

Other Technical Details

1. State of the Art: (Maximum 2 page)

(A concise review of the status of the proposed research and gap areas, if any)

Empowering water conservation and wastewater treatments for a sustainable future: An Ecological Reconnection with The Community at Ghamroj Village, Haryana

Rapid urbanization characterized by rural-urban migration and radical expansion of urban built-up areas has produced a new type of urban neighborhood in almost all the major cities, called Urban Village. Rapid expansion of cities encroaching on these types of villages has transformed their rural character and layers of changes due to urbanization and modernity have given them strange Urban-Rural duality.

This proposal focuses on the water body precinct of the village of Ghamroj, Sohna located in Gurugram as a base case example. Ghamroj is one of the many urban villages affected by or expected to be affected by the rapid urbanization and growth of hubs like Gurgaon, Badshahpur, and Sohna. It is one of the several urban villages located in the Sohna tehsil of the Gurgaon district, at the base of the Aravalli hills. It was established in 1198 and has a population of approx. 5000 people with around 842 houses (Census 2011).



Fig 1: Location of Ghamroj Village

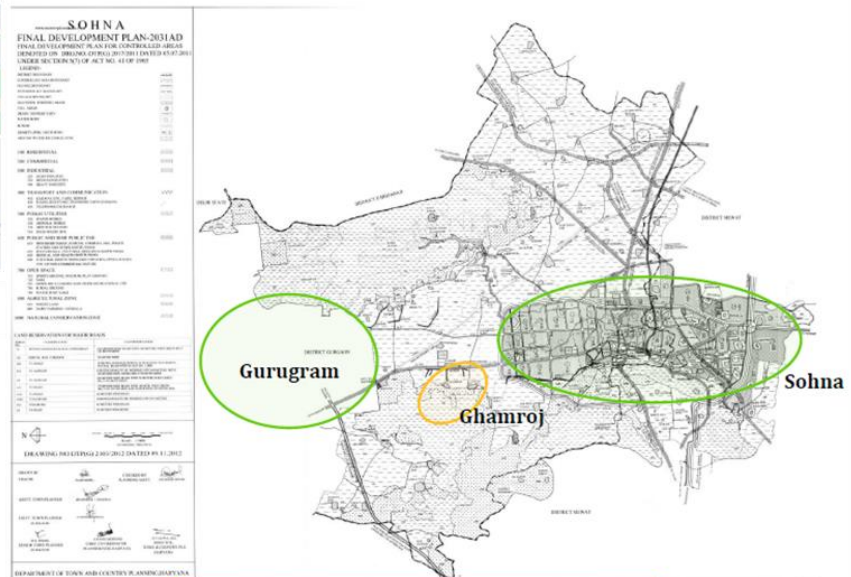


Fig 2: Ghamroj Village in Sohna Master Plan 2031 showing proximity to Gurgaon and Sohna



The completed Gurugram Sohna highway and the now completed Mumbai expressway that transverses the area have improved mobility of the region and several housing condominiums

have emerged on the two sides of the highway. The agricultural lands are being procured from the villagers and being developed into residential and commercial hubs. **This strange Urban-Rural duality has created a disconnect between nature and the inhabitants of these villages.**

The settlement of Ghamroj Village originally started around the **water body** and then expanded on all sides. However, over the centuries, as the village expanded and urbanized, the community got disconnected from the natural features especially the water body, *Johd*. This disconnect was further emphasized when a high wall was built around it and the old trees the *chabutras* and other seating arrangement that encompasses the water body were disconnected physically and visually from the water body. The original land slope, which once directed rainwater from the mountains to the pond, now channels contaminated water from the drains. Adjacent homes contribute to the problem by discharging wastewater, resulting in unpleasant odors and unsanitary conditions. The shallow perimeters designed for human interaction now serve as bathing spots for cattle. The water surface is marred by floating plastic bottles and other debris. **Through this project, we would like to revive and reconnect ecology, natural land features, contours, and their role in human settlement.**

This project proposes the revival of a water body to restore its ecological functions and regenerate its capacity to support natural ecosystems. The revival of a water body would help protect aquatic biodiversity, provide a habitat for fish, replenish the groundwater supply, improve water quality and reduce erosion and flooding. This project seeks to use an integrated approach, combining physical restoration techniques with ecologically sustainable management practices. This approach is focused on restoring natural functions, such as hydrology, sediment transport, and nutrient cycling, which have been compromised due to rapid urbanization.

The project has the potential to make a significant contribution to the field of ecological restoration and reconnecting community engagement. By restoring the water body to a more natural state, the project could serve as a model for other potential restoration projects. Furthermore, the project will provide extensive community engagement and educational opportunities, raising public awareness of the importance of aquatic conservation and restoration. **The project is anticipated to play a pivotal role in generating comprehensive data and evidence essential for the formulation of policies applicable to analogous comparable scenarios. This aspect holds the promise of contributing significantly to the development and implementation of policies geared towards fostering sustainable ecological transformation in the realm of rural-urban development.**

2. Origin of the Proposal *(Maximum 1 page)*

(Scientific rationale and importance of the proposed work. Proof of concept/preliminary studies, if any)

The settlement of Ghamroj originally started around the water body and then expanded on all sides. However, over the centuries, as the village expanded and urbanized, the community got disconnected from the natural features especially the water body, *Johd*.

The current situation of the Jodh is as such that it is totally disconnected from the civilization and the village population does not care about its existence. They have built a high wall around it the old trees and the chabutras and other seating arrangement that encompasses the water body are disconnected physically and visually from the water body. The pond is neglected to the extent that it now acts as a collection point of the sewage and rainwater runoffs through the

drains and the natural slope of the region respectively. The edges of the water body which should have been the part of human habitat is now being used by the cattle to bathe. Plastic bottles and other garbage is causing severe impact on the flora and fauna of the Jodh, which could have otherwise flourished.



Figure 3,4 & 5: Existing condition of the Jodh

Objectives:

To conserve the natural landforms and resources by emphasizing their importance in human settlement and integrating them with human needs like social, visual, functional, economic, and environmental factors.

