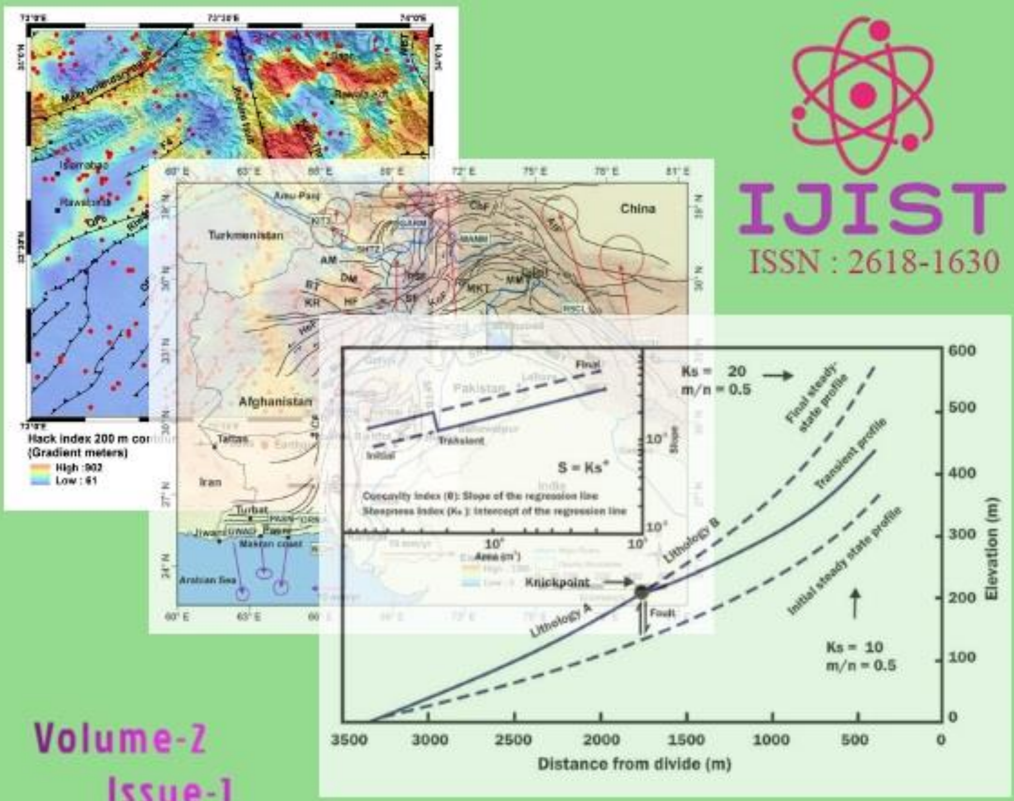
INTERNATIONAL JOURNAL OF INNOVATIONS IN SCIENCE & TECHNOLOGY

(ISSN 2618-1630)



IJIST

ISSN : 2618-1630

Volume-2

Issue-1

- Optimize Elasticity in Cloud Computing
- Investigation of Surface Deformation
- Synthesis Of Nio/Zno Nanocomposites In Ethylene Glycol

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Prof Dr. Ali Iqtadar Mirza
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P ISSN : 2618-1630
E ISSN : 2909-6130

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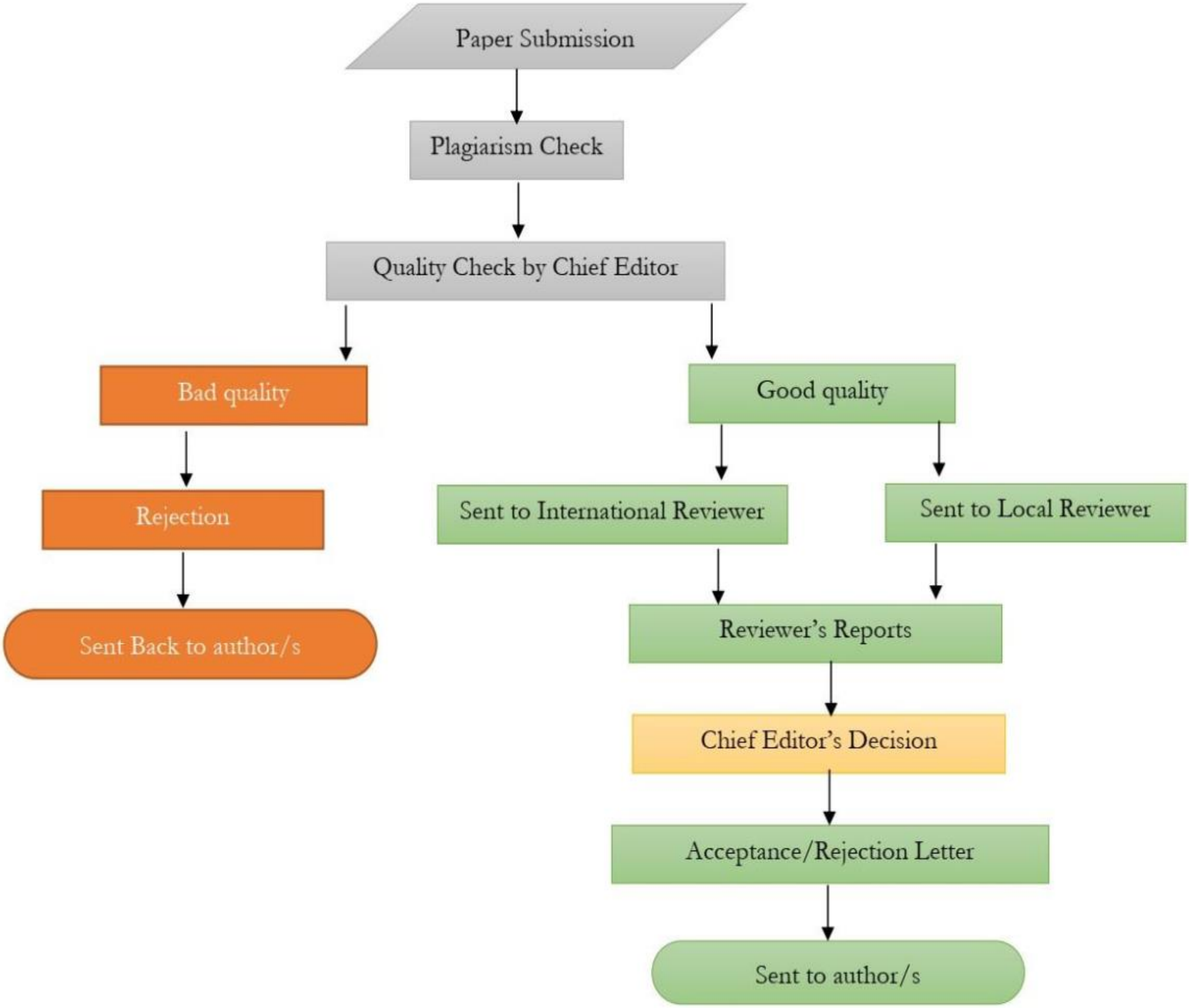

Table of Contents

International Journal of Innovations in Science & Technology (IJIST) ISSN 2618-1630 V2-I1 | March 2020

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IJIST
ISSN : 2618-1630

Optimize Elasticity in Cloud Computing using Container Based Virtualization

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Citation | Sehir e N, Shehzad M.A, Aslam M.S, Sajid W and Imran M, "Optimize Elasticity in Cloud Computing using Container Based Virtualization". International Journal of Innovations in Science and Technology, Vol 02 Issue 01: pp 01-16.

DOI |https://doi.org/10.33411/IJIST/2020020101

Received | December 01, 2019; Revised | December 26, 2019; Accepted | December 28, 2019; Published | January 01, 2020.

Abstract:

Cloud computing emphasis on using and underlying infrastructure in a much efficient way. That's why it is gaining immense importance in today's industry. Like every other field, cloud computing also has some key feature for estimating the standard of working of every cloud provider. Elasticity is one of these key features. The term elasticity in cloud computing is directly related to response time (a server takes towards user request during resource providing and de-providing. With increase in demand and a huge shift of industry towards cloud, the problem of handling user requests also arisen. For a long time, the concept of virtualization held industry with all its merits and demerits to handle multiple requests over cloud. Biggest disadvantage of virtualization shown heavy load on underlying kernel or server but from past some decades an alternative technology emerges and get popular in a short time due to great efficiency known as containerization. In this paper we will discuss about elasticity in cloud, working of containers to see how it can help to improve elasticity in cloud for this will using some tools for analyzing two technologies i.e. virtualization and containerization. We will observe whether containers show less response time than virtual machine. If yes that's mean elasticity can be improved in cloud on larger scale which may improve cloud efficiency to a large extent and will make cloud more eye catching.

Keywords: Grid computing, Elasticity, Virtualization, Containerization, Docker

Image

Introduction:

Cloud computing is getting immense importance due to its demand and availability of resources. Elasticity is the degree on which cloud paradigm is judged from other earlier approaches like grid computing. With the advent of time cloud computing has solved physical and maintenance cost of physical systems. It has many key characteristics like multi-tenancy, reliability and rapid elasticity. Elasticity is one of the main features defined from cloud service providers to compare cloud services. Elasticity of a cloud computing system is referred as its "ability to contract overtime over user demand". [1] Cloud works available in three service models IaaS, PaaS and SaaS. Platform as a service provides vendors to develop their services online. Software as a service provides users online services. Infrastructure as a service provides online API's and works on the physical layer of networks like physical resources, their location, and data distribution over cloud, backup, scaling and security. Here virtualization is used for managing requests according to demand with host OS. Both hardware and software-based virtualization exist. Hypervisor runs virtual machines and it pools services according to the customers demand. [2] Cloud computing has overheads and constrains over flexibility and scalability especially when diverse users with different needs wish to use cloud resources. To meet up such needs an alternative to virtualization is gaining importance especially in micro-hosting services is container-based solutions. [3] This enables bundling of applications and data in manner to deploy applications easily and best utilization of available resources. Along with solving many problems like dependency it also helps to improve response time in cloud that certainly helps to lighten the servers and decrease response time as it removes extra layer of host machine.

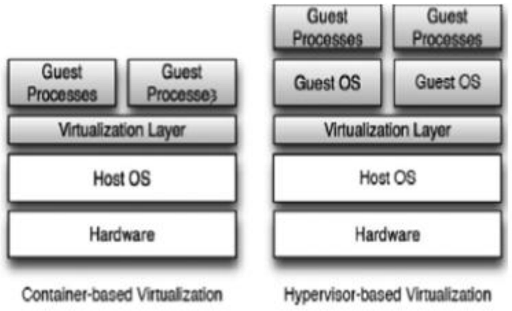


Figure1: Hypervisor Vs Containerization

To optimize elasticity different approaches have been introduced. Previous researched shows that technologies which use hypervisor face high performance overheads that lessens performance Therefore a lighter approach being introduced that is container based solution especially for micro hosting services. As in hypervisor there is always an extra layer on top of the host OS that creates an extra burden while resource provisioning and de-provisioning. While containers don't create any host layer but works in same OS and manage resources that enhance elasticity of system. With the fame of cloud computing many IT service companies start shifting their services over cloud. This is a big achievement in cloud technology but it also brings a large number of users that leads to slowing down response time. But if there is latency in services that user demand then clouds are of no use. As different users comes with different needs and wants a rapid response. We should eradicate these hurdles. One of these research paradigms is shifting services from hypervisor to container [4]. Container is an approach that completely demolishes an extra layer between core OS whereas user service demand in virtualization. There are many techniques being adopted in containerization like LXC, rkt, solarise etc. In this research we will deal with Dockers. Dockers is an open source container engine that works in many other products. It is the latest and most powerful container technology. Because it can work with older servers and also can work with ship programs. Basically, Dockers has a container HUB works like container repository. [5] Virtualization is creating virtual version of something i.e. a server, network or storage devices. Infect it is a method for using share resources by many companies and organization that are geographically apart.

