictability of the encryption operation to $O(n^2)$ contrasted with RSA's $O(n^3)$. Newsome, J and others in 2004 present a Message Expansion Problem which can be unravelled by a Data Link-layer security engineering called 'Figure content Stealing strategy' for remote sensor systems.

Ordinary security conventions have a tendency to be traditionalist in their security ensures, regularly including 16-32 bytes of overhead. With little recollections, frail processors, restricted vitality, and 30 byte parcels, sensor systems can't bear the cost of this extravagance. TinySec tends to these extraordinary asset limitations with watchful plan. TinySec [Chris et al.2004], the connection layer security convention proposes a CBC plot called Skipjack alongside an extraordinarily arranged 8-bytes instatement vector (IV) to scramble the data[Xu& Liu, 1995]. Under the power and security mindful convention for sensor systems, [Tao et al. 2010] proposes the TEASR convention which depends on TinySec and EAR. The proposed convention is the expansion of EAR in which the RREQ message incorporates the leftover vitality level and bounce tallies of every hub alongside the way. Each moderate hub computes the ARE from the source to itself. At that point, middle hub advances a one RREQ message, which has the littlest ARE esteem, out of numerous got RREQ. The way that has the littlest EAR is at long last chosen According to these strategies, considering both leftover vitality and bounce tallies, the proposed plot chooses the last way between the source and goal. Once the way is totally figured, the goal sends back the RREP message to the source to advise an accomplishment in course foundation.

III. EXISTING SYSTEM

Typical WBSNs is composed of a group of wireless sensor nodes. Each node includes sensors such as physical sensors, image sensors, an analog-to-digital converter (ADC), a micro control unit (MCU), and a wireless transceiver with an antenna. In WBSNs applications, different physical signals, such as electroencephalography (EEG), electrocardiogram (ECG), thermal, and blood pressure (BP), are captured by different sensors. Hence, the MCU needs to process and merge the physical and imaged data and then send these processed and merged data to a 2.4 GHz band communication system for transmission. Because the communication system is composed of a transceiver, the control commands can be transmitted to the MCU in sensor nodes to change the optional selections from central control system. The specified physical signals captured by the sensors were converted to the signals in digital format by an ADC and then transmitted secretly by the communication system.

IV. PROPOSED SYSTEM

In order to develop a MCU design for wireless body sensor networks, a cost-efficient and power-efficient architecture of MCU had been developed. Fig.2 shows the architecture of the proposed MCU design. First, the physical data are detected by the four body sensors from human beings and then transformed as digital data by an analog-digital converter (ADC) device. Second, these digital data are processed by the proposed MCU design which consists of an asynchronous interface, a multi sensor controller, a register bank, a hardware-sharing filter, a lossless compressor, an encryption encoder, an error correct coding (ECC), a QRS complex detector, a power management. Finally, the processed digital data will be sent to the UART interface for transmission. All of operations and functions in the proposed MCU design are of low-complexity, which is suitable for development of WBSNs and implementation with a cost-efficient and high performance architecture via the VLSI technique.

A. Architecture Of Micro Control Unit

In order to build up a MCU plan for remote body sensor organizes, a cost-productive and control effective design of MCU had been created. Fig.2 demonstrates the engineering of the proposed MCU outline. Initially, the physical information are identified by the four body sensors from people and after that changed as advanced information by a simple computerized converter (ADC) gadget. Second, these computerized information are prepared by the proposed MCU plan which comprises of an offbeat interface, a multi sensor controller, an enrol bank, an equipment sharing channel, a lossless compressor, an encryption encoder, a mistake revise coding (ECC), a QRS complex finder, a power administration. At long last, the handled computerized information will be sent to the UART interface for transmission. All of operations and capacities in the proposed MCU configuration are of low-unpredictability, which is appropriate for advancement of WBSNs and usage with a cost-effective and superior design by means of the VLSI strategy. The subtle elements of every circuit are be explained in the accompanying.

