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A Novel Optimization for GPU Mining Using Overclocking and Undervolting

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Abstract: Cryptography and associated technologies have existed for a long time. This field is advancing at a remarkable speed. Since the inception of its initial application, blockchain has come a long way. Bitcoin is a cryptocurrency based on blockchain, also known as distributed ledger technology (DLT). The most well-known cryptocurrency for everyday use is Bitcoin, which debuted in 2008. Its success ushered in a digital revolution, and it currently provides security, decentralization, and a reliable data transport and storage mechanism to various industries and companies. Governments and developing enterprises seeking a competitive edge have expressed interest in Bitcoin and other cryptocurrencies due to the rapid growth of this recent technology. For computer experts and individuals looking for a method to supplement their income, cryptocurrency mining has become a big source of anxiety. Mining is a way of resolving mathematical problems based on the processing capacity and speed of the computers employed to solve them in return for the digital currency incentives. Herein, we have illustrated benefits of utilizing GPUs (graphical processing units) for cryptocurrency mining and compare two methods, namely overclocking and undervolting, which are the superior techniques when it comes to GPU optimization. The techniques we have used in this paper will not only help the miners to gain profits while mining cryptocurrency but also solve a major flaw; in order to mitigate the energy and resources that are consumed by the mining hardware, we have designed the mining hardware to simultaneously run longer and consume much less electricity. We have also compared our techniques with other popular techniques that are already in existence with respect to GPU mining.

Keywords: cryptocurrency; blockchain; mining; graphical processing units

1. Introduction

Due to the rise of information technology, cryptocurrency is decentralized digital cash that employs encoding to control online transactions. Satoshi Nakamoto [1] introduced

Bitcoin, launching the initial cryptocurrency in late 2008 [2]. Despite the very fact that there are about 900 cryptocurrencies [2], Bitcoin has been the foremost thriving digital currency since its launch in 2009 [2]. Bitcoin may be obtained through acquiring goods, supplying services or exchanging it for alternative currencies [3].

Mining has also referred to as acquiring these virtual money. Users can install a free pack software called a wallet-unrestricted user for their machines, because the initial step of Bitcoin extraction is transmitting and receiving money persecution Bitcoin into the location. Blocks will broadcast by miners connected to the Bitcoin network. When being verified into blocks using a secure hashing mechanism (SHA-256), block may be reservoir for Bitcoin transactions onto the overall people's blockchain [4]. A brand-new block is formed by one of the Bitcoin network's miners. Miners receive twenty-five supplementary Bitcoins in each ten-minute per block [5]; these species of mining create group action hashes. A miner knows how to store their block in an unending cycle extent achievable, employing a vast range of processor cycles and, as a result, a large quantity of electricity [5].

Originally, mining was performed on regular PCs. As mining became more popular, miners sought to increase their hash rates using different equipment [6]. As a result, mining difficulty in Bitcoin systems has continually risen [7]. Due to the hardware's inability to keep up to earn a fair return, computing resources available to the general public, such as first- and second-generation central processing unit (CPU) and graphic processing unit (GPU) miners, have become outdated. Choosing a mining pool has become increasingly complicated as more pools have joined the Bitcoin network, each requiring a unique technology set. Consequently, further research is needed to identify the most significant factors to consider when choosing the most exclusive Bitcoin mining machinery, including energy consumption, hash rates, and a hardware cost [7].

There was no such thing as Bitcoin before 2009. Bitcoin mining on home PCs became a practical alternative for many individuals as technology evolved to match the increased demand [8]. As a result of the introduction of new equipment, the mining process and efficiency have improved over time. Since graphics processing units (GPUs) are more efficient than their immediate equivalents, they have been utilized in mining for years [9].

Most people are attracted to mining because of the gadgets, but this is no longer possible, as mining has become more complex and time-consuming. As a result, the demand for more powerful equipment has grown, resulting in the construction of mining complexes. By fulfilling tasks in mining pools, each miner tries to mine Bitcoin [9]. Pool statistics, hash rates, and different mining software are some of the most well-known mining topics. A mining company's purpose is to make a profit, and various factors, such as collector fees, power fees, and income minus equipment costs, may be used to determine if cryptocurrencies are profitable [10]. It is worth discussing the results of cryptocurrency mining with GPUs, demonstrating which technique works best for the mining process and contributes to increased profitability and energy savings. Cryptocurrency mining requires a large amount of computational power [11].

Bitcoin was first mined using CPUs (central processing units). On the other hand, the CPU-based mining technique was inefficient because of its slow processing speed and high-power consumption. As a result, miners have switched to GPUs, which are more powerful and have dedicated memories, resulting in more efficient Bitcoin mining [12].

Table 1 represents the major differences in CPU and GPU mining, and it also shows why GPUs are much better when it comes to mining cryptocurrency.

Table 1. GPU mining vs. CPU mining.

Parameters	CPU	GPU
Speed	2256 bit	3200 bit
Energy Efficiency	Not energy efficient	Energy efficient
Maintenance Level	Difficult to maintain	Easy to maintain
Difficult	Harder to mine	Effortless mining
Memory	No memory	Has memory depending upon the GPU
Installation	Not easy to install	Easy to install
Support	No regular updates	Has regular software updates
Optimization	Not easy to optimize	One-click optimization

1.1. Our Contributions

Mining might be a process used to validate a transaction on the Bitcoin network. Cryptocurrency miners are individuals or businesses who use their GPUs as servers to create a decentralized network of computing power. To mine Bitcoins, the GPU groups recent transactions into 'blocks', which are subsequently validated using the Secure Hash Algorithm (SHA). Hashes per second (H/s) is the unit of measurement for the hash rate, or how rapidly this procedure is accomplished. The miner will earn a small amount of the money as an associate degree incentive if the validation is successful. This implies that the more processing power a miner has, the more they will mine and, as a result, the larger the reward. Graphics processing units, more so than CPUs, are exceedingly cost-effective in doing these jobs; as a result, when high-end GPUs become available, they are instantly purchased. Cryptocurrency mining is so popular that cyber cafés and server farms are springing up across Asia and China to meet the demand.

