# Hybrid Database Architecture of Molecular Databases Management Systems

**M.A. Makhdoom Rana[1,3], Irfan Abbas[1,4], Urooj Asgher[2] , Munib Ahmad[1], , Ali Raza[3], Afzaal Ahmed[1], M. Ans Shoukat[1], Ahmad Raza[1] , Shahan Yamin Siddiqui [1,5]**

[1]School of Computer Science, Minhaj University Lahore, Lahore, Pakistan.

[2] Department of Electronics and Electrical System, The University of Lahore, Lahore 54000, Pakistan.

[3] Department of Physics, The University of Lahore, Lahore 54000, Pakistan

[4]Department of Computer Science & IT, University of Central Punjab, Gujrat, Pakistan.

[5]Department of Computer Science, National College of Business Administration and Economics, Lahore, Pakistan

**Abstract**

As we know storing data is now the biggest problem in world to store Big data we need high storage capacity devices Effective DBMS and advanced computing systems. on this article we create an image f Database Called "Hydride Database" design of two database works with two separate computing technologies coordinates each other's as bridged. Upcoming computing and storing mechanism are in molecular and bionic using nanotechnology. Big data is a major problem throughout the world. Article is about computing technology capability and data depositing on storage media with old format structure and a brand-new scheme with modern states of the molecular and bionic structure in form of readable, writeable, cloned, small space and secured than other obsolescence technologies.

***Key Words:***

*Database Management System(DBMS)Molecular Data Base Management System (MDBMS), Organic Data Base Management System (ODBMS), Artificial intelligence (AI), Organic Computing (OC), Molecular Computing (MC), Artificial Intelligence Monitoring Program (AIMP).*

## 1. Introduction:

From the beginning of database designing, it's continuously updating, upgrade and advancement within the database system. The database always affected if any part of technology is updated, upgraded or major launch. The database consists of the major part of the system is database management system, computing technologies (Hardware), security, storage media and its environment. All major parts contain subcomponents and these components are time by time improved which increases the performance of the processing. The database can be disturbed by a cooling system even its system is up to date and more advanced computing power. This era new advancement in the computing technologies not only affects a single system its wave touches the whole computing technology devices because the architecture of the computing technologies is moving to Organic Computing (OC) [1, 2]. All the previous technologies are based on digital gates. The digital-gates are supporting the database from its deployment. Quantum computing is more advanced than integrated chips. But it still depends on the digital gates technology. They are used in the quantum gates which are determined the superposition of motion of the qubits and translate into digital form. This is a hybrid development, but it disturbs processing power and computing response time [3]. Second major part of a database is storage media. With every day 2.5 quintillion bytes is created for this world, which is a most arising question within the datasaving media space. It is very costly to maintain a database stay in online data [4]. The energy usage of the data centres and its environment expending with the time of it more requirements. Storage media speed of the data storing and retrieving is participating in the processing speed of the database management system. Storage media device updates, upgrade and developed in forms. Today there are lots of storing media some are very fastest like solid-state drive (SSD), Intel optane more energy savers but due to some recovery problem, limited capacity and high cost are failed to adjust with database systems. However, some databases are using these storage media for their requirement and demands. Until digital gates computing technology handling the database system which is developed at present even quantum computing in the field. Nevertheless, at the moment the computing technologies are taking a turn to OC. [5, 6] The OC is a whole new discipline of computing, which not only changes computing method, its interaction and its input/output device structure will be manipulated. As discuss the OC its peripheral organic devices then its data saving system as well different than running storage media. As OC is the most advanced in computing and its storing media based on deoxyribonucleic acid (DNA) hard

