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INNOVATIVE AND OPTIMIZED COMPUTING

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ABSTRACT - There are thousands of products that are not quite related to computers but require microprocessors like car accessories and appliances. Examples of Embedded Technology like Smart-bands, Smart Watches, iPod's etc. also require them. As the world is advancing towards a new and better era the need, demand and use of such technologies will extremely increase. But the methods currently used are not quite able to help building the future till forever. Better materials, techniques of development and smarter approaches are required today to meet the better tomorrow. There are several challenges that have to be dealt with like creating smaller architecture of Microprocessors, and dealing heating issues of modern computers & devices, Before giving our vision a more realistic shape the challenges has to be faced today. This paper focuses on providing the consumers and industries both the realistic vision of future computing. This paper present solutions to the most threatening issues in making highly efficient computers and smart gadgets by replacing the traditional use of Silicon from Graphene, and by providing efficient and commercially implementable techniques to utilize the heat generation in Laptops and other devices by using it for the sake of the device itself, which will be beneficial for all present industrial trends like Cloud Computing, Internet of Things and Big Data and also for the consumers.

GENERAL TERMS - Graphene, Zeolites, Cloud Computing, Big Data, Zeolites, Thermoelectric, Graphene Films

Keywords - ***Graphene, Processor, Heating, Battery Bank, Embedded Technologies, Efficient Computing, Heat Utilization, Zeolites, Flexible Screens***

I. INTRODUCTION

Today Microprocessors are used in everything from embedded systems and handheld devices to giant mainframes & Supercomputers. A Microprocessor incorporates CPU's functions on single or few IC's. Over Computer's history, capability & speed of processors has dramatically improved.

Intel 4004(released in 1971) had 2300 transistors performing 60,000 operations/sec. As of 2015, the highest transistor count in a commercially available CPU (in one chip) is over 5.5 billion transistors, in Intel's 18-core Xeon Haswell-EP. The pretty good new days, as progress continues—will be more difficult, Moore's Law states that number of transistors per square inch on integrated circuits will almost be doubled every year. Improvement in transistor density can be done but comparatively little improvement in transistor speed and energy can be done. Therefore, the frequency of operation will increase slowly. Energy is going to be the key limiter of performance, forcing processor designs to use large-scale parallelism with heterogeneous cores, or a few large cores and a large number of small cores operating at low frequency and low voltage. That is what is already going on around since years. Creating very small sized Microprocessors after a certain limit is difficult with silicon and also threat of high level of heating is there, dealing which has always been a challenge. So Working with silicon based chips cannot give the future anymore. Better alternatives have to be used for posing new types of design and deal with manufacturing challenges. The aim of this paper is to provide commercially possible ways to create highly efficient Computers with Heat utilization and longer runtime & reliability.

II. HEATING ISSUES

Waste heat is by necessity, produced both by machines that do work and in other processes that use energy, rejecting heat as by product is fundamental law of thermodynamics. In electronics industry, although small in terms of power, the disposal of waste heat from microchips and other electronic components represents a significant engineering challenge. This necessitates the use of fans, heat sinks, etc. to dispose of the heat. The heat can even damage the processors and even may cause decreased system performance. Heat is generated due to many reasons primary being, [1] The CPU that carries out various algorithms so it is quite obvious that heat will be generated as lots of internal

processes are going on in there at high rate also the GPU that handles 3D Imaging, and support High-End games also contributes to heating and usually there part is greater than that of CPU & Hard disks that due to having moving parts in it, generates heat due to movement of disks in them. Heat can slowly damage electronic devices over time that is the reason why utilizing it or maybe reducing it or probable doing both is a necessity in present situation. High End processors even require installing of an additional CPU Cooler instead of ordinary fan, if used in personal computers; also accessories like Laptop Cooler are required for some Laptops due to high heat generation by some Processors. So there is a requirement of some ideas to come up posing some possible innovative ways to make our way through heating problems and spending our resources in making technology better rather than spending a part of it to deal with the consequences of it.