Elasticity:

Elasticity is one of main cloud performance measuring parameter. From other sciences it has many definitions but in cloud it is the ability of a cloud to give sharp response to consumers according to their need and demand. It is actually measuring of time that takes by servers during scaling up and scaling down in provisioning and de-provision of resources when demand of user changes [6]. Cloud computing has become a trademark for "on-demand" service providing as it has ability to change resource "on the fly" by adding and removing them for handling load. It works on "pay as you go" model rather you are using its infrastructure, platform or application. [7] Elasticity is a model to check QoS quality of service in clouds. Cloud providers are free to add or remove updates in their projects without any interruption on the fly. Available resources for cloud users are unlimited and can purchase according to demand and need at anytime. Normally elasticity of a system is associated with scalability but there is a major difference between them. Scalability is associated with adding or removing resources according to the variation of load. While elasticity is the ability of a system to give response to consumer demands when resources are added or removed. [8] Scalability is a time free notation while elasticity is time dependent. Elasticity is the other name of system performance or matching its level of performance after provisioning and de-provisioning of resources which is a fundamental cloud principle. Hence In this thesis will discuss how important elasticity of the system is, what are propose of elasticity improvement and how Docker container can help for improving elasticity.[9] There are five main layers of network cloud which can reside which include infrastructure, kernel, hardware, application and environment. [10] It is very important to take an estimation of an average response time. In physics it is defined as the physical property of a system to retain its original position after some stress applied and response time against user request [11]. Here in cloud we term stress as a load of network and strain is bearing ability or tackling [12].$^{stress}/_{strain}$In terms of cloud it is defined as

$$^{DemandedComputingcapacity}/_{AllocatedComputingCapacity}$$

Cloud computing demand is measured in terms of GB this data is measured in terms of memory, processing time and storage ability [13].

$$cc = cpuunit * numberofcores * processingspeed * processingtime + allocatedmemory + allocatedmemory.$$

Change in it is calculated and measured in terms of resource allocation and de allocation in view of system load and bandwidth.

$$AverageBandwidth = ^{(IncomingBandwidth + OutgoingBandwidth)}/_{2}$$

Another definition of elasticity in cloud computing is refer as "configurability and expandability of resources" it means along with network bandwidth or system how resource can migrate or shift during a single request handling, which is also very important. In other words, physical resources affect the elasticity. Therefore, we focus on hardware virtualization, one main technology was VM but with passage of time and its comparatively low response, time a new technology is introduced i.e. containerization as an alternative to virtual machines.

Virtualization:

Virtualization plays a vital role in cloud computing. Normally users of cloud share application over clouds but in actual they are sharing infrastructure [14]. Through IT companies have reduced their cost to a large extent for example if you need to update a software you don't need to change it completely at every machine you just have to release updated version over cloud and it reaches all over. [15] There are four types of virtualization including hardware virtualization operating system virtualization, and server virtualization, this paper is related to compare elasticity using container virtualization which is a type of hardware virtualization.

Containerization:

Containerization is a method for packaging an application that it can run in an isolated environment with its own dependencies. Many cloud provider companies use container with its software choices like rkt, Dockers and Kubernetes. The name of container is derived from shipping industry, in spite of shipping. Each good individually a container ship different thing in a package. So container is a point that can take goods in form of one unit. Similarly all applications of one process work together in a container those are independent to others. [16] Mostly service providers face the problem of underlying hardware resource in differences. An application runs perfectly on one computer but get messy whenever shifted or migrated to other structures. This issue mostly arises when shifting applications from one server or data centre to other. This is due to the difference between machine environment, underlying libraries, storage medium, security and network topologies.[17] By using container technology this issue does not exist more as it works like a crane that picks up all shipment as one unit and place them onto vehicles for transport. Container technology carries not only software but also all libraries, binaries and configuration files. It also helps to deploy software in a server.

How containers work:

Container is not a new paradigm in industry, rooted in LINUX long ago. Recent form of container is advanced version of that technology it is quite easy to use for general purpose for deploying applications and upgrading software over cloud. [18] They also provide functionality of dividing big programs into smaller services known as micro-services. Different containers work for these parts of services interact timely and as a whole give result [19]. For faster and automate deployment in portable containers an open source project introduced Docker. Docker uses LXC with API of kernel and application level. Both of them together run applications in an isolated environment using their own CPU, memory, I/O, networks etc. Namespaces are used for differentiation of process's ID, network, process tree, file system and network [20]. Docker are created by using base images of OS. That includes basic ongoing infrastructure and repositories in a sophisticated environment. During the building often image in container every command takes a new action and creates a new layer over the previous one. These commands can execute manually or docker files use for automatic execution. [21] Every docker file is scripted having many commands to take actions against every listed command on a base image and creates a new image. These commands and images have full record of processes and provide every necessary action for deploying applications from start to end. Container gives end users an abstraction layer which makes each unit to work separately but in a collaboration manner. [22] Each process which migrates from one machine to other shifted along with all its own service routine on container, have separate process ID, network routine and other API etc. [23]

Methodology:

This research is based on reducing service response time during resource provision and de-provision. Through this the main hurdle of network load can be improved. For this we take hardware virtualization and judged its functionality thoroughly we observe that workload on servers got affected due to limitations of virtual machines. Those limitations can be improved by using a technology 'docker'. By using this technology, we will improve the service response time toward user's requests. That in turn help to solve biggest issue of cloud technology is facing i.e. handling user requests.

From previous discussion we see in detail that elasticity is main metrics for measuring cloud QoS. There are many methods of improving elasticity, One of them is lighting "Overlying OS"S so that response time can be lessened. Then we see different types of virtualization and how Container based technology improved the way of virtualization. In this research we will compare Virtual machines and Docker-container technology.

This paper contains two main parts one is about VM virtualization second is container-based virtualization. We simulate the system by using two main software including. "Azure Microsoft" and "Desktop Docker" along "data Dog". Their configuration gives results and then compares results through graphs of CPU, I/O and memory utilization analysis.

Data Dog (Docker-Container)

Data Dog is an online monitoring tool for measuring CPU utilization, Network traffic, resource allocation and their usage which covers SaaS based cloud applications. It works for docker installed on native machine by creating an agent that resides over the system and connect it with data dog server. Working with docker is very easy. You just need to give command and it automatically pulls that specific software or services over your system in an image form. That are a big advantage as it is very light to have an image rather than that full software. It saves memory, and maintaining cost.

Docker Desktop:

This version of docker is installed from docker Hub by creating an account. This is specifically for window 10 or higher version. It help developers to create images for creating lightweight virtual machines "container" that have a process and all of its necessary dependencies. Docker follow client-server mechanism and a remote API for creating images and run applications over it [29]. Docker container relationship is same like object and class. Docker have following instances in it.

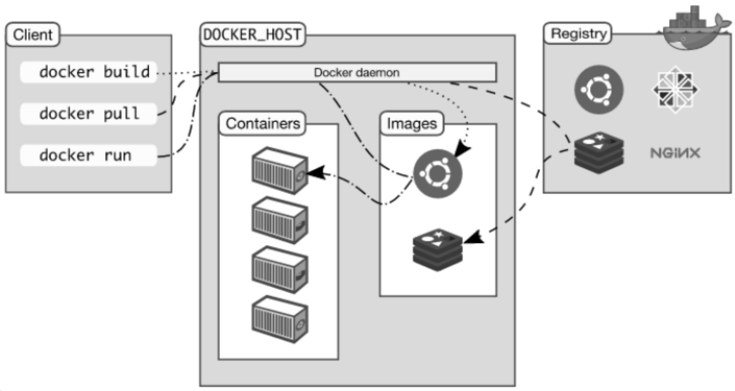
Docker Images: It is like an empty vessel which provides complete environment for creating Docker containers in it.

Docker Container: A virtual machine instance flourishing according to the instruction created in Docker image.

Docker Client: Applications or other users that take advantage of container over the cloud and communicate with docker.

Docker Host: **V**irtual machine that is running in container for handling and managing API's.

Docker Machine: A manager that mange docker hosts rather running on localhost or far apart over cloud.



```
docker build
docker pull
docker run
```

Figure 2: Docker-Container structure

Microsoft_AZURE (VM-virtualization)

It is second part of our research i.e. virtual machine based virtualization. In this we used online Microsoft Windows Azure SaaS based platform. We created an online virtual machine then linked it with cloud platform provided by Azure. Then created a dashboard for observing its working and different metrics. Here was whole process of creating VM and linked it with cloud and system. This observation was for same time as by data Dog i.e. 14 days. First we created an online account for getting Azure services then choose windows VM creation tab and started building VM. its specifications and checked simulation results after some time.

Results and Discussion:

By using both of these technology docker-container for containerization and Microsoft-azure for windows we will compare results in terms of response time, I/O network, memory, latency.

Memory:

A fix memory was assigned in our experiment and created a specific 17GB fix memory in machine. It was mounted means whereas no other services can be used in this area was spite of fact it is free or in use. That's why system having virtual machine needs more time to load. On the other hand containers don't need a fix amount of memory. It just reside in specific require memory along with all their dependencies and ship accordingly. This is why containers are considered as light weight processes and have a big advantage over virtual machines. In our experiment it just uses 52MB of memory.

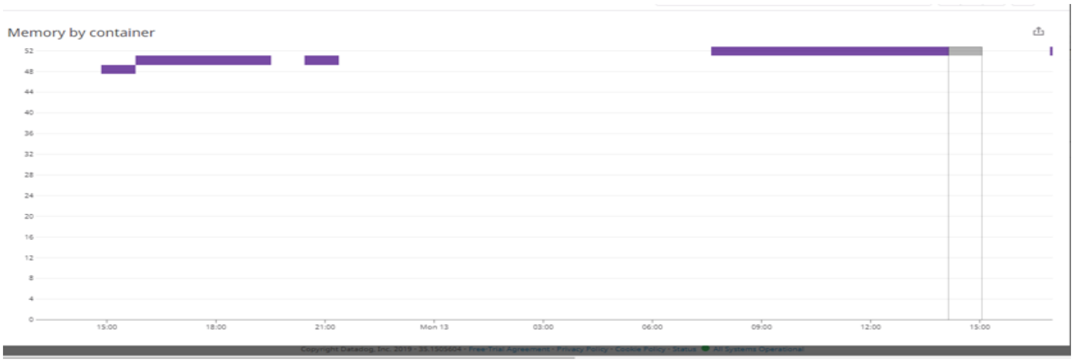
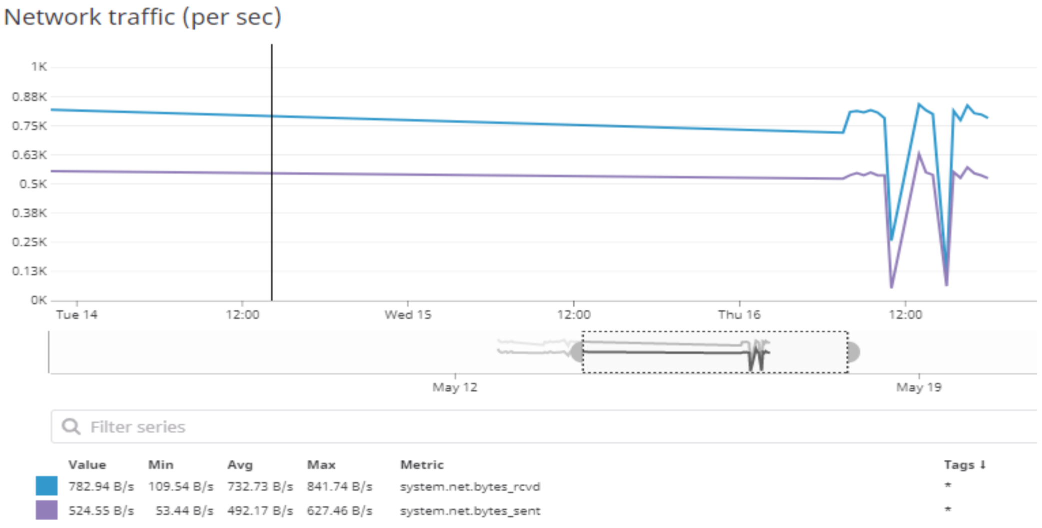


Figure 3: Container Memory Utilization

Network:

System I/O is also very important as it monitors the total load variations in the system. It is divided into two main parts to input traffic i.e. user request and system output in the form of user response. As our research work is done on personal computer that's why traffic load was not so high. Following are use case scenario showings an average overview of system traffic bytes sent and received.