Manuscript received July 5, 2020
Manuscript revised July 20, 2020

drives. These hard drives structures have an own pattern of storing data, reading, writing, copying, modifying and maintaining its shape in sequence. DNA storing media are very energy efficient, abilities to store 455 exabytes in one gram, less space than 3.5 or 2.5 inches Disc hard drive, faster speed of access, very cheap cost, very less maintenance, and better coding scheme than a binary system. OC and its new organic application for storing data media. It is true that the OC system is not so stable and their development going more and more progressive. It needs lots of work and new advancement to make it strong to utilize it all fields' professions [7]. Each profession needs a different type of computing nature for their environment. In computing science term is very an import who is called compatibility. Compatibility means an ability of support for two computing technologies or two software types or combination of software, and hardware provides service well balanced short of having to be transformed to do working or performing tasks. There are lots of different means of compatibility in computer science. One means of compatible is a brand-new technology supports a step old technology and a step ahead for upcoming modern technology. Existing database systems are very stable, but they are facing a problem with big data storing in data centers are covering lots physical space and its cost so high for updating. Scientists developed organic structure to solve this problem. However, Organic Database Management System (ODBMS) cannot be implemented directly because it contains many defects in design [8]. It is in its early stages of development. The main focus of this paper about an obsolescence database system, and work with an organic database system to cover and support it until it becomes stable and develops its parameter along collecting data and performs the operation its beta version. Coordination of two platforms for the same purpose is called a hybrid. Two databases together functional on their computing and software platforms. The old hybrid database management is an only combined level of shared memory in data storage to give the performance. A compatibility technology helps to interpretability to them and both records operative activities, an issue in logs. Even more stable database systems track an advance bug or problem which hasn't occurred yet. Artificial intelligence (AI) helps to make the stable organic database in few years as compared to previous database systems.

Hybird Intelligence approaches like combinations of Fuzzy system [9, 10, 11], Neural Network [12, 13, 14] like Genetic Algorithm [15, 16], Differential Evolutionary (DE), Island GA [17], Island DE [43, 44], Deep Extreme Learning Machine [18, 19, 20] are strong candidate solutions in the field of smart city [21, 22, 22], Smart health [23, 24, 26] wireless communication as well as Hybird database [27] etc. are hot research area which is also used in databasemanagement systerms.

## 2. Necessity of Hybird

The first hybrid creates in computing by emerging analogue computing with digital computing. After that, it repeated in the computer science its hardware components mostly and not much in the software form. The main idea of it to utilize the power of old technology and a step ahead of technology to give the maximum performance of new feature with compatible until it becomes stable or help the user to use it with the old system and smooth convince him to toward new technology [28]. Nevertheless, sometimes it is most important for them to build a hybrid model to develop to control a whole new architectural model and its mechanism, it is very being a not easy job to hybrid two technologies to create a whole new technology. It depends on the level of interconnectivity of the creating relation complexity. For example, a system with system hybridge, or systems with a system hybridge, or component to components, sub-components to a component, or function hybrid. Or any mean of hybriding.

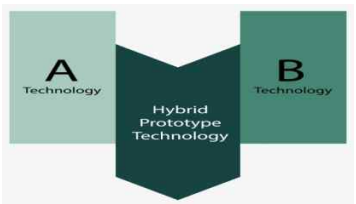


**Figure 1. Hybrid Prototype Technology.**

The main concern of hybrid is to get to use advanced technology with aged technology and try to maximum feature and reduce the weakness of the elderly technology, transferring all the working on new technology. With monitoring, parameters detect flaw of new and recover them using new possible solve or discovering its solution.

## 3. Hybrid Database System

Entail quantum computing there wasn't any advancement major system launch in the database system but after successful development of the OC, everything evolutionary changed in the computing technology from hardware to its

software each of part. Now for emerging database system, which is based on integrated chip computing, input/output (Digital Gates-based Hardware), on binary system and storing data on media with two states, database management system software and mechanism of data structure, and (old software and Hardware) interaction.

With OC, which is based upon different types of molecular computing materials, input/output (Organic based Hardware), on DNA structure system and storing data on media with more than two states, ODBMS software and mechanism of organic data structure, and (Organic software and Hardware) new interaction.

## 3.1 Foremost Components of Hybriding

As the highlight every single thing for the system. In future hybriding will consist of the three major systems. These are main parts to support a database system, and all these parts within the database system are completely changed. All of these are going too hybrid with old technology.