- To enable reconnection of the water body with the inhabitants in a way that **visual, social, functional, environmental, and economic factors are considered while proposing a strategic intervention.**
- **To come up with design proposals in phases to facilitate this reconnection and revival of Jodh with the community at Ghamroj.**
- **Moving towards sustainable ecological transformation of rural-urban development.**
- **To furnish comprehensive data and evidence aimed at formulating a policy** that can be implemented in comparable scenarios, thereby fostering sustainable ecological transformation in rural-urban development.

3. Work Plan:

3.1 Methodology: (Maximum 5 pages)

(It should contain all the details of how each of the objectives will be addressed. This section must be detailed and have clear plans, not vague and generalized statements. It should have several schemes, tables, figures, equations etc. in addition to text, explanation and justification of why the project research plan will work)

Stage 1:

1. Survey of the Ghamroj Village through drone-
 - a. Slope, terrain, topography, vegetation, and organic growth
 - b. Nolli map for population density- real time survey
2. Soil bearing capacity

3. Water testing- PH Testing to measure the acidity of water, Chloride test to check for minerals dissolving and industrial pollution, and Pesticide test to measure whether any pesticides are present and their concentration levels.

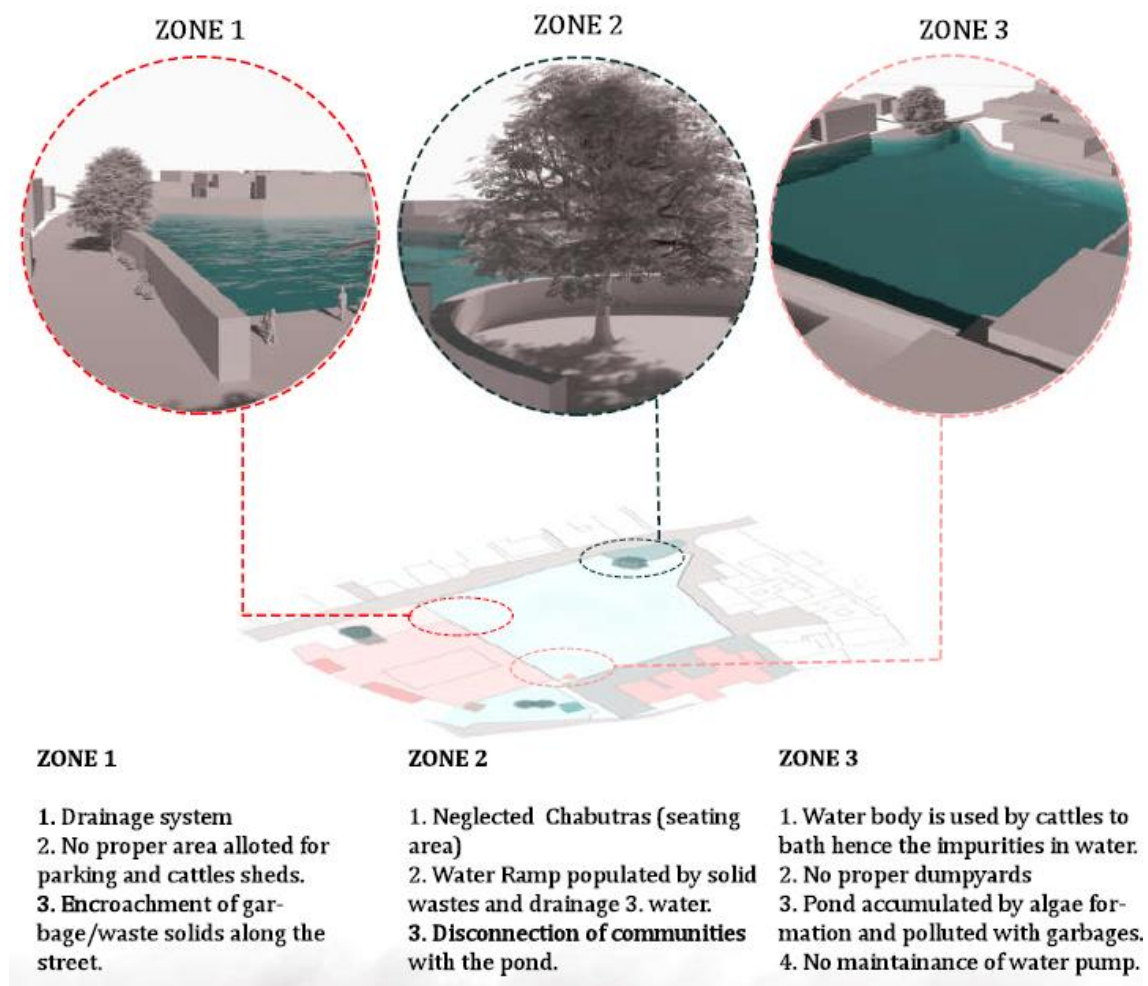
Stage 2:

1. Cleaning up the water body, *Johd* in Ghamroj Village with the help of local community. Introducing aquatic plants and fish in and around the pond to naturally clean and maintain the water in the pond.
2. Creating a partition in the water tank for cattle. Making a channel for the drains and leading it to the partitioned part of the pond where water will be treated.
3. Creating visual connection with all *chabutras* and trees in the vicinity by replacing the solid wall with fences in strategic locations.
4. Repaving of the *chabutras* and some walking paths in terracotta blocks around the pond. Widening of water channels and covering them with paving and plantations.
5. Garbage Collection points and their suitable disposal.

Stage 3:

1. Setting up of water filtration units for the water body. (Depending upon the testing of the water, appropriate filtration units can be installed ranging from low-cost technological unit).
2. Installation of solar panels for power generation.
3. Water supply and drainage to be sorted for the entire village of Ghamroj.