	Value	Min	Avg	Max	Metric	Tags ↓
🟦	782.94 B/s	109.54 B/s	732.73 B/s	841.74 B/s	system.net.bytes_rcvd	*
🟪	524.55 B/s	53.44 B/s	492.17 B/s	627.46 B/s	system.net.bytes_sent	*

Figure 4: Network Load

CPU Usage:

CPU usage in a system is considered as the trademark for how well the system is showing benefit of processor, if CPU is idle most of the time that means system efficiency is poor and vice versa. The term CPU percentage directly relate the current working of the processor. For example, if the CPU usage percentage is 100% it means system is working at its best in that current working time period. But yes the thought of diversity of workload can't be ignored in it. So, maximum CPU usage is a sign of a good system working. In this scenario, performance of container is better on average than that of VM based virtualization. It can be observed by both of these graphs provided. On average trail system is working better over a period of 14 days. This observation was for one-hour network traffic and workload was also low. Table 1 shows that Dog CPU-usage percentage varies from 0.53% to 31.6% and on average it was 6.24%. On the other hand VM-virtualization wasted a lot of time in context switching from host to native server on average that is observed in my created environment it is 4.72%on average.

Table 1: CPU Usage

Number	Technology	Avg percentage	Min percentage	Max percentage
1	Containerization	6.24%	.53%	31.6%
2	Virtualization	4.72%	.37%	27.54%

Following are the relative graphs shown in result of simulation. Fig 5 shows results of Azure-Microsoft dashboard. In which x-axis shows time duration and y-axis percentage of CPU utilization over a specific time period.

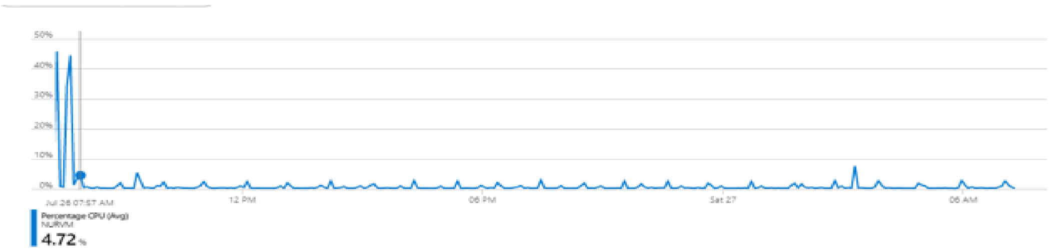


Figure 5: VM_CPU Usage

Fig 6 shows results of container based experiment on average usage of CPU. This result was taken by data dog dashboard which we set for container work monitoring in our system by creating an agent. This graph has time along x-axis and percentage on y-axis.

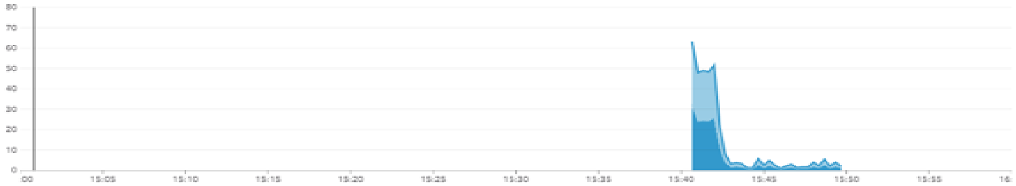


Figure 6: Container_CPU usage

An ideal system used maximum resources and from table and graph it is clear that containers utilize CPU as other part of system also use resources in spite of that idle one situation happens in case of virtual machines.

System Latency:

In cloud computing latency means the delay of response between service provider and client request. In other words it means how much a system is efficient to deal with system load during resource providing. It directly relates to elasticity of a system as main topic of our research. Latency of a system depicts the need of vertical or horizontal scaling according to the need and demand of user requests. [26] Elasticity is directly proportional to the latency. A system is more elastic if it can handle requests rapidly. We observed in detail how docker reduces time as it removes an abstract layer of virtual machine. That is an extra overhead and load to native kernel machine. It also removes many dependencies.[33] It can be seen by following results shown in Table 2 latency change from 20msto 56ms, while at docker it varies from 10ms to 44ms.

Table 2: System Latency

Number	Technology	Avg Time	Min Time	Max Time
1	Containerization	44ms	15ms	49ms
2	Virtualization	48ms	20ms	56ms

Finally, it is clear that docker based virtualization is more elastic than that of VM. Difference is smaller as it has less network flow on PC, whereby large-scale difference is quite impressing. Following are graphs that shows result of dashboard of both Microsoft-Azure and datadog dashboard having time duration of observation along x-axis and response time of system along y-axis.

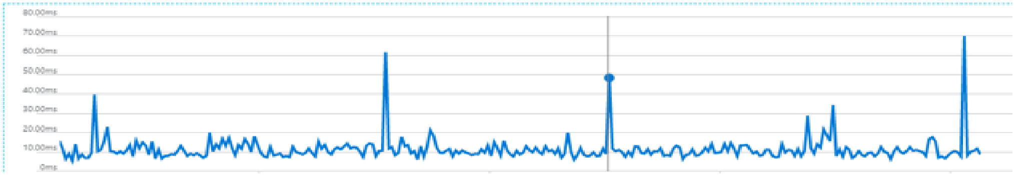


Figure 7: VM- System Latency

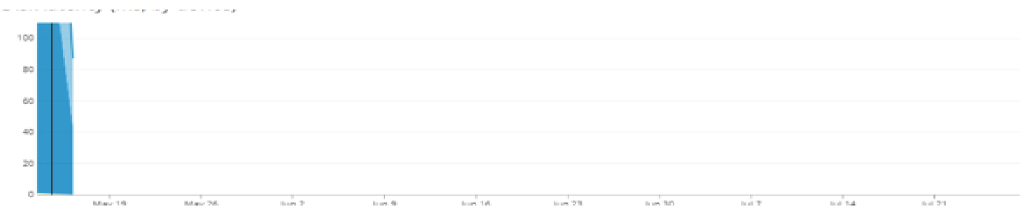


Figure 8: Container-System Latency

From Table 2 and Fig 7, 8 it is clear that response time of container based technology is short as a result elasticity of system improves.

Conclusion:

As we discussed, that the worth of a cloud infrastructure elasticity is very much important. There are many methods to improve elasticity one of them is hardware virtualization. Traditionally, it has only one method that was to create virtual machines over host machine but from some past decades a new technology gained much importance i.e., containerization etc. The main point of our thesis was to prove that using docker technology we can enhance elasticity of a cloud. Docker is a tool for creating containers in host server that diminishes an extra layer in server during resource provisioning and de-provisioning. It improves response time of system. Elasticity is main measure in cloud industry. You can refer it as a key point for checking integrity of a system. In our research we proved that a new technology that is flourishing so rapidly directly affects elasticity. Whenever response time improves, users request fulfilled faster. For this we use docker technology which doesn't create an extra layer over kernel and works like in a same OS which removes many dependencies and overhead. Which increases the response time? In future, we hope to apply docker technology for more improvement in cloud infrastructure, and security improvement which is still an open question in industry. Although container uses a whole separate group, for handling processes but there are some open issues still need to be discussed. Moreover, we hope to check more parameters on the basis of docker container for cloud improvement when system load change on a large scale, I/O control etc.

Acknowledgement: We all acknowledge our parents for supporting us throughout.

Author's Contribution: All authors contributed equally in this research.

Conflict **of interest:** We declare no conflict of interest for publishing this manuscript in IJIST.

Reference:

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ISSN : 2618-1630

Investigation of Surface Deformation in Lower Jehlum Valley and Eastern Potwar using SRTM DEM

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Citation | Firdous M, Ali A, Tanveer M.U, Munawar R.K, Rehman U. S, Aslam. I, Tanveer G, Mahmood S.A. "*Investigation of Surface Deformation in Lower Jehlum Valley and Eastern Potwar using SRTM DEM*". International Journal of Innovations in Science and Technology, Vol 02 Issue 01: pp 17-30, 2020.

DOI: https://doi.org/10.33411/IJIST/2020020102

Received | December 01, 2019; Revised | December 23, 2019; Accepted | December 25, 2019; Published | January 03, 2020

Abstract.

This study describes the surface deformation in lower Jehlum and eastern Potwar using remotely sensed Shutter Radar Topographic Mission (SRTM) Digital Elevation Model (DEM) to identify regional uplift rates. Mapping of active surface deformations help to predict seismic hazards. DEMs are the fundamental input factors that identify the surface geometry and its belongings. These belongings include stream Offset, elevation, and slope breaks within a contributing area. This study provides an evidence of tectonic activity and its impact on regional drainage network using SRTM DEM. Various indices including concavity and steepness were computed using power law in steady state conditions. We prepared the drainage network map of the study site showing uplift rates in mm/year. The deflection in stream network proves the existence of active fault in this region which controls the local drainage network. The results prove the relative uplift along Main Boundary Thurst (MBT) and the impact of active tectonic on evolving young organs.

Keywords: SRTM, DEM, MBT, Indices Power Law, Deformations

Introduction.

The controls on tectonic structures in a hilly area are technically sound regarding horizontal translations, rock uplift, bed rock erosion, climatic variations and the development of incised structures [1]. River pattern demonstrates multiple forces in action e.g. river geometry is useful to identify the spatial patterns of uplift in variouscases [2]. Longitudinal river profile can retort to climate by erosional and hydrological situations and also affected by orographic precipitations [3,4].

Lithology is a fundamental element which defines the concavity of the river[5]. Lithology of a river describes the rate of erosion and incision. This study describes the neo-tectonics in the investigation site e.g. faults in eastern Potwar and the stream interactions. It is based on remotely sensed analysis of tectonic activity and its impactson regional surface deformations. Digital Elevation Model (DEM) is used here to define the surface geometry in details.

Tectonic movement along fault is characterized by various features including stream offset, elevation, moraines, landslides, slope breaks, fluvial terraces and the drainage zone. We performed the stream profile analysis to compute surface deformation in the study site. Stream analysis is important to draw stream network and their characteristics in the study site. This analysis is useful to study tectonic activity indirectly.

This study aim at computing steepness, and concavity which is helpful to compute the uplift rates. It also aims at investigating the impacts of Muzaffarabad earthquake 2005 in Pakistan.