- OC Technology
- Organic Genetic Programming Software
- Organic Storing Media

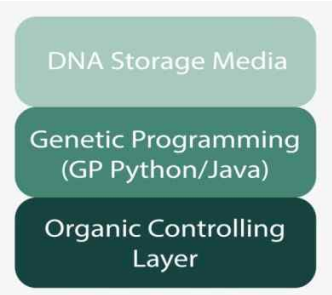


**Figure 2**.Organic Computing (OC) Structure.

OC is very successful because of the speed of data inputting, giving result and Processing. Its supporting states are more than a binary system. However, not only that enough benefits of the OC some properties are:

- Self-Enhancing
- Self-Configuration
- Self-Optimization
- Self-Protection
- Self-Explanation
- Self-Healing
- Self-Describing


**Figure 3.** Organic Computing (OC) Properties.

Organic Genetic Programming Software Hereditary algorithms are helping to build organic inherited Programming, and a framework named [29, 30] "Data Modeler" suite is created for the general of progressive biological programming using AI evaluation, erroneous and efficient of multivariate statistics of data sets. Some developed of the organic programming core system is under experiments. It's compatibility of data computing much advanced than binary based software.

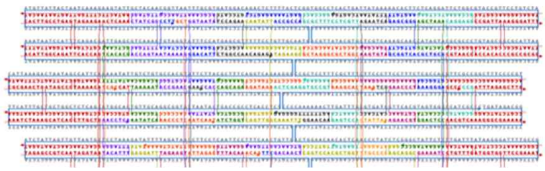

**Figure 4.** DNA and molecular programming by MIT.

Every second storing media increasing its volume because each day the world consumption is 2.5 quintillion bytes of data.

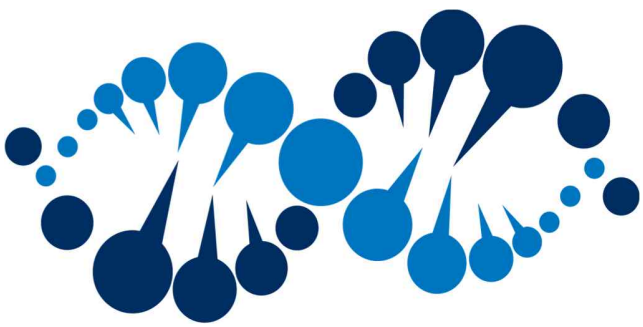

**Figure 4.** DNA Structured Form of Storage.

However, in [31, 32] OC compatibility, storing media is DNA architectural designed hard drives are providing maximum performance, but it is not adequate to warehouse the very exceptionally vast of data in a pint-sized organic formed saving device to save physical space capacity and power energy. Smart relationship control to minimizing the usage bionic memories, data for reprocessing, storing clone data, scrap removing from the kept data.

## 4. Emerging Computing Technologies

The OC is underdevelopment have lacked Interaction with users. It is required to interact with users. Digital gates' technology is helped to develop it configuring the organic structure. That why the digital gates computing is the best candidate to be hybrid with the OC. Even its filling interaction requirements. The artificial intelligence monitoring program (AIMP) will help both technologies work with perfect coordination and handle any problem, which can be solvable by it. Otherwise, it creates a log file and alerts the develop for bug reporting. It altogether records each transaction of both database and helps to develop an achieved system structure for OC. It can convert data into a binary form or biological when a development requires a data to analysis on another system or need for the other systems. It will manage CPU overheating and as well as biological molecular behavior. It equally important sees the overload of data and creates load balancing. AIMP runs on it small computing device (Raspberry Pi, Banana, Intel Giulio or Arduino).

Because some time system crashed and properly the cause of failure can be properly logged. When monitoring system running on the same machine. This hybrid model will give sooner a perfect ODBMS. The binary to organic adapter will work under the AI Monitor program and that will help to translate the binary to organic. The physical database will slow as compare to DNA database. In this design, the maintenance cost is less but the Physical hard drives cost more than it maintains as days will pass. This design will model the upcoming database models.

