iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 4 **Issue:** VII **Month of publication:** July 2016

DOI:

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

Volume 4 Issue VI, June 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Bathymetry Mapping and morphometric characteristics demarcation of Lake Manasbal, Kashmir valley, India using Echo Sounder and Geospatial Technology

C.V. Nishikanth[1], S.Vasudevan, P. Balamurugan, R. Selvaganapathi
Department of Earth Sciences, Annamalai University, Annamalai Nagar-608 002, Tamil Nadu, India

Abstract--Bathymetry is a key element of surface water body, which includes the shape, area, volume and depth (N.Khare, et al., 2008 and N.Basos, et al., 2014). Bathymetry survey are maps that can be used to describe the lakes physical characteristics and also help in learn more about the effects of climate change on the environment. Bathymetry mapping in lake Manasbal using echo sounders forms first of its kind to prepare the bathymetry map and delineate various morphometry characteristics based on the geospatial survey. Bathymetry survey were carried out using Garmin 178 sounder and Global positioning system (GPS) to compute Longitude, latitude, depth and water temperature. This in turns helps in preparation of contour maps, morphometry maps and base maps. The Maximum depth of the lake is 43.2 feet, which is located at the wester part of the lake. Several morphometric parameters for the Manasbal lake has been computed which includes Maximum Length (3.4967 Km), Maximum Effective Length (3.4875 Km) Effective width or Mean Width (0.6545 Km), Relative Depth 4.35, Length of Shore line (10.0932Km) Shore Line Development (1.88) and the Total Lake Area (2.28 Sq Km).
Keywords-Bathymetry, Open source QGIS, SRTM, surfer, GPS Echo sounder

I. INTRODUCTION

Bathymetry is the study of land surfaces inside the water bodies, which exhibits the shape and depth of lake (José de Anda, *et al.*, 2012). It is also used to read the principal characteristics and bottom topography of the lake and the maps as similar to Toposheets where the contour determines points that are of equal height. Bathymetry maps connect points of equivalent depths; they are foremost method used to define lake physical features. Bathymetry map helps in understand the function of lake systems for which the variety of measurements like surface area, maximum length and width, mean width, mean depth, maximum depth, mean depth, shoreline length, shoreline development and lake volume can be Fig.d(Army Corps of Engineers, 2001, Cole, T.M. and S.A. Wells, 2001, Gardner, J.V. and P. Dartnell, 2001, Hughes, B.V. and C.M. Taube, 2000, Morgan, L.A., *et al.*, 2001 and Welch, P.S. 1948).
Bathymetry data were collected using GPS enabled Echo sounders and the acquired data has been made in to a map using QGIS. Bathymetry data are used for variety of purposes which includes 3D Models, interpreting Lake Floor profiles, behavior of water over that terrain (Jawak, S.D *et al.*, 2015).Detailed bathymetry will improve the quality for enhanced management of lakes. Also Lake Eco systems are more predominant for environmental changes, features like water retention time (A.R.Yousuf and M.Y. Ioadri, 1986).dominance of sedimentation and accumulation process over erosion, large contact area of the lake to the surrounding catchment have a significant impact on water quality and quantity in reservoirs and influence biological process that occur in water bodies.
Shape of the lake has been described as morphology, whereas the measurement of shapes in respect to various contexts has been described as morphometry, output of complete representation of lake morphometry is bathymetry maps. Lake Morphometry can be derived by variety of sources, but more precise outputs are achieved using the modern day geospatial technology which includes both GIS and Remote sensing.

II. STUDY AREA

Manasbal Lake is situated in Ganderbal district of Jammu and Kashmir; Lake is surrounded by three villages namely Jarokbal, Kondabal and Ganderbal.Spatial extent of the study area ranges from 74.6519° E to 74.6885° E and 34.2439° N to 34.2569° N, which is 30 kilometers north of Srinagar (Fig. 1), The lake finds its source of water through a large number of springs spread over its basin. On its eastern side a branch of an irrigational channel drains into it from March to October. Excess water from the lake is

Volume 4 Issue VI, June 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

drained out into river Jhelum by a channel on its western side (David Rankin, 1994). Lake Manasbal has been classified as warm monomictic that never freeze, they are mostly dominated by elevated plateaus which are rugged and comprise fluviatile, loessic and lacustrine deposits. The presence of abundant underwater weeds shows that the lake has been under eutrophication.