DIVISION OF PROBLEMS IN THREE ZONES



ABOUT THE SITE : JOHD (POND)

Area:

1. Earlier - 5 acres (20,200 sqm)

2. Now - 1.5 acre (6000 sqm)

Depth of the pond : 12-14 feet (3.6-4.2 metre)

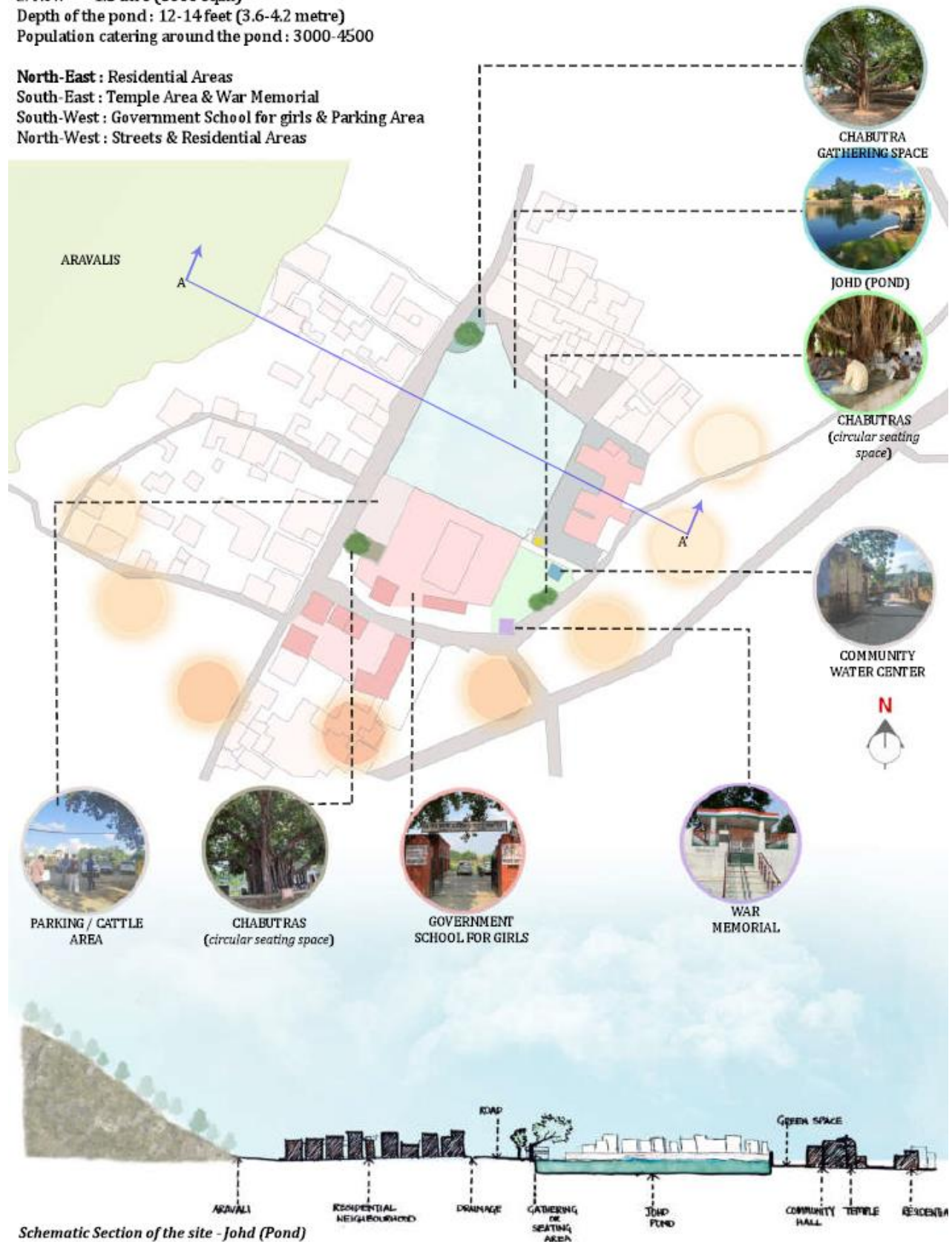
Population catering around the pond : 3000-4500

North-East : Residential Areas

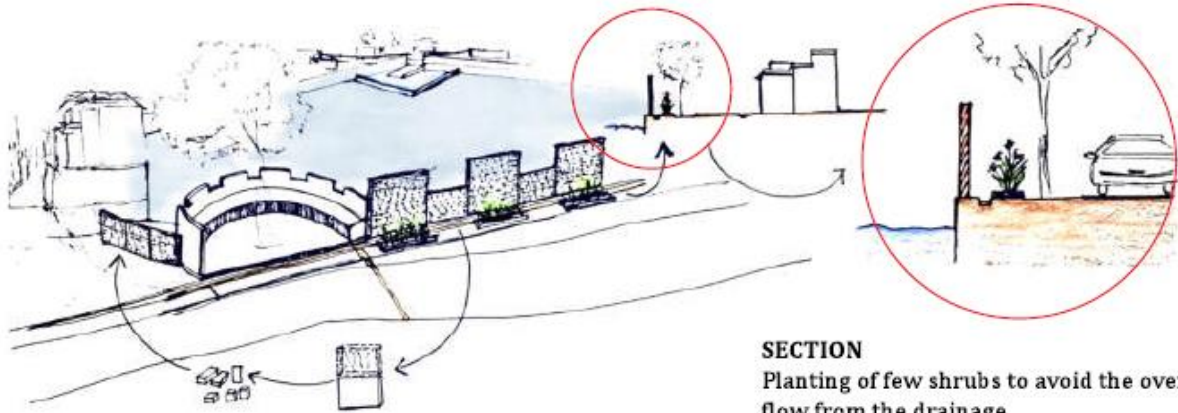
South-East : Temple Area & War Memorial

South-West : Government School for girls & Parking Area

North-West : Streets & Residential Areas



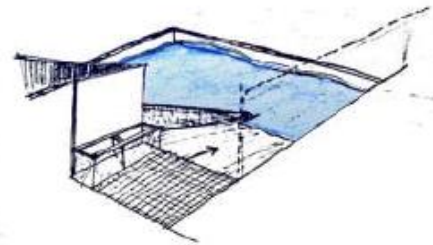
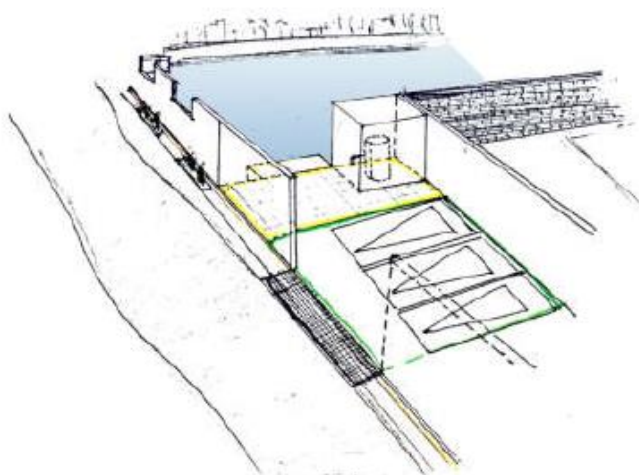
CONCEPT AND DESIGN DEVELOPMENT