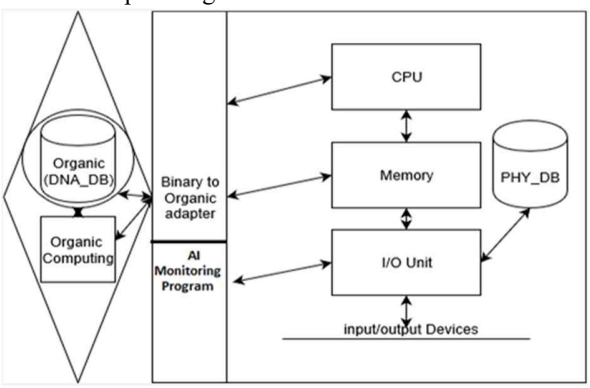


**Figure 5.** Binary to Organic Adapter

## 5. AI Monitoring Program (AIMP)

At the powering, up of the system first, the AI Monitoring system will boot up, and then it will turn on both systems in a sequence. For that purpose, it can monitor each computing instruction of the systems. When every service on a system is operational then the AIMP true the ready signal, the system and the system start accepting the queries by the specific system scheme which purpose this system is being formed. Its main responsibility is to maintain the system stable. When a new bug reported then it traced all the impact of that bug. It enlisted the roots' paths of the originating and where the most area infected. It deals the spacing address recording and the nature of the queries and types of queries. If the hybrid system is facing problem to execute the query. Monitoring Program manages the standardized query language (SQL) query to organic understandable form.

For organic database system needs lots of work to do [33] because it going to design the pattern from the whole new sequence. Because binary states are very easy to understand, but its volume of data is big with respect to DNA biological scheme, and it is little heavy to understand but the data saving ability in very tiny space using macro pathologies. It also deals with the binary to the organic adapter and gives direction to the traffic of data. Every transaction of received will do verification of the data storing. It coordinates for a management system. That maintain the modification of the data or update orupgrade.

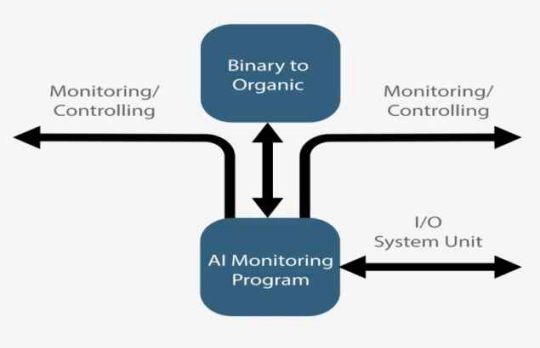


**Figure 7.** AI Monitoring Program (AIMP)

AIMP helps to create an organic file system format and its structure stronger.

- Input watcher
- Output watcher
- Power Management
- Tracking
- Adapter Controller
- Debugging
- Organic Controller
- Digital Gates Controller

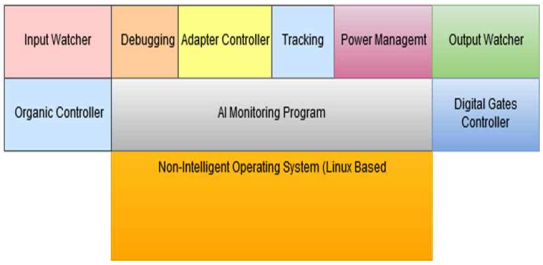


**Figure 6**. Internal Components

It will work together and from time to time, it will be updated by the developer or researcher for enhancing and featuring, the AIMP. There are major details about of these pasts AIMP.

## 5.1 Input watcher

Organic computing will be connected to the digital gates computing Input/output unit systems. It is true that the biological computing does not have its interaction interface. That's why the Input\output unit system hybriding with biological computing helps it to communicate with the data. This is one major benefits of the hybriding. Monitoring program converts, Input\output unit system received Input\output into biological to binary and binary to biological. It is an essential part of the database management system. Database management system. Because the validation input integrity constraints applied to securing the input and monitors the in unauthentic access and tracks the path of instruction. Bring that instruction to the required process of the [33, 34] database management system.

## 5.2 Output Watcher

As know that will adjust the It for check put adjust according to output for output devices according to them. The output interface helps with this hybrid management database system to interact with a user with their familiar user interface. Organic computing will work until brand new organic user interface designs. When a new interface introduced then it needs time to settle and develop the friendly interface. Organic output devices will not be familiar with the digital-gates computing. Both are distinctive from each other and totally distinct than each. The computing procedures are different as mathematical principles[35].

## 5.3 Power Management

The power management system will monitor the power states. Have full rights to turn on and off any part of the hybrid. It is responsible to provide the proper power distribution. It will control the power in terms of failures.[18]

## 5.4 Tracking

This module tracks each detail about the system either it about both hybrid computing technologies. It will track each movement through the system. The AIMP each activity logged in inside the system.