III. DATA AND METHODOLOGY

Bathymetry data has been generated using Garmin Echo sounder which records the geocoordinates along with depth of the Lake. Surveys have been carried out in very calm conditions, (July 2015) where the Echo sounders are fitted over the boat and have been driven at constant speed. Readings were taken at regular intervals traversing in the Zigzag directions (Fig. 2) and vice versa, both waypoints and tracks were recorded and after completion data were downloaded and plotted using geospatial techniques. Base maps for the study area has been generated with the help of Toposheets and Satellite images. QGIS has been used to geo reference and vectorise the base map.

Shuttle Radar Topographic Mission (SRTM) digital elevation data, originally produced by National Aeronautic and Space Administration (NASA) and National Geospatial Agency (NGA), is a major invention in digital mapping of the world, and brings a major development in the accessibility of high quality altitude data for large portions of the tropics and other areas of the developing world. Initially it provides elevation datasets for the globe at 3 arc second resolution (approximately 90 m at the equator) (USGS, 2006) and in the recent times they have resembled the existing SRTM and improved the resolution to 1 Arc second resolution. The SRTM DEM of 1 arc resolution has been used in the present study to delineate the lake boundary, which has been processed using QGIS and terrain surfaces have been read in detail to superior extent. Slope and various other Morphometric parameters which includes Maximum Length of the Lake (Lmax), Effective Length (Le), Maximum width (Bmax), Effective width (Be), Shore Length, Total Area of the lake has been generated using geospatial tools. Shoreline development is a catalogue for regularity of shoreline; they are calculated based on the length of the shoreline and area of the lake, which are important because it replicates the potential for development of littoral groups.