B. Asynchronous Interface

The stages and frequencies of the distinguished physical signs changed over by ADC and UART correspondence interface are altogether different with the proposed MCU plan. Subsequently, three offbeat interfaces were added into MCU configuration to deal with the diverse stages and frequencies of identified signs. These offbeat interfaces handle signals conveyed amongst ADC and MCU, those amongst MCU and those between remote correspondence module, and those amongst MCU and UART interface. Through these non-concurrent interfaces, the proposed MCU can get and transmit flags precisely.

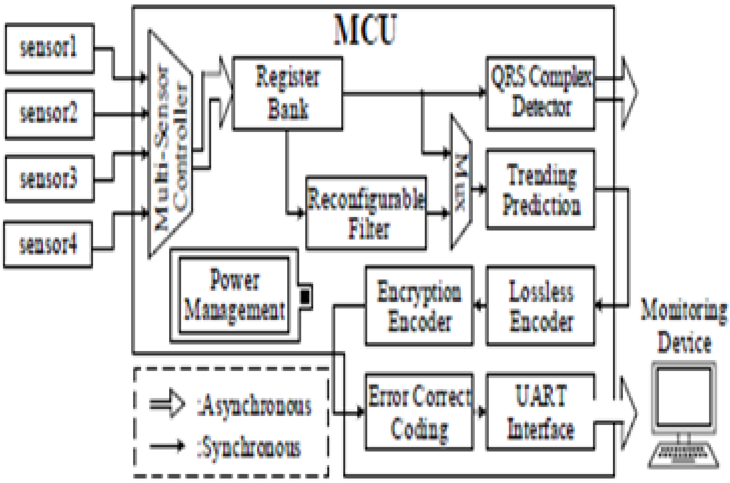

Fig.2. VLSI architecture of the proposed micro control unit (MCU).

C. Multi-Sensor Controller

The WBSNs contain sensors are utilized to distinguish diverse physical signs from human and the proposed MCU configuration likewise bolsters multi-sensor identification. By creating a control flag to a 4-to-1 multiplexer, the multi sensor controller can deal with four distinct sensors, for example, sensor1, sensor2, sensor3 and sensor4 as appeared in Fig. 2. The multi-sensor controller can choose one of four signs as indicated by the control flag sent by MCU. Since the multiplexer chooses the sensor appropriately, the MCU can acquire the predefined motion for preparing effectively. Albeit more than one sensor is dynamic and sending signs to the MCU at the same time, the information can even now pass on consecutively by the multi-sensor controller plan. Likewise, the multi-sensor controller additionally controls the signs to store the information to one of four-line enrol supports in the enlist bank of the MCU. Along these lines, in view of the plan of the multi-sensor controller, the proposed MCU configuration can proficiently keep information from missing and bolster four unique sensors.

D. Register Bank

With a particular true objective to process four unmistakable signs, an enrol bank was formed in the proposed MCU. Fig. 3 exhibits the designing of the enrol bank which contains four-line underpins X1, X2, X3, X4, and one multiplexer. There are 16 move registers used to store the four regards for each channel. The proposed MCU produces control movement by a constrained state machine circuit to arrange sensor data. Each redirect in the enrol bank stores four regards: the present regard X_i (t) and three past qualities X_i (t-1), X_i (t-2) and X_i (t-3) where "i" is the record of line pad. Each enrol can get only a solitary estimation of physical banner in each time. The new 11 bits of ADC_OUT regard which is gained by the odd interface will be secured into the relating register in light of the control banner of state machine. The proposed enroll bank arrangement gives basic information to the reconfigurable channel and lossless compressor.