## 5.5 Adapter Controller

This will communicate the adapter separate computing from the AI Monitoring Program Computing machine because everything putting on AI monitor program machine to overload and creates a disturbance for performance. It only designed for converting purposes. It only communicates with the AIMP unit. [36, 37, 38]

## 5.6 Debugging

Debugging is a most important aspect of in computer science. In this, many of the things involved programming languages lack support, or solve the problem using different technology and sometimes engineering problems. AIMP will take steps to solve its own. However, the preferable way is a developer fix it. Manually, in this multi-step process framework analysis and detecting a problem. Continuously testing code, redesigning and deployed the updated version until it solves the problem [39, 40].

## 5.7 Organic Controller

Biological computing [41, 43] structure is different as written. Organic controlling will manage computing operations. It works as organic input/output unit for organic computing. Which deals with molecular instructions. Which are programmed with genetic programming (GP)? [44].

## 5.8 Digital Gates Controller

It not fully controls the computing because its operating system manages to computer operations. It will share's its input/output unit of its system with AI Monitoring Program.

There are many of the programming languages to develop [45].

## 6. Analysis

In the next year, the OC will take place and quantum computing will not make its place because of its cost. The Organic Computing is so cheap and can build any molecular properties. Nevertheless, the database systems will expend due to physical space covering, and big data will demand new solution. Then its proper solution is available in shape of organic computing, which is not much developed. That's why the necessity is a hybrid system of databases systems. Which are mostly built to support new technology to be intact with user smoothly and make its position. The user moves on the latest one. However, main concern tracks the defects which aren't visible yet. Something going wrong then analyzed the defect and implements the recovery. So technology never stays in a shape, and it continually changes the shapes and structure.

## 7. Conclusion

Hybrid database system was only limited to the sharing of single memory concept of its self in the but this paper focuses on hybriding of completely two computing database management systems and connects them using AIMS to build up faster mechanism of the ODBMS. In this, paper it structures, important, compatibility and its plans are discussed. In the future, hybrid database's collaboration us to deal big data problem and assistance to transfer us to the new computing technologies. That will open the doors of many research fields and move to more advanced technologies.

## References

[1] Schneider, E. (2010). Identifizierung und Charakterisierung von Genen für sensorineurale Hörstörungen.

[2] Wang, H., Hu, Y., & Tsien, J. Z. (2006). Molecular and systems mechanisms of memory consolidation and storage. Progress in neurobiology, 79(3), 123-135.

[3] Adleman, L. M. (1994). Molecular computation of solutions to combinatorial problems. Science, 266(5187), 1021-1024.

[4] Jones, J. A., & Mosca, M. (1998). Implementation of a quantum algorithm on a nuclear magnetic resonance quantum computer. The Journal of chemical physics, 109(5), 1648-1653.

[5] Muller-Schloer, C. (2004, September). Organic computing-on the feasibility of controlled emergence. In International Conference on Hardware/Software Codesign and System Synthesis, 2004. CODES+ ISSS 2004. (pp. 2-5). IEEE.

[6] Saparov, B., & Mitzi, D. B. (2016). Organic–inorganic perovskites: structural versatility for functional materials design. Chemical reviews, 116(7), 4558-4596.

[7] Nicolau, D. V., Lard, M., Korten, T., van Delft, F. C., Persson, M., Bengtsson, E., ... & Linke, H. (2016). Parallel computation with molecular-motor-propelled agents in nanofabricated networks. Proceedings of the National Academy of Sciences, 113(10), 2591-2596.

[8] Kluge, F., Mische, J., Uhrig, S., & Ungerer, T. (2008, June). An operating system architecture for organic computing in embedded real-time systems. In International Conference on Autonomic and Trusted Computing (pp. 343-357). Springer, Berlin, Heidelberg.

[9] Hussain, S., Abbas, S., Sohail, T., Adnan Khan, M., & Athar, A. (2019). Estimating virtual trust of cognitive agents using multi layered socio-fuzzy inference system. Journal of Intelligent & Fuzzy Systems, 37(2), 2769-2784.