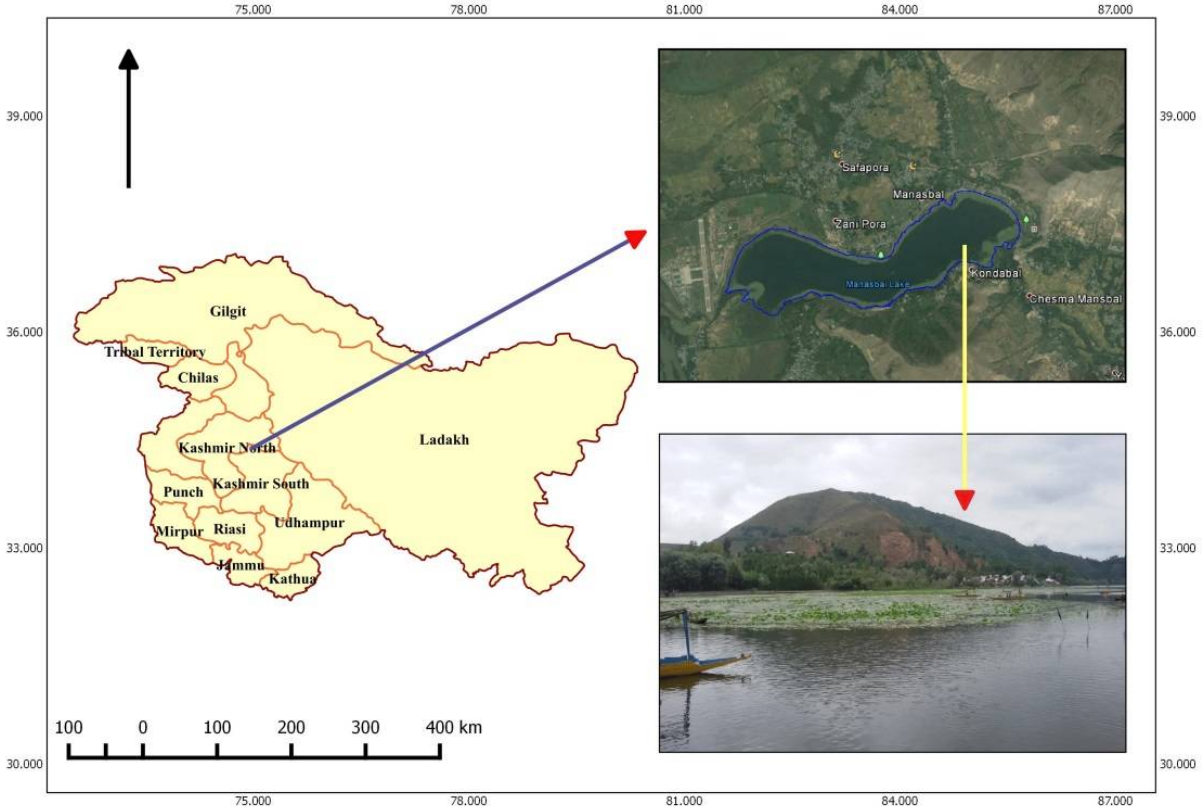


Fig. 1: Location map of Study Area

Volume 4 Issue VI, June 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

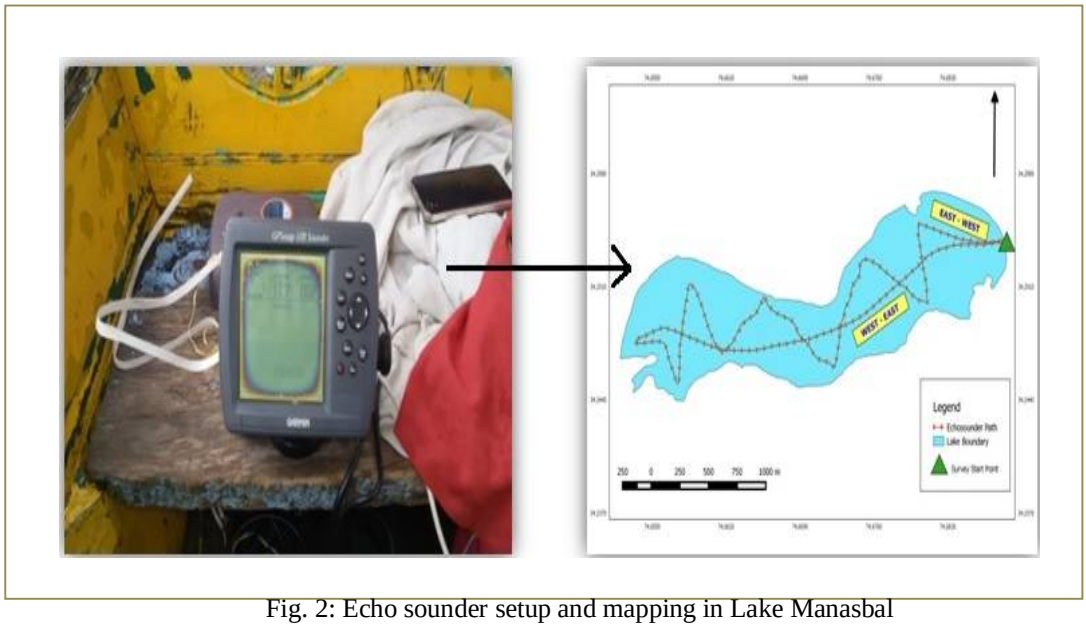


Fig. 2: Echo sounder setup and mapping in Lake Manasbal

IV. RESULTS AND DISCUSSIONS

A. Bathymetry Map

Based on the hydrographic survey, Bathymetry map was generated with the help of QGIS and Surfer software. Based on the bathymetry map it has been identified that the depth of the lake increases towards the central part (Fig. 3) and the maximum depth of the lake have been identified as 43.2 feet (13.16 meters) in the west central part of the lake. The bathymetry profile of the Lake Manasbal exhibits, the presence of three sub basins within it (Fig. 4). The west central part of the sub basin has the maximum depth of 43feet, the sub basins present in the central part is having the depth of 34 feet and the sub basin situated at eastern part exhibits shallow in nature with 18 feet. Also the bathymetry map exhibits that the lake is having steep slope along the eastern part and in the western part undulated with gentle slope up to certain distance and sudden increase in its depth were noticed.

The Bathymetry map of 0.5 m interval shows E- W oriented linear 'M' shaped lake steeper at the central part and flatter to gently sloping on the bank. The gentle slope in the eastern and western part is attributed to rapid accumulation of sediments.

