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Discrete Heart Rate Segregation of an Unborn Child from its Mother during Pregnancy

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Abstract – *By working with the QRS-complexes can be provided a precisely clean concept and explanation of heart rate analysis. However, detecting QRS-complexes takes an essential role in the ECG signal analysis, based on the number of heart beats and an irregularity of a heart beat through R to R (R-R) interval can be determined. Since an ECG may be of different lengths and as being a non-stationary signal, the irregularity may not be periodic instead it can be shown up at any interval of the signal, it is quite difficult for physician to analyze ECG manually. In the present study we have developed an algorithm that is used to separate signal and analyzing that signal to build a fetal heart monitoring system. The developed algorithm initially separates the signal of an unborn child from its mother by preprocessing the signal, applying denoising operations and enhance visibility. By using developed algorithm, the accuracy of the analysis can be increased and the analysis time can be reduced. These processes are using for analyzing a heart rate signal and that will lead to separate heart rate signal of an unborn child from its mother during pregnancy.*

***Key Words*: Analysis, Denoising, Handling, Processing, Checking**

1. INTRODUCTION

Biomedical signals monir, through measurement, quantification, evaluation, and classification of signal properties, is one of the primary tools for investigating the evolution of disease states. The overall architecture of a monitoring system has to combine technological tools with signal analysis methods in order to extract useful information to identify patient's condition. Inside these procedures, it is very important to select processing methods that can enhance pathophysiological signal properties, thus linking parameters to physiological events (and maybe to physical quantities). Traditional monitoring systems received a fundamental improvement by new technological devices allowing longer and deeper data collection as well as by advanced clinical tools for data interpretation. In recent years, the development of dynamical system analysis has led to the introduction of a large amount of signal processing techniques aimed at the extraction of parameters from experimental time series, thus enhancing new information about the characteristics of the system generating the time series. In most cases, however, an accurate model of the generating system is unknown or too complex and the output signal is the main available information about the system itself [1].

1.1 Reasons

Generally, we have chosen this topic because of the increasing of fetal heart problem of new born babies. Besides any prior works have not done yet properly. Moreover, those are costly. When it comes to your heart rate, it's a bit like the speed of your car. What you want is not too fast, not too slow, and not too erratic. In fact, most of the time, heart rhythm and pace are not things you need to think about. And unless something unusual is going on, you're likely completely unaware of what your heart is doing. Heart rate is important because the heart's function is so important. The heart circulates oxygen and nutrient-rich blood throughout the body. When it's not working properly, just about everything is affected. Heart rate is central to this process because the function of the heart (called "cardiac output") is directly related to heart rate and stroke volume (the amount of blood pumped out with each beat) [2]. So, if we can work with heart rate signal, we can analyze it in various properties. From that we will be able to measure and determine heart rate, monitor heart rate, predict age, determine physical condition, predict disease and determine it etc. Also, will be able to detect fetal heart of an unborn child from its mother during pregnancy. Besides, we have chosen discrete heart rate signal processing and analyzing it to separate an unborn child heart rate signal from its mother. We have chosen this field because every year 4 in 1,000 babies (less than 1 percent) are dying for this fetal heart with other some diseases [3]. If we can analyze the heart rate signal in discrete form and separate it, then it will be to detect heart fetal heart by applying some machine learning algorithm.

1.2 Existing System

There are two different approach for fetal heart rate monitoring of an unborn child.

(1) Internal: In this approach a thin electrode wire put on baby's scalp. This (wire) runs from the baby through mother cervix and it is connected to the monitor. This approach gives better output because things like movement and other parameters don't affect it. But it can be done only if the fluid-filled sac that surrounds the baby during pregnancy called amniotic sac, has broken and the cervix is opened. Internal approach will be used when external monitoring is not giving a good reading [4].

(2) External: In this approach a device uses to listen and record baby's heartbeat through mother's belly. Doppler ultrasound is a device that is used to count the baby's heart rate for monitoring. Also, it is used to check the fetal heart rate during labor. Checking baby's heart rate continuously during labor and birth the ultrasound probe (transducer) is fastened to mother's belly. It sends the sounds of baby's heart to the computer. The pattern and rate of baby's heart rate are shown on a screen and can be printed on a paper [4].

