# Enhancement of Plant Disease Detection Framework Using Cloud Computing and GPU Computing

**Parul Sharma, Yash Paul Singh Berwal, Wiqas Ghai**

***Abstract:*** ***GPUs are very useful in high performance computing. With the emerging new trend of cloud environments with GPU instances are now gaining popularity in many real time applications. GPUs in a cloud environment still needs a long way to initiate various challenges in a cloud .The gap for making this as a shared resource in the cloud is still at preliminary level and still limited to many real life problems like plant disease detection at a grass root level. Timely information to farmers about diseases is still a great bottleneck for farmers. Due to this, farmers pour many rounds of pesticides to prevent their crops from diseases. But due to lack of proper ICT, farmers are not informed properly about their crop diseases which result in high loss to ecological balance and community people. Thus, to solve the problem of delayed updation about their crop diseases to farmers, GPU processing is used instead of Normal CPU processing on the cloud. This research paper focuses on the applications of GPU Computing within cloud and to study the performance of GPU image processing and Normal CPU image processing with respect to plant disease detection framework. This paper also addresses the problem of throttling in normal CPU when used for large datasets. GPU processors had shown a four-fold increase in performance as compared to normal datasets. GPU results shown 63 times faster as compared to normal CPU for analyzing 52,486 images of healthy and diseased leaf images. This include 16 plant types and 55 leaf diseases.***

***Keywords : GPU Computing, Cloud Computing , Plant Disease Detection, Deep Learning.***

## I. INTRODUCTION

Farmers sought information from various sources like Krishi Vigayan Kendra to earn maximum profit. But still, timely information to farmers is an uphill task. Most of the crop growing community is not educated, they don't follow different cropping pattern for years the same crops for centuries and do not know the consequences of growing the same crop pattern soil affects ecological balance. So, this disturbance in ecological system leads to the demand of fast processing information to come into action which ensure proper disease detection framework and allows the farmers to get proper advisories in time by making all the farmers connecting to the cloud. However, timely processed information to crop growing community related to crop disease detection is a challenge in itself due to self -driven nature of agriculture. This paper tries to bridge the gap between the slow processing of information in research centers to the operating farmer by demonstrating framework of cloud computing and its response with GPU. In recent years, various Information and Communication Technologies (ICT) are demonstrated good progress in the field of agriculture in developing nations. Thus GPU must be used in agriculture for timely processing of information related to crop disease detection.

## II. CLOUD COMPUTING

Cloud Computing is a web-based management system that can be useful in the agriculture sector to farmers in rural areas. All the data is processed within the cloud and can use a database for many applications with the preferred service provider. But to process that large information stored in the cloud , the role of GPU is still required. GPUs are well efficient in handling task parallelism leads to high performance computing. Thus it is very good scalability and power efficient features. Till now, GPUs are still most effective when used in conjunction with deep learning based data on a cloud platform. Cloud can help farmers in many ways. However, a farmer cannot afford its own technology. We are developing deep learning models which are of no use if information processed is not delivered on time to farmers. Farmers can afford phones through very low infrastructure for clicking images but due to limited memory storage options, information processing can be done on cloud. But for real world practicality, this information processing needs to be super fast. Because of the limited time of the cropping window, plant disease detection needs to be extremely fast. This problem can be solved by GPU Computing .This HPC ensures responds within seconds a farmer uploads a photo to cloud. By this GPU association with Cloud, farmers can lead to mobile access which help farmers in advance to check up on their crop diseases. This is really important for good decision making process.

## III. GPU COMPUTING

To solve the problem of data storage problem on mobile device every day by clicking of images by farmer of diseased leaf images, the best way is to send data from your device to cloud where GPUs are already installed for working with CNN model in plant disease detection[3] . This high computing power and fast processing helps a lot in solving problems which are

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still unresolved in agriculture. Thus collaboration of GPUs with cloud in agriculture resolves of problem of timely detection of diseases. But still exist some limitations like mobile device internet connections for smooth working of the concept [4]. Due to the nature of uncertainty in biological production system of agriculture, there exists always some discrepancies too.

## IV. APPLICATIONS OF GPU WITH CLOUD COMPUTING

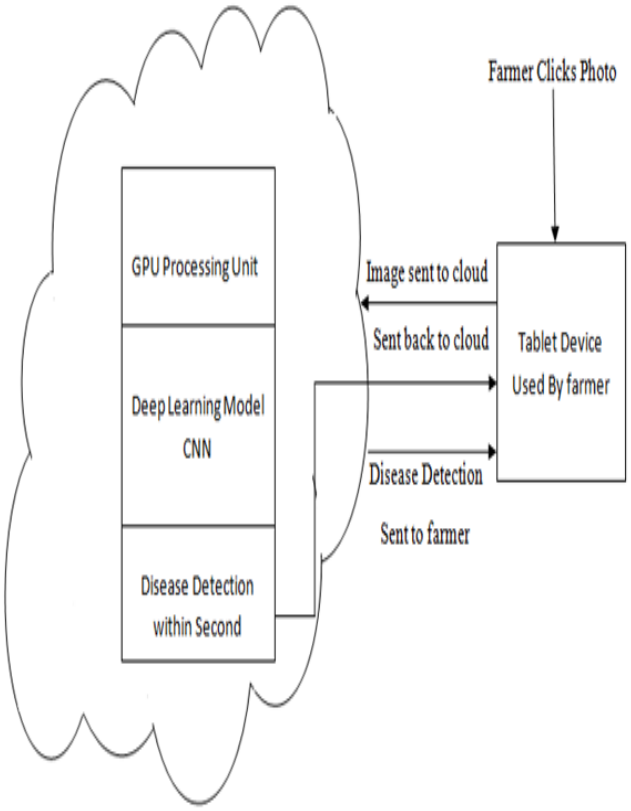
Save Money with GPU Cloud Computing
Normal CPU takes a long time when working with image processing on high quality images .The processing time is so high that result obtained is not effective due to time limit. GPU computing is the only solution as it can add or delete resources when required thus it saves a lot of time and money.By using GPU along with cloud computing on deep learning models, it is very easy to update on diseases which needs timely information of data. This is very effective with the NVIDIA GPU. It is very scalable as compared to normal Intel CPUs. GPU cloud computing provides the required scalability. The latest trend is to enable these management systems to operate over the Internet [6].
Task Parallelism
The key feature of the GPU is task parallelism. The cards from NVIDIA support for task parallelism. Different processors supporting many applications simultaneously.

## V. KRISHIMITR FRAMEWORK OF GPU WITH CLOUD

The latest trend is to enable these management systems to operate over the Internet. [7] An always connected device sending signals to the cloud to process data is not practical in many parts of the world. Thus, Krishimitr aims to solve this problem by combining an online-offline hybrid model with on-device computation. Furthermore, to achieve high accuracy, Krishimitr assumes that the farmer knows the plant type under investigation. This makes training the models more robust, but at the same time increases the total size of database required on device (80MB/plant type). Thus, regular updates of the models becomes a large data transfer problem in regions with slow network connectivity. Krishimitr framework consists of the following three components:

1. A cloud server: This acts like a central repository and a bridge between the farmers and experts for feedback/communication. Runs Linux OS.
2. Tablet device: A mostly offline device storing a local copy of the models to do on-device disease identification. This is a touchscreen tablet device based on the Raspberry PiTM platform with camera running Linux OS.

3. GPU Computing Workflow
Figure 1 details the dataflow between the three components during information processing. When a farmer clicks a photo by using a tablet device, then Graphical Processing Unit installed on Google cloud runs the deep learning model (Convolutional Neural Network) then the diseased leaf is processed within seconds. Then information is sent back to cloud, which then final result in updated information to the farmer. In this way GPU really speeds up the image processing very efficiently.




## VI. RESULTS AND DISCUSSIONS

In this research paper focuses on the application of GPU Computing within cloud and to study the performance of GPU image processing with leaf disease detection is performed and Normal CPU image processing with respect to plant disease detection framework is compared. The fact is that CNN works quite well on existing model architectures with the multi-GPU setting is promising.[9]
The results shown in the table below demonstrates the state of the art performance of GPU (1X GPU Tesla P100 and 6X GPU Tesla P100) computes results 63 times as compared to normal 16 Core CPU Intel i9-9960X when measured run time in days

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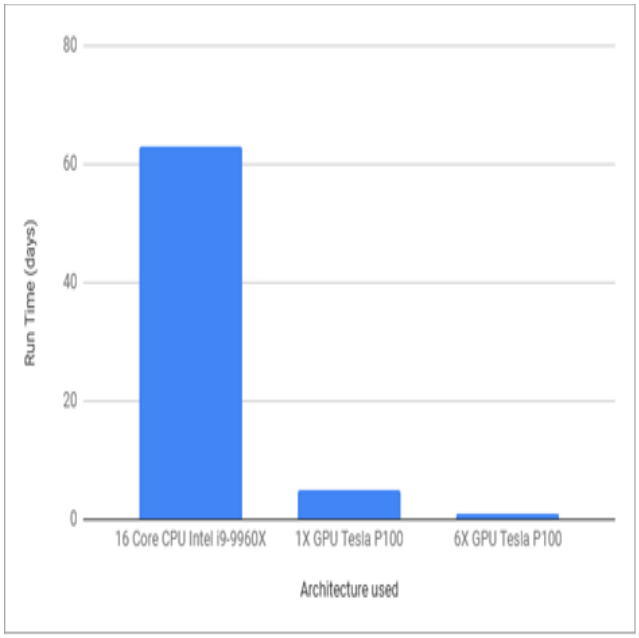
| ARCHITECTURE USED | RUN TIME (DAYS) |
|---|---|
| 16 CORE CPU INTEL I9-9960X | 63 |
| 1X GPU TESLA P100 | 5 |
| 6X GPU TESLA P100 | 1 |

This graph shows the effectiveness of plant disease detection framework model in real time information processing as compared to the normal CPU image processing tasks.




GPUs are great for deep learning applications in some of the real life problems that are still untouched like agriculture. Various types of data (images, video, animated, graphical) are very well processed and manipulated very well in deep learning. Due to the self- training of the feature maps in CNN in Deep learning, GPU works well in Image Processing. Advanced mathematical transformations obtain results within seconds with GPU. This makes deep learning algorithms run several times faster on a GPU compared to a CPU. Also it is free from problem of Throttling.

## VII. FUTURE WORK AND CONCLUSION

For processing high dataset of images, normal CPU suffered from thermal throttling. Therefore, GPU needs to be used in real time processing application for plant disease detection framework model using Convolutional Neural Network Therefore, GPU support reduce the time needed for inference.

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