2.1 Heat Utilization by-Thermoelectric materials & Battery Banks

Thermoelectric materials (materials that convert temperature differences into electric voltage) and alloys (mixture of metals or a mixture of a metal and another element) provides a way to cool our System Temperatures by absorbing the heat and converting it to Electrical energy which can be stored into a battery bank. The battery bank is capable of storing that electrical energy, to fulfill that purpose materials like Zeolites can be used to store heat that can raise temperatures of photovoltaic cells on the battery bank and make them store the energy due to the heat, just like the solar power banks works to charge electronic devices like smartphones by storing energy captured by sunlight. Zeolites are known for storing heat for a long time and major advantage is that the energy loss is very less, so the energy loss will be negligible. Such Battery Banks can be fitted in computers internally, that will be used to provide electricity to charge mobile phones and other small gadgets through a dedicated USB port in modern computers & also to provide charge to laptop's battery, resulting in longer runtime. Already in present scenario several Apple MacBook Versions & Business Laptops are claiming battery life of over 10-12 hours but with an extra hardware supporting that runtime can literally boost the runtime by more than twice from now! And the best part is that the energy is the heat generated by the device so the source is always there, the need is always there and all that have to be done is reap the benefits. They are also cheap to produce and hence the suggestion of battery bank in Laptops can be made commercially viable. Materials like [2] Bismuth Telluride (Bi_2Te_3) which is a gray powder that is a compound of bismuth and tellurium, is a semiconductor which when alloyed with antimony or selenium is an efficient thermoelectric material for refrigeration or portable power generation. It can be produced by sealing a sample of bismuth and tellurium metal in a quartz tube under vacuum and heating it to 800 °C in a muffle furnace. Thermoelectric materials can be used to transfer the heat to broader surfaces and to the power banks and if some heat is left it can be transferred near Heat sinks and fans. That means that the heat will be utilized by battery banks, the temperature will be maintained internally since the heat has been spread near fans and heat sinks, hence quickly removing the excess heat. That means even if users are working over heavy processes like playing high-end graphic intense games, working on editing with 4K videos and editing with heavy graphics, the system still will operate under normal temperatures that will increase the life of hardware components, increase the runtime since heat is being utilized to increase the battery charge.as a result providing a computer system that charges itself with its own heat generation, works with high efficiency and have longer runtime.

2.2 Refrigeration Cooling-for Computers

Refrigeration is a process of moving heat from one location to another in controlled conditions. [3]Few years back researches at Purdue University found a technique for using Refrigeration cooling in devices like laptops. Previously they were unable to do so as there were lot of challenges for making a small compressor that could be appropriately fitted with whole mechanism into the laptop, but now the answer to our vows is present. In simple commercial refrigeration systems the compressor is normally controlled by a simple pressure switch, with the expansion performed by a capillary tube or simple thermostatic expansion valve. In more complex systems, including multiple compressor installations, the use of electronic controls is typical, with adjustable set points to control the pressure at which compressors cut in and cut out, and temperature control by the use of electronic expansion valves. Using this mechanism is beneficial for PC's and laptops too, Specially for high end laptops having better and advanced GPU and high configurations, since they produces more amount of heat than Entertainment based, Business based and General Laptops. This Technique may prove beneficial for Server computing also, Since Air Conditioned Rooms and Nitrogen-Gas based Cooling Systems also requires a meaningful amount of money.

- It keeps temperature within the operating limit, so the system needs not to depend on heat sinks & Fans.

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- Fans & heat sink structure can be made smaller as they will no longer be a primary component of cooling, leading to fewer amounts of aluminum & copper usage, hence reducing the production cost.

- Also the components used for Refrigeration cooling has long life, and in total the process is inexpensive

2.3 Graphene Films

Graphene based Films will protect our electronics components from facing rise in temperature due to heat generation of several devices. [4] Properties of Graphene allow Graphene based films to be attached with electronic components based on silicon without any trouble, and it has a thermal conductivity capacity that is four times that of copper which can be used to provide cooling effect on our silicon based electronics. Graphene-based film could also pave the way for faster, smaller, more energy efficient, sustainable high power electronics.

III. GRAPHENE

Graphene is a one of the most appropriate alternative to Silicon, in making transistors and chips. Transistor is a semiconductor device used to amplify and switch electronic signals and electrical power .in general,[10] Graphene is a form of carbon consisting of planar sheets which are one atom thick, with the atoms arranged in a honeycomb-shaped lattice. With Graphene high frequency Transistors can be made, so that less Transistor Count will be required there in the device which may reduce the cost of production and surely will raise the system performance. The main problems when combining a high concentration of transistors with high clock speeds are heat and error rate therefore the focus is dragged upon voltage levels. Also in past few years there's not much improvement seen on the clock-speed area, as the heating issues are also a big concern and has to be managed. But with Graphene made Transistors, in a device Transistor Count could be reduced and since their frequency is high, goal of achieving higher clock speeds can be accomplished. That in turn means a computer with a smaller chip with more frequency, less heat dissipation, more clock speed and what not? Better CPU's can be designed even with multiple-cores, where each core will be able to do lot of stuff on its own. Scientists have figured out techniques to turn Graphene into working Transistors and speediest one to date was amazingly clocked at 427 GHz! That is 100 times of what Silicon could offer that makes Graphene a very promising material.