Study Site and Tectonic Settings

The study site lies between 73-74E longitude and 33-34N latitude. A part of Main Boundary Thurst (MBT) is lying underneath the study site in the northwest direction. Various structural styles are located underneath the study site e.g. Riasi and Kotli Thurst is in SE-NW oriented and the Jehlum fault is also in the same orientation. Another fault "Rawat" is oriented in SW-NE direction. The lineaments and out crops are right angle to the direction of transportation at a rate of 17-19 mm/year [6]. Thestudy site is mapped in the figure 1:

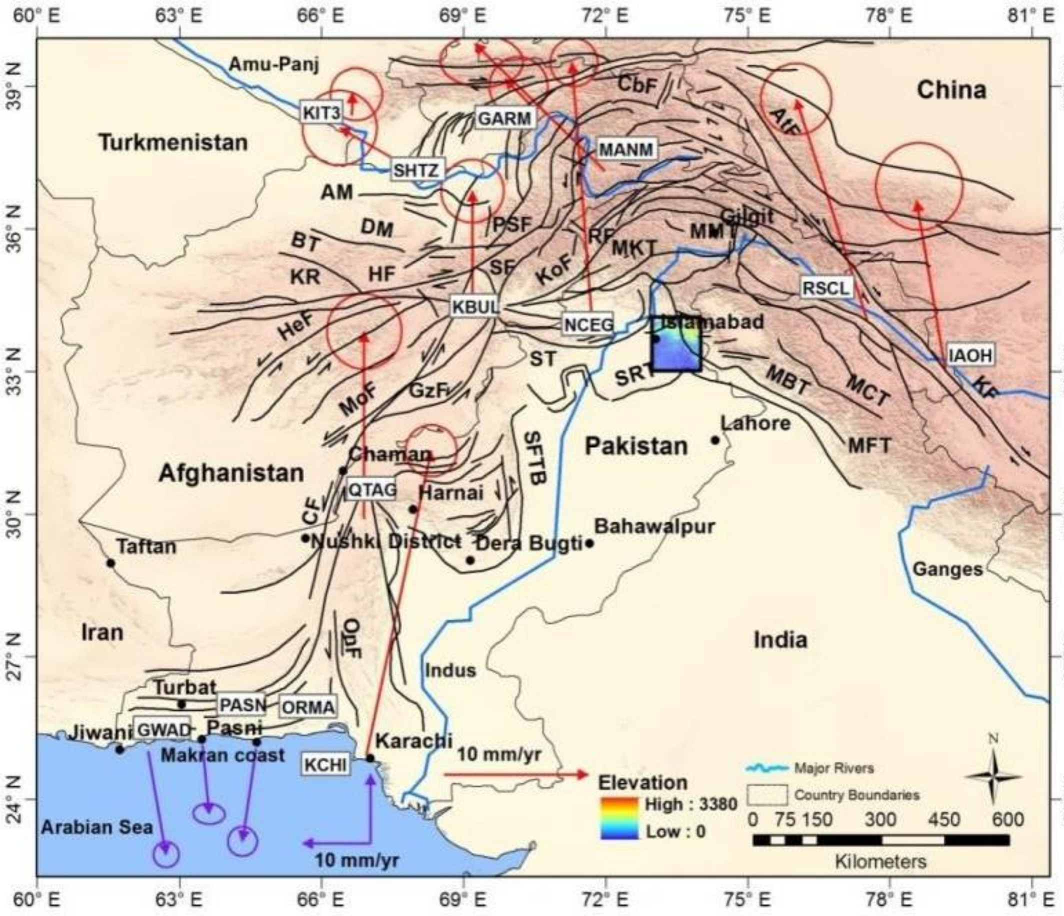

Figure 1. Tectonic map of the Hindu Kush-Himalaya-Pamirs-Karakoram showing reported and newly confirmed faults with inset showing the study area.

Figure 2 is showing that topography is more heave in NE part in comparison to southern part.

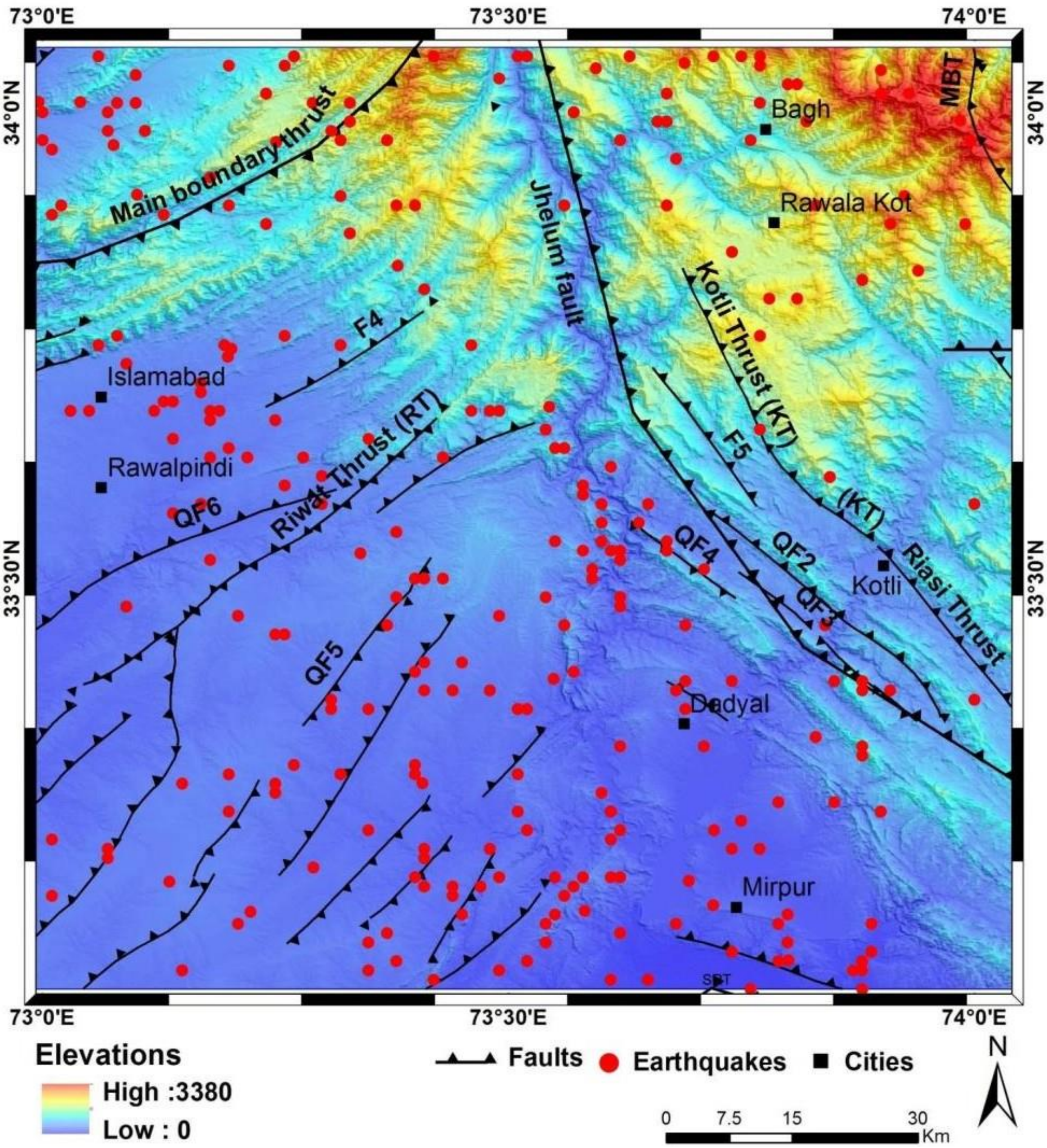

Figure 2. Location of study area with earthquakes locations in red and thick black lines represent thrust faulting with teeth symbols showing direction of thrust movements.

Data and Methods

SRTM Digital elevation model (DEM) is used in this study to extractdrainage network and to compute steepness, slope, and concavity.

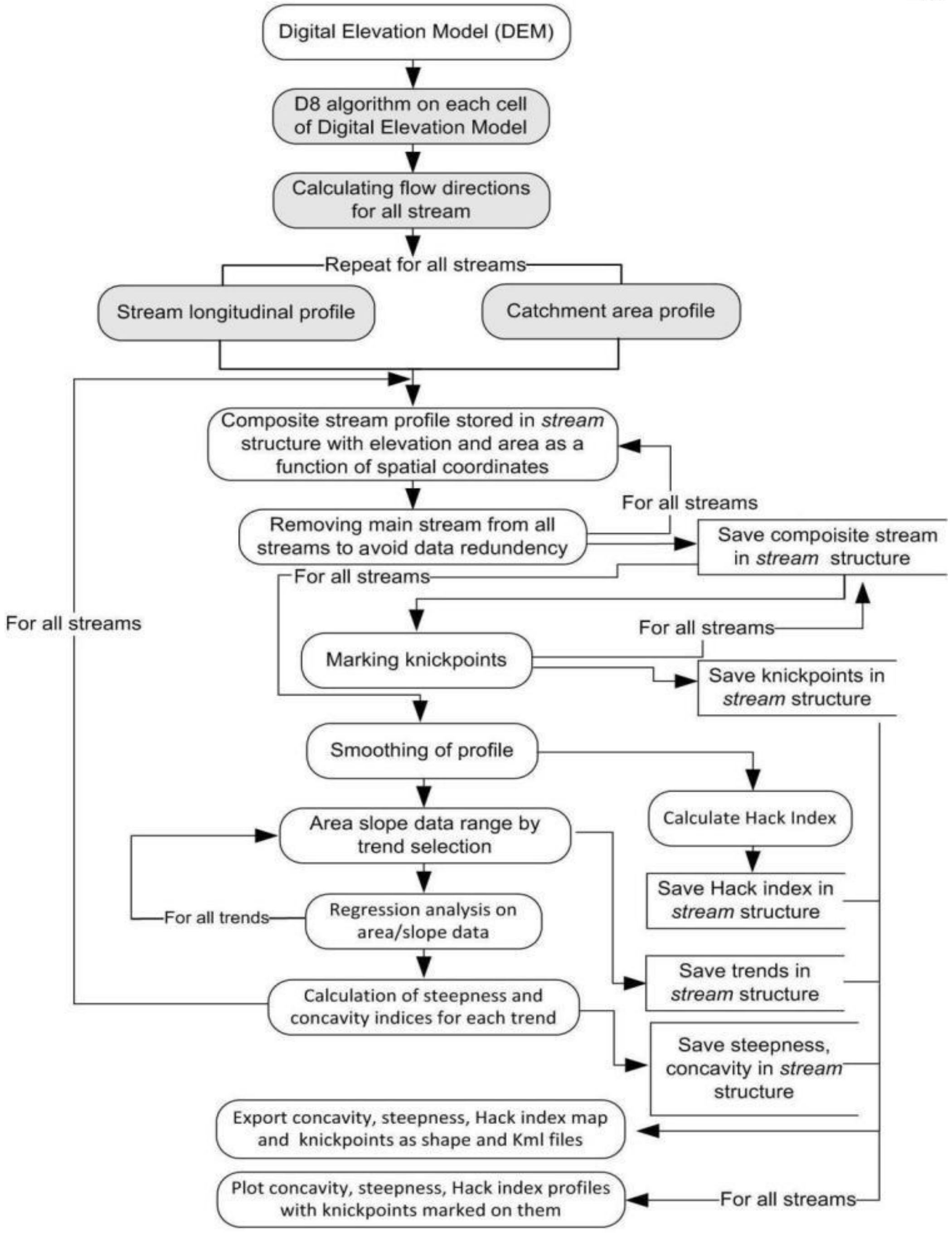
Digital Elevation Model (DEM)
D8 algorithm on each cell of Digital Elevation Model
Calculating flow directions for all stream
Repeat for all streams
Stream longitudinal profile
Catchment area profile
Composite stream profile stored in *stream* structure with elevation and area as a function of spatial coordinates
For all streams
Removing main stream from all streams to avoid data redundency
Save compoisite stream in *stream* structure
For all streams
For all streams
For all streams
Marking knickpoints
Save knickpoints in *stream* structure
Smoothing of profile
Calculate Hack Index
Area slope data range by trend selection
Save Hack index in *stream* structure
For all trends
Regression analysis on area/slope data
Save trends in *stream* structure
Calculation of steepness and concavity indices for each trend
Save steepness, concavity in *stream* structure
Export concavity, steepness, Hack index map and knickpoints as shape and Kml files
Plot concavity, steepness, Hack index profiles with knickpoints marked on them
For all streams

Figure 3. Flow chart showing various algorithms implemented during SRTM DEM processing.