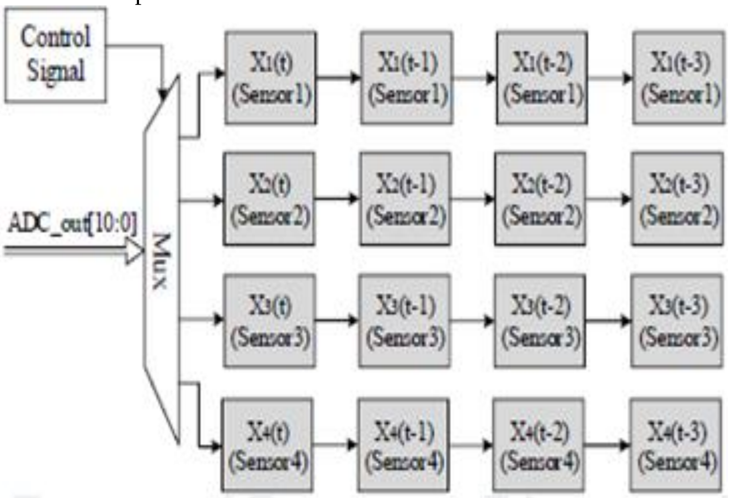

Fig.3. Architecture of the register bank.

E. Hardware-Shared Filter

The proposed MCU needs to help different physical flag preparing. Nonetheless, the attributes of each physical flag are particular. With a specific end goal to process the signs in various prerequisites, three sorts of channels were intended to accomplish the capacities of various physical signs separating: hone channel, binomial channel, and normal channel. Hone channel G(x) utilizes Gaussian condition to build the power of high recurrence parts and sift through low recurrence parts of the flag. Binomial channel P(x) can be gotten by Pascal's triangle, and the channel can improve focal esteem and cut off high and low recurrence clamors. Normal channel A(x) utilizes a similar weighting coefficients to ascertain normal estimation of the flag put away in enroll bank. By utilizing the various types of channels, the physical signs can be watched obviously. The estimations of hone channel G(x), binomial channel P(x), and normal channel A(x) are acquired by

$$G(x) = \frac{1}{\sqrt{2\pi\sigma}} e^{\left(\frac{x^2}{2\sigma^2}\right)} \quad (1)$$

$$P(x) = (1 + x)^n \quad (2)$$

$$A(x) = \frac{1}{n}\sum_{i=1}^{n} x_i \quad (3)$$

Where x is the estimations of the signs, σ is standard deviation of the Gaussian conveyance, n is the quantity of signs, and i is the record of the signs. As a result of the proposed MCU configuration put away four estimations of each direct in the enlist bank, the separated estimations of hone channel (G'(x)), binomial channel (P'(x)), and normal channel (A'(x)) can be ascertained by

$$G'(x) = \frac{[(-1)X_i(t)+3X_i(t-1)+3X_i(t-2)+(-1)X_i(t-3)]}{2^2} \quad (4)$$

$$P'(x) = \frac{[X_i(t)+3X_i(t-1)+3X_i(t-2)+X_i(t-3)]}{2^3} \quad (5)$$

$$A'(x) = \frac{[X_i(t)+X_i(t-1)+X_i(t-2)+X_i(t-3)]}{2^2} \quad (6)$$

The registering asset of hone channel G'(x) and binomial channel P'(x) both incorporate five adders and three shifters. With a specific end goal to diminish the many-sided quality of coefficient figuring, the increase of 3 can finish by a shifter and an additional. The 22 and 23 can be computed by a shifter with various parameters. The figuring asset of normal channel A'(x) incorporates 3 adders and 1 shifter. The second section in Table I demonstrates the registering asset of the three channels. By this plan, the equipment engineering can be executed by VLSI strategy. Albeit flag sifting is a successful approach to process flags properly, the silicon cost of each channel will be very tremendous while understanding these three channels exclusively. In a reconfigurable channel joining three channels into one condition was proposed. The standard of reconfigurable channel R(x) streamlines the conditions of the hone channel, binomial channel, and normal channel by

$$R(x) = \frac{[k_0 X_i(t) + k_1 X_i(t-1) + k_2 X_i(t-2) + k_3 X_i(t-3)]}{2^n} \quad \textbf{(7)}$$

Where k is the coefficient of comparing signals. These three sorts of the channels are reasonable for the equipment goal by utilizing the reconfigurable strategy. Also, it was acknowledged by VLSI engineering as appeared in Fig.4 (a).