1.2. Organization of Paper

This paper is divided into different sections. Section 2 is the background, Section 3 is the proposed methodology, implementation, and a brief description about the techniques we have used, Section 4 details the experimentation results based on our technology, Section 5 is the discussion and comparison, Section 6 is the conclusions, and regards the future scope.

2. Background

2.1. Cryptocurrency Mining

Mining is the name given for the development of manufacturing a cryptocurrency. Adding up the transaction information on to the blockchain's community files of prior transactions is referred to as "pushing transactions into blocks". Extraction is aggressive, power-intensive business requiring state-of-the-art technology. By providing computer power to a grid, miners fix the artificial scientific issues, or procedures, which serve as a basis for the encryption evidences (proof-of-work protocol) [13]. We will not go into all the technical specifics of each proof for the sake of this research; we will instead focus on the most typically utilized evidence, proof-of-work. Bitcoin is a decentralized and scattered network due to proof-of-work mining, which ensures that currency is distributed evenly and competitively. Proof-of-work is a concept that allows nodes to compete regularly by solving challenges using their processing power [12,13]. If one of the nodes is fortunate enough, it will be tasked with proposing to the blockchain one other block. Consequently, the entire system lacks central authority. No-one will pick which node proposes the coming block. Nodes are still solving riddles, validating transactions, and distributing currency [14,15]. Evidence in the proof-of-work does need a significant amount of computer processing power, and since most cryptocurrencies use proof-of-work practices, digging them consumes a significant amount of energy [15] The proof-of-work technique is about time- and more energy-severe, however that is needed to decrease dual expenditure and care for the blockchain and decentralized network. A competitive economy has likewise assures that the currencies assigned to equitably [16]. Nevertheless, cryptocurrency mining is energy-intensive since the process of manufacture a new set-top token requires use of big, mighty machines solve complex cryptographic issues [17]. Each transaction must be validated by the mining since Bitcoin is distributed networks that do not have substantial body. Bitcoin, highly prevalent at cryptocurrency, spends roughly 80 terawatt-hour period of electricity per year, corresponding numbers at the university of Cambridge's Bitcoin Power Consumption Index number [18].

2.2. Different Methods of Mining Cryptocurrencies

The time it takes to complete different Bitcoin mining procedures varies. In the early days of the technology, central processing unit mining, for example, was the go-to alternative for many miners. Many people these days feel that CPU mining is simply too

inefficient and impractical since it takes months to obtain even a touch profit, particularly as power and cooling expenses rise, as they will eventually everywhere [19].

Mining Bitcoins with a graphics processing unit (GPU) is a one-of-a-kind Bitcoin mining technique. It boosts processing speed by integrating many GPUs into a single mining machine. GPU mining necessitates the use of a motherboard as well as a cooling system. In contrast, ASIC mining is a one-of-a-kind Bitcoin mining process. In a distinction to GPU miners, ASIC miners are designed specifically to mine cryptocurrencies, and as a result, they produce a lot more Bitcoin units than GPU miners [20]. They are, however, costly, and if mining becomes more difficult, they will quickly become obsolete. Because the prices of GPU and ASIC mining are still increasing, cloud mining is becoming more popular. Individual miners will utilize cloud mining to achieve access to the computing power and dedicated crypto mining facilities of enormous corporations.

Individual Bitcoin miners could use the net to go looking for free and paid cloud mining sites, using rent mining instrumentation for an amount of time. This can be the best type of cash mining [21].

2.3. Mining Pools

Miners can join mining pools to pool their computing power and increase their chances of discovering and mining blockchain blocks. If a mining pool is successful, the reward is divided among the miners in accordance to the quantity of resources that the pool received. Despite the fact that the bulk of Bitcoin mining software comes with a mining pool, cryptocurrency enthusiasts may now collaborate online to create their own mining pools. Miners can swap pools at any time because some pools pay more than others [22].

Miners trust official crypto mining pools more since their hosting companies give frequent updates and technical support. Crypto Compare is a website that ranks mining pools based on their reputation, profitability, and coin of choice [23]. Figure 1 below shows the working of cryptocurrency mining pools.

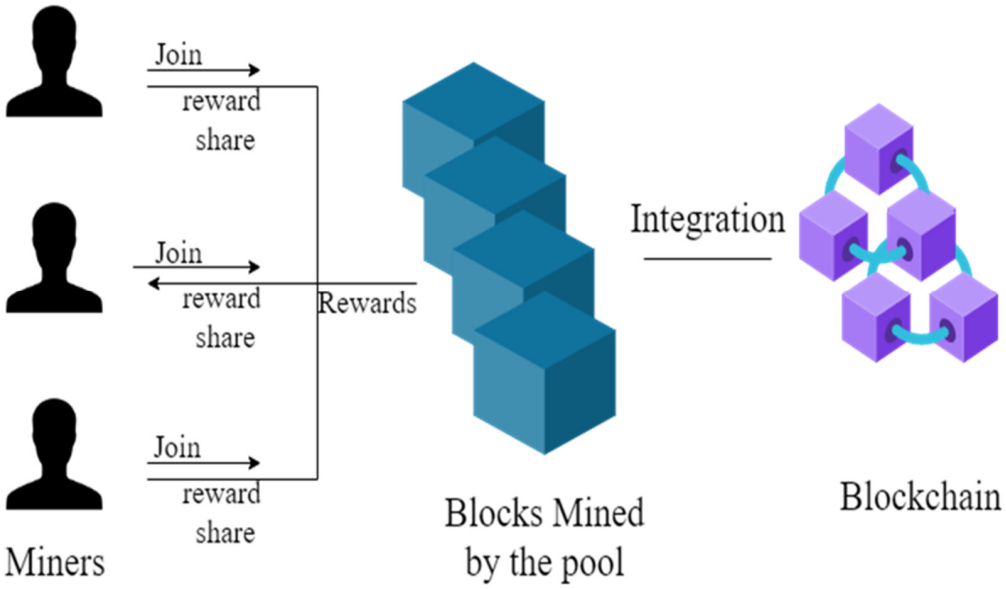

Figure 1. Working of cryptocurrency mining pools.