[10] Areej Fatima, Muhammad Adnan Khan, Sagheer Abbas, Muhammad Waqas, Leena Anum, and Muhammad Asif, Evaluation of Planet Factors of Smart City through Multi-layer Fuzzy Logic (MFL). The ISC Int'l Journal of Information Security. 51-58, 2019.

[11] Siddiqui, S. Y., Hussnain, S. A., Siddiqui, A. H., Ghufran, R., Khan, M. S., Irshad, M. S., & Khan, A. H. (2019). Diagnosis of Arthritis Using Adaptive Hierarchical Mamdani Fuzzy Type-1 Expert System. EAI Endorsed Transactions on Scalable Information Systems, 19(18), 1-16.

[12] Atta, A., Abbas, S., Khan, M. A., Ahmed, G., & Farooq, U. (2018). An adaptive approach: Smart traffic congestion control system. Journal of King Saud University-Computer and Information Sciences.

[13] Khan, M. A., Umair, M., Saleem, M. A., Ali, M. N., & Abbas, S. (2019). CDE using improved opposite based swarm optimization for MIMO systems. Journal of Intelligent & Fuzzy Systems, 37(1), 687-692.

[14] Khan, M. A., Umair, M., & Choudhry, M. A. S. (2015). GA based adaptive receiver for MC-CDMA system. Turkish Journal of Electrical Engineering & Computer Sciences, 23(Sup. 1), 2267-2277.

[15] Khan, M. A., Umair, M., & Choudry, M. A. S. (2015, December). Island differential evolution based adaptive receiver for MC-CDMA system. In 2015 International Conference on Information and Communication Technologies (ICICT) (pp. 1-6). IEEE.

[16] Ali, M. N., Khan, M. A., Adeel, M., & Amir, M. (2016). Genetic Algorithm based adaptive Receiver for MC-CDMA system with variation in Mutation Operator. International Journal of Computer Science and Information Security, 14(9), 296.

[17] Umair, M., Khan, M. A., & Choudry, M. A. S. (2015, December). Island genetic algorithm based MUD for MC-CDMA system. In 2015 International Conference on Information and Communication Technologies (ICICT) (pp. 1-6). IEEE.

[18] Umair, M., Khan, M. A., & Choudry, M. A. S. (2013, January). GA backing to STBC based MC-CDMA systems. In 2013 4th International Conference on Intelligent Systems, Modelling and Simulation (pp. 503-506). IEEE.

[19] Kashif, I., Muhammad, A.K., Sagheer, A., Zahid, H., & Areej, F (2018). Intelligent Transportation System (ITS) for Smart-cities using Mamdani Fuzzy Inference System, International Journal of Advanced Computer Science and Applications (IJACSA). ISSN: 2158-107X, Vol. 9, No. 2, (pp. 94-105), Digital Object Identifier (DOI): 10.14569/IJACSA.2018.090215.

[20] Abbas, S., Khan, M. A., Ata, A., Ahmad, G., Saeed, A., & Anwar, N. (2019). MULTI USER DETECTION USING FUZZY LOGIC EMPOWERED ADAPTIVE BACK PROPAGATION NEURAL NETWORK. Neural Network World, 29(6), 381-401.

[21] AsadUllah, M., Khan, M. A., Abbas, S., Athar, A., Raza, S. S., & Ahmad, G. (2018). Blind channel and data estimation using fuzzy logic-empowered opposite learning-based mutant particle swarm optimization. Computational intelligence and neuroscience, 2018.

[22] Khan, M. A., Umair, M., & Choudry, M. A. S. (2015, December). Island differential evolution based adaptive receiver for MC-CDMA system. In 2015 International Conference on Information and Communication Technologies (ICICT) (pp. 1-6). IEEE.

[23] Ata, A., Khan, M. A., Abbas, S., Ahmad, G., & Fatima, A. (2019). MODELLING SMART ROAD TRAFFIC CONGESTION CONTROL SYSTEM USING MACHINE LEARNING TECHNIQUES. Neural Network World, 29(2), 99-110.

[24] Siddiqui, S. Y., Athar, A., Khan, M. A., Abbas, S., Saeed, Y., Khan, M. F., & Hussain, M. (2020). Modelling, Simulation and Optimization of Diagnosis Cardiovascular Disease Using Computational Intelligence Approaches. Journal of Medical Imaging and Health Informatics, 10(5), 1005-1022.