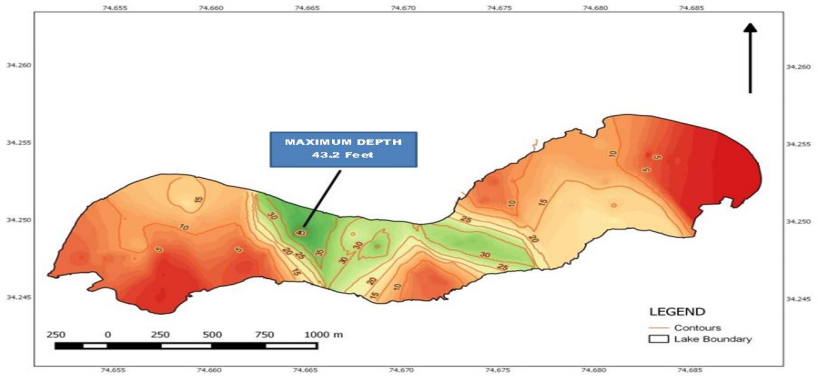


Fig.3: Bathymetry Map of Lake Manasbal

Volume 4 Issue VI, June 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

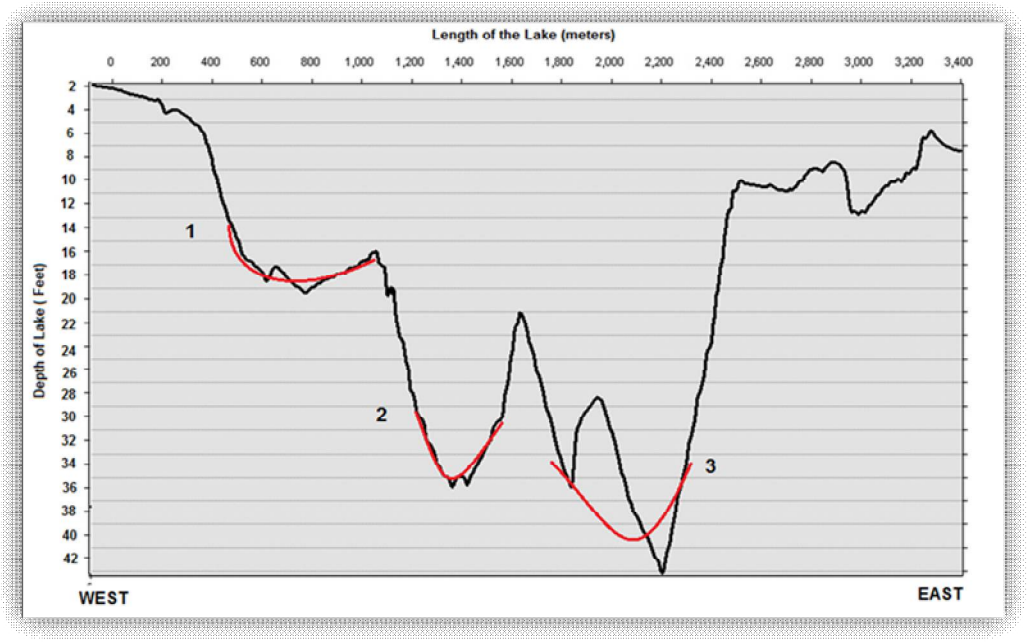


Fig. 4: Profile of Lake Manasbal

B. Morphometric characters

The morphometry is a unit that has direct relation with the process occurring within the lake. The significant morphometric characteristics evolved for the lake Manasbal are given in Table 1.Maximum Length (Lmax) and Effective length (Le) (Fig. 5) for Lake Manasbal has been calculates as 3.4968 km and 3.4876 km respectively.

The Effective Breadth (Be) may not cross land or islands and the effective width is computed as 0.9481 Km. Direction of the Major Axis is defined by compass direction of the maximum length (Lmax). It is the direction in which the lake is oriented E-W is the direction of orientation, Length of Shore line is 10.0933 Km and surface area is calculated as 2.2888 Sq Km (Fig. 6).