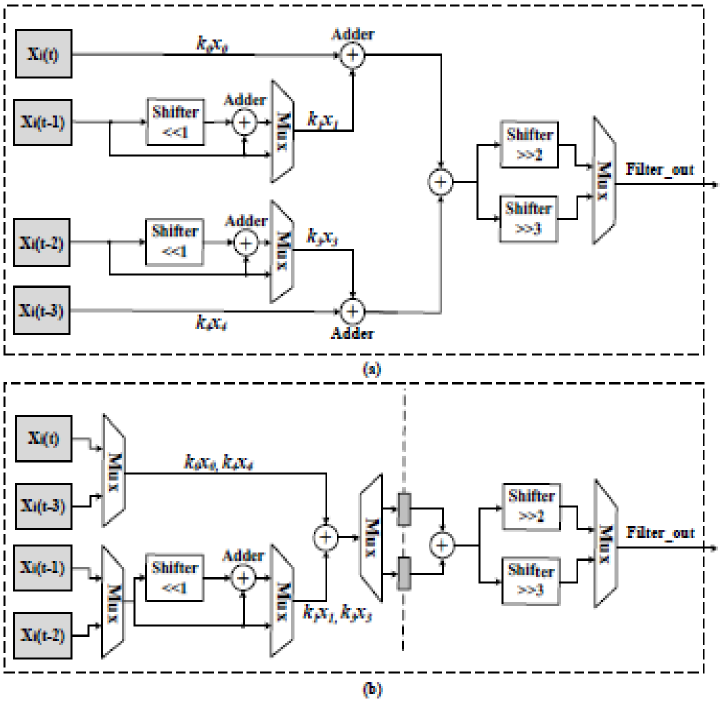

Fig.4. Architecture of reconfigurable filter circuit with (a) design, (b) the proposed hardware-shared reconfigurable filter for silicon area reduction.

TABLE I: Comparison of Computing Resource With Previous Techniques

Filter	Adder	Shifter	Gate Count
Three Filters (Average, Binomial, Sharpen)	13	7	7.92-K
Reconfigure Filter [23]	5	4	3.24-K
Proposed Hardware-Sharing Reconfigurable Filter	3	3	2.85-K

F. Lossless Compressor

With a specific end goal to decrease the power utilization caused by the remote correspondence and keep up the honesty of physical signs, a lossless compressor including a versatile slanting indicator and a cross breed entropy encoder was made for the WBSNs. To have the capacity to diminish the information repetition productively, a versatile three-inclining forecast calculation was proposed. The present esteem X_i (t) was guage by the previous three estimations of X_i (t-1), X_i (t-2) and X_i (t-3). The primary request was utilized as fundamental forecast technique when the flag was in the level area. The primary request expectation can be gotten by

$$X_i'(t) = X_i(t-1) \quad \textbf{(8)}$$

Where X_i ′(t) and X_i (t-1) are the anticipated esteem and the past incentive in the enlist bank individually. Fig.5 (a) demonstrates the primary request expectation procedure. Since the level district speaks to the relationship of current esteem and past esteem are close, the past esteem X_i (t-1) will be chosen as anticipated current esteem X_i ′(t) . Additionally, a moment arranges expectation technique was utilized as another system when the flag was in the direct locales. The second-arrange forecast can be gotten by