[25] Siddiqui, S. Y., Khan, M. A., Abbas, S., & Khan, F. (2020). Smart Occupancy Detection for Road Traffic Parking using Deep Extreme Learning Machine. Journal of King Saud University-Computer and Information Sciences.

[26] Hussain, A., Hussnain, S. A., Fatima, A., Siddiqui, S. Y., Saeed, A., Saeed, Y& Khan, M. A. (2020). A Novel Approach for Thyroid Disease Identification Empowered with Fuzzy Logic. IJCSNS, 20(1), 173.

[27] Naz, N. S., Khan, M. A., Abbas, S., Ather, A., & Saqib, S. (2020). Intelligent routing between capsules empowered with deep extreme machine learning technique. SN Applied Sciences, 2(1), 108.

[28] Gani, A., Safitri, R., & Mahyana, M. (2017). Improving the Visual-Spatial Intelligence Snd Results of Learning of Juniour High School Students' with Multiple Intelligences-Based Students Worksheet Learning on Lens Materials. Jurnal Pendidikan IPA Indonesia, 6(1), 121912.

[29] Reuther, C., Hajdo, L., Tucker, R., Kasprzak, A. A., & Diez, S. (2006). Biotemplated nanopatterning of planar surfaces with molecular motors. Nano Letters, 6(10), 2177-2183.

[30] Takapoui, R., Moehle, N., Boyd, S., & Bemporad, A. (2020). A simple effective heuristic for embedded mixed-integer quadratic programming. International Journal of Control, 93(1), 2-12.

[31] Hess, H., Clemmens, J., Qin, D., Howard, J., & Vogel, V. (2001). Light-controlled molecular shuttles made from motor proteins carrying cargo on engineered surfaces. Nano Letters, 1(5), 235-239.

[32] Yoon, Y., Jeong, C., Lee, J., Song, C. B., Kwon, Y. S., & Cha, S. K. (2014). U.S. Patent No. 8,782,100. Washington, DC: U.S. Patent and Trademark Office.

[33] Li, M., Xie, K., Kuang, H., Liu, J., Wang, D., Fox, G. E., ... & Tsien, J. Z. (2018). Neural coding of cell assemblies via spike-timing self-information. Cerebral Cortex, 28(7), 2563-2576.

[34] Xie, K., Fox, G. E., Liu, J., & Tsien, J. Z. (2016). 512-channel and 13-region simultaneous recordings coupled with optogenetic manipulation in freely behaving mice. Frontiers in systems neuroscience, 10, 48.

[35] Simonetti, C. T. (1994). U.S. Patent No. 5,295,261. Washington, DC: U.S. Patent and Trademark Office.

[36] Qumber, S. A. Hybrid Databases Systems and Artificial Intelligent Monitoring Program.

[37] Tang, G. L., Cheng, Y. Q., & Shen, B. (2004). Leinamycin biosynthesis revealing unprecedented architectural complexity for a hybrid polyketide synthase and nonribosomal peptide synthetase. Chemistry & biology, 11(1), 33-45.

[38] Koza, J. R., Keane, M. A., Streeter, M. J., Mydlowec, W., Yu, J., & Lanza, G. (2006). Genetic programming IV: Routine human-competitive machine intelligence (Vol. 5). Springer Science & Business Media.

[39] Jagadish, H. V., & Olken, F. (2004). Database management for life sciences research. ACM SIGMOD Record, 33(2), 15-20.

[40] Jarvis, D., Amador, P. G., Bhaskaran, M., Kalra, A., Gallaway, R., & Gopalakrishnan, V. (2020). U.S. Patent No. 10,683,171. Washington, DC: U.S. Patent and Trademark Office.

[41] Manglik, G., & Fu, T. (2020). U.S. Patent No. 10,678,602. Washington, DC: U.S. Patent and Trademark Office.

[42] Hemeida, A. M., El-Ahmar, M. H., El-Sayed, A. M., Hasanien, H. M., Alkhalaf, S., Esmail, M. F. C., & Senjyu, T. (2020). Optimum design of hybrid wind/PV energy system for remote area. Ain Shams Engineering Journal, 11(1), 11-23.