DEM based Drainage Extractions

D8 algorithm is commonly and mostly used algorithm to compute flow direction, accumulation, stream definition, stream segmentations, catchment grid delineation, catchment polygon processing and the drainage line processing. A depression less DEM is required as basic input to compute the flow direction. We used the built-in utility in Arc GIS 10.1. "Fill" to generate a depression DEM. This algorithm check depressions pixel by pixel and fill them by interpolating nearby pixel. To compute "flow direction", the elevation of central cell is compared with its eight surrounding cells and the direction leads to the cell having lowest elevation. In the proceeding step, flow is accumulated to define streams. The density of streams in drainage network is defined depending upon user's requirement. If user need high stream density, a small number of cells is given in input and vice versa. In the next step, streams are segmented by connecting points to define the stream order. The stream order is useful to compute catchments areas and to draw drainage network in vector format. The river was demarcated in the drainage network using river tool 2.4.

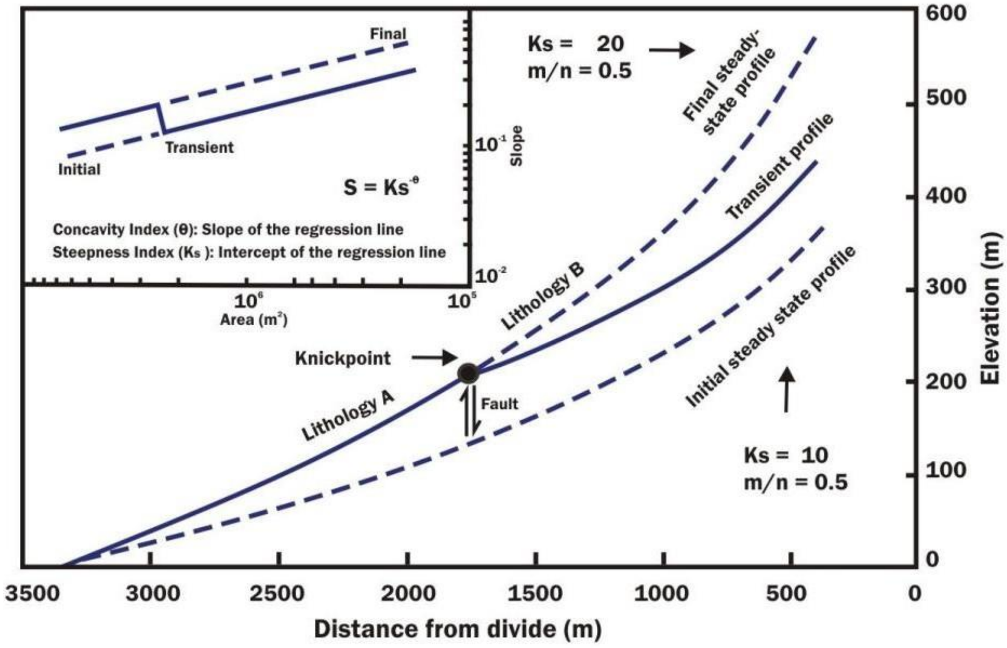

Figure 4. The diagram showing mechanism of River profile development, modified fromSnyder et al (2000).

Concavity and Steepness Indices

In a diverse topography, the DEM shows scaling, where the stream's slope is expressed by a function of Stream power law (SPL) [7,8] which is defined with formula as below

$$s = ks\ A - \theta$$

Where A is the drainage area of upstream, θ and ks are concavity and steepness indices respectively, and "s" is the slope of particular channel. Index of concavity (IOC) is represented by$\boldsymbol{\theta}$.

Results and Discussion

A consistency was not observed in stream river channels due to diverse neo-tectonic activities in NE and NNE parts of the study site. The pattern of spatially distributed stream channels represents local deviations in thurst belts. The information of stream profiles had detailed information of neo-tectonics signals.

The inconsistency in drainage profiles demonstrates the variation in uplift rates in thestudy site. As shown in figure 5.

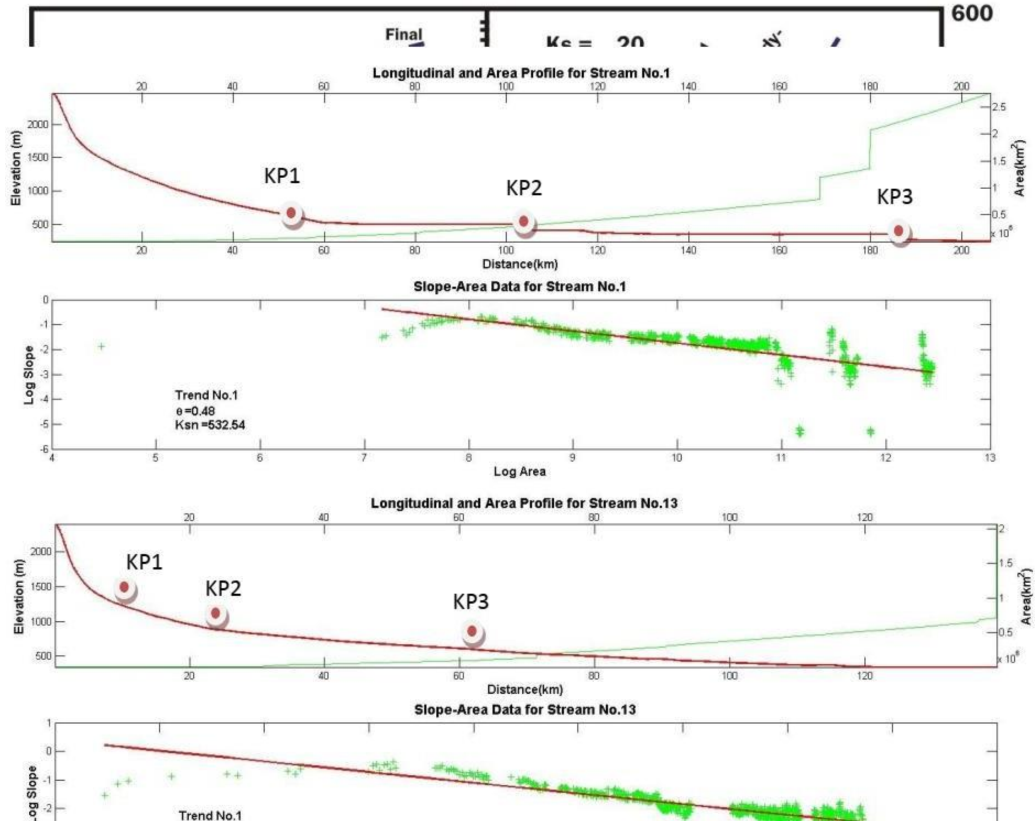

Figure 5. River profile analysis for the Jhelum and Poonch Rivers, three knickpoints are identifiable.

In a watercourse, a change within two index of steepness (IOS) is generally connected by a higher or lower index of concavity (IOC) value. However, IOC is comparable to early and ultimate profiles of drainage network [9]. The lower value of IOC describes the variability in rock strength. The degree of roughness in knick point, describes the tectonic events, and lithological disparity or stream capture events.

A sharp knick zone is an indication of most recent tectonic activity [10]. The stream no: 1 in figure 5 of Jehlum river profile shows the IOS value=532.54 and IOC=0.48. These values define that area corresponding to stream 1 is less eroded and is in uplifting process. KP1 describes Kotli Thurst (KT), KP2 represents Quaternary Fault (QF2), and KP3 indicates the interaction of Ponch river with Quaternary Fault (QF3). KP1 and KP2 is related to intersection of Jehlum Fault (JF) with Jehlum River KP3 is under the influence of QF3 in north of Mirpur which proves that Jehlum River is under the influence of JF.

The sudden variations in geomorphic expressions of stream profiles describes variations in horizontal or vertical tectonic movements in lithological contrasts, high values of Hack Gradient Index (HGI) were observed in NE and NW part of the study site as shown in figure 6, because IOS values are in direct relation to Relative Uplift Rates (RURs).

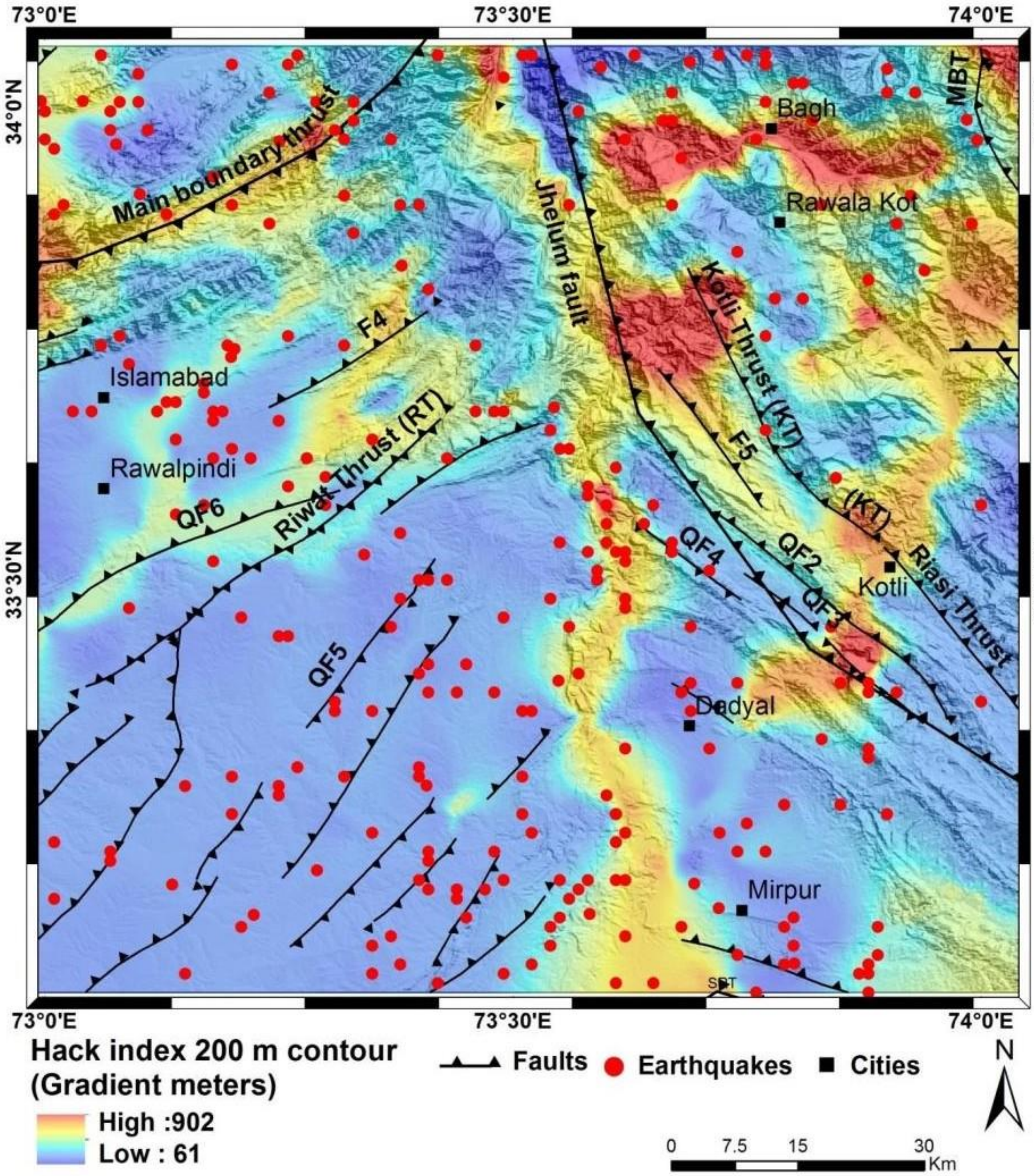

Figure 6. The interpolated Hack SL-gradient map for the study area.

We extracted 109 streams using SRTM DEM and computed IOS and IOC values as shown in figure 7 and figure 8 and applied geomorphic indices using stream power law (SPL) to all streams.

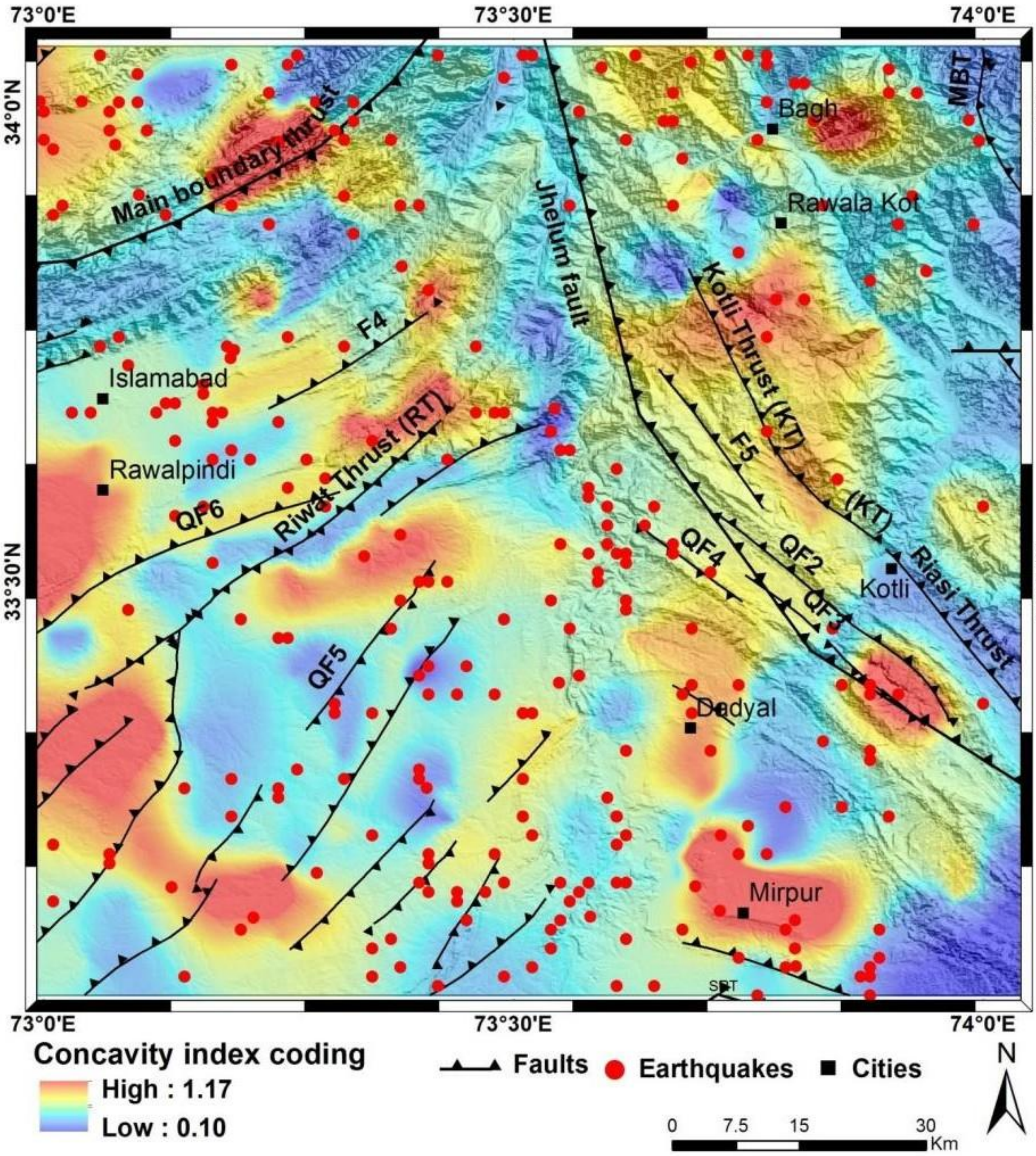

Figure 7. The interpolated IOC map of the study area.

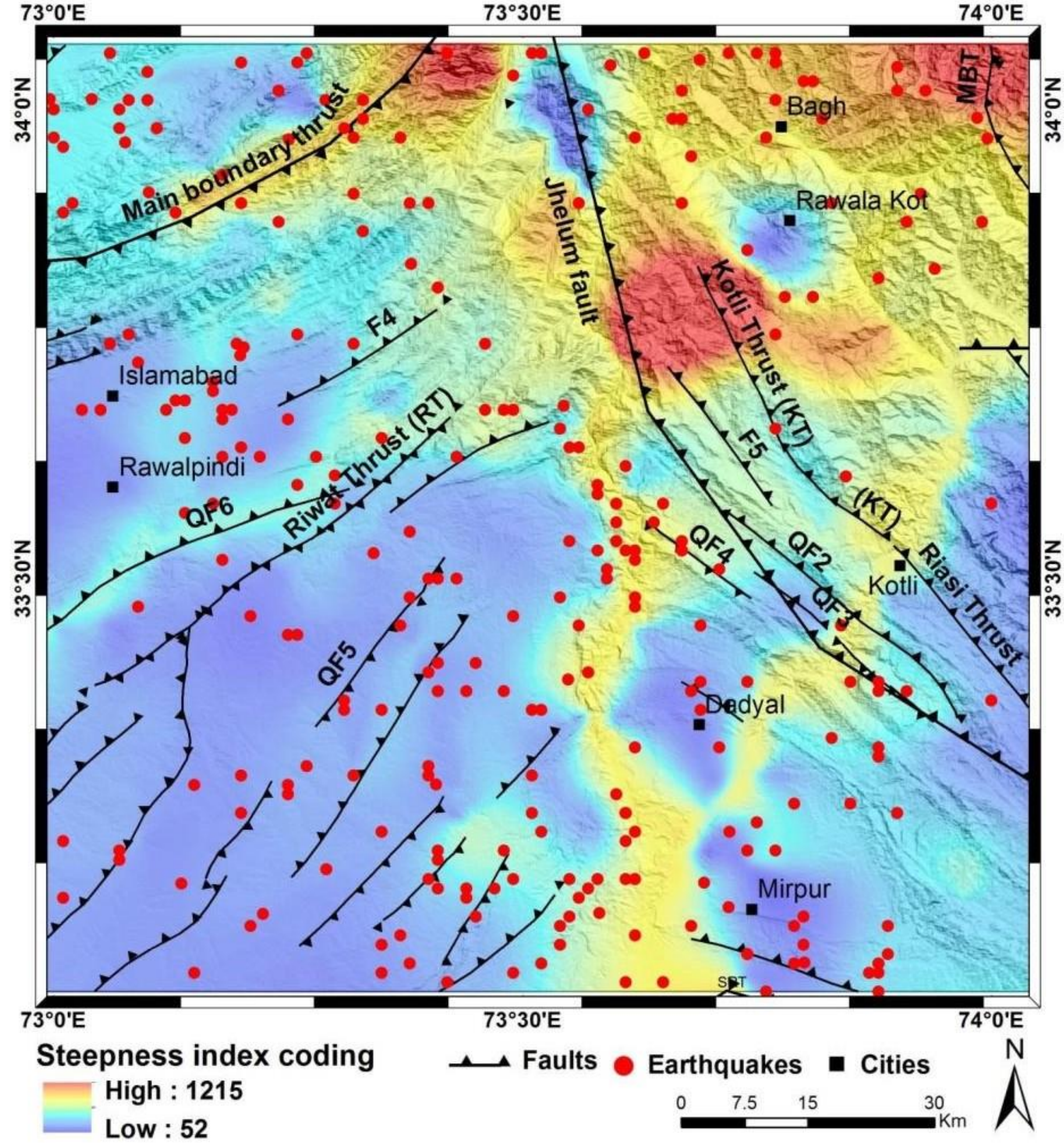

Figure 8. The interpolated IOS map of the study area

A relative uplift note map was generated for the study site in Mat lab environment. The RUR map show a diversity in uplift rates in various parts of the study site.

RURs is between 0.53-1.21 mm/year in NNE of the study site while RURs were observed between 0.05-0.51 mm/year as shown in figure 9. These rates were between 0.06-0.36 mm/year in the southern section.

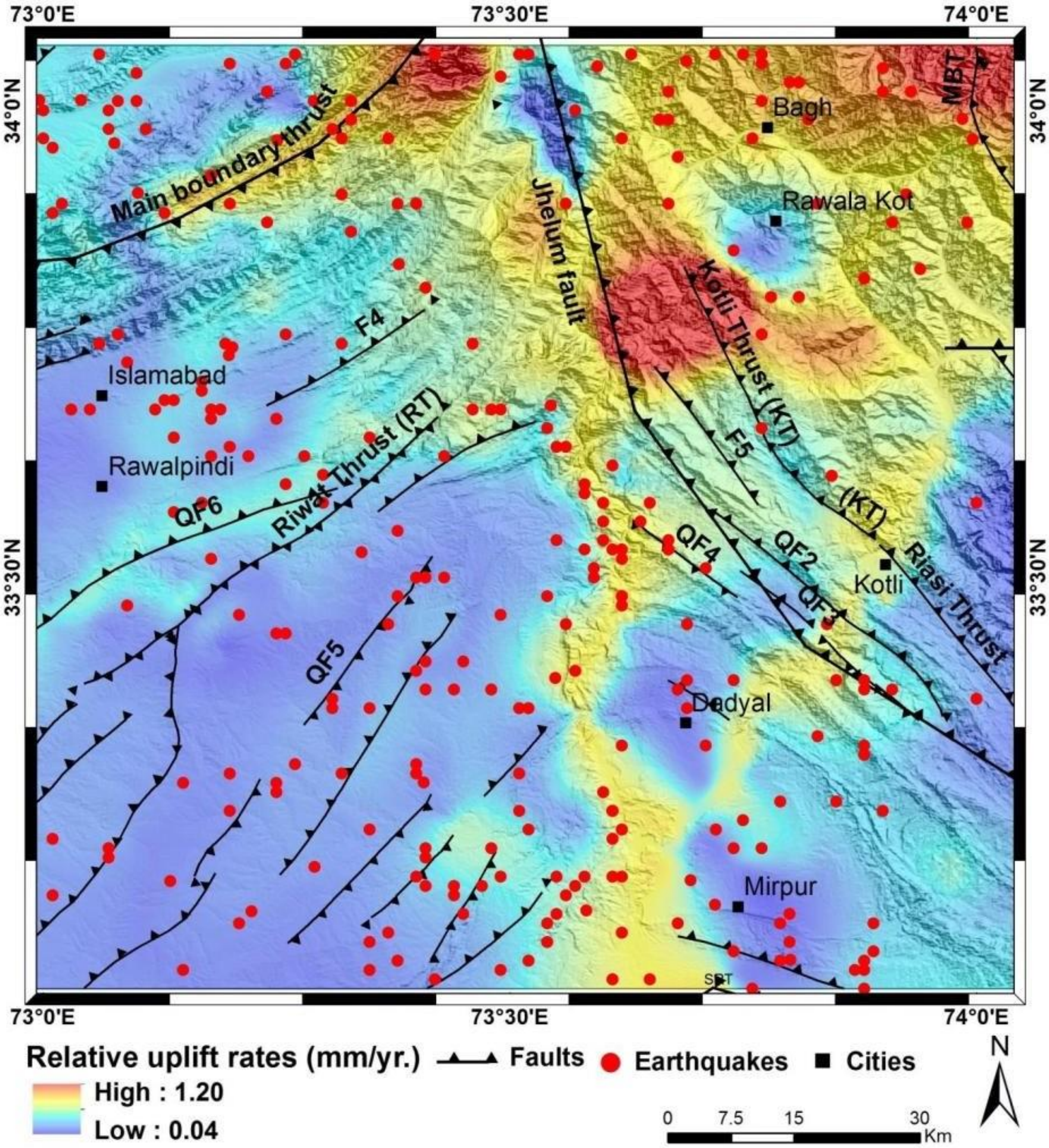

Figure 9. Map showing RURs of the study area.