$$X_i'(t) = 2X_i(t-1) - X_i(t-2) \quad \textbf{(9)}$$

Where $X_i'(t)$ is the anticipated esteem, $X_i(t-1)$ is the past esteem, and $X_i(t-2)$ is the second past an incentive in the enroll bank, individually. Fig.5 (b) demonstrates the second-arrange forecast procedure. Since the direct district speaks to the relationship of current esteem and the past qualities being incline slanting, the anticipated esteem will be gotten by the slant relationship. Something else, a change forecast technique was utilized as the last methodology when the flag was in the variance locales. The vacillation expectation can be acquired by

$$X_i'(t) = X_i(t-1) + \left(\frac{Diff1 - Diff2}{4}\right) \quad (10)$$

Where $X_i'(t)$ is the anticipated estimation of $X_i(t)$, $X_i(t-1)$ is the past estimation of $X_i(t)$, Diff1 is the distinction between $X(t-1)$ and $X_i(t-2)$, and Diff2 is the contrast between $X_i(t-2)$ and $X_i(t-3)$. Fig.5 (c) demonstrates the change forecast technique. On the off chance that the supreme estimations of Diff1 and Diff2 were not as much as an edge, the main request forecast strategy F1 was chosen as the expectation procedure. The second-arrange expectation strategy F2 was chosen when the flag was in the direct districts. Something else, when the estimations of Diff1 and Diff2 are of various indications of whole numbers, it was situated in the vacillation locale. An adjusted slant bearing F3 will be chosen as a more precise expectation. By this versatile inclining expectation system, the exactnesses of forecast are advanced fundamentally, and the anticipated information can be more incorporated in the zero-zone for the entropy coding.

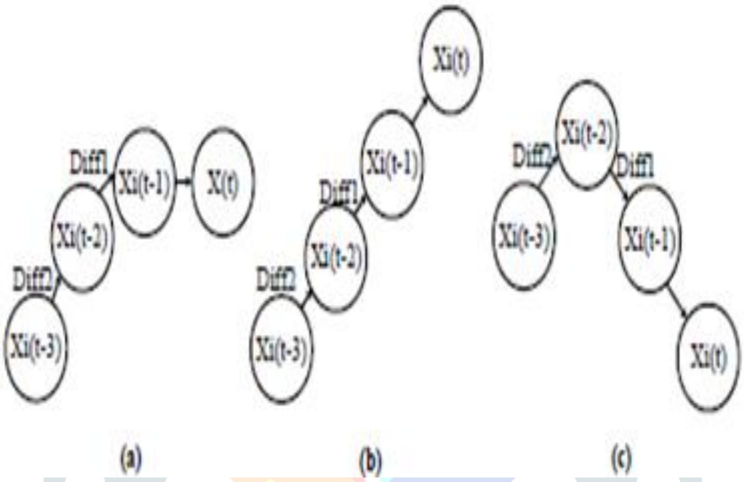

Fig.5. The proposed adaptive three-trending-prediction algorithm (a) first orders (b) second-order (c) fluctuation.

Fig. 6 demonstrates the design of the proposed lossless compressor. It comprises of a versatile slanting indicator and an extensible cross breed entropy encoder. The indicator made out of 1 enlists, 3 subtractors, 1 multiplexer, 3 forecast work generators, and 1 inclining controller. The slanting controller delivered control signs to choose an aftereffect of $X_i'(t)$ from three forecast work generators F1, F2, and F3. At long last, the forecast distinction (PD(t)) can be created by figuring the contrast amongst $X_i(t)$ and $X_i'(t)$.

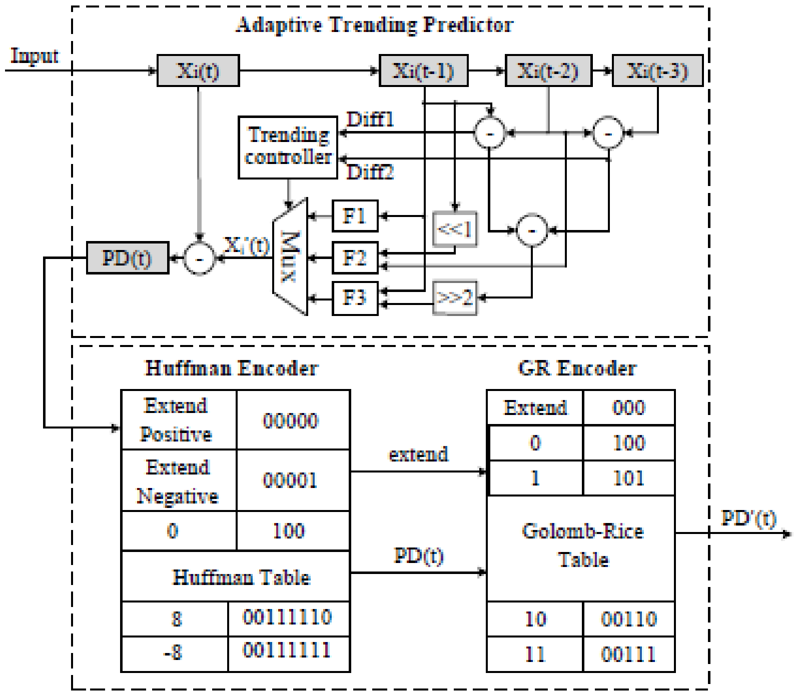

Fig.6. Architecture of the proposed lossless compressor.

V. SIMULATION RESULTS

Simulation results of this paper is as shown in bellow Figs.7 to 12.

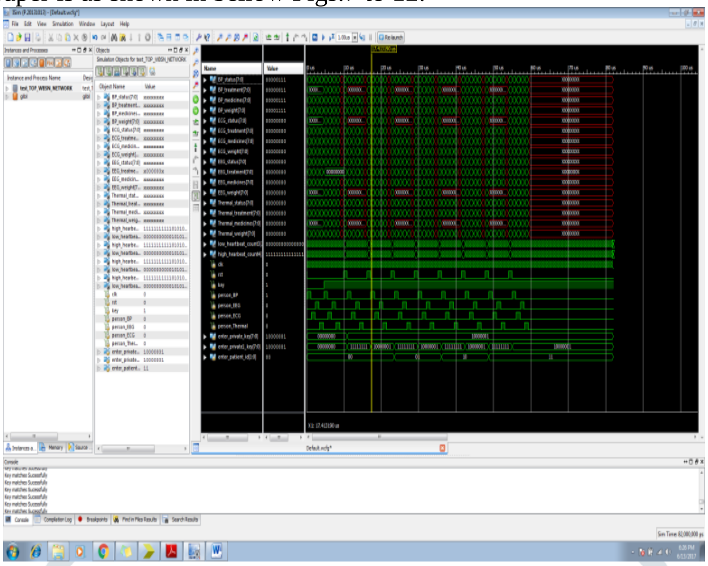

Fig.7. Simulation Results.

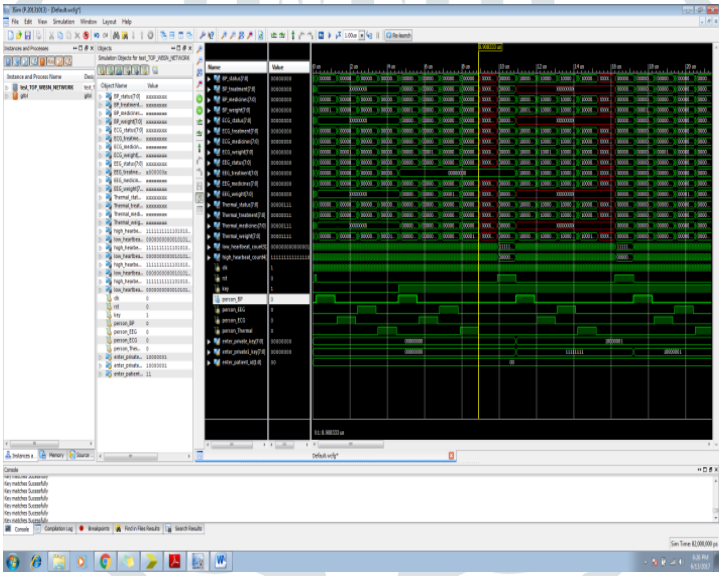

Fig.8. Simulation Results.