- 1 Renovating the seating area by making openings so that people can enjoy the view through it .
- 2 Reusing of the bricks to build a fencing on the existing ramp next to the seating area(chabutra) for prevention of garbage

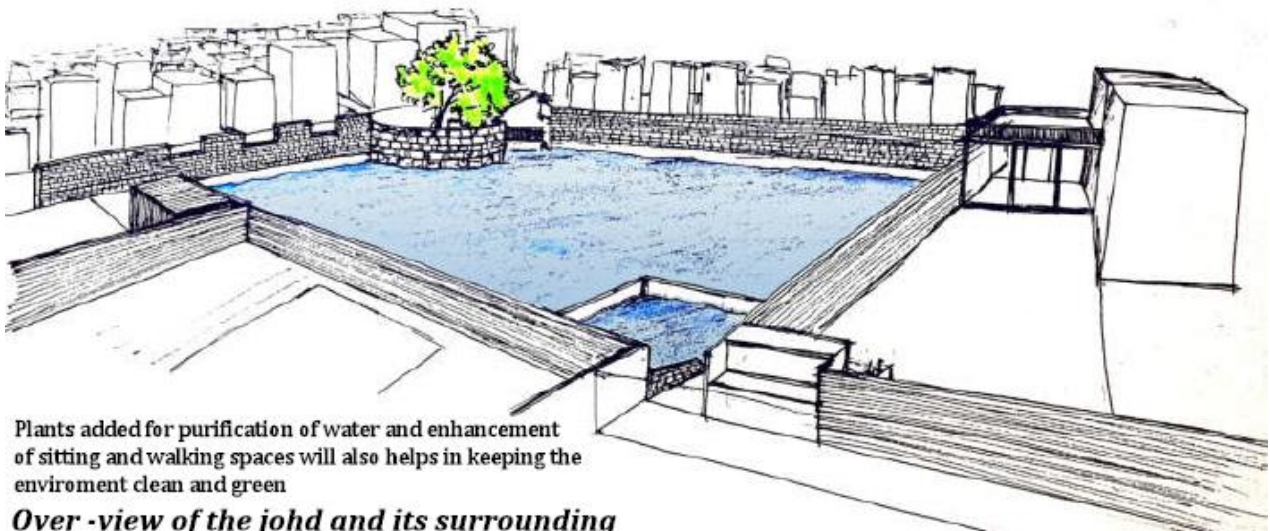
SECTION

Planting of few shrubs to avoid the over-flow from the drainage.
CANNA LILLY -It absorbs potassium and grows



- 1 Partitioned part of the water tank for drain water collection.
- 2 Separation of biodegradable and non biodegradable garbage.

- 1 Segregating the filtration area from the parking area.
- 2 cleaning the garbage area.



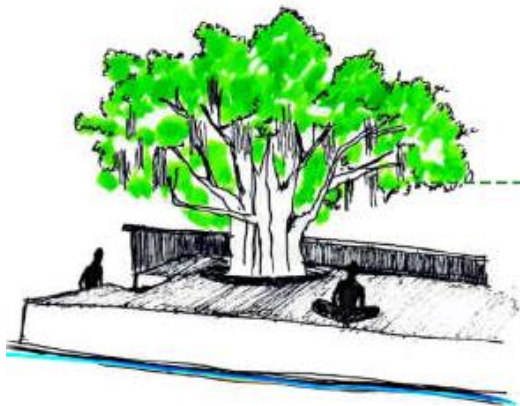
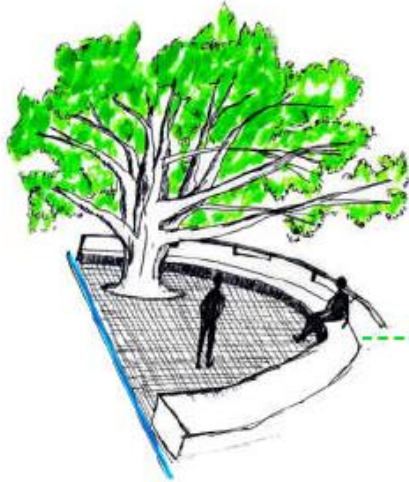
Plants added for purification of water and enhancement of sitting and walking spaces will also helps in keeping the enviroment clean and green