2.4. Hardware Required for Mining

Mining is computationally demanding and demands the solving of mathematical problems, as previously stated. Let us take a short look on the hardware that these computations need [24]. Mining was performed exclusively on the common end by the processors (CPUs) which were only used to run programs in the first generation [25]. At its current levels of trouble, CPU extraction no more cost-effective. When there was a result, a second wave of mining occurred as individuals began to use graphics [24–26].

Use a graphics processing unit instead of a CPU. To mine using a GPU, you will need a simple setup that includes commercially available graphics cards. It is also possible to combine a large number of GPUs to increase mining performance and earnings. GPUs, by contrast, consume a lot of electricity, necessitating the acquisition of expensive hardware in order to build a multi-GPU arrangement. FPGAs (arena-programmable entrance matrices) have been introduced in 2011, with the promise of outperforming GPUs in terms of performance and cooling [26,27]. Regardless, FPGA mining was a transitory phenomenon. ASICs, or an application-special electronic circuits, have taken over mining industries [27]. Chips for mining have been created, fabricated, and optimized.

In Bitcoin mining, CPUs, GPUs, FPGAs, and you now ASICs everything were employed. They have also transitioned from being more readily available to being mined by larger enterprises with more resources and, thus, more earnings [27]. Another interesting aspect of Bitcoin mining is that the great majority of revenue has gone to companies selling/renting equipment (ASICs), rather than individuals looking to profit. Move from CPUs to ASICs resulted in a 20 fourfold increase implementation and effectiveness [27,28].

3. Proposed Methodology

When it comes to this paper, we have used GPU for mining Monero. We also utilized two separate procedures, such as the undervolting and overclocking GPU techniques, which help to optimize the GPUs and can mine more efficiently.

- Overclocking is a technique of enhancing the GPU's omission retention-and center timer rates to speeds higher than those specified by the manufacturer. You can increase the power limit when overclocking, but bear in mind that this will increase power utilization. The overclocking technique is best for lower-end GPUs, such as the Nvidia GTX series of GPUs, as they have less memory and lower clock speeds compared to the newer generation of cards, such as the RTX series cards. Effectiveness is crucial in mining because it affects global profitability.
- Undervolting the GPU is another important technique which helps the GPU to consume less power than the default power consumption of the GPU. When a GPU is undervolted, its energy consumption falls by around 30%, and its blower rate will be reduced by 33%. As a result, the GPU may run at a lower temperature and consume less power.
- In regard to mining optimization, Monero will use a new algorithm known as RandomX. We will go through how to overclock your GPU, which will help you optimize your earnings when mining with the RandomX algorithm. By performing a GPU overclocking, you could damage the GPU, so to overcome this issue we have also implemented undervolting techniques, which help the GPU to run with less power. RandomX mining is dependent on GPU clock speeds and VRAM. Our tests with different GPU clock speeds on RTX 3060 Non-LHR GPU yielded different results. Tests were performed on a system with 8 RTX 3060 GPUs. The results might change depending on which GPUs use clock speeds and VRAM better in their mining rig.
- Hardware Optimization is the core part our paper. When it comes to undervolting the GPUs, we have utilized the MSI AFTERBURNER software to undervolt and overclock the GPUs. When it comes to undervolting we have reduced the power consumption by 20% from its default power consumption, which is 225 watts. We have managed to reduce it to 180 watts for each GPU and we have used 8 RTX 3060 GPUs which are Nvidia's custom-made GPU design called "Founders Edition". With overclocking, we have increased the clock speeds of the GPUs with the afterburner itself. Its base clock speed was 1320 MHz and we have boosted the clock speeds to 1777 MHz, which uses the GPU to its maximum. Even though overclocking will increase the temperatures significantly, the undervolting technique will ensure the temperatures will not increase, as the power consumption will be reduced. With the help of these GPU Mining techniques, we have managed to increase the mining efficiency from

100% to 147%, which really adds to to the overall mining. All the experimental results are listed down below in Section 4 Experimentation Results.

GPU mining is a method of validating electronic transactions on a blockchain by using the graphics processing unit of a gaming computer to tackle complicated arithmetic problems. To be mined, digital money is often built on a blockchain architecture that permits proof-of-work (PoW) mining. Some of the cryptocurrencies that may be mined are Bitcoin (BTC), Ethereum (ETH), Monero (XMR), Litecoin (LTC), and Dogecoin (DOGE) [29].

While a variety of graphics cards are available, those utilized for crypto mining are designed for gaming rather than video rendering. As miners strive to earn cryptos using their processing power, the shares of GPU makers, such as NVIDIA and AMD, have risen [29]. The NVIDIA GeForce GTX 1070 is one of the most popular mining rigs in terms of power usage, but there are other options if you research what might work best for you.

While it used to be possible to mine cryptocurrencies on your laptop at home, this is no longer possible for most cryptos, due to rising mining demand and the halving of cryptocurrency's rewards. The vast bulk of mining activities, such as graphics cards and specialized mining rigs, are now conducted in shared pools, where users pool their processing resources to get quicker results. Miners are compensated after mining a block of money [30].

Regarding the techniques used in this paper, when mining cryptocurrency, the most important part and step of mining is to choose a cryptocurrency to mine, as there are many available cryptocurrencies out there depending upon the mining hardware being used for mining. The other important part is to have a digital wallet. For instance, in our experiment, we have mined Monero, and to store the rewarded crypto, we chose the PrimeXBT wallet. The wallet and the hardware, depending on the crypto type, will be mined and differ from coin to coin.

We have used GPUs as our mining hardware. Specifically, we have utilized RTX 3060 GPUs for NVidia, which do not have mining limits as other GPUs do. The techniques we have used to mine Monero are undervolting and overclocking, which lets us get the most out of the GPUs with less power. These techniques also help us to maintain the GPUs' temperatures and help them to run with less noise.

We will utilize Bitcoin [31,32] to demonstrate how this works theoretically. All transaction fees and BTC prizes will go to the first Bitcoin miner that completes this arduous task [33]. As a result, miners who use more powerful hardware are preferred by the Bitcoin network over those who employ less powerful internals.