Table 1: Morphometry Parameters for Lake Manasbal

S.no	Morphometry Parameter	SRTM based Output
1	Total Lake Area	2.2888 Sq. Km
2	Maximum Length (L*max*)	3.4967 km
3	Maximum Effective Length (L*e*)	3.4875 km
5	Effective width or Mean Width (B*e*)	0.6545 Km
6	Direction	SW-NE
7	Lake Depth(Dm)	13 Meters
8	Relative Depth (Dr)	4.3540
9	Length of Shore line (L)	10.0932 Km
10	Shore Line Development (F)	1.88

Volume 4 Issue VI, June 2016
ISSN: 2321-9653

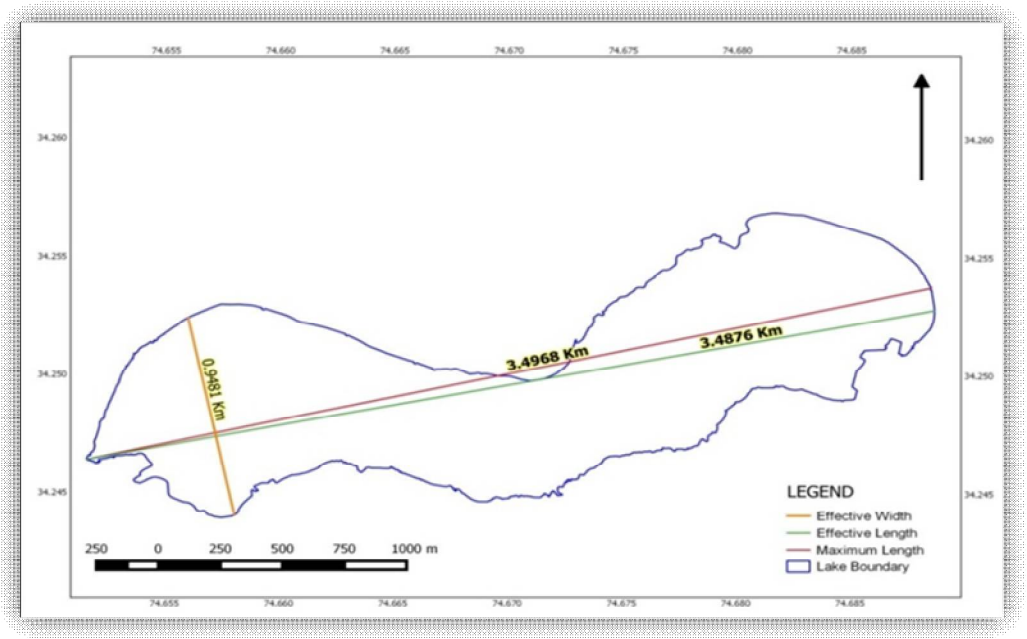


Fig.5: Length and width of Lake Manasbal

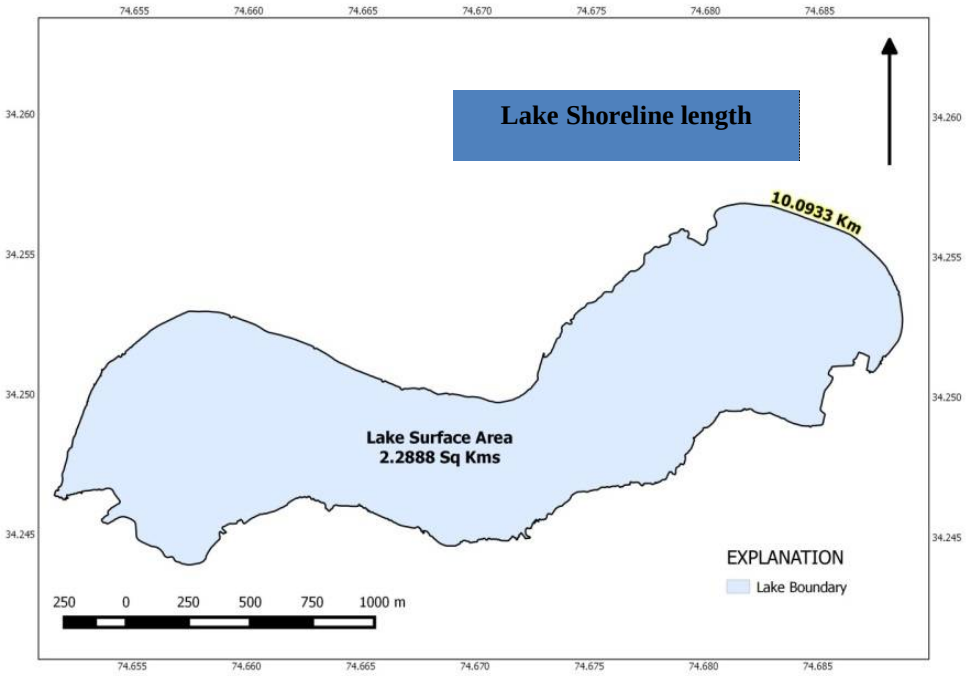


Fig. 6: Surface Area and shore line length

Volume 4 Issue VI, June 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

V. CONCLUSIONS

Morphometric characteristics and Bathymetry map of Manasbal lake exhibits, that the lake is having the maximum depth of 43.2 feet with the 3.4875 Km effective length and 0.6545 km mean width. Shoreline is the fringe of land at the edge of a water body, the derived shoreline length of Lake Manasbal is 10.093 km. The degree of irregularities in the shoreline are determined as shoreline development. The shoreline development of the Lake Manasbal is 1.88, which indicates crinkled nature of the shore and favours for the breeding of the organisms. Though the Lake Manasbal is exhumed as a single basin, the bathymetry indicates three sub basins within it at different depths.

REFERENCES