These rates clearly describe that the NNE region of study site is more uplifted in comparison to SW part.

The highest value of RURs was observed near to MBT between JF and KT. This research indicates that the flow direction and the orientations of streams is influenced by local and regional faults.

Most of Jehlum River is controlled by JF and some of its path is under lithological control which again run under Mangla fault upto Mangla reseruior. Local and lineaments are responsible for growth and development of spatial drainage distribution at local scale.

Conclusion

The automated drainage network extracted using SRTM DEM is significant to investigate SPL which provides information regarding active surface deformation and the topographic development in a study site. Geomorphic indices of Poonch and Jehlum River are important to examine the surface activity across a study area. This study reveals that geomorphometric features are effective indicator to study neo- tectonics in young topographies with variable uplift rates.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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ISSN : 2618-1630

SYNTHESIS OF NiO/ZnO NANOCOMPOSITES IN ETHYLENE GLYCOL

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Citation | Hussain T, Sajjad B, Ali U, Nadeem A, Noor L and Farrukh M A "Synthesis of Nio/Zno Nanocomposites in Ethylene Glycol". International Journal of Innovations in Science and Technology, Vol 02 Issue 01: pp 31-37.
DOI: https://doi.org/10.33411/IJIST/2020020103
Received | January 03, 2020; Revised | February 14, 2020; Accepted | February 23, 2020; Published | March 04, 2020

Abstract.

The availability of water has become a serious concern globally, therefore, it is a need to use wastewater by its treatment. This treated water can be used in various sectors e.g., agriculture, leather industry, textile industry and in chemical reactors etc. The oxides of semiconductor nanoparticles are effective catalyst which are used in wastewater treatment. Ethylene glycol is used in sol-gel method to synthesize NiO/ZnO nanocomposites. ZnCl2 along with NiCl2.6H2O were used as precursors during synthetization of NiO/ZnO nanocomposites. We used various techniques such as Thermogravimetric Analysis (TGA), Differential Scanning Calorimetry (DSC), Fourier Transform Infrared Spectroscopy (FTIR) and particle size analysis for synthesis of the nanocomposites which confirm that these nanocomposites act as catalyst.

KEYWORDS: Sol-gel method, Methylene blue, photo catalyst, Nano composites

Introduction

The availability of water has become a serious concern globally, because most of diseases are water borne. This concern leads the researchers to make proper treatment of wastewater. This treatment must be cost effective enough so that it can be used at large scale. The major benefit of recycled water is to save huge amount of pure water by reusing recycled water in agriculture, textileand in other industries. The oxides of semiconductor nanoparticles are effective catalyst which are used in wastewater treatment [1].

Zinc Oxide is n-type in nature which has a band gap of 3.2ev. ZnO has unique characteristics such as nontoxicity, photo catalytic activity, quantum efficiency, photosensitivity and the low cost [2]. It has micro-structural benefits due to which it is used in many devices e.g., gas sensors, Light Emitting Diodes (LEDs), Field Effect Transistors (FETs), Piezoelectric devices and the solar cells. Many researchers proved that ZnO is used as photo-catalytic for degradationof organic pollutants. Coupling of different semiconductors having variable energy levels haveincreased their functional properties as reported by many researchers [2, 3, 4, 5]. The integration of two semiconductor oxides having different polarity such as n-type and p-type results in P-N junction and generates the effective electron pair.

Nickle oxide is p-type semiconductor having a band gap of 3.5-4.0ev. It has a number of applications in catalysis, chemical sensors, magnetic materials, electro chromic films, photovoltaic devices, and gas sensing instruments [3].

This study aims at synthesizing NiO/ZnO nanocomposites using ethylene glycol and involves the use of NiO/ZnO nanoparticles for photo-degradation of methylene blue in visible spectrum.

Materials and methods:

Nickel chloride hexahydrate, sodium hydro oxide and methylene blue were acquired from sigma Aldrich, zinc chloride from Riedl-de Haen and Ethanol from labscan.

Preparation of NiO/ZnO nanocomposites:

About 0.013g zinc chloride and 0.024g of nickel chloride hexahydrate was dissolved in 10 ml ethylene glycol. This solution was stirred for 20 minutes at room temperature to make it homogenous. About 20ml deionized water was added in 0.034g NaOH.

$ZnCl_2$ and $NiCl_2.6H_2O$ solution was shacked and the NaOH solution was added at 0.3ml/5 minutes up to the level when the pH of the solution was raised up to 9. This solution was centrifuged at 12500rmp up to 2 minutes. The precipitates were put in oven for the whole night and calcined at a temperature of 450°C up to 2 hours to get oxides out of hydroxides as expression below:

$$\mathbf{NiCl_2.6H_2O + ZnCl_2 + 4NaOH \ \square \ 4NaCl + Ni(OH)_2 + Zn(OH)_2 + 6H_2O}$$

$$\mathbf{Ni^{2+} + Zn^{2+} + 4OH^{-} \square \ Ni(OH)_2 + Zn(OH)_2}$$

Figure 1 is showing the sequential flow of study to make nanocomposites of NiO/ZnO.

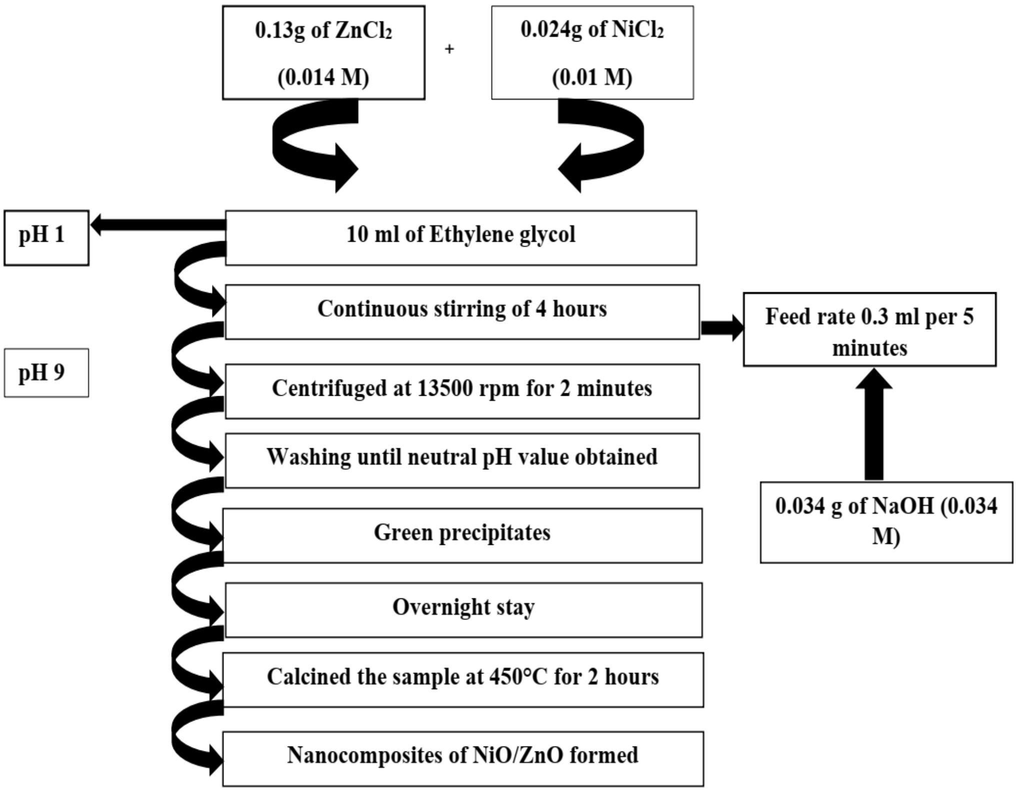
0.13g of ZnCl₂
(0.014 M)
+
0.024g of NiCl₂
(0.01 M)
pH 1
10 ml of Ethylene glycol
Continuous stirring of 4 hours
Feed rate 0.3 ml per 5 minutes
pH 9
Centrifuged at 13500 rpm for 2 minutes
Washing until neutral pH value obtained
0.034 g of NaOH (0.034 M)
Green precipitates
Overnight stay
Calcined the sample at 450°C for 2 hours
Nanocomposites of NiO/ZnO formed

Figure 1 Scheme of NiO/ZnO Nanocomposite Preparation

Dye degradation:

About 100ppm of Methylene blue solution was taken as stock solution. A 20ml was taken out of stock solution into volumetric flask and mixed with 80ml of distilled water. A 20ml of solution was put into the beaker from 20ppm solution and a quantity of 10mg NiO/ZnO nanocomposites were taken in the same beaker and stirred for 1 hour.

This solution was passed through ultraviolet visible spectrophotometer to examine the maximum wavelength of methylene blue. The absorption capacity was checked using ultraviolet visible spectrophotometer at 659nm for a duration of 15 minutes. Figure 2 is describing the step- by-step flow of dye degradation.

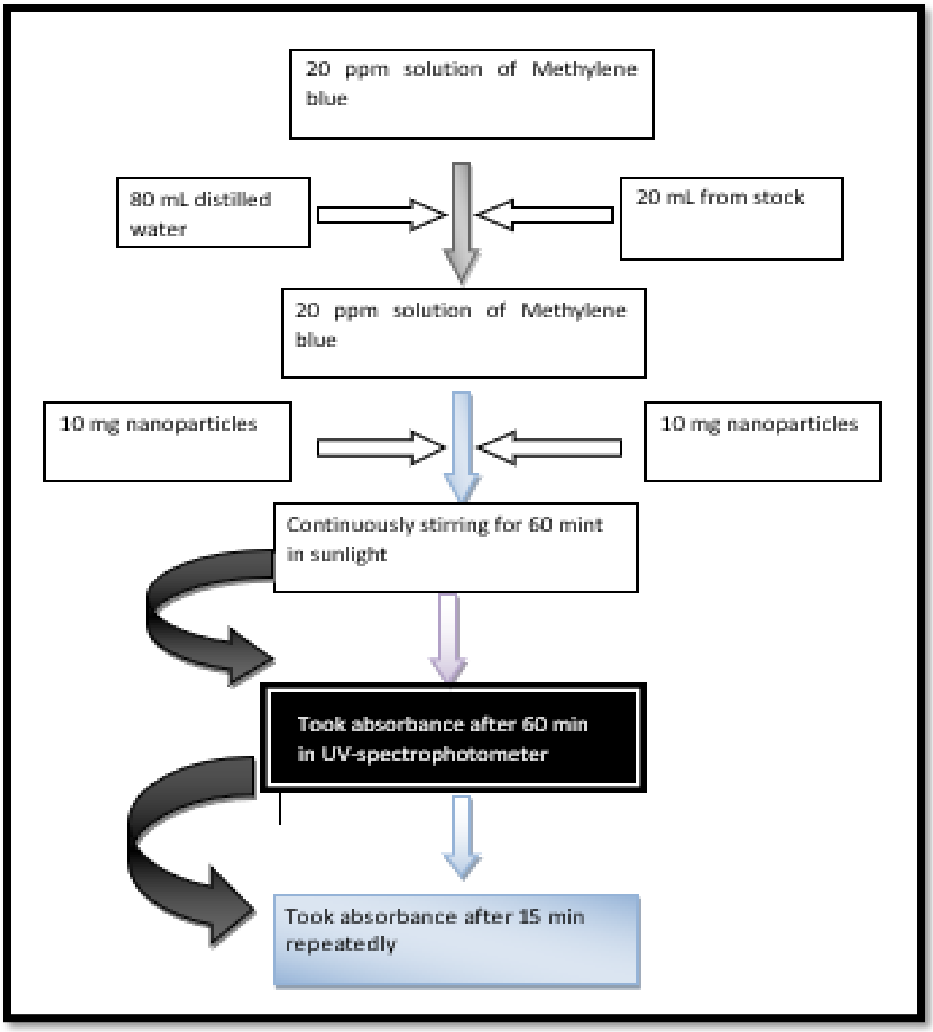
20 ppm solution of Methylene blue
80 mL distilled water
20 mL from stock
20 ppm solution of Methylene blue
10 mg nanoparticles
10 mg nanoparticles
Continuously stirring for 60 mint in sunlight
Took absorbance after 60 min in UV-spectrophotometer
Took absorbance after 15 min repeatedly

Figure 2 Degradation of Methylene blue using NiO/ZnO nanocomposites

Results and discussion:

Thermo Gravimetric Analysis (TGA).