Everyone in a shared pool earns a percentage of the earnings based on the amount of processing power they contributed. Individual computers can be compared to mine employees who are paid to seek treasure or rewards. GPU mining became a major issue in 2017 as Bitcoin achieved fresh highs of over $20,000 per coin [30]. Since then, people from around the world have been competing for the best GPUs to participate in Bitcoin block rewards. Computers frequently employ SHA-256 hash algorithms to solve difficult arithmetic problems. In mining, the computer generates an output using the SHA-256 encrypted mathematical algorithm [30,31]. The length of the resulting integer is always 256 bits. Bitcoin depends on a blockchain, which is a distributed and continual digital ledger of dealings that is shared and replicated by a peer-to-peer network [32]. The blocks of a blockchain are full of Bitcoin transaction knowledge till they reach a size of 1 megabyte. Bitcoin miners are then responsible for substantiating every block's lawfulness and believability [33]. Things start to become intriguing at this stage. Each block presents a difficult arithmetic problem. All transaction fees and BTC prizes will go to the first Bitcoin miner that completes this arduous task [33]. As a result, miners who use more powerful hardware are preferred by the Bitcoin network over those who employ less powerful internals.

To practically demonstrate our GPU mining technique, we chose Monero as an illustration of how mining works, because in 2022 [31,32] there are so many cryptocurrencies on the market that discussing them all would be impossible. Crypto mining contains deter-

mination science equations that exploit one's hardware in exchange for digital currency prizes, recognition tokens, and financial incentives.

Monero follows Bitcoin's proof-of-work formula. It does, however, use much less energy than BTC, that generates much of electricity and high temperature [33,34]. Our Randomx algorithm, which is least difficult than the SHA-256 algorithm utilized through Bitcoin, is used by Monero. RandomX features in the lower number sources accordingly, permitting drillers to dig for Monero on devices with lower processing power.

Figure 2 below shows the working of proof-of-work algorithm and explains it in a step-by-step fashion. Proof-of-work is one of the most important algorithms, and is used by the majority of cryptocurrencies, such as Bitcoin, Ethereum, Dogecoin, etc.

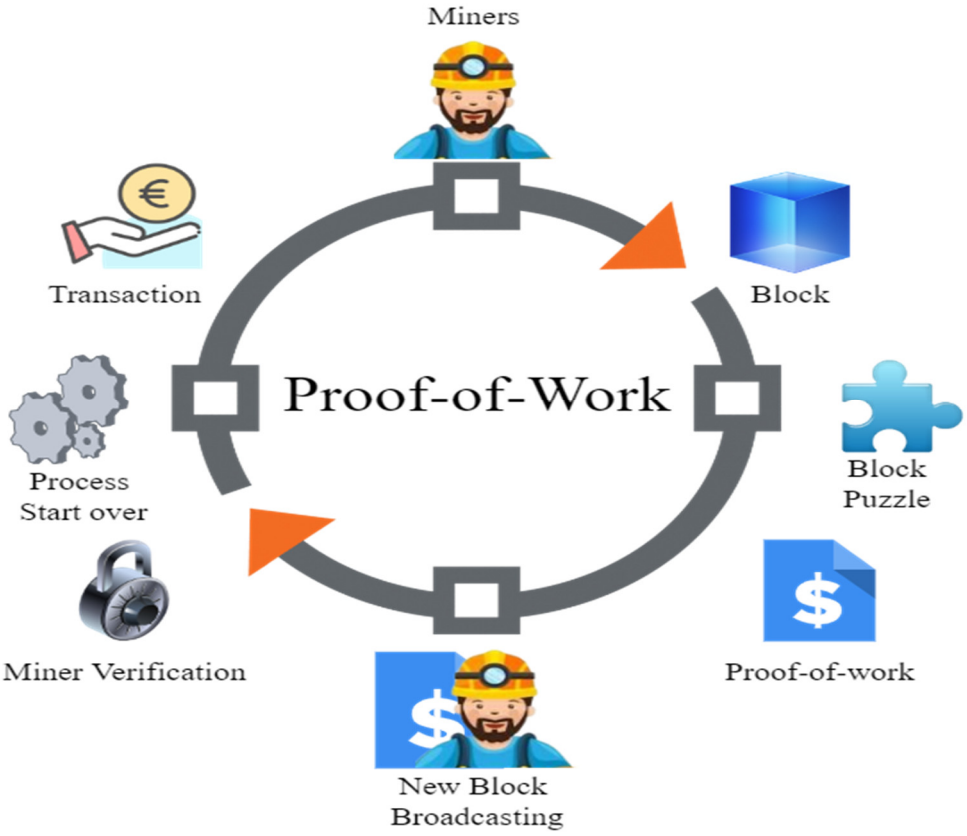

Figure 2. Working of proof-of-work.

Monero is one of the most secure cryptocurrencies to mine due to its untraceable cryptographic mechanism, which allows users to keep their transactions hidden [35]. Samsung has stated its intention to develop semiconductors for the mining industry. Because there are no limitations or dynamic scaling, detrimental use is difficult. Monero is a CryptoNote system that is resistant to ASICs. Mining for Monero necessitates the use of specialized software [34]. In this paper we have mined Monero using GPUs and on top of that we have also mined Monero using techniques, such as undervolting and overclocking, to optimize and get more out of the GPU.

They are, unfortunately, few and far between, but they are the most effective. Whattomine.com is the best place to learn about the economics of mining Monero. A Monero mining rig is both expensive and energy intensive [36,37]. Monero mining hardware, as a cryptocurrency mining operation, is necessary and must be included. It is not necessary for Monero cloud mining hardware to be compatible with any specific environment [35].

In Figure 3 above, we show the workflow that is adopted by this paper, beginning from choosing the mining hardware (in our case, we have choose RTX 3060 GPU to mine Monero), then creating a digital wallet, and lastly, implementing the mining techniques.

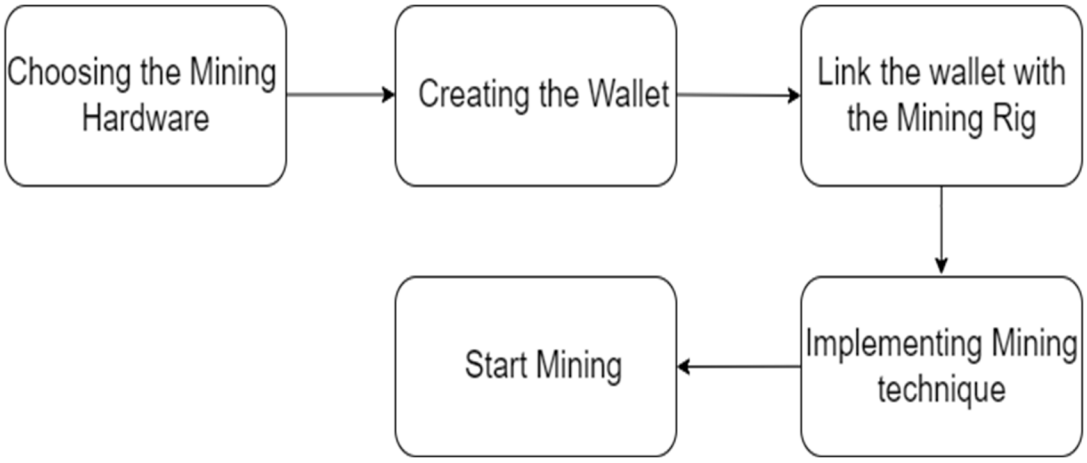

Figure 3. Work overflow adopted by our paper.

Best Monero Mining Software:

1. XRP Stak
2. Miner Gate
3. Monero Spelunker
4. CC Miner

In our analysis, we used the XRP Stak mining software, which supports mining with CPUs, GPUs, NVIDIA, and AMD GPUs and runs on Windows, Mac, and Linux. XMR Stak is a global stratum pool that mines not only Monero, but also Electroneum, SumoKoin, and coins using the CryptoNight and CryptoNight Lite algorithms [35,36]. XMR Stak is well known for outperforming other miners in terms of hash rate and optimization. In response to the latest ASIC release, Electroneum and Monero have modified their PoW to CryptoNight V7 [36]. As a result, setting up XMR Stak may help you get started using CryptoNight's V7 algorithm [38–40].

4. Experimentation Results

When compared to the already available technology, procedures governing mining techniques, that include the GPU overclocking, undervolting, as well as mining with renewable power as the main source, helping lessen the environmental impact of cryptocurrency mining at the same time as tolerating sappers to obtain a lot more energy due to the element of the renewable power fonts are cheaper than orthodox power-driven authority.

Whole our tests and models were conducted on a PC equipped with A non LHR on the identity card, RTX 3090, RTX 3060, RTX 2070, AMD RX 5700 XT, AMD RX 580, plus a Nvidia RTX 3080, GTX 1660 Super. We went through the experiment not including and alongside with the overclocking in a GPU, and we used solar inspection as our fuel supply on the to reduce electricity consumption.

The GPU's power usage while overclocked is shown in Table 2, as well as the event dice percentage, MHz, and fan velocities. overclocking the GPU is the process of increasing a graphics card's speed beyond its factory settings. Before we get started, let us go above what overclocking a GPU makes. A GPU Overclocking increases its competence through maximizing operating pace of graphics processors. Even though all GPUs are set to run simultaneously speed (the base clock), various cards frequently outperform the manufacturer's speed.

Figure 4 shows the GPU temperature while mining cryptocurrency and with respect to power. The temperature increases as the GPU consumes more power. The GPU we are mentioning below is RTX 3060 Non-LHR card. The temperature is in Celsius, and the power is in Watts.

Table 2. Hash rates of RTX 3060 when the GPU is being overclocked.

GPU Power Consumption (Watts)	MHz	Hash Rate (MH/S)	Fan Speed (RPM)
200 W	1750	60 MH/S	1250 RPM
215 W	1800	62.39 MH/S	1350 RPM
231 W	1850	65.41 MH/S	1400 RPM
262 W	1900	67.61 MH/S	1460 RPM
291 W	1950	69.11 MH/S	1570 RPM
315 W	2000	71.28 MH/S	1650 RPM
320 W	2050	73.91 MH/S	1670 RPM

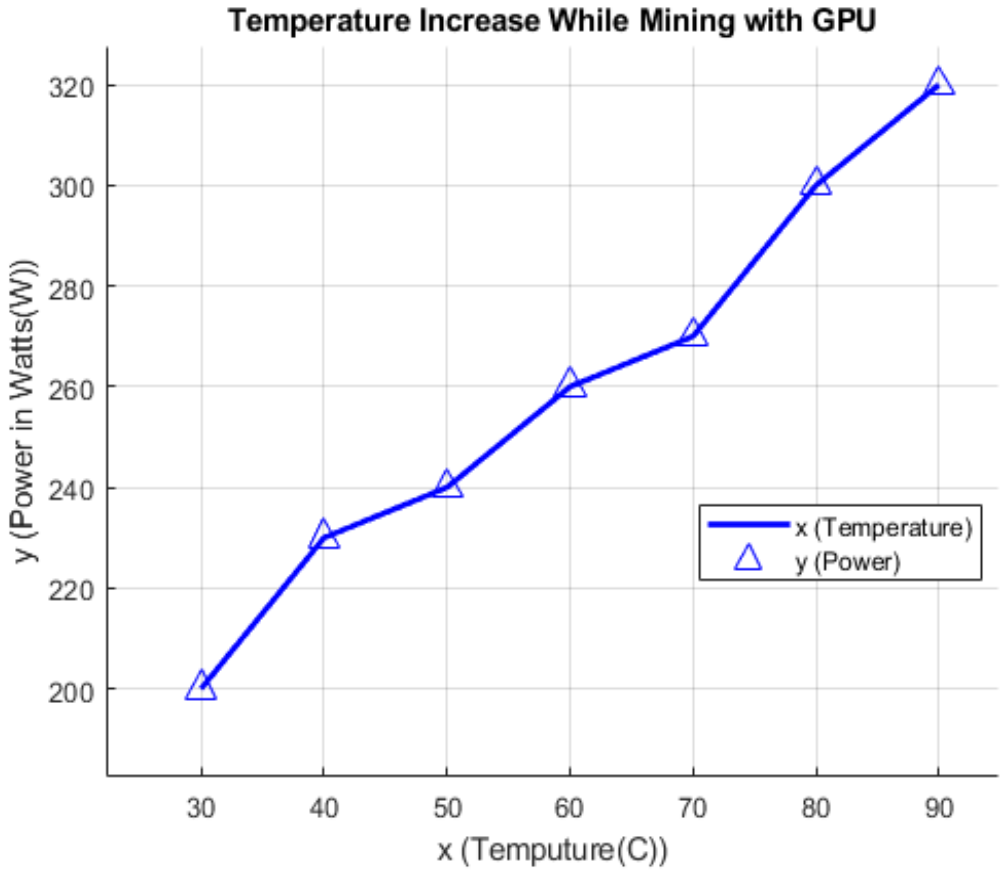

Figure 4. GPU Temperature Increase While Mining Cryptocurrency.

Figure 5 shows the CPU temperature while mining cryptocurrency and with respect to power. As the temperature increases, the CPU consumes more power. The CPU we are mentioning below is AMD Ryzen 7 5800×. The temperature is in Celsius, and the power is in Watts.

Overclocking boosts the GPU's temperature and leads it to consume more power. It is vital to achieve a balance between enhanced performance and keeping your graphics card at a constant temperature. Every GPU is distinct. Furthermore, because of manufacturing variations, your RTX 3080 can securely overclock on higher incidence in comparison to friend's RTX 1080. Consequently, you will be trying overclocking rates up to find sweet spots on your own. If you overclock your GPU too high with MSI Afterburner, the video card will be or view graphical faults or processor has to collapse. If this happens, no worries; you just need to lower your GPU velocity to a safe level. Advisable start lightly and slowly boost your workload as long as you don't notice certain matters. The following information builds on Nvidia's RTX 3060 GPU, produced by the MSI. Table 3 below mainly focuses on GPU power consumption and mixing percentage relative to the amount of fuel in terms of the power that GPU is consuming.

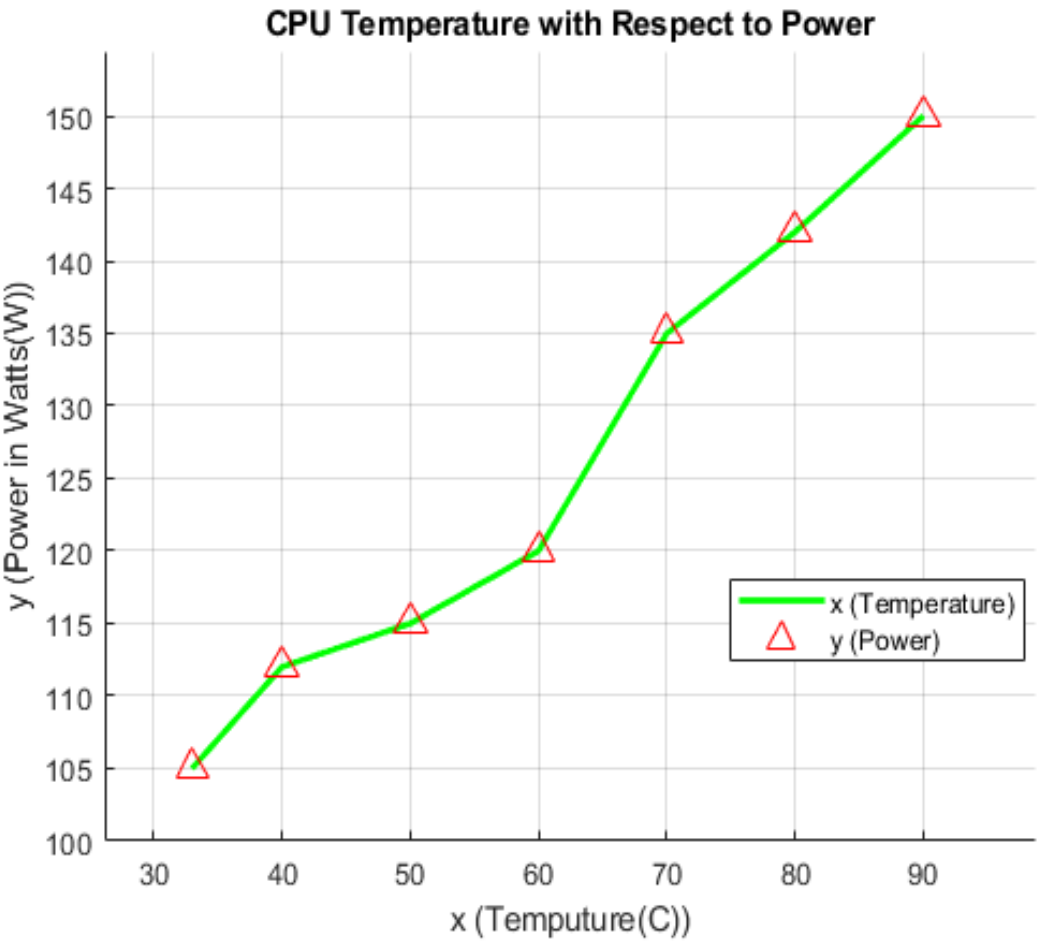

Figure 5. Temperature Increase While Mining With CPU.

Table 3. Monero Mining Electricity Savings.

GPU Power Consumption	Profit Per Day	Electricity Savings
200 W	321.85 Rs	40.837 Rs
215 W	328.48 Rs	40.837 Rs
231 W	336.12 Rs	40.837 Rs
262 W	349.99 Rs	40.837 Rs
291 W	362.35 Rs	40.837 Rs
315 W	374.94 Rs	40.837 Rs
320 W	380.21 Rs	40.837 Rs

Information elaborated in Table 3 primarily focuses on the profit generated by solar renewable energy; remember income will not be calculated for each GPU. For a full mining rig with eight RTX 3060 GPUs, and the data have been taken while the GPUs mined Monero for seven consecutive days, with the electricity savings determined every day. A hybrid solar system with on-grid and off-grid solar system functionality was used in conjunction with the domestic solar control order with a highest productivity of 5 kW. Our mining equipment includes eight RTX 3060 GPUs, each of which can mine at a maximum of 2000 Watts.