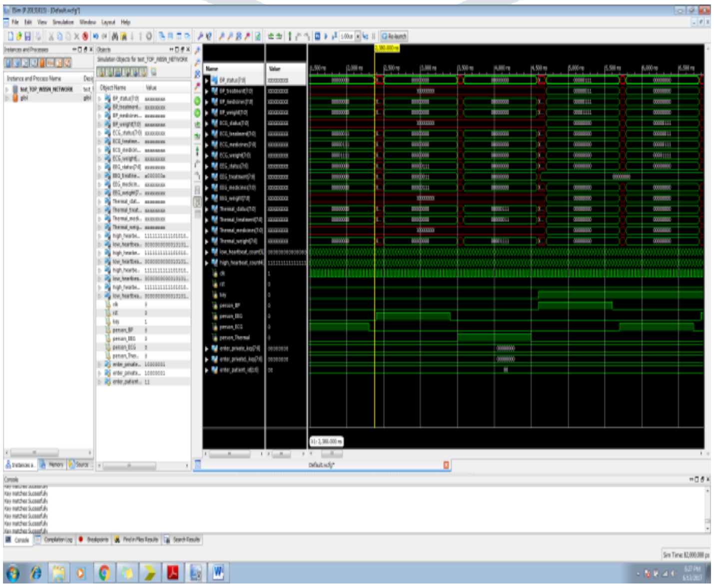

Fig.9. Simulation Results.

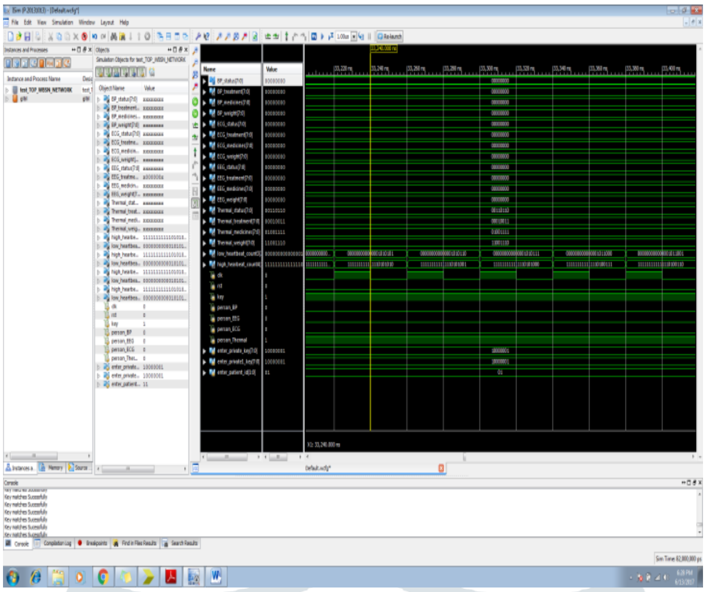

Fig.10. Simulation Results.