Over -view of the johd and its surrounding

CHABUTRAS - Reconnecting elements for the communities

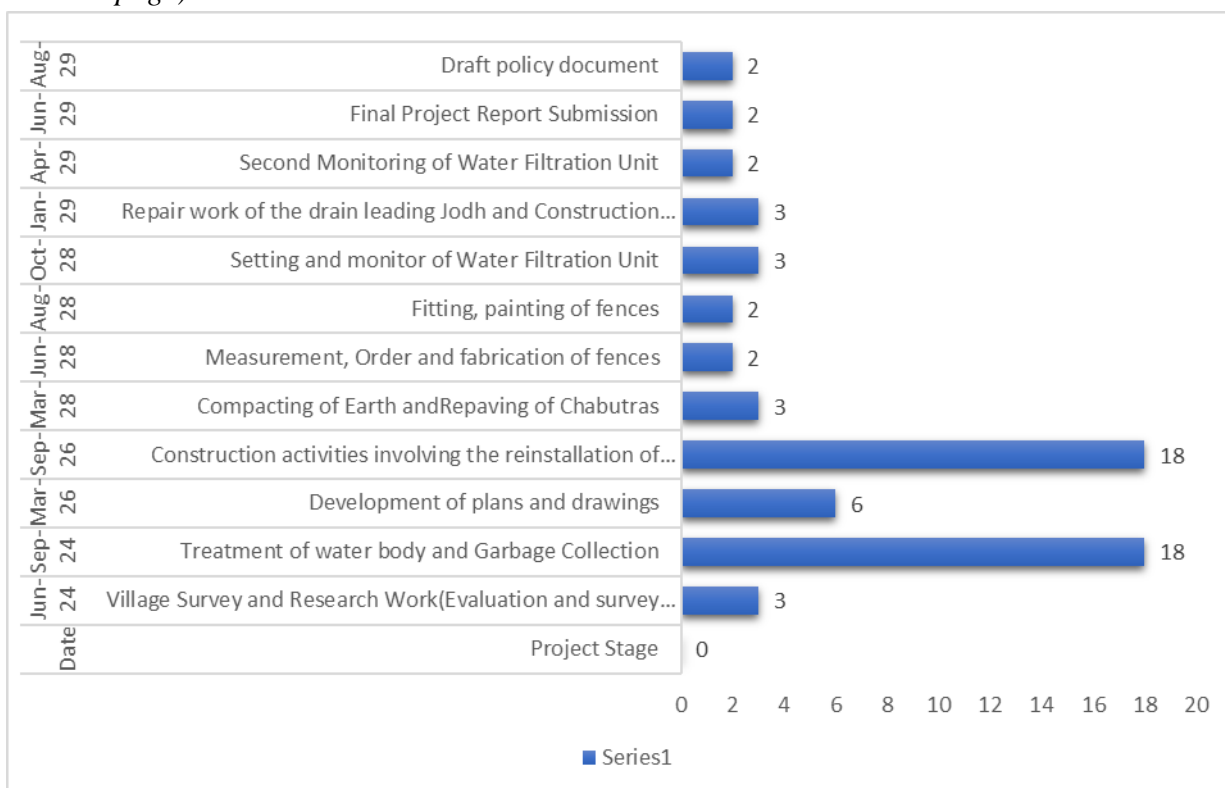
Chabutras with renewed seating and terracotta paving

Chabutra word is a Gujrati word meaning "Pigeon-Tower" or "Pigeon-hole-tower" influenced from the word kabutar (pigeon). In earlier times gurus (teacher) believed that chabutra provides the positive environment which help students to concentrate and keep their mind calm.



It is a structure made up of bricks and stone around a big tree. the purpose of building it is to provide sitting area for villagers and feeding area for birds.

3.2 Time Schedule of activities giving milestones through BAR diagram. (Maximum 1 page)



Project Time Line		
Date	Project Stage	Months
Jun-24	Village Survey and Research Work(Evaluation and survey of Existing Drainage of Ghamroj water quality etc.)	3
Sep-24	Treatment of water body and Garbage Collection	18 (continuous)
Nov-24	Development of plans and drawings	6
May-25	Construction activities involving the reinstallation of drainage systems in the vicinity of the site.	18 (continuous)
Nov-25	Compacting of Earth and Repaving of Chabutras	3
Feb-26	Measurement, Order and fabrication of fences	2
Apr-26	Fitting, painting of fences	2
Jun-26	Setting and monitoring of Water Filtration Unit	3
Sep-26	Repair work of the drain leading Jodh and Construction of Parking and Cattle Area	3
Dec-26	Second Monitoring of Water Filtration Unit	2
Feb-27	Final Project Report Submission	2
Apr-27	Draft policy document	2
	Total	36

4. Expertise:

4.1 Expertise available with the investigators in executing the project: *(Maximum 1 page) (Professional expertise existing with each of the investigators in terms of publications, Patents and preliminary results, to execute every component of the proposal should be highlighted)*

In connection to the fulfillment of the project “Empowering water conservation and wastewater treatments for a sustainable future: An Ecological Reconnection with The Community at Ghamroj Village, Haryana” it shall be taken into consideration that the PI and Co PI of the proposed project are faculty members K R Mangalam University. Being in the proximity of the proposed site of the project the team members have good accessibility to do real-time research and monitoring work required for the project. The huge and sound infrastructure such as labs and workshops of K R Mangalam University are at the team member disposal

The Principal Investigator (PI), Ar. Mansha Samreen has extensive experience in conducting projects of architecture and design. She has spent substantial time on working on the Aanganwadi project of Ghamroj village and has proposed promisable solutions for the issues identified in the area. The Co-PIs are an experienced team that has multiple years of experience in both research and teaching. They have co-authored multiple publications in the proposed area and each holds a dean positions in the institution, where they have access to the necessary resources and personnel. They also have experience mentoring students in conducting research, which will be beneficial to the proposed project.

Dr. Pankaj Agarwal,Co-Investigator

He has a rich teaching experience of more than 22 years in reputed engineering institutions of NCR and research experience of more than 15 years. He has more than 60 research publications in international journals/conferences to his credit. He has 12 research patents to his credit including Australian, German, South African, Canadian & Indian patent grants. He has successfully executed 4 industry projects. His areas of interest & research includes Data Science & Machine Learning algorithms, Algorithms Design & Analysis, Geo-Spatial analysis, Data Analytics, Data mining techniques, with hands on experience in ML, NLP, Computer Vision & Deep Learning with Python Programming, Tableau, KNIME etc. He is an IBM certified data Science Professional & Microsoft certified Programmer.

Dr. Tanaya Verma,Co-Investigator

Dr. Tanaya Verma is a distinguished academic and researcher in architecture with over 21 years of experience. She is a practicing architect and interior designer, renowned for her diverse project portfolio. Holding a PhD in Climate responsive vernacular architecture, she has published extensively in national and international journals and authored book chapters. Dr. Verma's research interests include sustainable architecture, spatial planning, housing, and design pedagogy. Passionate about teaching, she emphasizes heritage, context, and climate in contemporary design education.

The team has access to the facilities and equipment necessary to conduct the research. The PI has access to a computer lab, with the necessary computer infrastructure and storage capabilities. Additionally, the Co-PIs have access to resources of K R Mangalam University, allowing them to conduct research at multiple locations.