1.3 Why does it need to modify?

Described above two approaches are effective but not more efficient. However, checking the fetal heart of the unborn baby is risky according to the described methods. So, there is another way to check fetal heart rate by separating signals. Here has a possibility by separating baby's heart rate signal from its mother, then we can analysis on that signal to find out fetal heart. During pregnancy, the amount of blood pumped by the heart (cardiac output) increases by 30 to 50%. As cardiac output increases, the heart rate at rest speeds up from a normal pre-pregnancy rate of about 70 beats per minute to 80 or 90 beats per minute. During exercise, cardiac output and heart rate increase more when a woman is pregnant than when she is not. At about 30 weeks of pregnancy, cardiac output decreases slightly. Then during labor, it increases by an additional 30%. After delivery, cardiac output decreases rapidly at first, then more slowly. It returns to the pre-pregnancy level about 6 weeks after delivery [5]. So, if we compare the signal frequency with a pregnant woman with a non-pregnant woman then we can find out a normalized signal. After that, we can compare that normalized signal with the heart rate of new born baby (4 weeks old). This will provide a result with less risk. We are developing a system to determine that.

2. Proposed System

Here we have designed a computerized system architecture for separating heart signal of an unborn child from its mother. After that we will analyze that for checking fetal heart rate. Here we have divided our proposed system architecture in two different part,

(1) Heart Rate Segregation: At first, we need to separate heart rate signal from its mother signal.

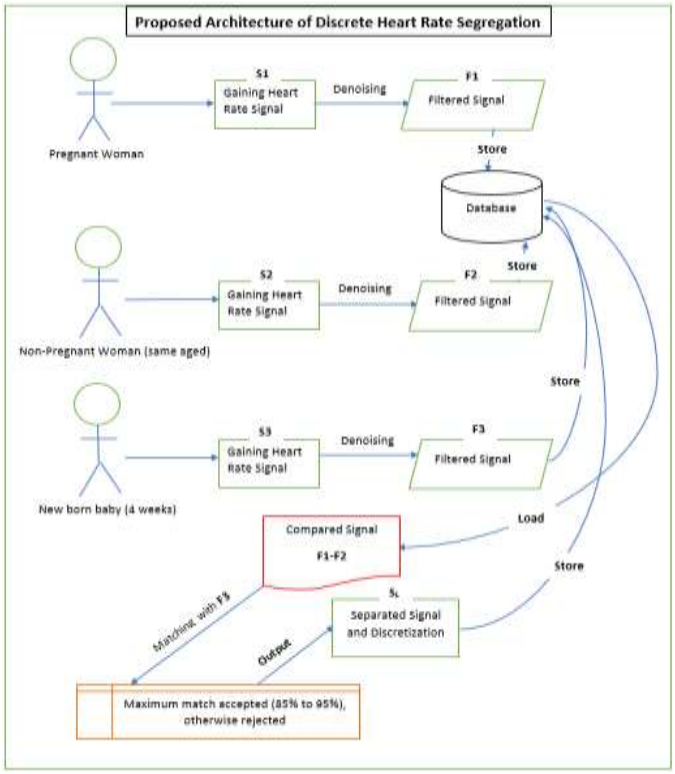

Fig -1: Discret Heart Rate Segregation Proposed Architecture

(2) Heart Rate Analysis: In this portion we will analyze the output signal and applying some operations and matching prior fetal heart data for finding out fetal heart or further diseases.