[1] Khare N, Chaturvedi SK, Saraswat R, Srivastava R, Raina R, & Wanganeo A, 2008. Some morphometric characteristics of Priyadarshini water body at Schirmacher Oasis, Central Dronning Maud Land, Antartica with special reference to its bathymetry., Indian journal of Marine Sciences Vol 37(4): 438-438

[2] Basos N, Martins F and Rodrigues J, 2014. Bathymetry interpolation for hydrodynamic modeling, Lisboa 24, 25 e 26

[3] José de Anda, Jesus Gabriel Rangel-Peraza, Oliver Obregon, James Nelson, Gustavious, Williams P, Yazmín Jarquín-Javier, Jerry Miller and Michael Rode, 2012. The Use of Digital Elevation Models (DEMs) for Bathymetry Development in Large Tropical Reservoirs, Bathymetry and Its Applications, Dr. Philippe Blondel (Ed.), ISBN: 978-953-307-959-2, [online] URL: http://www.intechopen.com/books/bathymetry-andits-applications/the-use-of-digital-elevation-models-dem-for-bathymetry-development-in-large-tropicalreservoirs

[4] Army Corps of Engineers, 2001. Engineering Design and Hydrographic Surveying,Manual No. 1110-2-1003. Department of the Army. Washington, DC.

[5] Cole, T.M. and S.A. Wells, 2001. CEQUAL-W2: A Two-dimensional, Laterally Averaged Hydrodynamic and Water Quality Model, Version 3.1 Instruction Report EL-00-01. U.S, Army Corps of Engineers.

[6] Gardner, J.V. and P. Dartnell, 2001-2000. Multibeam SONAR survey of Crater Lake, Oregon: Data, GIS, images, and movies. U.S. Geological Survey, Digital Data Series DDS-72.

[7] Hughes, B.V. and C.M. Taube, 2000. Mapping lakes with echo sounders. In J.C. Schneider (Ed.), Manual of Fisheries Survey Methods II: with periodic updates. Ch. 10. Michigan Department of Natural Resources, Fisheries Special Report 25