4.2 Summary of roles/responsibilities for all Investigators:

(If the proposal contains more than one Investigator, it is important to clearly mention the role of each Investigator in implementing the objectives of the proposal. The Board does not encourage Investigators who do not have specific scientific role in the proposal)

S. No.	Name of the Investigators	Role	Responsibilities
1.	Ar. Mansha Samreen	PI	Overall project coordination, site mapping and execution
2.	Dr. Pankaj Agarwal	Co-PI (1)	Technical and Drone mapping expert
3.	Dr. Tanaya Verma	Co-PI (2)	Urbanism and community involvement

4.3 Key publications published by the Investigators about the theme of the proposal during the last 5 years

Dr. Tanaya Verma

International Journals – SCOPUS Indexed

- Passive Techniques for Achieving Thermal Comfort in the Vernacular Dwelling of Bikaner. International Journal on Emerging Technologies 8(1): 01-06(2017)
- Evidence Based Patient Room Design and Improving Outcomes: Case of Healthcare Facility in Saudi Arabia. S Ahmad, MA Kamal, P Sudhakaran, T Verma, S Roy Journal of Positive Psychology and Wellbeing 6 (2), 1901-1910
- "Vernacular Havelies of Bikaner: Indigenous approach for Thermal Comfort" International Journal of Innovative Technology and Exploring Engineering (IJITEE), ISSN: 2278-3075, Volume-9 Issue-4S, March 2020 , DOI: 10.35940/ijitee.D1024.0394S20
- Daylight Perforation Into The Interior Spaces Of The Vernacular Haveli Of Bikaner. International Journal of Technical Research & Science (Special Issue) ISSN No.:2454-2024 (online)
- An Appraisal of Vernacular Architecture of Bikaner: Climatic Responsiveness and Thermal Comfort of Havelis: Journal of the International Society for the Study of Vernacular Settlements, ISVS e-journal, Vol. 9, no.2, April, 2022

- Challenges and Opportunities in Design of Highrise Healthcare Buildings in Saudi Arabia: An Overview in Journal of Harbin Engineering University, Vol 44 No 11, ISSN: 1006-7043

Papers in International Conference

- Verma Tanaya “Solar and green building guidelines for hot arid climate in india” Sustainable cities conference Dhaka
- Neog Dristi, VermaTanaya “Intelligent Technological Innovations for Energy Efficiency in the Built Environment: Application to the Ansal University Campus in Gurgaon, India” Extropianism Towards Convergence of Human Values and Technology, PP 255-259, 2013. Excellent Publishing House.

Papers in National Conferences

- Verma Tanaya “Nature as a Model, Measure & Mentor for Architecture” Design Art & Research, Past Present & Future conference proceeding.2015
- Verma Tanaya “An appraisal of vernacular courtyard houses in hot and arid region: a case of Bikaner” Amritsar conference proceeding 2017
- Verma Tanaya “Nature as a Model, Measure & Mentor for Architecture” Design Art & Research, Past Present & Future conference proceeding.2015
- Abstract accepted for the “**International Conference on Resilient and Livable City Planning –RLCP 2020**” Organized by School of Planning and Architecture Vijayawada. Paper titled “Climate Responsive Architecture of Haveli’s of Bikaner – A Critical Analysis”
- Abstract accepted for the “**International Conference on Resilient and Livable City Planning –RLCP 2020**” Organized by School of Planning and Architecture Vijayawada. Paper titled “Lighting Performance Of Urban Vernacular Architecture”

Chapter for Book

Jauhari,V and Verma,T, 2014, 'Designing Sustainable Hotels - Technical and Human Aspects', Managing Sustainability in the Tourism and Hospitality Industry: Paradigms and Directions for the Future, Apple Academic Press, Inc., New Jersey, USA (expected release in Spring 2014).

1. Pankaj Agarwal et al. , Machine Learning-based Cloud Optimization System, **Computer Science Engineering and Emerging Technologies, Proceedings of ICCS 2022, Chapter 11**, Taylor & Francis Group, London, CRC press, ISBN 978-1-032-52199-2, 2023
2. Pankaj Agarwal et al. De-noising the image using DBST-LCM-CLAHE: A deep learning approach. Multimed Tools Appl (2023). **Springer Nature**, I.M: 2.5, Indexed in **SCIE, Scopus**; <https://doi.org/10.1007/s11042-023-16016-2>
3. Pankaj Agarwal et.al ; An Effect of Stacked CNN for Network Intrusion Detection System; ICIMMI '22: Proceedings of the 4th International Conference on Information Management

& Machine Intelligence; Article No.: 64; Pages 1–9, Indexed in **ACM Digital Library**, 2023; <https://doi.org/10.1145/3590837.3590901>

4. Pankaj Agarwal et. al ; Parametric Influence Of Intrusion Detection System In Healthcare Sector Using Deep Neural [LSTM] Network; Journal of Pharmaceutical Negative Results, Volume 14, Special Issue 1, 2023, indexed in Scopus, ESCI. <https://doi.org/10.47750/pnr.2023.14.S01.93>
5. Pankaj Agarwal et. al; *Realtime Crop field monitoring system using IoT*, *International Journal of Nanotechnology*, **Inderscience Journal**; **indexed in SCIE, Scopus (Elsevier) & Web of Science**, ISSN: 1475-7435, I.F: 0.511. <https://doi.org/10.1504/IJNT.2023.134016>
6. Pankaj Agarwal et. Al; Seizure Prediction and Detection Using Integrated Learning Algorithms from Multi-Source Data; Computational and Mathematical Methods in Medicine; **Hindwai Journal, Indexed in SCIE, Scopus & Web of Science Indexed**
7. Pankaj Agarwal et. al; "Cyber-Internet Security Framework to Conquer Energy-Related Attacks on the Internet of Things with Machine Learning Techniques", Computational Intelligence and Neuroscience, vol. 2022, Article ID 8803586, 13 pages, 2022. <https://doi.org/10.1155/2022/8803586>, **Hindwai Journal, SCIE, Scopus & Web of Science Indexed, Wiley Publication (I.F: 3.12)**
8. Pankaj Agarwal et al; "Biomedical Application of Identified Biomarkers Gene Expression Based Early Diagnosis and Detection in Cervical Cancer with Modified Probabilistic Neural Network", Contrast Media & Molecular Imaging, vol. 2022, Article ID 4946154, 10 pages, 2022. <https://doi.org/10.1155/2022/4946154>, **Hindwai Journal, SCIE, Scopus & Web of Science Indexed**, Published 2022 (I.F: 3.10)
9. Agarwal, P., Yadav, S, 'Bayesian-based binary compression with bandwidth optimization for UAV aerial images', *Int. J. Engineering Systems Modelling and Simulation*, **Inderscience Journal**, DOI: 10.1504/IJESMS.2022.10046833 (in press), **Indexed in Scopus, Emerging Sources Citation Index** (Clarivate Analytics), CiteScore : 0.8 (2022) doi: 10.1504/IJESMS.2022.10046833