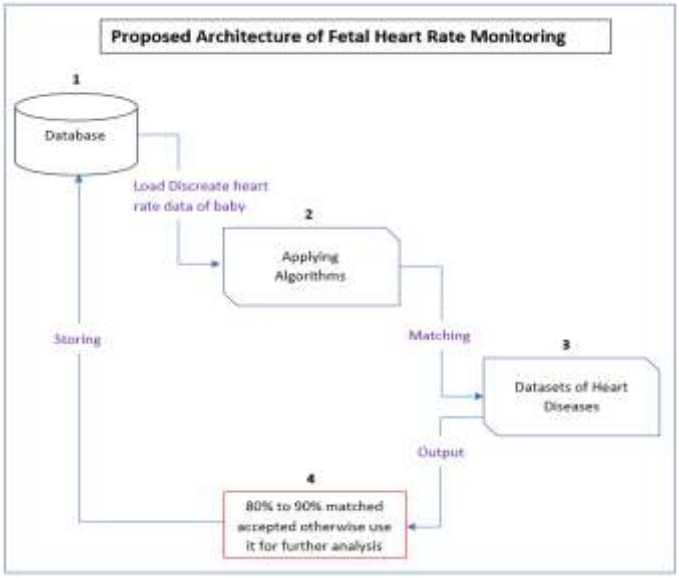

Fig -2: Proposed Architecture of Fetal Heart Rate Monitoring

2.1 Technology Used

Here for developing system we have tried some operation by using some components. These are,

- **Integrated Development Environment (IDE):** Spyder v3(Windows 10) and VM Editor (Linux)
- **Language:** Python v3.7
- **Operating System (OS):** Windows 10, Linux
- **Database:** My SQL

Here, for the programming language we have used **Python** for having large amount library functions. Those reduce our time and energy. For Windows 10, **Spyder** and for Linux, **VM Editor** are used for expertise coder. **My SQL** is used for easily monitoring database management system. For testing purpose, we generated a program (used healthy man hear rate signal) [7] that produces heart rate average in beat per minute in python and run it for the frequency =500 Hz and got this,

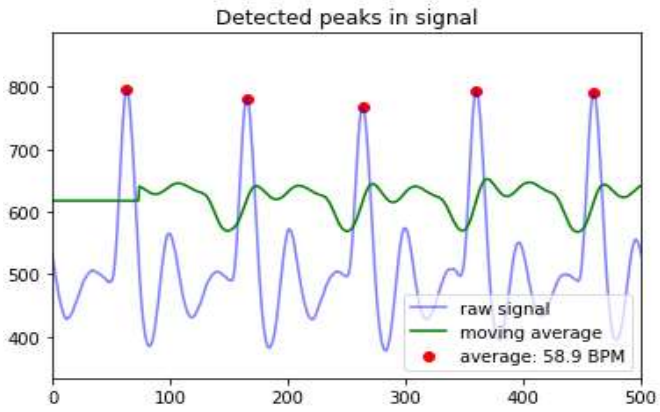

Fig -3: Detecting peak and calculating the average heart rate (Frequency = 500 Hz) [7]

For the frequency of 1000 Hz we get,

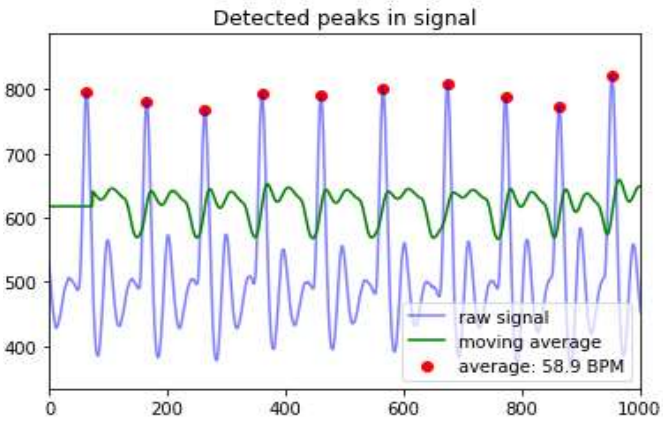

Fig -4: Detecting peak and calculating the average heart rate (Frequency = 1000 Hz) [7]