Table 4 presents the best graphic processing units available today, along with thei absorbed power, the watch in rate, hash rate, CUDA Cores for Nvidia GPUs, and Streaming Process, and VRAM for each card. Please keep in mind that these projections are for mining Monero in 2021, and the readings are for individual cards rather than a whole mining operation.

Table 4. Best Monero Mining GPUs based on Hash rate and Power Consumption.

GPU	Power Consumption	Clock Speeds	Hash Rates	CUDA Cores	VRam
RTX 3090 OC	350 W	1371 MHz	120 MH/s	10,496	24 GB GDDR6X
RTX 3080 OC	320 W	1350 MHZ	100 MH/S	8704	10 GB GDDR6X
RTX 3060 Ti	200 W	1400 MHz	60 MH/S	4864	8 GB GDDR6X
AMD RX 5700 XT	225 W	1445 MHz	1090.3 H/S	2304 SP	8 GB GDDR6
RTX 2070	225 W	1596 MHz	710.0 H/S	2304	8 GB GDDR6
AMD RX 580	185 W	1241 MHz	470.0 H/S	2048 SP	8 GB GDDR5
GTX 1660 Super	125 W	1513 MHz	505.0 H/S	1408	6 GB GDDR6

The graph in Figure 6 shows the hash rate and power consumption of the graphic cards, which are mentioned above.

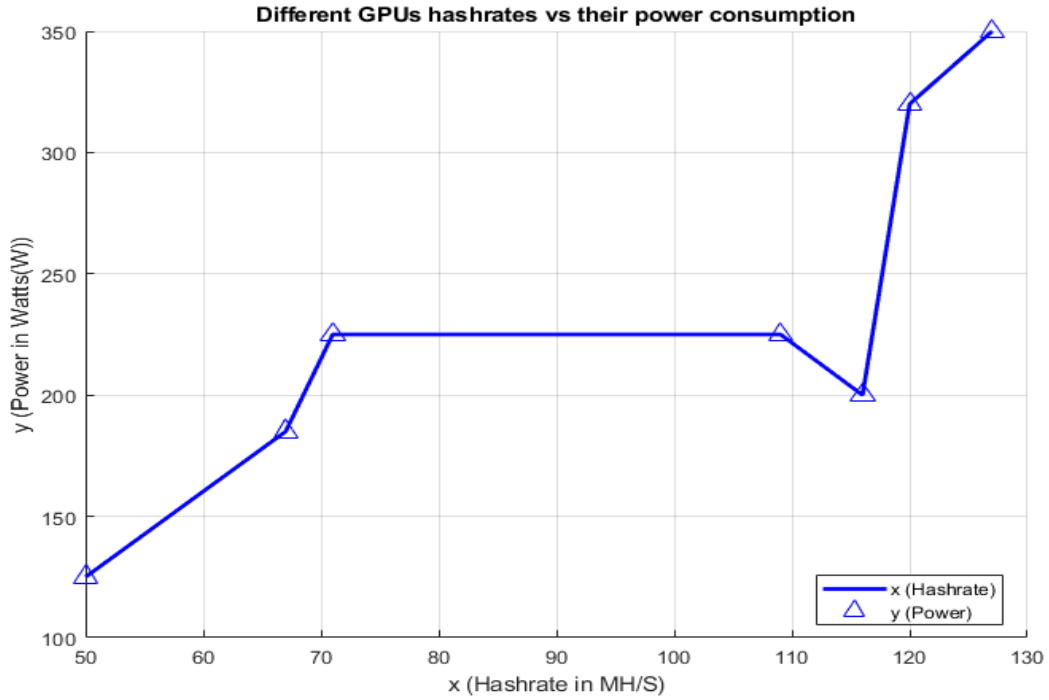

Figure 6. Different GPUs' hash rates vs. their power consumption.

Figure 7 shows the fluctuations in hash rate as a result of GPU undervolting. Undervolting is the technique of lowering the voltage of your GPU while maintaining the same clock speed. Undervolting the GPU will decrease the amount of warmth produced by the power in your workstation. Are you now striving to produce fewer warmth, that benefits the system by lowering abrasion brought on by the circular motion. Warm temperatures lead to an increase in electricity use, that engenders considerably additional warmth. Undervolting lessens your computer's power consumption over time, resulting in less power being used by your system and a lower temperature. As previously said, undervolting not only minimizes the amount of heat generated, but it also allows the GPU to run longer and spend less energy, resulting in higher mining profits. The majority of miners use this technology, but when combined with renewable energy, it is not only more cost effective, but it also has a significant environmental benefit.