INTERNATIONAL JOURNALS

1. Neda F, Pankaj A, Sapna Y. COVID-19 Vaccination Progress in India and its Neighbors. International Journal of Current Research and Review, 13(23), December, 2021, 108-112, <http://dx.doi.org/10.31782/IJCRR.2021.132318>, Indexed in Indian Citation Indexed, Scopus Indexed (till Dec 2021)
2. Sapna Yadav, Pankaj Agarwal, S.M Rizvi; "Applying Machine Learning for Prediction of Future Strains of Influenza-A Virus"; Journal of Drugs and Cell Therapies in Hematology (DCTH), Italy; 10(1), 1435–1449. <http://www.dcth.org/index.php/journal/issue/view/1> **indexed in ESCI, Web of Science** (2021)
3. Pankaj Agarwal, Sapna Yadav; "How India and its Neighbors are doing during Covid-19 Pandemics- A Critical Analysis"; International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-9 Issue-3, **Scopus Indexed**, DOI: [10.35940/ijrte.C4261.099320](https://doi.org/10.35940/ijrte.C4261.099320) (September 2020)

4. Sapna Yadav, Pankaj Agarwal; “*Influenza Prediction: Analyzing Machine Learning Algorithms*”; Asian Journal of Computer Science and Technology, DOI: [10.35940/ijrte.C4261.099320](https://doi.org/10.35940/ijrte.C4261.099320), ISSN: 2249-0701 Vol.9 No.1, 2020, pp. 14-18 (2020)
5. Yash Bansal, Vishal Sharma, Pankaj Agarwal, “Imagenics Super-Resolution Generative Adversarial Networks (ISRGAN),” *International Journal of Computer Sciences and Engineering*, Vol.8, Issue.5, pp.196-200, 2020
6. Yadav, Sapna and Pankaj Agarwal, Predictive Model for Analyzing PM 2.5 Level Of Air (March 28, 2020). Proceedings of the International Conference on Innovative Computing & Communications (ICICC) 2020, Available at SSRN: <https://ssrn.com/abstract=3562955> or <http://dx.doi.org/10.2139/ssrn.3562955>
7. Pankaj Agarwal, Mukesh Singh, “A multipurpose drone for water sampling & video surveillance”, Second IEEE International Conference on Advanced Computational and Communication Paradigms, Sikkim (2019). IEEE e-explore ref (<https://ieeexplore.ieee.org/document/8883017>)
8. Shivani Agarwal, Pankaj Agarwal, “By using MADALINE Learning with Back Propagation and Keras to Predict the Protein Secondary Structure”, *International Journal of Engineering and Advanced Technology (IJEAT)* ISSN: 2249 – 8958, Volume-9 Issue-2, December, 2019 (**Scopus indexed**)
9. **Pankaj Agarwal** et al, “Prediction of Secondary Structure of Proteins by using Back-propagation and Sliding window for Error Minimization”, International Conference SIGMA-2018 organized by NSIT Delhi, **Springer book series**, Feb 2018
10. Kaushal Kishor, **Pankaj Agarwal** “Secure and Efficient Routing Protocol for MANET” *Indian Journal of Public Health Research & Development*, Volume 9, No. 12, December 2018. (**Scopus index journal**)
11. Kaushal Kishor, Parma Nand, **Pankaj Agarwal**, “Subnet Hybrid Gateway MANET Protocol on the basis of Dynamic TTL Value Adjustment” *Journal of Engineering and Applied Sciences*, Issue 13 (3), pp. 776-783, March 2018. **Scopus Indexed, Springer Open**
12. Kaushal Kishor, **Pankaj Agarwal**, “Subnet Based Ad Hoc Network Algorithm Reducing Energy Consumption in MANET”, *International Journal of Applied Engineering Research*, (**Scopus Indexed**), ISSN 0973-4562 Volume 12, Number 22 (2017) pp. 11796-11802 (ISI Indexed Journal with I.M 4.4)
13. K Kishor, P Nand, **P Agarwal**, “*Subnet Based Ad Hoc Network Algorithm Reducing Energy Consumption MANET*”, *International Journal of Applied Engineering Research*, Issue 22, Volume 12, ISSN 0973-4562, pp. 11796-11802, October 2017. (**Scopus Indexed Journal**)
14. Abhjeet Sekhon, **Pankaj Agarwal**, “Face Recognition Using K-Means and RBFN”, *International Journal of Computer Science and Mobile Computing*, Vol.6 Issue.2, , February -2017,pg. 137 -141, ISI indexed (2017)
15. **Pankaj Agarwal** et al ; “Machine Learning Tool Box”; *Machine Learning and Applications: An International Journal (MLAIJ)*; Vol 3, No. 3, September 2016
16. Abhjeet Sekhon and **Pankaj Agarwal**; ‘Face Recognition Using Artificial Neural Networks’; *International Journal of Computer Science and Information Technologies*, Vol. 7 (2) , 2016, 896-899. I.F 3.2 (2016)

17. Abhjeet Sekhon and **Pankaj Agarwal**; 'Face Recognition Using Unsupervised Learning Technique'; International Journal of Computer Science and Information Technologies, Vol. 7 (5) , 2016, 2163-2166
18. Pankaj Agarwal et al; "Multiple Sequence Alignments with Parallel Computing"; Published in International Journal of Computer Applications® (IJCA) (0975 – 8887),USA. (2014).
19. Ruchi Gupta, **Pankaj Agarwal**, A.K Soni" MSA-GA: Multiple Sequence Alignment Tool Based on Genetic Approach", International Journal of Soft Computing and Software Engineering [JSCSE], Vol. 3, No. 8, pp. 0-0, 2013; **indexed in SCIVERse(SCOPUS)**; published by Advance Academic Publisher; San Francisco, USA (2013)
20. Ruchi Gupta and **Pankaj Agarwal**; "Two New Genetic Algorithm Based Methods for Obtaining Alignment of Multiple Sequences"; International Journal of Advanced Research. (**impact factor: 1.6**)(2013)
21. **Pankaj Agarwal** et al.; "To Study the Effect of Genetic Operators on Alignment of Multiple Sequences"; Journal of Computer Science & Systems Biology (ISSN: 0974-7230); published by OMICS Publishing Group, Los Angeles, USA; Impact Factor: 1.62 (2013)
22. **Pankaj Agarwal** et al.; "Genetic Algorithm Based Approach for Obtaining Alignment of Multiple Sequences"; published in International Journal of Advanced Computer Science and Applications (IJACSA); U.S ISSN : 2156-5570(Online) ;U.S ISSN : 2158-107X(Print); Vol 3, No. 12; IM:[1.187](#)(2011), indexed in **Scopus (Elsevier)** (Dec, 2012).
23. **Rahul & Pankaj Agarwal**; 'A Review: Applying Genetic Algorithms for Motif Discovery'; International Journal of Research in Computer Science, A Unit of White Globe Publications; ISSN (Print) : 2249 – 8257 (2012)
24. **Pankaj Agarwal** et al.; "Secondary Structure Prediction Using ANN Learning"; **International Journal of Computer Science & Engineering Technology (IJCSET)**,ISSN: **2229-3345**; Vol 1 Issue 1 2011; indexed & archived in all major academic databases like **Citeulike - sponsored by Springer** etc (2011).
25. **Pankaj Agarwal & Laxmi Kant.**; "Enhanced Matrix Model for Finding Sequence Motif", **International Journal on Computer Science and Engineering (IJCSSE)** (ISSN: **2229-5631**) Volume 3 Issue 1 2011; Published by: Engineering Journals Publications; indexed & archived in all major academic databases (2011).
26. **Pankaj Agarwal**; "Hand-Written Character Recognition Using Kohonen Network"; International Journal Of Computer Science & Technology (IJCSST) , VOL.2, ISSUE.3, SEPTEMBER, 2011, ISSN : 0976-8491 (online), 2229-4333 (Print), Indexed in ACM Computing Reviews, ACM Guide to Computing Literature, SCOPUS, DBLP, EBSCO database, Google Scholar etc (2011).
27. **Pankaj Agarwal** et al.; "Sequence Alignment Using Sequence Comparison and Analysis Tool", **International Journal on Recent Trends in Engineering & Technology [IJRTET]**, Volume 4, Issue 2, 2010[ISSN: 2158-5563], [ACEEE](#),USA; indexed in major academic databases, including Scopus, SEARCH Digital Library, IEE INSPEC, EI (Compendex), Thomson ISI (ISTP), and other indexing services (2010). [IM-1.084]
28. **Pankaj Agarwal** et al.; "Performance Analysis Of Exact Pattern Matching Algorithms On Molecular Sequences", **International Journal on Recent Trends in**

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GRANTS RECEIVED

- Completed Research project with Grant of Rs. 485000 from AKTU, Lucknow for project "Multipurpose Drone", 2017-2020 under [Visvesvaraya research scheme](#) as principal investigator.

PATENTS

1. Pankaj Agarwal et. al; "An Impaired Voice Correction Device and its Method Thereof", Application Number: [2021105188](#), published on 27/10/2021 (**Australian Patent Grant**)
2. Pankaj Agarwal et. al; "Collective Movement Prediction and Learning Model for Team Sports", Application Number: 202141042396 (Indian Patent), Status: Published, Publication date: 29/10/2021(**Indian Patent**)
3. Pankaj Agarwal et. al; "Intelligent System for Management of Healthcare Recourses in Hospital Using Data Mining & Machine Learning", Application Number: 202111051627 (Indian Patent), Status: Published, Publication date: 19/11/2021(**Indian Patent**)

4. Pankaj Agarwal et. al; “A Smart Nervous System and a Method Based on Artificial Intelligence and Machine Learning to Assist Paralyzed People”, Application Number: 202111053267 (**Indian Patent**), Status: Published on 26/11/2021
5. Pankaj Agarwal et. al; “Smart Shoe for Blind People to Detect Obstacles Using Internet of Things & Artificial Intelligence”, Application Number: 202121048446 (**Indian Patent**), Status: Published: 3/12/2021
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5. List of Projects submitted/implemented by the Investigators

(All the Investigators should list out details of the Projects submitted, implementing and completed by them. The list should start with the Projects implemented by the Principal Investigator, followed by Co-PI1, Co-PI 2 etc.)

5.1 Details of Projects submitted to various funding agencies

Prof. Pankaj, Completed Research project with Grant of Rs. 485000 from AKTU, Lucknow for project “Multipurpose Drone“, 2017-2020 under [Visvesvaraya research scheme](#) as principal investigator.

S. No	Title	Cost in Lakh	Month of submission	Role as PI/Co-PI	Agency	Status
1	“Multipurpose Drone”	4.85 Lakh	August	principal investigator	Visvesvaraya research scheme	complete

6. Equipment available with the Institute/ Group/ Department/Other Institutes for the project:

Equipment available with	Generic Name of Equipment	Model, Make & year of purchase	Remarks including accessories available and current usage of equipment
PI & his/her group	Auto CAD	Drafting software, 2022	Computer lab equipped with all drafting and mapping software
PI's Department	Machine Learning and Learning facility	Anaconda	For data analytics and development
	Surveying and leveling lab	Surveying equipments	Site mapping