3. Methodology

Here we are following this working flow,

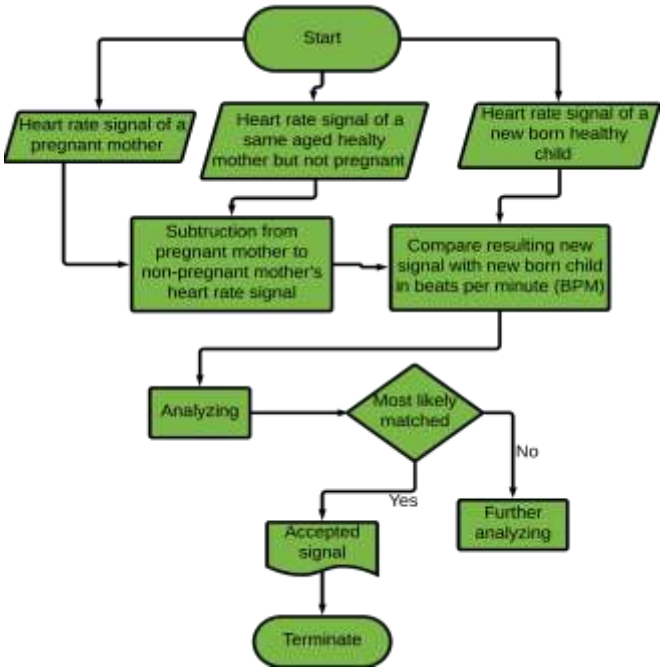

Fig -5: Working Flow Diagram

From the **Fig -5** we can see that the total works are divided into three parts which contain some parameters. Above we have already described our proposed system architecture. So, it will be easier to understand our system developing working flow. Three parts are:

1. Data collecting
2. Processing
3. Analyzing and handling output

(1) Data collecting: We need heart rate signal data of three entities. These are:

- Mother heart rate signal (pregnant)
- Same aged woman heart rate signal
- New born baby heart rate signal (4 weeks old)

During pregnancy a mother heart rate increases 30% to 50% [5] where we can get a high frequency heart rate signal. So, we can easily use another woman (non-pregnant) heart rate signal for applying subtract operation from pregnant woman to non-pregnant woman. It will give an output. Now we need to collect a new born (4-7 weeks old) baby's heart rate signal for analyzing the output data (hear rate signal).

(2) Processing: We need process the heart rate signal by denoising it. We know that most of the signals have noises. For gaining proper signal we need to filter this by denoising.

Thresholding Technique is popular denoising technique for filtering signal. Using **Thresholding Technique,** we can be able to filter signal like this on **Fig -6**,

(3) Analyzing and handling output: In this section we will analyze output that is filtered and comparing signal to the respected child signal. Here some cases may appear. The signal may not be matched for sometimes and we will take those signals for further analyzing. On the other hand, maximum matching signal will be accepted. Next, we will apply fetal heart rate signal for matching purpose. Again, here maximum matching percentage of signal will be accepted (80% to 90%) and if not, then this will go for further analysis (applying FFT, Thresholding, Summing etc. operations).

3.1 Algorithm

For making ours process more easier we are developed an algorithm. From above described architecture we can divide algorithm in two parts,

(1) Algorithm of Discrete Heart Rate Segregation

Steps:

1) Start
2) Gaining heart rate signal (S1) from pregnant woman and removing noise (using filtering) and finally store it (say f1) in database.
3) Gaining heart rate signal (S2) from non-pregnant woman (same age) and removing noise (using filtering) and finally store it (say f2) in database.
4) 4. Gaining heart rate signal (S3) from new born baby (<4 weeks) and removing noise (using filtering) and finally store it (say f3) in database.
5) Then, we have to separate f1 and f2 (say f) and compare with f3. If f maximum match within (85% to 95%) then it will be accepted (means no fetal), otherwise rejected (means fetal heart).
6) And finally output signal store in database.
7) End

(2) Algorithm of Fetal Heart Rate Monitoring

Steps:

1) Start
2) Load discrete heart rate data of baby from database and then applying algorithms.
3) After applying algorithms, matching it with dataset of heart diseases and check matching percentage, if (80% to 90%) matched then it will be accepted, otherwise use it for further analysis.
4) And finally result store in database.
5) End

These algorithms are implemented in **Python**. But also, these can be implanted in **MATLAB**. We have used python for its mobility (faster than **MATLAB**), lighter (consume less physical memory) and for having a huge amount of built in packages (**MATLAB** has limited packages).