3.1 . Graphene Problems & Scope

Unlike silicon, [5] Graphene does not have an energy gap. Therefore Graphene cannot be―switched off," So a problem arises that probably the system can never be turned off, the processes will always be running but after trying and testing several one solution is observed as a possible one that by providing negative resistance to the transistors, the transistors can be turned off. There's no limit to the size of a Graphene transistor as it's of an atom's thickness & because of this reason Graphene is more robust in terms of device scaling, while it's known that the quality of silicon will suffer significantly once it's thinned down, Graphene really makes its own space in the upcoming era. Graphene transistors can achieve a higher clock speed than those made of silicon with the same gate length, as the electrons in Graphene's can move at a higher speed than those in silicon. That means Graphene is not only an ordinary alternate to Silicon but also is extremely better in several or almost all expects. Gordon Moore, co-founder of Intel, states that number of transistors per square inch on integrated circuits will be doubled every year. But with the help of Graphene scientists and researches has been able to create transistors of 1000ghz (1Thz),so maybe in future the number of transistors in a IC will reduce significantly rather than increasing at around double rate. Hence defying around a 50 year old Law. Among others, IBM is one company that has expressed its serious commitment in building a Graphene processor, The goal is to build [6] IBM Graphene transistors that measures only 7 nanometers but unrivalled in terms of the power it can provide to The Company has invested $3 billion to provide the funding necessary for the development of the technology and in having it polished before finally being introduced in the market. This shows how much expectations IBM is having from Graphene, probably be a game changer for their Supercomputers and Mainframe business. Graphene can give provide the future PC's and Laptops that would be having very less heating, less energy wastage, high clock speed and improved system performance.

3.2 Efficient Graphene based Processors

Some might not find Increasing Clock Speed as good because they don't know that a slower chip can perform better than a faster chip just because of having high clock-speed, as they are able to do quite more per tick! But The Manufactures have almost stopped focusing on increasing the clock speed of processors as it leads to more heat generation, & that would be a challenge to deal with. Even if a suitable alternative is found, amount of energy has to be wasted in order to cool down the processor. But

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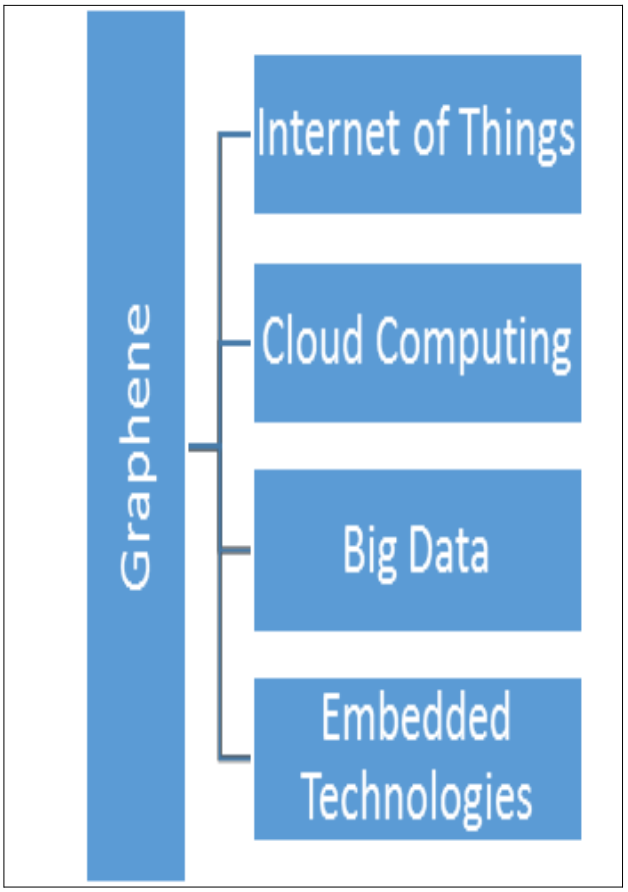
with Graphene, less no. of transistors will be used which can be of any size, since it is of an atom's thickness. It is clearly visible that in future. Silicon can't help to reach the goal of producing powerful chips of single digit nanometer size having high clock speeds Graphene may cover the gap. [7]The global market for Graphene is reported to have already reached $9 million by 2014 with most sales in the semiconductor, electronics, and battery energy and composites industries.

3.3 Touchscreens/modern devices

Everybody knows and have witnessed the ―bang made in industry by Touchscreens, it provides users ability to do our work faster and in some cases, with far more accuracy as it makes the stuff of daily life take shorter duration for ex- marking a attendance in a company via biometric or probably making an emergency call by our mobile by two-three simple taps. It also provides the accuracy while interacting with devices. Touchscreens these days are made of Indium Tin Oxide which is expensive and not quite flexible. But the researchers of Surrey and AMBER, the materials science center based at Trinity College Dublin have found a technique by using Graphene to make touchscreens by which amount of [8] nanowires required to build those touchscreens has reduced by nearly 50 times, as Graphene interpret touch commands very well as it is good conductor of electricity, whilst still being transparent.[9] Such techniques can be used to create cheaper touchscreens to provide consumers today's technology (Smart bands, fit bands, Smart Watches, portable media players, Smartphones, Tablets etc.) in affordable prices without compromising in performance.