TGA analysis reveal that the curve moved steep till it became flat in shpae as shown in Figure 3. In thermogram, molecules of water which were adsorbed till it became horizontal at the temperature of 500 °C. Water molecules which were adsorbed, then dehydrated below the temperature of 120 °C. Overall loss was about 9% which was about 17.28 gmol$^{-1.}$ This change might be due to the loss of water molecules that were adsorbed upon the surface of nanocomposits.

The second loss which was observed at the temperature of 135 °C to 230 °C which was about 6% having a mass of about 11.52 gmol^{-1}. This loss might be obtained by the disintegrationof solvents and the residues of ash.

The third loss was observed between a temperature range 250°C to 330°C which was about 18%. It represented the changing of hydroxides to the oxides by losing two molecules of water. It was observed no change in weight beyond a temperature of 550°C. This no change confirms the presence of ZnO nanoparticles. Same results were recorded by various researchers at various temperature ranges [4, 5, 6, 7, 8].

Differential Scanning Calorimetry (DSC).

The reference and the sample materials were exposed to a furnace and the changes were observed in both materials. We observed two peaks in DSC. The first peak represents the de-hydration of nickel hydro-oxide Ni $(OH)_2$ at a temperature 270°C and the other one was observed at a temperature 420°C which is proof of existence of zinc hydro-oxide as shown in Figure 3.

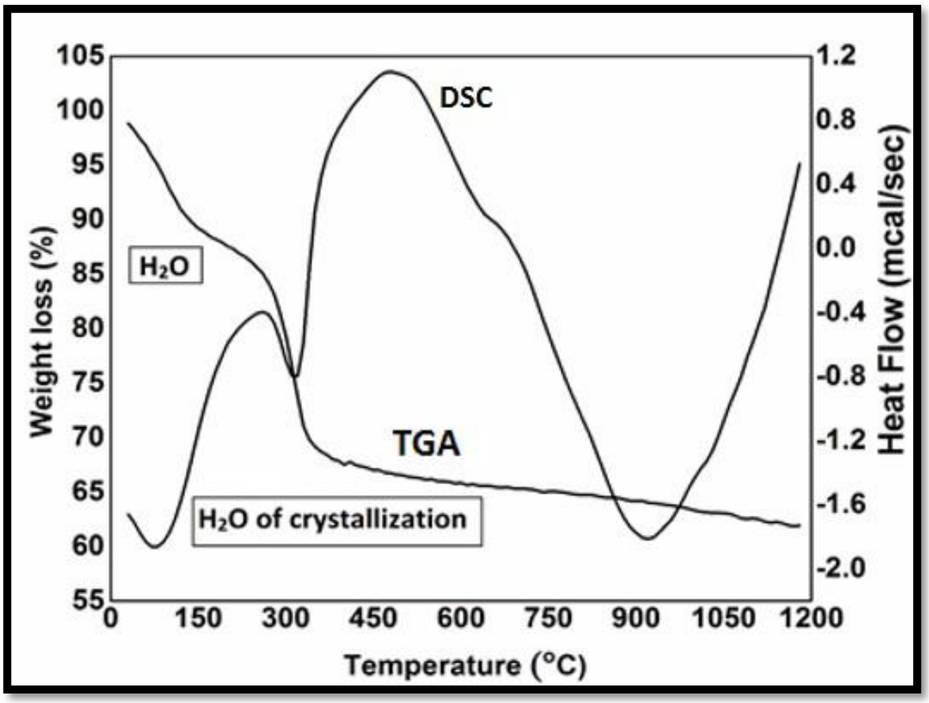

Figure 3. DSC curve of NiO/ZnO nanoparticles using Ethanol as a solvent

Particle size Analysis:

The particles within a range of (1-100nm) are known as nanoparticles. Bt-90 was analyzer which used to determine the particle size. The particle size was estimated after 1 hour during synthesis. After one hour, the particle size was about 165nm having surface area 15.11m^2/g. The particle size was computed as 135nm after two hours having surface area 19.32m^2/g. After three and four hours the particle size was declined to 75nm to 55nm and the surface area was increased from 25.67m^2/g to 37.21m^2/g respectively as shown in table 1 and Figure 4.

Table.1. Particle size and surface area of nanoparticles.

Sr. No.	Time (Hour)	Particle size (nm)	Surface area (m^2/g)
1	1	165	15.11
2	2	135	19.32
3	3	75	25.67
4	4	55	37.21

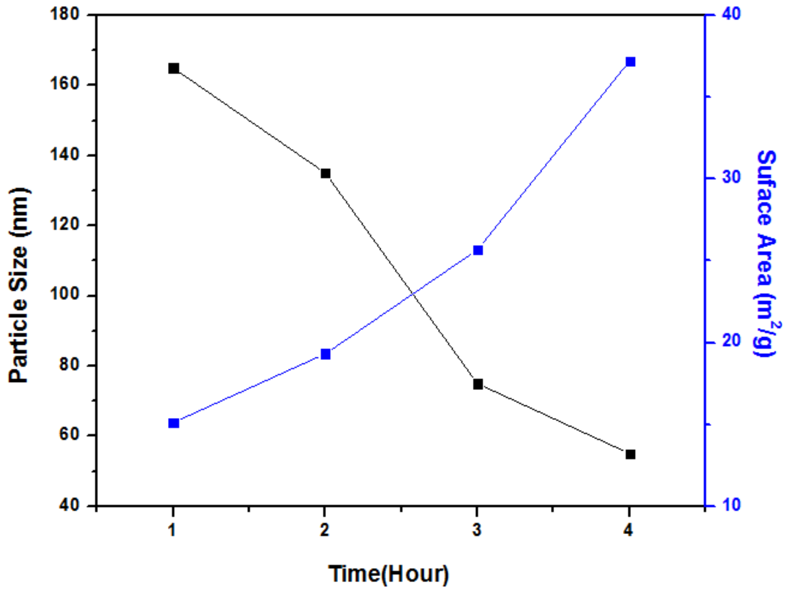

Figure 4. Relationship between Particle size and Specific surface area with respect to time.

Fourier Transform Infrared Spectroscopy (FTIS).

FTIR spectra was used to confirm the existence of functional groups in nanoparticles that generated a curve as showing in Figure 5. A dip was observed at 3475cm^{-1} which determine the existence of O-H functional group. Another dip was observed at 1631cm^{-1} which might be due to the movement of water molecules in curvature according to researches [9, 10, 11]. Another dip was observed at 1416cm^{-1} which show asymmetric stretching of C=O according to researches [12]. The dip at 638cm^{-1} shows the vibrations of metal oxygen metal bond. The dip formed at 475 cm^{-1} represents the stretching of ZnO nanoparticles, which also confirm the existence of NiO nanoparticles according to research [13].

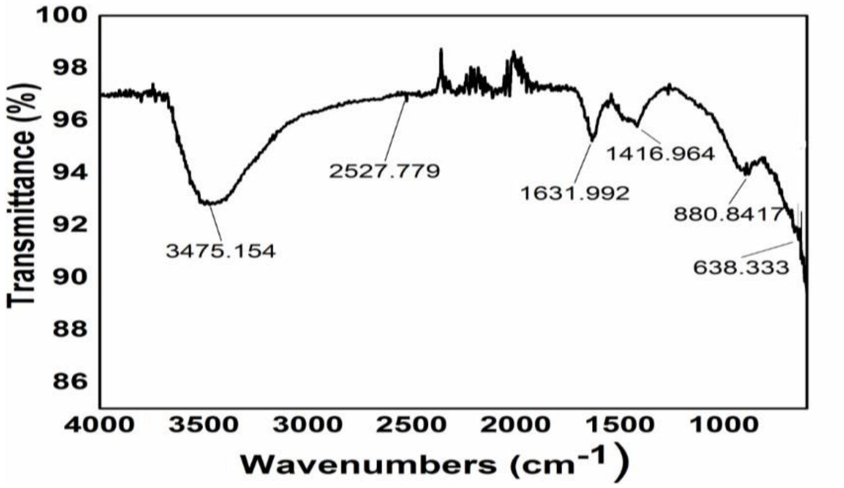

Figure 5 FTIR spectra of NiO/ZnO Nanocomposites

Degradation of Methylene Blue:

Methylene blue degradation was checked through NiO/ZnO nanocomposites using spectrophotometer and a curve was formed in Figure 6. The process was executed in sunlight and the absorption rate was computed for a duration of 15 minutes. It was observed that the absorption rate decreased with passage of time due to decline of methylene blue concentration as shown inTable 2.

Table.2. Photocatalysis data of 20ppm methylene blue

Sr. No.	Time (min)	Absorbance
1	Blank	2.986
2	0	2.809
3	15	2.683
4	30	2.370
5	45	2.114
6	60	1.927
7	75	1.781
8	90	1.630
9	105	1.471
10	120	1.302
11	135	1.231

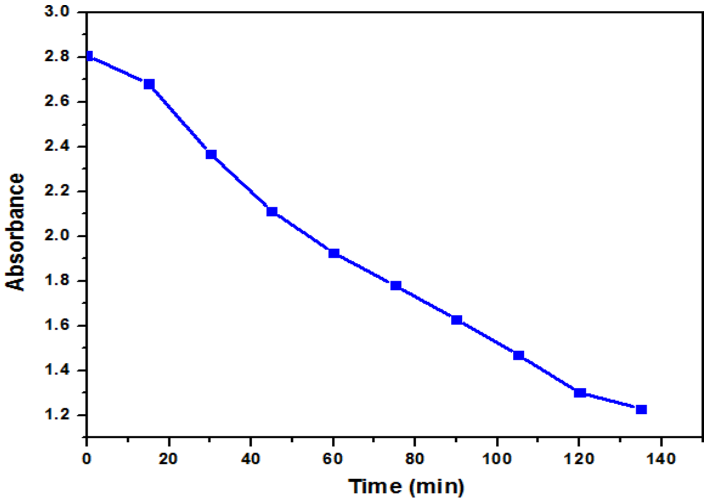

Figure 6. Methylene blue absorbance with respect to time.

Conclusion:

Sol-gel technique is efficient to determine the preparation rate of NiO/ZnO Nano-composites. Various characterization techniques such as DSC, Particle size analyzer, UV-Vis and FTIR were performed. TGA analysis confirm the weight loss up to 18% which confirms the existence of hydroxide nanocomposites. Particle size was confirmed by particle size analyzer. Peak at 475 cm^{-1} might be due to stretching vibrations of the nanoparticles of ZnO. The catalysis activity checked by degradation of methylene blue in the presence of sun light. It was observed that the concentration of the methylene blue decreased as the time of reaction passed. It confirmed the catalytic activity of the NiO/ZnO nanocomposites.

Acknowledgement. H. Tanzilla Hussain, Bakhtawar Sajjad, Umer Ali and Auswa Nadeem are sincerely thankful to Government College University and Muhammad Akhyar Farrukh for conducting this research.

Author's Contribution. All the authors contributed equally.

Conflict of interest. We declare no conflict of interest for publishing this manuscript in IJIST.

Project details. NIL

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