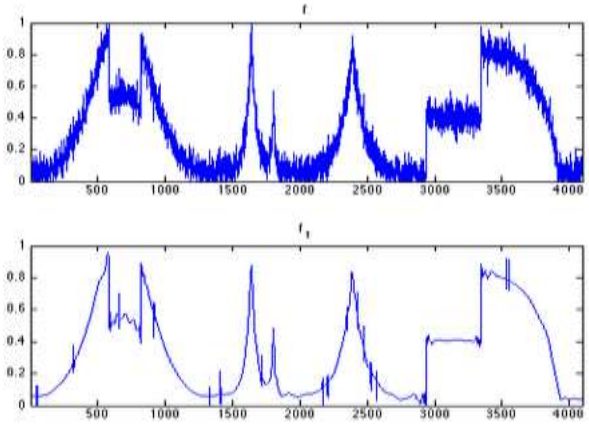

Fig -6: Filtering Signal by Thresholding [6]

4. Conveniences

Our topic leads to fetal heart monitoring system and that has some major advantages. From those,

- **Low cost:** Process can be implemented in low cost. We need just data and that's all.
- **Reduce risk:** Since we will work with the heart rate data, a pregnant mother should not worry about the attachment of a bunch of sensors on her body. Attaching sensor on child sculp through cervix etc. situations are very sensitive for a pregnant mother. Any mistakes can be brought serious damage.
- **Lighter and faster:** Implementing the system required less physical memory and processor. Does have faster processing capability for using computer programmable operation.
- **Universality:** This system is designed for all kind of patients. For low cost heart rate checking, it will be helpful for poor families.
- **Mobility:** The system does not have any physical infrastructure. Can be carried through any computer. Can be implemented in any operating system. That brought portability and increases mobility.

4.1 Limitations

No system is free from errors. Likely, our system does have some limitations also. These are:

- **Time consuming:** The process is time consuming. From the collection of data to gaining output will kill lot of time.
- **Data inconsistency:** More brute force on data causes inconsistence of data. Here we need to apply various operation on data, where there has a big possibility of raw data modification. If it does then expected output will not be computable.

- **Data redundancy:** This is another vital part of data error in which we can find same valued that for several times. See, we are applying some analyzing, processing, handling etc. operations for gaining expected or more acceptable output and that can be a cause for data redundancy.
- **Case sensitivity:** The whole process will be done by a bunch of programs. So, these programs are highly case sensitive. Need to be careful otherwise we will not be able to expected output and this will kill more time and energy.
- **Image sensitivity:** Taking input from image does not provide accurate result. We know images are consisted a bunch of pixels and those have some particular value, where each signals image does have these kinds of values and increasing complexity. So, data must be import from any CSV (coma separated value) or TXT (text) file, where signal coordinate values are properly given.

5. CONCLUSION

Separation of heat rate signal can be helpful for executing any kind of analysis. The resources were too limited. However, we are separating an unborn child heart rate signal by using these limited resources. Which leads us to implement a fetal heart monitoring system. In this era of technology, we are trying to use our valuable wealth in efficient way. Our proposed fetal heart rate monitoring system does have some disadvantages but ignorable where advantages are efficient. There is various way for monitoring fetal heart rate, but our approach is new. We hope that this new process of monitoring fetal heart rate will provide the best service to all the peoples of different levels.

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REFERENCES

[1] Maria G. Signorini, Andrea Fanelli and Giovanni Magenes. 2014. "Monitoring Fetal Heart Rate during Pregnancy: Contributions from Advanced Signal Processing and Wearable Technology." Computational and Mathematical Methods in Medicine 10.

[2] Robert H. Shmerling, MD. 2017. "Heart-Health." How's your heart rate and why it matters? 01.R. Nicole, "Title of paper with only first word capitalized," J. Name Stand. Abbrev., in press.

[3] Dimes, March of. October, 2017. "Neonatal death." Complications & Loss.

[4] Jhons Hopkins, Treatment, Tests and Therapies "Fetal Heart Monitoring", accessed 20 February 2020, < https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/fetal-heart-monitoring>

[5] Artal-Mittelmark, Raul. August, 2019. "Physical Changes During Pregnancy." Women's health issues 01.

[6] Johnstone, D. L. Donoho and I. M. 1994. "Ideal spatial adaptation via wavelet shrinkage." Biometrika 425-455.

[7] van Gent, P. (2016). Analyzing a Discrete Heart Rate Signal Using Python. "A tech blog about fun things with Python and embedded electronics". Retrieved from: http://www.paulvangent.com/2016/03/15/analyzing-a-discrete-heart-rate-signal-using-python-part-1/

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