[43] Huang, H. Y., Lin, Y. C. D., Li, J., Huang, K. Y., Shrestha, S., Hong, H. C., ... & Xu, J. T. (2020). miRTarBase 2020: updates to the experimentally validated microRNA–target interaction database. Nucleic acids research, 48(D1), D148-D154.

[44] Abbas I, Ahmad M, Sarfraz HS, Nadeem M, Subhan R (2020) Efficient and robust security implementation in a smart home using the internet of things. Indian Journal of Science and Technology. 13(15): 1563-1569.

[45] Abbas I, Iqbal H, Ahmad M, Naveed A, Qudoos B (2020) Comparative study of technologies and intelligent train ticketing system. Indian Journal of Science and Technology. 13(15): 1570-1579.

## Authors Profile:

**M.A. Makhdoom Rana** is the student of Master of Philosophy in Computer Science at Minhaj University Lahore, Lahore. His research area is Data Science.

**Irfan Abbas** is the student of Minhaj University Lahore Pakistan. He is doing Master of Philosophy in Computer Science from the School of Computer Science, Minhaj University Lahore, Pakistan. He received the B.S degree in Computer Science from the Department of Computer Sciene, Arid Agriculture university Rawaplindi, Gujrat, Pakistan He is working as a lecturer of computer science at University of central Punjab, Gujrat, Punjab, Pakistan His research interest includes Knowledge Based Systems, Networking, Data Science, Cloud Computing and Theory of Computation.

**Urooj Asgher** has completed her MS from The University of Lahore, Pakistan in 2018. Prior to this, she has completed BS from the same university in 2013. Urooj has been teaching in University of Lahore (UOL) as an Assistant Professor in Department of Electronics &Electrical Systems. The research interests include; Energy Optimization in Smart Grid, Linear, Non-linear & Heuristic Optimization techniques, Renewable Energy Integration also working on Python with deep learning.

**Munib Ahmad** is currently working as an HoD at the Department of Information Technology, Minhaj University Lahore, Pakistan. He is doing Ph.D. from University of Central Punjab, Lahore, Pakistan. He completed his MS Software Systems & Engineering from Muhammad Ali Jinnah University, Islamabad, Pakistan. He has been teaching graduate and undergraduate students in computer science and Information Technolgy for the past 20 years. His research area is Knowledge Based Systems, Networking, Data Science, and Theory of Computation.

**Ali Raza** is studying MS in Solid State Physics from The University of Punjab, Lahore Pakistan. Prior to this, he has completed BS from the university of Lahore (UOL) in 2013. He has been working as a lab supervisor in UOL in department of Physics. The research interests include; Energy optimization through PV System and Lithium ion battery for efficiency improvement.

**Afzaal Ahmad** is the student of Master of Pholosphy in Computer Science. He is the student of Minhaj Universty Lahore, Punjab, Pakistan. His research intrest is Database Models, Cloude Computing and Cloud Research Models.

**Muhammad Ans shoukat** is doing Master of Pholosphy in Computer Science from Minhaj Universty Lahore, Punjab, Pakistan. His research intrets areas are Internet of Things (IoT),

**Ahmad Raza** is doing Master of Pholosphy in Computer Science from Minhaj Universty Lahore, Punjab, Pakistan. He was completed BS Computer Science from Government College University Faislabad, Sahiwal Campus. His is working in Database Models and Cloude Computing.

**Mr. Shahan Yamin Siddiqui** is currently working as an Associate Head at the School of Computer Science, Minhaj University Lahore, Lahore, Pakistan. He is doing a Ph.D. from School of Computer Science, NCBA&E, Lahore, Pakistan. He received the B.S degree in Electrical Engineering from the School of Engineering, University of Management and Technology, Lahore, Pakistan. He completed his Master of Electrical and Computer Engineering from the School of Science and Technolog, University of Management and Technology, Lahore, Pakistan. He became the member of Pakistan Engineering Council as registered engineer in 2013. His association with IEEE was established as member in 2019 and acting as an Advisor of IEEE-MUL Student Branch. Shahan's research interests primarily include Fuzzy Systems, Computationl Intellignece, Machine Learning, Cloud Computing, Image Processing, Conginitive Machines,