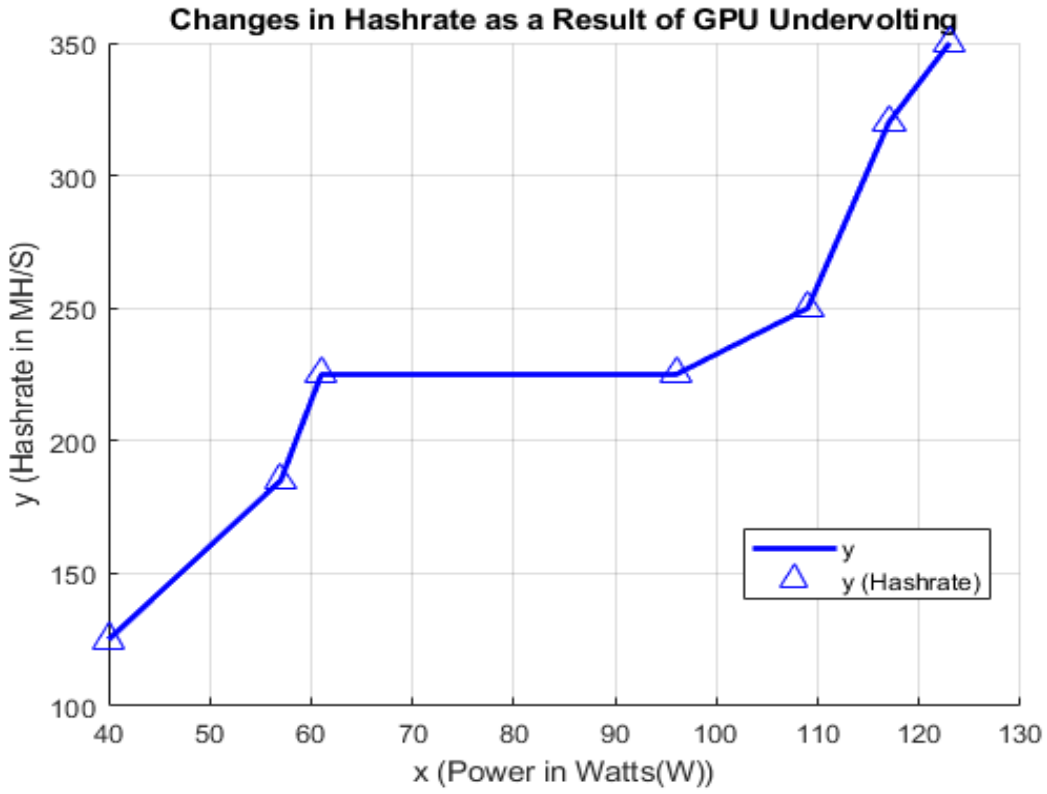

Figure 7. Changes in Hash Rate as a Result of GPU Undervolting.

5. Discussion

Undervolting the GPU is an excellent place to start if you want to obtain the highest hash rate while consuming the least amount of electricity. Before tinkering with the settings, research brand name and designs of your map, calculate their basic suspense, and then simply stays a little at a time. Magnify memory clock and the core timepiece in case the you're mining the memory-rigorous procedure.

Mining efficiency is important since it impacts profitability. Mining's most expensive ingredients are strength and cooling systems. Reduces power and heat, for our undervolting strategy, we used Nvidia graphics cards. Both AMD and Nvidia GPUs benefit from undervolting. When using the default fan speed, power consumption is decreased by around 30%, and after undervolting, power consumption is reduced by about 33%. Undervolting is also quieter, and we have discovered that it keeps the GPUs significantly cooler, roughly 5–10 degrees colder with a very small hash in the rating to be lost.

Overclocking is a different method we have been using. Overclocking technique is of boosting the GPU's standard value memory-and basic clock frequency up to speeds more quickly than manufacturers specifications. We have increased the power limit and/or voltage when overclocking but be aware also because that would also be maximizing the usage of the power. Experimentation from extreme watches combined with average infections is typically a secure, but do not forget they may cause their hardware for not pass quicker than the normal. With correct overclocking, you may increase your mining money while also reducing your energy expenditure.

Underclocking is the opposite of overclocking. Memory and core clocks slow down because of underclocking. Although underclocking lowers power consumption by lowering the power limit and voltage, it has a considerable influence on performance.

As clock speeds increase, GPUs will require more power to perform. The mining efficiency of the GPU may be improved by balancing power consumption, hash tariff recollection, and basic clocks. You could exceed the energy restriction by using energy from renewable sources, making it cheaper and does not have an impact on the environment, or

by permitting GPU to function at higher control rate, but keep in mind about those higher temperatures result from more power demand.

In Table 5 below, we have compared our techniques with other techniques used by different papers, highlighting the major differences with respect to mining cryptocurrency.

Table 5. Comparison of our mining technique to others' techniques.

Constraints	Our Work	Dev [3]	Alkaeed [7]	Fadeyi [24]	Han [32]
Cryptocurrency	Monero	Bitcoin	Ethereum	Ravencoin	Dogecoin
Algorithm	RandomX	SHA-256	Keccak-256	KAWPOW	Scrypt
AverageHash rate	427.97 MH/s	193 TH/s	12,638 MH/s	3.51 TH/s	461 MH/s
Mining Hardware	RTX GPU	ASIC	RTX GPUs	Nvidia GPUs	RTX GPU
Power Consumption	190 kWh	214.93 TWh	113 TWh	194 kWh	101 kWh
Energy source	Renewable Energy	Renewable Energy	Renewable Energy	Renewable Energy	Renewable Energy
Overclocking	✓	✖	✖	✖	✖
Undervolting	✓	✖	✖	✖	✖
Mining Efficiency	✓	✖	✖	✖	✖
Hardware optimisation	✓	✖	✖	✖	✖

Underclocking is the opposite of overclocking. The memory and core clocks are slowed when you underclock. Underclocking lowers power consumption by lowering the power limit and voltage, but it has a significant impact on performance.

As clocks increase, GPUs will demand more power to function into higher clocks. By balancing power usage (reducing power restriction) and hash rate, a GPU's mining efficiency may be improved (memory and core clocks). You can raise authority across the border by using renewable energy, making it less costly, and does not have any effects on the environment, as well as permitting GPU function at higher clock rates but note that greater strength means more heat.

6. Conclusions and Future Works

The study's main contribution, as previously stated, is the creation of a novel and straightforward approach to analyzing the benefits of GPUs in mining. The results show that mining with a GPU is more profitable since the GPU can perform a wide range of challenging mathematical computations, and we can fully utilize the GPU by combining overclocking and undervolting techniques. These techniques stand out from the other techniques and help miners optimize their mining rigs. Findings contained in this research will be helpful to miners who are mining cryptocurrency with GPUs and will help them mine crypto while maintaining the GPU temperatures and simultaneously reducing the power consumption of the GPU.

Cryptocurrency mining can be viewed as shifting energy consumption into profit. Non-renewable energy is now the world's most popular source of electric energy for Bitcoin mining since it is less expensive than renewable energy. Mining Bitcoins with renewable energy and then remodeling them into a valuable currency is the breakthrough technique delineated here to scale back emissions and expenses. Furthermore, using additional renewable energy to mine Bitcoin offers tremendous promise for overcoming monetary and technological constraints. It is the power to turn waste into money while minimizing financial risk. The profits from this sort of cryptocurrency mining could be invested in a wide variety of renewable assets.

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