3.4 Graphene with other technologies

Graphene is beneficial for several other industrial trends and technologies like Internet of Things since it deals with taking actions in response to real-time monitoring and helps industries in tackling problems for which sometimes they even cannot be prepared.it demands highly specialized data processing ability, and Graphene based transistors can provide that highly efficient processors and can help corporate data infrastructures, also for Big-Data analytics & Cloud Computing. Graphene based processors can be a game changer since the technology is used specially for unstructured or semi-structured data, and knowledge of Hadoop alone cannot help the business out, skills in field of data warehousing, business intelligence (BI) is another must along with data-mining and predictive analytics. High processing power and Systems with High Clock speed can really help data analysts making the data available quickly for analysis, run algorithms very fast for sorting and searching within the data. High speed processors can really reduce execution time which is beneficial. Graphene also helps in embedded technologies as the modern technology is inclining towards embedded technologies, they are portable, light, delivers high performance in small amount of time, and do not require lot of actions done by user. These technologies are everywhere like traffic lights, MP3 Players, Digital watches etc. They require small architectures of hardware components which can be achieved by Graphene since it is only of an atom's thickness.

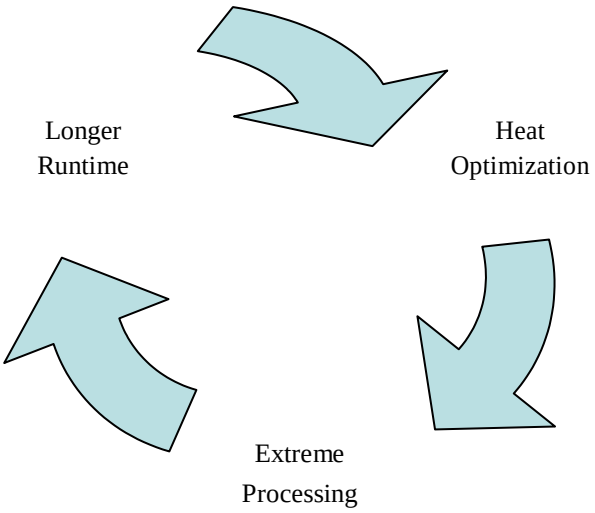


IV. CONCLUSION

It is clearly visible that in coming era of technologies more innovation will be seen few of which like Extremely Slim Smartphones, Curved Televisions, Smart Watches and Motion control Gaming Devices has been developed and made commercially available. In Future, the things will be continuing as it is pretty much clear that the more busy human lives get the need of accurate, portable, handy and cheap devices increases to make the lives easier. Smaller devices means small architecture of hardware components, accuracy means real time processing which needs be fast, portable means small enough

that it can be easily carried with the consumer on-the-go. So as the need becomes more advanced, smarter approaches will be required to deal with the problems and issues. So the consequence has to be dealt with too. The motive of this paper is to divert the attention towards the fields where the industry is lacking innovation at present.in the competition of staying in market maybe the developers or the manufacturer have forgotten that investing in the project that creates resolution and stays for several years is always better than the innovations that is done each quarter of year. The smaller the device gets harder it becomes to repair it if required, so to make efficient, reliable and trustworthy devices the product firstly has to be made with reliable things for sure that is durable, if possible easy to manufacture since the devices has to be in budget of both manufacturers and consumers in order to sell good number of units. Graphene will help make highly efficient processors with high clock speed.it offers over 100 times of maximum of what silicon can offer (if compared in clock- speeds)The smaller the devices get, more portable they become, but elimination of produced heat becomes extremely difficult, some Smart phones that promises to be waterproof these days are so closely packed in order to be water-proof that heat vents and pipes are required to be installed to eliminate the heat and protect the phone from damaging itself by its own heat generation skills. Whereas some innovations like Sony Xperia Z2 was having Liquid heat pipe cooling mechanism that moves heat by evaporating and condensing in an endless cycle. That proves that in future such innovations will be more and more required as they are pretty much required right now! Hence our suggested ways included innovative ideas like thermoelectric materials, refrigeration cooling for laptops and servers and Graphene Films .The ideas of charging a device with its own heat also is quite revolutionary and innovative as this way the device becomes more capable of running for longer time, in turn making it more reliable for long journeys and for those who regularly uses their computers. The following diagram (fig 1) shows the conclusion of our paper also the part that was concentrated upon. the ideas presented or suggested are not going to raise the prices of modern devices since manufacturing of all materials and devices like Battery banks (power banks),Zeolites, Bismuth Telluride, Thermoelectric Materials are already being done at present but are having applications in several other fields not in computing. But their introduction to the world of industries and consumers can really change the world as they are capable.

Fig 1: Features of Future Computing



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