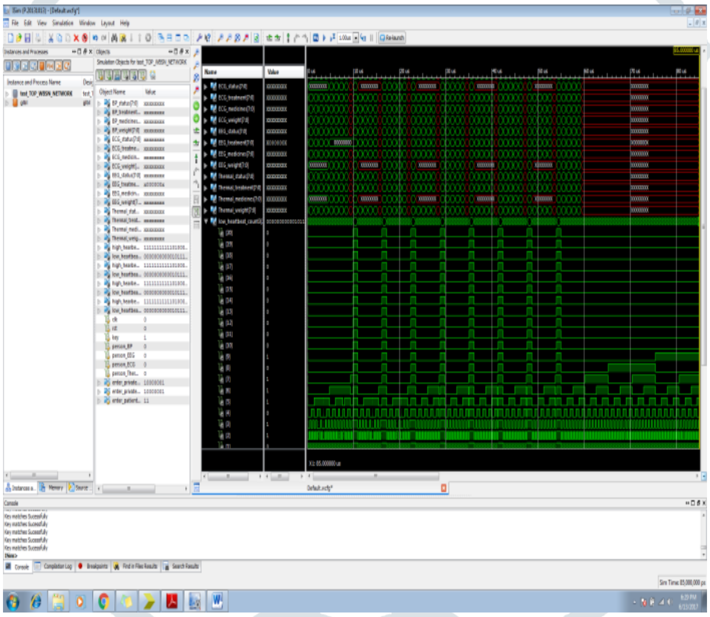

Fig.11. Simulation Results.

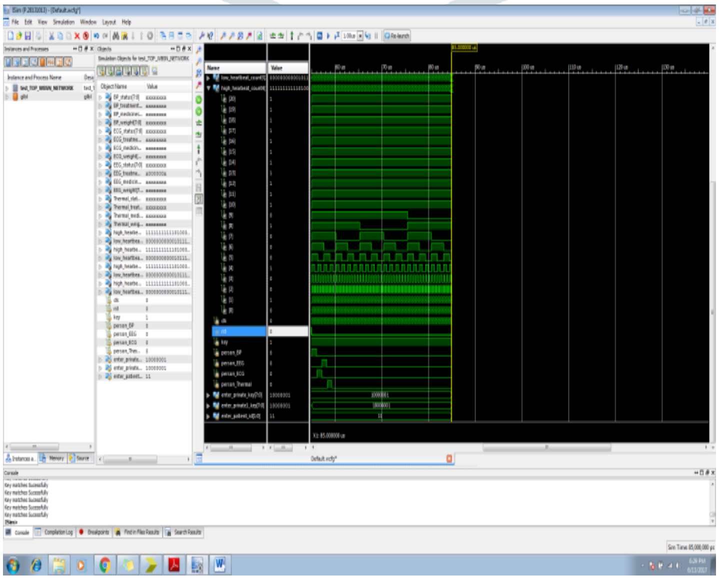

Fig.12. Simulation Results.

VI. CONCLUSION

In this task, VLSI engineering of a cost-proficient and multi-work small scale control unit (MCU) plan for WBSNs was displayed. The novel equipment sharing channel was plan for diminishing the chip region and giving three sorts of channels to acquire more data in physical signs. To lessen the potential outcomes of misdiagnosis and abatement the transmission control, the lossless compressor which incorporated a versatile drifting indicator and an extensible half breed entropy encoder was produced. Through including a topsy-turvy design of encryption encoder (EEC), the individual data can be ensured enough amid remote transmission. Also, an extra engineering of QRS complex finder was joined into MCU outline, which gave more data of physical flags, for example, heart-pulsates for the clients.

Future Scope: A novel multi-sensor controller was created for the proposed MCU outline as this is important to help multi-sensor location. It produces control signs to a multiplexer for flag determination. The multi-sensor controller is worked with a 4-to-1 multiplexer which has a Boolean condition to interface with four information signals, known as sensor1, sensor2, sensor3, and sensor4. The MCU sends guidelines to the multi-sensor controller, which at that point produces control flags so the multiplexer can choose the sensor in light of the order of the operation. On the off chance that more than two sensors are working at the same time, the information from various sensors can be gone through accurately. Every sensor has its own support for putting away the information got through the multiplexer's determination system. The sensor-select empower flag can ensure that the yield information is handled freely. Accordingly, the MCU can keep the information stream from having missing information in light of the outline of the multi-sensor controller.

VI. REFERENCES

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