Performance Improvement of Multimodal Biometric System by GPU centric Coding

Dr. Vinayak Bharadi, Mr. siddhesh Salvi, Mr. Sarvesh Horambe, Mr. Abhinav Watve

Finolex Academy of Management and Technology, Ratnagiri

ABSTRACT:

Multimodal biometric Authentication provides much better security than any unimodal system but, it requires a lot of processing power. This processing power can be achieved using the GPUs which have thousands of cores for multithreading. Following paper proposes the unification of these two concepts to achieve better performance. In this system we will be shifting the execution of processes requiring heavy computational power to GPU, so that it can produce results in shorter time.

KEYWORDS: *Biometric Authentication, GPU coding, WLD,*

INTRODUCTION:

Biometrics is a branch of information technology that establishes one's identity based on it's personal traits like physical features or behaviour. These features can be classified into 2 main types, which are as follows:

1. Physiological traits:Fingerprints,DNA,face,hand, retina, ear drums, odor,etc.
2. Behavioural traits: Typing rhythm, gait, gestures,etc.

Even though the biometric features are very secure due to their uniqueness, there are some challenges like spoofing attacks, no secrecy,etc. Some of these challenges can be overcome by using a multimodal biometric system which utilizes more than one physiological or behavioural characteristics rather than the unimodal systems which only employ single biometric feature.

As referenced in paper multimodal biometric systems require a lot of time for enrollment, verification or identification to be used in a real time system. To overcome this disadvantage, we are proposing to perform operations on a GPU.

As we reach the limit observed by Moore's law, new technologies have been emerging to increase system performance. Parallel processing is one such option. Since the launch of first commercial GPU, Nvidia GeForce 256, the GPUs have evolved greatly.

The latest GPU by Nvidia, GeForce RTX 2080 Ti has nearly about 4352 CUDA cores. Now, CUDA(Compute Unified Device Architecture) refers to the framework used for GPU programming. That means that GPU can run a function parallely 4352 times. But, in our case we will be using more than enough cores, so that program does not go out of the bound.

LITERATURE REVIEW:

As referenced from paper, Multimodal biometric systems use multiple biometric features to provide better security. This does provide better security but if two different types of biometric features are used, like Iris which is physiological and Signature which is behavioural, the possibility of any weakness gets even lower.[2]

Now to extract features, WLD will be used which gives better performance than SIFT and LBP. For a given pixel, differential excitation(ξ) is calculated based on the ratio

between two terms, one is the relative intensity differences of a current pixel against its neighbors and other is the intensity of the current pixel. In addition we also calculate the gradient orientation(θ) of the current pixel. By combining these two features for each pixel of the input represent an input image with a histogram which is called as WLD histogram.[3]

To calculate the final decision, we need to combine the results of two different biometric features. For this there are three main approaches Features Fusion, Score Fusion and Decision Fusion. The best results were observed from Score Level Fusion.[4]

For GPU, best results were acquired by optimum use of GPU capabilities which can be done by following some basic methods. These methods involve the number of threads allocated, device memory allocated, transfer of data for execution from host memory to device memory to reduce bottleneck,etc.[1]

PROPOSED SYSTEM:

The proposed system can be subdivided into major parts which are as follows:

1) Multimodal Biometric System:

a) The multimodal biometric system also involves more steps like enrollment and verification.First in enrollment, iris image and signature of a user is used and feature extraction is done on it.
b) The extracted features will be stored and used later for user verification.
c) Now, to check the user's authenticity, system will take the user's biometrics, apply feature vector extraction technique and compare them using necessary comparison techniques.

2) Feature Vector Extraction:

a) For feature vector extraction, Weber Local Descriptor(WLD) is used. WLD is a type of Dense descriptor because it works pixel by pixel.
b) For a given pixel, differential excitation(ξ) is calculated based on the ratio between two terms, one is the relative intensity differences of a current pixel against its neighbors and other is the intensity of the current pixel.
c) In addition we also calculate the gradient orientation(θ) of the current pixel.
d) By combining these two features for each pixel of the input represent an input image with a histogram which is called as WLD histogram.
e) This technique will be applied for each image of iris and signature. Therefore, two features vectors will be generated for each user.

3) Multimodal Fusion of Signature and Iris

a) The iris and signature are fused at score level, where the matching scores output of each of these two traits are weighted and combined.
b) Fusion at matching score level is preferred as it is relatively easy to access and combine the scores presented by different modalities.
c) There are two approaches for score level fusion. One is classification problem approach, where a feature vector is constructed using the matching scores output by the individual matches.
d) Second is Combination problem approach, where the individual matching scores are combined to generate a single scalar score, which is then used to make the final decision.

4) GPU centric Coding

a) Nvidia released CUDA , their own proprietary programming framework to be used for their GPU programming
b) This framework provides NVCC compiler for C code to be run on GPU it also provides different libraries which include functions transfer data between root machine memory to device memory and vice versa, and other graphical processing operations

c) Using the features of CUDA ,we will utilise all the cores provided in GPU to boost the performance of the system. There are different parameters which are responsible for the variation in system performance. These parameters were referenced from the paper[1].
d) In this, we will convert the traditional code which runs on CPU to run on GPU.
e) To do this, the data needs to be stored on GPU memory and access data from that memory to avoid bottleneck of RAM access.

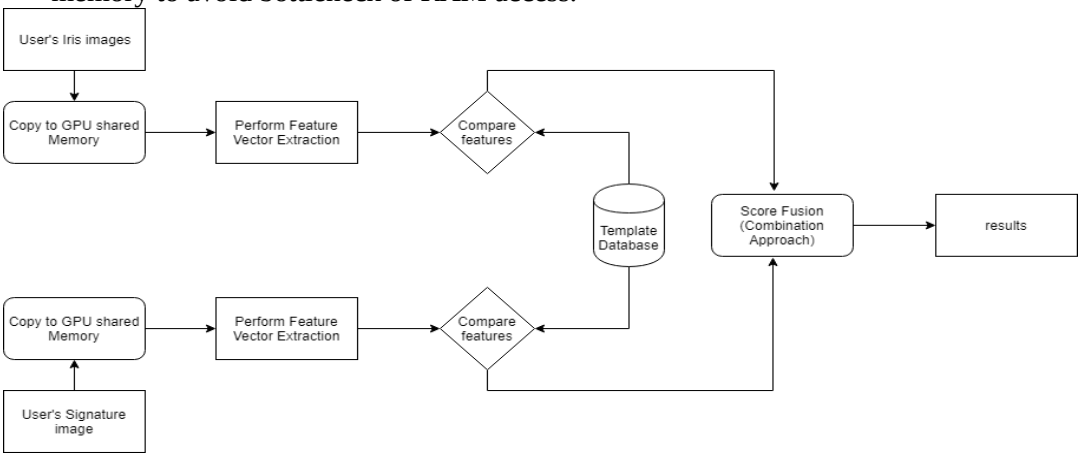

Fig 1: Proposed System work Flow

EXPECTED RESULTS:

In current system it takes about 5 minutes for a user for enrollment and for more users it takes considerable time.We are expecting at least three times better performance after employing GPU for our major processing operations like feature vector extraction and decision making.

For multiple users, CPU takes considerable time as it performs operations for all users sequentially. But, in case of GPUs, they can perform better as they do all the tasks parallely. This will give considerably better performance in case of multiple users.

CONCLUSION:

The proposed system's aim is to reduce the time required for the processes which require heavy computational power by shifting these operations execution from CPU to GPU. This will definitely result in better performance as it employs parallelism in code execution.

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