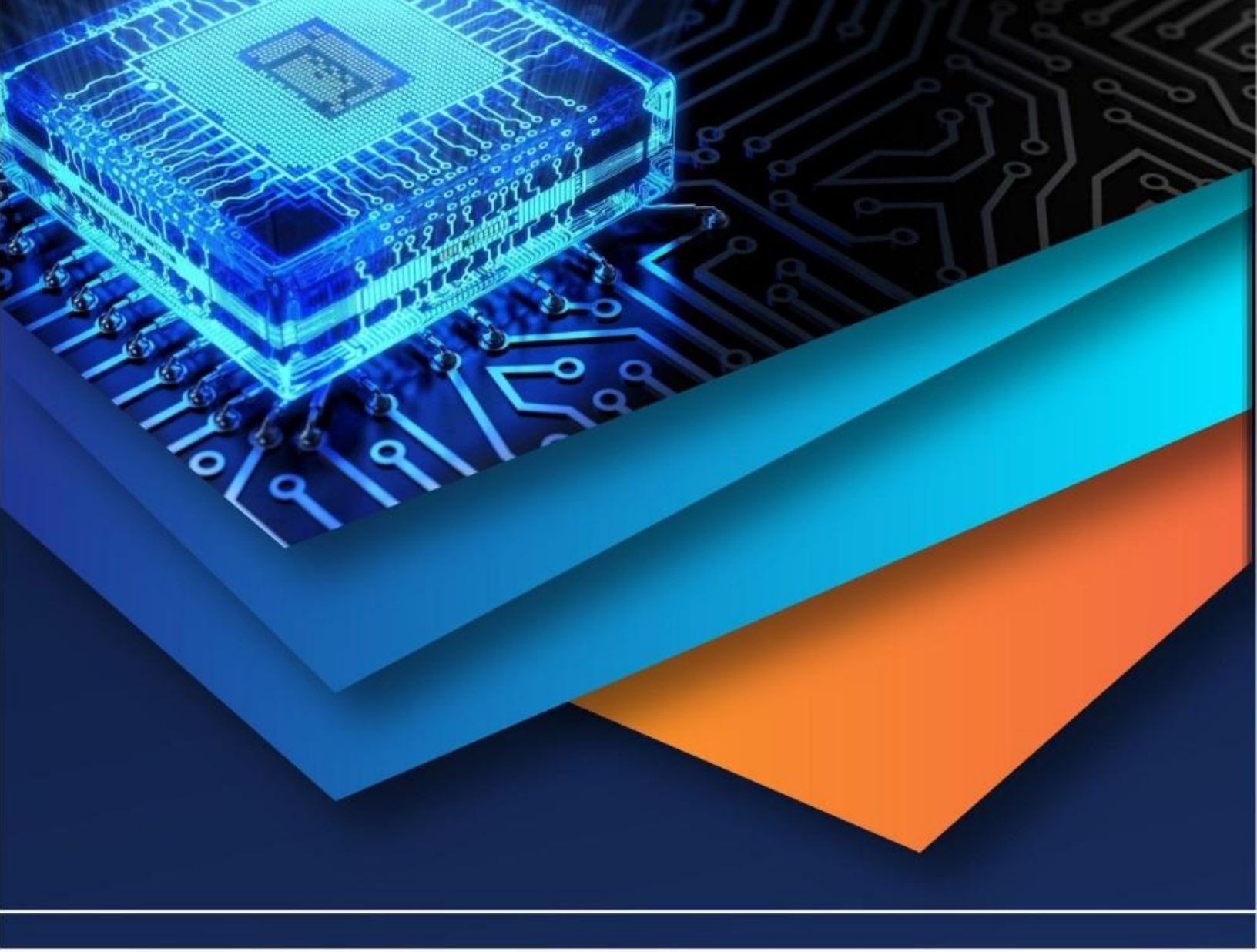
[8] Morgan, L.A., W.C. Shanks III, D. Lovalvo, M. Webring, G. Lee, W.J. Stephenson, and S.Y. Johnson, 2001. In R.J. Anderson and D. Harmon (Eds.), Yellowstone Lake: Hotbed of chaos or reservoir of resilience, 6th Biennial Scientific Conference on the Greater Yellowstone Ecosystem.

[9] Welch, P.S. 1948. Limnological Methods. The Blakiston Company, Philadelphia. 381 pp.

[10] Jawak, S.D., Vadlamani, S.S. and Luis, A.J. 2015. A Synoptic Review on Deriving Bathymetry Information Using Remote Sensing Technologies: Models, Methods and Comparisons. Advances in Remote Sensing, 4, 147-162.[online] URL: http://dx.doi.org/10.4236/ars.2015.42013

[11] A. R. Yousuf and M. Y. Ioadri, 1986. Distribution of Polyarthra vulgaris Carlin (Rotifera: Monogonota) in a warm monomictic lake of Kashmir, India, J. Indian Inst. Sci., 66, pp. 405-410

[12] David Rankin, Freshwater Ecosystems and Human Populations: Great Lakes Case Study: Bulletin 107, YALE F&ES BULLETIN [online] URL: http://environment.yale.edu/publication-series/documents/downloads/0-9/107Rankin.pdf



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY