PRANAVAM RESEARCH AND DEVELOPMENT ORGANIZATION

No.2/3 TNHB Flats, Sector -1, Maduravoyal, Chennai -600 095.
www.prdo.in, E-mail: pranavamtrust@yahoo.com,
Mobile: +91-9566161619, 7550042555

Dr. R. Kalavathy
CEO

Dr. M. Rajaram Narayanan
Managing Director

06.10.2022

To,

The Principal,

A.R Engg College

Villupuram.

Dear Sir,

Sub: Project Proposal "A.I Interfaced Humanoid base Voice Assistance Robotic Chat BOT" funding Sanction – Reg.

**Ref :** Letter dated 18.08.2022/2022-2023

Greetings from PRANAVAM RESEARCH AND DEVELOPMENT ORGANIZATION! We are pleased to accept the request for a short-term research project from your institution. When followed, it helps to achieve a goal. We consider it - the art of thinking through. Upscale your development and integrate new ideas and practice for public good. In order to ensure the effective completion of the project titled "A.I Interfaced Humanoid base Voice Assistance Robotic Chat BOT", we guarantee that we will give the necessary technical assistance from our end.

We would like to express our gratitude for the earlier quote and project technical specification. For the purpose of our coordination, kindly designate a SPOC from your side. Excited to work with you in the future.

Regards,

For PRANAVAM RESERCH AND DEVELOPMENT ORGANISATION
Authorized signatory
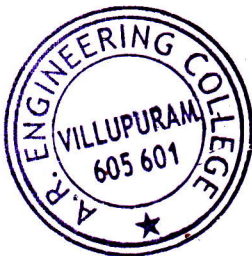
Proprietor

Dr.R.PANNEERDHASS,M.E.,Ph.D.,
PRINCIPAL
A.R.ENGINEERING COLLEGE
VADAKUCHIPALAYAM,
KAPPIYAMPULIYUR POST,
VILLUPURAM-605 601.
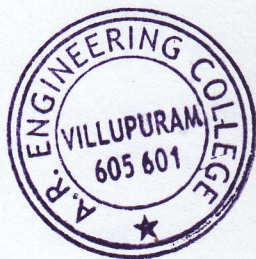
CONSULTANCY WORK AGREEMENT

Between

A. R. ENGINEERING COLLEGE

(Approved by AICTE, New Delhi & Affiliated to Anna university, Chennai)

Vadakuchipalayam, Kappiyampuliyur post,Villupuram-605601,Tamilnadu

And

. PRANAVAM RESEARCH AND DEVELOPMENT ORGANIZATION

Dr.R.PANNEERDHASS,M.E.,Ph.D.,
PRINCIPAL
A.R.ENGINEERING COLLEGE
VADAKUCHIPALAYAM,
KAPPIYAMPULIYUR POST,
VILLUPURAM-605 601.

CONSULTANCY WORK AGREEMENT

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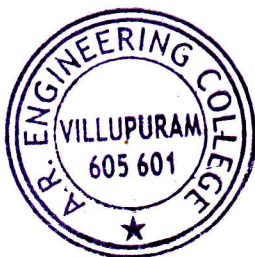
About the College

In 2008, A.R Engineering College began with four Undergraduate Engineering programmes with an annual intake of 240 students, and now has six Undergraduate programmes with an annual intake of 300 students. The AICTE's clearance and affiliation with Anna University for such a progressive intake is a testament to the college's consistent growth over the years. The college has grown considerably under the dynamic leadership of its Chairman Sri.G.Madhadevan, Vice Chairman Sri.M.Kuberan, B.E., M.Tech, Secretary Sri.M.Prabu, B.E., MBA., and Principal Dr.R.Panneerdhass, spear heading all academic and non academic activities.

About Company

Centre for Research Lab is established by Pranavam Educational & Scientific Public Charitable Trust (PESPCT) as a Research Centre under which research support is provided for the scholars pursuing PhDs. It is fully equipped with sophisticated instruments accessible to all the researchers. The main objective of the CRL is to promote high-quality research in science and engineering disciplines by providing facilities and technical expertise in support of basic and applied research activities. The laboratory promotes scientific thinking and experimental exposure for researchers.

In continuation, both parties planned to involve in the research activities and both parties agree that,

1. A.R Engineering College may involve subject experts from the pranavam research and development organization for their funded project and consultancy work.

2. All Services to be provided by the Investigators shall be performed with promptness and diligence in a workmanlike manner and at a level of proficiency.

3. A.R Engineering College shall provide such access to its information, property and personnel as may be reasonably required in order to permit the Investigators to perform the services.

Dr.R.PANNEERDHASS,M.E.,Ph D.,
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4. A.R Engineering College and pranavam research and development organization experts are partners for the funded project and consultancy work.

5. A.R Engineering College can utilize the resources from pranavam research and development organization for funded project work for testing and other related works.

6. This agreement shall commence on the effective date and shall remain in effect until the completion of the services. (From18.08.2022 to 08.11.2022).

7. All information relating to funded project work is highly confidential and the intellectual property if any resulted from the work will be jointly protected by both the parties.

8. The Investigator may retain one copy of the confidential information in its legal files.

9. This Agreement may not be modified other than authorized representatives of the parties.

TITLE OF THE RESEARCH PROJECT

A.I INTERFACED HUMANOID BASED VOICE ASSISTANCE ROBOTICS CHAT BOT

Principal Investigators   : Dr. B. JAGAJOTHI

Associate Professor/ Dept of EEE

Co-Investigators   : Mr. R.UDAYAKUMAR

Assistant professor/Dept of EEE

Duration   : 12 months

Project Amount   : Rs 500000 - (Rupees Five lakhs only)

Description of the Consultancy work: Our training programs are structured around present human capital training demand, an anticipation of the future needs.

Outcome of the short-term research project: Revolutionize human-robot interaction by developing a humanoid robot capable of understanding and responding to voice commands with high accuracy and context-awareness. This system will offer real-time assistance in various domains such as personal support, customer service, education, healthcare, and smart home automation. Powered by advanced speech recognition and natural language processing, the robot will deliver personalized, adaptive responses based on user preferences and behavior. Its integration with IoT devices will enable seamless automation and control of
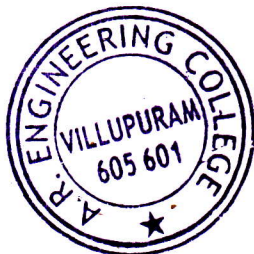
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smart systems, enhancing convenience and efficiency. The project emphasizes inclusivity by offering voice-assisted technology to support individuals with disabilities, improving accessibility to cutting-edge tools. With a scalable and modular design, the chatbot can be easily customized and upgraded for diverse applications, ensuring long-term relevance. Furthermore, the project will contribute valuable insights to the fields of AI, robotics, and data analytics, promoting innovation and research advancements. By combining user-friendly interfaces with state-of-the-art technologies, this humanoid chat bot will redefine the boundaries of intelligent assistance.

For M/s Pranavam Research and Development Organization

For PRANAVAM RESERCH AND
DEV~~Authorized signatory~~ANISATION

Proprietor

Proprietor

Place : Villupuarm

Date : 08-11-2022
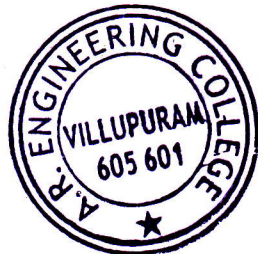
For M/s A. R Engineering College

08|11|2022

Authorized Signatory

Principal

Place : Villupuarm

Date : 08-11-2022

Dr.R.PANNEERDHASS,M.E.,Ph.D.,
PRINCIPAL
A.R.ENGINEERING COLLEGE
VADAKUCHIPALAYAM,
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PROJECT REPORT

A.I INTERFACED HUMANOID BASE VOICE ASSISTANCE ROBOTIC CHAT BOT

PROJECT DESCRIPTION

1. Introduction and Background

A cutting-edge integration of artificial intelligence (AI) and robotics to create an advanced voice-interactive humanoid system. This innovative chatbot is designed to bridge the gap between human-computer interaction by delivering natural, intuitive, and context-aware conversational experiences. Leveraging state-of-the-art speech recognition, natural language processing, and machine learning, the humanoid robot aims to provide real-time assistance across various domains, including customer support, healthcare, education, and home automation. Its adaptive capabilities ensure personalized interactions, enhancing user satisfaction and efficiency. By incorporating IoT connectivity, the system enables seamless control and automation of smart devices, showcasing its potential in modern smart environments. This project also addresses accessibility challenges by offering voice-enabled support for individuals with disabilities, fostering inclusivity. Rooted in the principles of scalable and modular design, the chatbot is primed for future advancements, making it a versatile tool in AI and robotics innovation

2. PROBLEM STATEMENT

In an increasingly digital world, the demand for intuitive, user-friendly, and efficient human-machine interaction is growing rapidly. Traditional interfaces, such as text-based or screen-based systems, often fall short in providing natural and accessible communication, especially for individuals with disabilities or those unfamiliar with complex technologies. Current voice-assistance systems, while functional, lack the personalization, contextual understanding, and humanoid interaction capabilities required for an immersive user experience. Additionally, the integration of such systems with IoT devices for seamless automation remains limited, leading to fragmented user experiences.

The absence of a robust, AI-driven humanoid robotic solution that combines advanced speech recognition, natural language processing, adaptive learning, and IoT connectivity creates a significant gap in meeting these evolving needs. This project, "A.I Interfaced Humanoid-Based Voice Assistance Robotic Chat Bot," seeks to address these challenges by developing a humanoid chatbot capable of real-time,
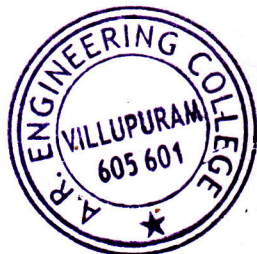
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personalized assistance across various domains, offering accessibility, scalability, and an enriched user experience that bridges the gap between humans and technology.

3. OBJECTIVES AND VISION

Objective

The primary objective of the project "A.I Interfaced Humanoid-Based Voice Assistance Robotic Chat Bot" is to develop an intelligent, voice-interactive humanoid robot that leverages advanced artificial intelligence, natural language processing, and IoT integration to provide seamless, personalized, and real-time assistance across diverse domains. The project aims to enhance accessibility, improve user engagement, and create scalable, adaptive solutions for applications in customer service, healthcare, education, home automation, and beyond.

Vision Statement

To revolutionize human-machine interaction by creating an AI-powered humanoid robot that delivers intuitive, empathetic, and accessible voice-based assistance, fostering a world where technology seamlessly integrates with human life, enhancing productivity, inclusivity, and connectivity.

4. TARGET AREAS OF RESEARCH

The Projects aims to address multiple sectors and areas where intelligent voice-interactive systems can enhance functionality and user experience. The primary target areas include:

Healthcare:

- Providing voice-guided assistance for patients, enabling appointment scheduling, medication reminders, and health monitoring.
- Supporting doctors and nurses by offering real-time access to medical records and procedural information.

Education:

- Acting as a virtual tutor to assist students with learning tasks, answering questions, and providing resources.
- Enhancing interactive learning experiences through voice-based and conversational engagement.

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Customer Service:

- Offering personalized support in retail, banking, and service industries through AI-driven conversations.
- Reducing response time and improving customer satisfaction by handling queries efficiently.

Home Automation:

- Controlling smart home devices through voice commands, enabling automation of tasks like lighting, security, and temperature control.
- Providing companionship and assistance for elderly or differently-abled individuals.

Industrial Applications:

- Assisting in workplace environments by providing real-time data, safety updates, and process instructions.
- Enhancing productivity and reducing errors through automation and conversational interfaces.

Public Services:

- Facilitating information dissemination in public spaces like airports, train stations, and hospitals.
- Acting as a multilingual guide for tourists and individuals in need of localized assistance

5. PROJECT IMPLEMENTATION

The implementation of the "A.I Interfaced Humanoid-Based Voice Assistance Robotic Chat Bot" in the healthcare sector focuses on enhancing patient care, optimizing healthcare services, and improving the efficiency of medical professionals. By leveraging advanced AI and robotic technologies, the project integrates voice assistance capabilities with healthcare systems to address key challenges in the industry.

Patient Interaction and Support:

- The humanoid chatbot will act as a virtual assistant for patients, providing voice-guided support for appointment scheduling, medication reminders, and routine health check-up notifications.
- It will facilitate communication for patients with disabilities or language barriers by supporting multiple languages and voice-based interaction.
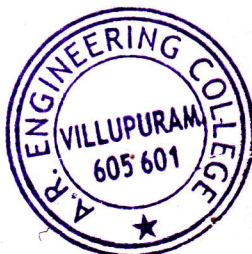
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Medical Professional Assistance:

- The robot will assist healthcare professionals by providing instant access to medical records, treatment histories, and procedural guidelines through voice commands.
- It can be programmed to perform administrative tasks, such as documenting patient information or generating reports, reducing the workload on staff.

Real-Time Health Monitoring:

- Equipped with IoT connectivity, the chatbot can integrate with wearable health devices to monitor vital signs like heart rate, blood pressure, and blood sugar levels.
- It can alert medical staff or family members in case of abnormal readings, ensuring timely intervention.

In-Hospital Assistance:

- The humanoid can guide patients and visitors within hospital premises by providing directions, answering queries, and offering information about hospital services.
- It can also enhance patient comfort by acting as a companion during hospital stays, reducing feelings of isolation.

Telemedicine and Remote Healthcare:

- The chatbot can assist in telemedicine services by facilitating remote consultations, answering preliminary health-related questions, and collecting patient data before a doctor's consultation.
- This implementation improves accessibility for patients in remote or underserved areas.

Data Analytics for Improved Care:

- The system can collect and analyze interaction and health data, providing valuable insights to improve treatment plans, hospital management, and patient satisfaction.

By integrating into healthcare, the project creates a holistic and patient-centered approach, reducing the burden on medical staff while ensuring quality care and improving patient outcomes.

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Dr. M. Rajaram Narayanan
Managing Director

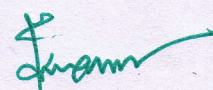Dr. R. Kalavathy
CEO

Date: 18.05.2023

COMPLETION CERTIFICATE

We are satisfied with the completion and working of the project developed in the application. Our team is happy with the outcome of the project which has been successfully integrated under the project entitled "A.I Interfaced Humanoid base Voice Assistance Robotic Chat BOT" implemented at PRANAVAM RESEARCH AND DEVELOPMENT ORGANIZATION. The Coordination is excellent in completing the research project successfully within the time frame. As discussed, the project amount of Rs 500000/- would be disbursed in favor of A.R Engineering College.

We are happy to associate with you in future.

For PRANAVAM RESERCH AND
DEVELOPMENT ORGANISATION
Authorized signatory
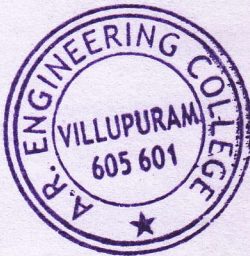
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VILLUPURAM-605 601.

08.11.2021

To

The Principal

A.R Engineering College

Villupuram.

Sir,

Sub: Project Proposal "Familiarization of Zynq-7000 Dual Core for FPGA So C programming and its application"funding Sanction – Reg.

Ref : Letter dated 18.08.2021/ 2021-2022

Greetings from HIGHFLIERS ASSOCIATES! We are pleased to accept the request for a short-term research project from your institution. When followed, it helps to achieve a goal. We consider it - the art of thinking through. Upscale your development and integrate new ideas and practice for public good. In order to ensure the effective completion of the project titled "Familiarization of Zynq-7000 Dual Core for FPGA So C programming and its application", we guarantee that we will give the necessary technical assistance from our end.

We would like to express our gratitude for the earlier quote and project technical specification. For the purpose of our coordination, kindly designate a SPOC from your side. Excited to work with you in the future.

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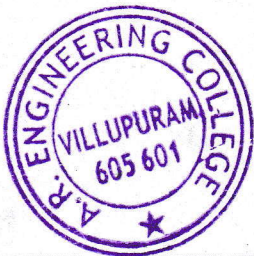
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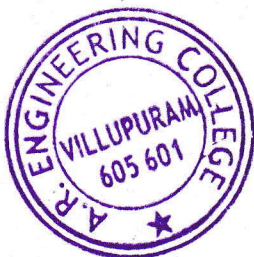
Between

A. R. ENGINEERING COLLEGE

(Approved by AICTE, New Delhi & Affiliated to Anna university, Chennai)
Vadakuchipalayam, Kappiyampuliyur post,Villupuram-605601,Tamilnadu

And

HIGHFLIERS ASSOCIATES

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About Company

High Fliers Associates is set up with the objective of increasing employment opportunities of fresher's, by developing their competencies. High Fliers is engaged in placement of professionals at senior, Middle and junior levels in well-known organizations across India. We pledge to meet and exceed the expectations of our customers through the process of continuous improvement.

In continuation, both parties planned to involve in the research activities and both parties agree that,

1. A.R Engineering College may involve subject experts from the HIGHFLIERS ASSOCIATES for their project and consultancy work.
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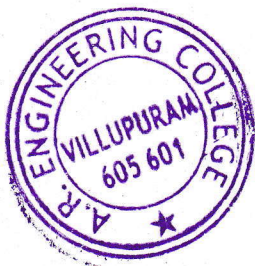
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3. A.R Engineering College shall provide such access to its information, property and personnel as may be reasonably required in order to permit the Investigators to perform the services.

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8. The Investigator may retain one copy of the confidential information in its legal files.

9. This Agreement may not be modified other than authorized representatives of the parties.

Project title : Familiarization of zynq-7000 dual core for FPGA SoCc programming and its application

Principal Investigators	: Dr. V. MURUGAN, Professor/Dept of ECE
Co-Investigators	: Mr. P. SARAVANAN, Assistant Professor/ Dept of ECE
Duration	: 12 months
Project Amount	: Rs 500000 - (Rupees Five lakhs only)

Description of the Consultancy work:

Focuses on exploring and leveraging the capabilities of the Xilinx Zynq-7000 System on Chip (SoC) platform. The Zynq-7000 series combines a dual-core ARM Cortex-A9 processor with a programmable FPGA fabric, making it a versatile platform for high-performance embedded system development.

The primary goal of this project is to familiarize with the architecture, tools, and programming paradigms required to efficiently utilize the Zynq-7000 SoC. Through hands-on implementation, the project will explore the integration of software and hardware, enabling the development of high-speed, low-power, and application-specific designs.
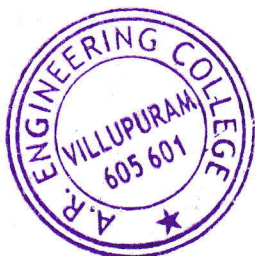
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Expected Outcome:

The project titled "Familiarization of Zynq-7000 Dual Core for FPGA SoC Programming and Its Application" is expected to deliver the following outcomes:

Comprehensive Understanding of Zynq-7000 Architecture:

- Gain in-depth knowledge of the Zynq-7000 SoC, including the dual-core ARM Cortex-A9 processing system (PS) and the programmable logic (PL).

- Clear insights into the integration and interaction between hardware and software components within the SoC.

Proficiency in Hardware-Software Co-Design:

- Skills in partitioning system functionality between software and hardware for optimized performance.

- Experience in implementing co-design principles to maximize the efficiency of embedded systems.

Practical Experience with FPGA Development Tools:

- Hands-on familiarity with tools such as Xilinx Vivado for hardware design and SDK for software development.

- Proficiency in writing and debugging HDL code and using high-level synthesis tools for FPGA programming.

Implementation of Real-World Applications:

- Successful development of prototype applications demonstrating the capabilities of the Zynq-7000 platform, such as signal processing, image recognition, IoT systems, or real-time control systems.

- Showcasing the potential of FPGA SoC in solving industry-specific challenges.

Performance Optimization Skills:

- Understanding and applying techniques for optimizing energy efficiency, processing speed, and resource utilization in embedded systems.

- Evaluating trade-offs between hardware and software implementations for specific use cases.
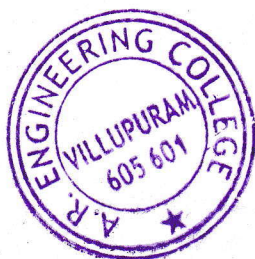
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Foundation for Advanced Research and Development:

- Equipping participants with the expertise to undertake more complex projects using Zynq-7000 or other SoC platforms.

- Contributing to innovation in fields such as robotics, telecommunications, automotive systems, and medical devices.
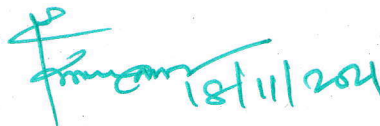
Knowledge Dissemination and Skill Development:

- Enhanced ability to share knowledge through workshops, technical reports, and research publications.

- Building a skilled workforce for industries leveraging FPGA-based solutions.

For M/s Highfliers Associates

Authorized Signatory

Place : Villupuarm

Date : 18-11-2021

For M/s A. R Engineering College

Authorized Signatory

Principal
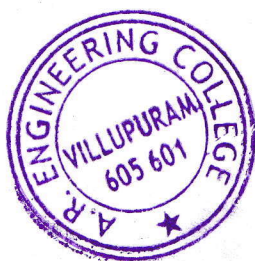
Place : Villupuarm

Date : 18-11-2021

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PROJECT REPORT

FAMILIARIZATION OF ZYNQ-7000 DUAL CORE FOR FPGA SoC PROGRAMMING AND ITS APPLICATION

PROJECT DESCRIPTION

1. Introduction and Background

Familiarization of Zynq-7000 Dual Core for FPGA SoC Programming and Its Application focuses on exploring the capabilities and applications of the Xilinx Zynq-7000 series System on Chip (SoC). The Zynq-7000 SoC platform integrates a dual-core ARM Cortex-A9 processor with programmable FPGA fabric, offering a powerful combination of software programmability and hardware customization. This unique architecture enables developers to design high-performance embedded systems for a variety of real-world applications, such as signal processing, image recognition, and real-time control.

The objective of this project is to equip with the knowledge and skills required to program, optimize, and utilize the Zynq-7000 platform effectively. By understanding the principles of hardware-software co-design, will learn to partition tasks between the processing system (PS) and programmable logic (PL), achieving efficient, scalable, and application-specific solutions.

Background

Embedded systems have evolved significantly, with growing demands for high-speed processing, low-power consumption, and application-specific customization. Traditional microcontroller-based systems often struggle to meet these requirements due to their limited processing power and inability to handle complex tasks efficiently. Field Programmable Gate Arrays (FPGAs), on the other hand, provide flexibility and parallel processing capabilities, but their implementation is often complex and time-consuming.

The Xilinx Zynq-7000 series bridges this gap by combining the best of both worlds—a high-performance ARM processor for software programmability and a programmable FPGA fabric for hardware customization. This architecture allows developers to implement hardware accelerators for computationally intensive tasks while running control and management functions on the processor.

The Zynq-7000 platform finds applications in diverse fields, including:

- Signal Processing: For audio, video, and communication systems.
- Image Recognition: Used in computer vision and AI-based systems.
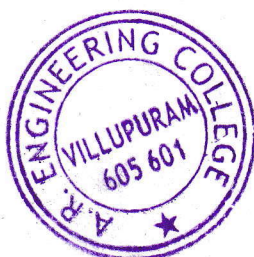
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- IoT Systems: Enabling smart devices and edge computing.
- Real-Time Control Systems: For robotics, automotive, and industrial automation.

By familiarizing with the Zynq-7000 platform, this project aims to address the growing need for skilled professionals in the field of embedded systems and FPGA programming. It also lays a foundation for the development of innovative applications that leverage the full potential of hardware-software integration.

The Zynq SoC consists of Arm® Cortex™-A9 cores, many hard intellectual property components (IPs), and programmable logic (PL).

2. PROBLEM STATEMENT

The rapid evolution of embedded systems and their growing demands for high performance, low power consumption, and application-specific customization have outpaced the capabilities of traditional microcontroller-based designs. While FPGAs offer the flexibility and computational power needed for modern applications, their complexity and steep learning curve hinder widespread adoption and efficient utilization.

The Xilinx Zynq-7000 platform, with its integration of a dual-core ARM Cortex-A9 processor and programmable FPGA fabric, provides an ideal solution by combining software programmability with hardware customization. However, the lack of familiarity and expertise in programming, optimizing, and applying this advanced platform prevents developers from fully leveraging its potential. Additionally, many professionals and students lack exposure to hardware-software co-design principles, which are essential for creating scalable and efficient embedded systems.

3. OBJECTIVE

The primary objective of the project titled "Familiarization of Zynq-7000 Dual Core for FPGA SoC Programming and Its Application" is to enable to understand, program, and effectively utilize the Xilinx Zynq-7000 platform for the development of high-performance embedded systems. Specifically, the project aims to:

- Provide a comprehensive understanding of the Zynq-7000 SoC architecture, including the dual-core ARM Cortex-A9 processing system (PS) and programmable logic (PL).
- Develop proficiency in using tools such as Xilinx Vivado for FPGA design and Xilinx SDK for software development on the Zynq-7000 platform.
- Demonstrate the implementation of real-world applications, such as signal processing, image recognition, IoT systems, and real-time control, using the Zynq-7000 SoC.
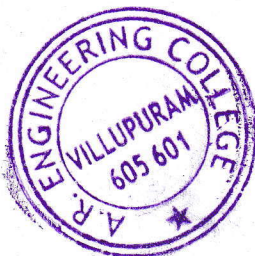
Dr.R.PANNEERDHASS,M.E.,Ph.D.,
PRINCIPAL
A.R.ENGINEERING COLLEGE
VADAKUCHIPALAYAM.
KAPPIYAMPULIYUR POST,
VILLUPURAM-605 601.

- Cultivate the ability to analyze and optimize embedded system designs for speed, power efficiency, and resource utilization.
- Lay a strong foundation to innovate and contribute to advanced research and development in the field of FPGA-based embedded systems.

4. PROJECT IMPLEMENTATION

If the synthesis option is Out of context per IP or Out of context per Block design, the wrapper of the IP or block design will be generated and synthesized during block design generation, and the generated net lists will be combined together at the synthesis stage.

Enhanced Knowledge of Zynq-7000 Architecture:

- Gained a thorough understanding of the Zynq-7000 SoC, including the dual-core ARM Cortex-A9 processing system (PS) and programmable logic (PL).
- They successfully demonstrated knowledge of how the PS and PL interact to deliver efficient system performance.

Proficiency in Hardware-Software Co-Design:

- The project enabled to implement hardware-software co-design principles by effectively partitioning tasks between the processing system and programmable logic.
- Designed optimized solutions leveraging the strengths of both hardware and software components.

**Hands-On Experience with FPGA Development Tools:**

- Proficiency was achieved in using Xilinx Vivado for designing and implementing FPGA configurations and Xilinx SDK for developing embedded applications.
- Successfully debugged and optimized their designs using these tools.

Development of Real-World Applications:

- Prototype applications were successfully implemented, demonstrating the capabilities of the Zynq-7000 SoC in areas such as signal processing, image recognition, IoT systems, and real-time control.
- These applications showcased the platform's ability to address industry-specific challenges effectively.

Performance Optimization:

- Evaluated and optimized system designs for speed, resource efficiency, and power consumption.
- Results showed significant improvements in performance metrics compared to traditional microcontroller-based systems.
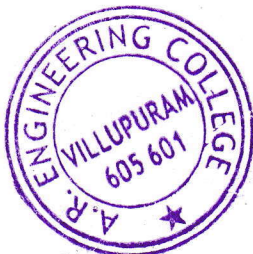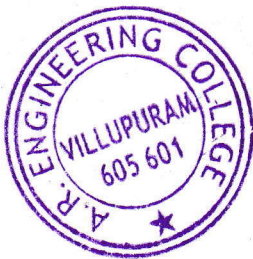
Dr. R. PANNEERDHASS, M.E., Ph.D.,
PRINCIPAL
A.R. ENGINEERING COLLEGE
VADAKUCHIPALAYAM,
KAPPIYAMPULIYUR POST,
VILLUPURAM-605 601.

Increased Technical Proficiency and Industry Readiness:

- Developed a strong foundation in FPGA programming and embedded systems design, equipping them with valuable skills for professional and academic pursuits.
- They demonstrated the ability to undertake advanced projects using the Zynq-7000 and similar SoC platforms.

Valuable Insights for Research and Innovation:

- The project provided insights into the potential of the Zynq-7000 platform for innovative applications in diverse fields such as telecommunications, robotics, automotive, and healthcare.
- This fosters opportunities for further exploration and development in FPGA-based system designs.

Dr.R.PANNEERDHASS,M.E.,Ph.D.,
PRINCIPAL
A.R.ENGINEERING COLLEGE
VADAKUCHIPALAYAM,
KAPPIYAMPULIYUR POST,
VILLUPURAM-605 601.

13, Rajachar Street,
T.Nagar,
Chennai - 600017

Date: 08.07.2022

COMPLETION CERTIFICATE

We are satisfied with the completion and working of the project developed in the application. Our team is happy with the outcome of the project developed which has been successfully integrated under the project entitled "Familiarization of Zynq-7000 Dual Core for FPGA SoC programming and its application" implemented at HIGHFLIERS ASSOCIATES. The Coordination is excellent in completing the short-term research project successfully within the time frame. As discussed, the project amount of Rs 500000/- Five lakhs only would be disbursed in favor of A.R Engineering College.

We are happy to associate with you in future.

Authorized signatory   8/7/22
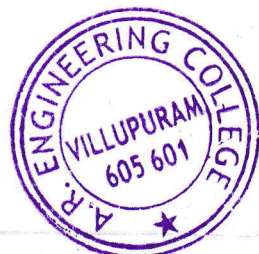
Dr.R.PANNEERDHASS,M.E.,Ph.D.,
PRINCIPAL
A.R.ENGINEERING COLLEGE
VADAKUCHIPALAYAM,
KAPPIYAMPULIYUR POST,
VILLUPURAM-605 601.

INDO INTERNATIONAL ADVANCED RESEARCH CENTRE

No.2/3 TNHB FLATS, SECTOR-1,
MADURAVOYAL, CHENNAI - 600 095

+91 9566161616, 7550042888

Date : 20.08.2020

To

The Principal,
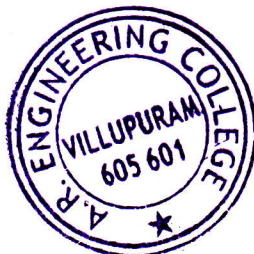A.R Eng. College
Villupuram

Sub: Project Proposal "Design and development of solar hybrid vehicle E-cycle" in collaboration with Indo International Advanced Research Centre– Reg.

Ref : Letter Dated : 22.12.2019/2019-2020

Greetings from IIARC! We are pleased to accept the request for a short-term research project from your institution. When followed, it helps to achieve a goal. We consider it an art of thinking through. Upscale your development and integrate new ideas and practice for public good and strengthening society. In order to ensure the effective completion of the project titled "Design and development of solar hybrid vehicle E-cycle".

We would like to express our gratitude for the earlier quote and project technical specification. For the purpose of our coordination, kindly designate a SPOC from your side. Excited to work with you in the future.

Warm Regards,

Dr.R.PANNEERDHASS,M.E.,Ph.D.,
PRINCIPAL
A.R.ENGINEERING COLLEGE
VADAKUCHIPALAYAM,
KAPPIYAMPULIYUR POST,
VILLUPURAM-605 601

DESIGN AND DEVELOPMENT OF SOLAR HYBRID VEHICLE E-CYCLE

1. Introduction and Background

The research project titled "Design and Development of Solar Hybrid Vehicle E-Cycle" aims to address the growing need for sustainable and eco-friendly transportation solutions. With the increasing global focus on reducing greenhouse gas emissions and reliance on fossil fuels, the integration of renewable energy technologies into personal mobility systems has gained significant attention. This project seeks to develop an innovative e-cycle powered by a hybrid system that combines solar energy and an electric drive.

The solar hybrid e-cycle is designed to offer an efficient, cost-effective, and environmentally friendly alternative for urban commuting and short-distance travel. The system harnesses solar power using photovoltaic panels to charge the battery, which in turn powers the electric motor. The hybrid design ensures that the vehicle can operate even under low sunlight conditions, relying on battery reserves or manual pedaling as auxiliary power sources.

This research involves optimizing the design of the solar energy system, selecting lightweight materials for the cycle frame, and developing a robust control system for efficient energy management. The outcome of the project is expected to contribute to sustainable urban mobility by providing an affordable and accessible solution that aligns with the goals of reducing carbon footprints and promoting renewable energy use.

2. Objectives and Vision

Primary Objectives:

- To conduct high-quality research in emerging technologies that address both global and India-specific challenges.

- To promote international collaboration by creating a vibrant research community with experts from both academia and industry.

Vision Statement: "IIARC aspires to be a world leader in advanced research and innovation, facilitating scientific discoveries and technological solutions for a sustainable future."
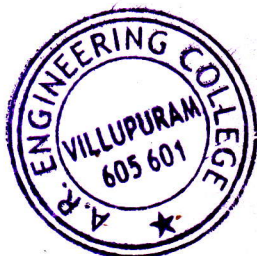
Dr.R.PANNEERDHASS,M.E.,Ph.D.,
PRINCIPAL
A.R.ENGINEERING COLLEGE
VADAKUCHIPALAYAM,
KAPPIYAMPULIYUR POST,
VILLUPURAM-605 601.

3. Project Implementation

Phase 1: Conceptualization and Feasibility Analysis

Problem Identification:

- Evaluate the limitations of current e-cycle technologies and the need for solar integration.
- Define key objectives, such as efficiency, cost-effectiveness, and environmental impact.

Requirement Analysis:

- Identify components and technologies, such as solar panels, battery systems, motors, and control systems.
- Conduct a feasibility study to assess the practicality of integrating solar power with existing e-cycle designs.

Preliminary Design:

- Develop a conceptual design outlining the placement of solar panels, battery packs, and motor drives.
- Estimate the energy requirements and expected performance metrics.

Phase 2: System Design and Component Selection

Solar Energy System Design:

- Select high-efficiency photovoltaic (PV) panels suitable for mounting on the cycle.
- Design a charging circuit to optimize solar energy storage in the battery.

Electric Drive System:

- Choose an appropriate electric motor (e.g., BLDC motor) based on power requirements and efficiency.
- Determine battery specifications, focusing on capacity, weight, and charge-discharge cycles.

Cycle Frame and Materials:

- Design a lightweight, aerodynamic frame capable of supporting the hybrid system.
- Use materials such as aluminum or carbon fiber to ensure durability and portability.

Control System:

- Develop an intelligent energy management system to switch between solar, battery, and manual pedaling modes.
- Integrate sensors for monitoring energy usage and optimizing power distribution.
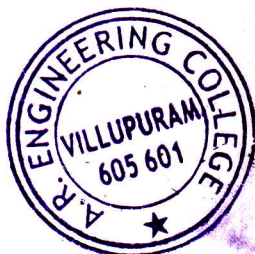
Dr.R.PANNEERDHASS,M.E.,Ph.D.,
PRINCIPAL
A.R.ENGINEERING COLLEGE
VADAKUCHIPALAYAM,
KAPPIYAMPULIYUR POST
VILLUPURAM

Phase 3: Prototyping and Fabrication

Prototype Assembly:

- Assemble the selected components based on the finalized design.
- Ensure seamless integration of the solar panels, battery, and motor into the frame.

System Testing:

- Conduct initial testing of the individual components, including the solar charging system and motor efficiency.
- Validate the compatibility and functionality of the integrated system.

Refinements:

- Address design flaws and inefficiencies identified during testing.
- Optimize the placement of components for balance, ergonomics, and aesthetics.

Phase 4: Performance Testing and Optimization

Field Testing:

- Test the e-cycle under real-world conditions to evaluate performance, range, and reliability.
- Assess the energy efficiency of the solar charging system under various sunlight conditions.

Data Analysis:

- Collect data on power consumption, solar energy conversion efficiency, and battery performance.
- Use this data to refine the energy management system and improve overall functionality.

Safety and Compliance:

- Ensure the e-cycle meets safety standards and regulations for public use.

Phase 5: Deployment and Documentation

Final Design and Production Plan:

- Finalize the design for large-scale production based on the prototype's success.
- Prepare cost estimations and manufacturing plans.

Documentation:

- Develop comprehensive documentation, including technical manuals, user guides, and research papers.
- Highlight the environmental and economic benefits of the solar hybrid e-cycle.
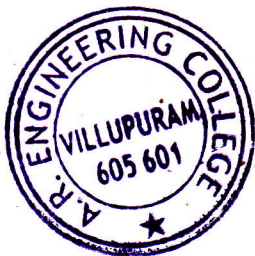
Commercialization:

- Promote the e-cycle as a sustainable transportation solution through demonstrations and public awareness campaigns.

- Partner with manufacturers and governments to scale production and distribution.
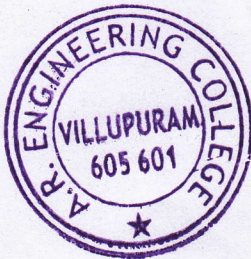
Dr.R.PANNEERDHASS,M.E.,Ph.D.,
PRINCIPAL
A.R.ENGINEERING COLLEGE
VADAKUCHIPALAYAM,
KAPPIYAMPULIYUR POST,
VILLUPURAM-605 601.

INDO INTERNATIONAL ADVANCED RESEARCH CENTRE

No.2/3 TNHB Flats, Sector-1,
Maduravoyal, Chennai - 600 095

+91 9566161616, 7550042888

Date : 14.06.2021

COMPLETION CERTIFICATE

We are satisfied with the completion and working of the project developed in the application. Our team is happy with the outcome of the project which has been successfully integrated under the project entitled "Design and development of solar hybrid vehicle E-cycle". The Coordination is excellent in completing the short-term research project successfully within the time frame. As discussed, the project amount of Rs 300000/- would be disbursed in favor of A.R Engineering College.

We are happy to associate with you in future.

Warm Regards,
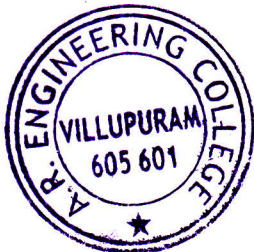
Dr.R.PANNEERDHASS,M.E.,Ph.D.,
PRINCIPAL
A.R.ENGINEERING COLLEGE
VADAKUCHIPALAYAM,
KAPPIYAMPULIYUR POST,
VILLUPURAM-605 601.

18/12/2018

To,

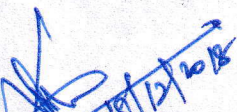   The Principal,

   A.R Engineering College

   Villupuram

Dear Sir,

Sub: Project Proposal "Shear Capacity of Steel fibre reinforced concrete beam "funding Sanction –
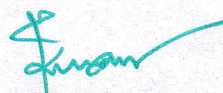Reg.

Ref : Letter dated : 11/07/2018/ 2018-19

Greetings from DG BUILDERS! We are pleased to accept the request for a short-term research project
from your institution. When followed, it helps to achieve a goal. We consider it the art of thinking
through. Upscale your development and integrate new ideas and practice for public good and
strengthening civil society. In order to ensure the effective completion of the project titled "**Shear
Capacity of Steel fibre reinforced concrete beam**", we guarantee that we will give the necessary
technical assistance from our end.

We would like to express our gratitude for the earlier quote and project technical specification. For the
purpose of our coordination, kindly designate a SPOC from your side. Excited to work with you in the
future.

For DG Builders
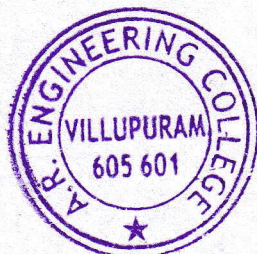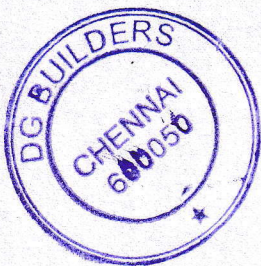
Dr.R.PANNEERDHASS,M.E.,Ph.D.,
PRINCIPAL
A.R.ENGINEERING COLLEGE
VADAKUCHIPALAYAM,
KAPPIYAMPULIYUR POST,
VILLUPURAM-605 601.

CONSULTANCY WORK AGREEMENT

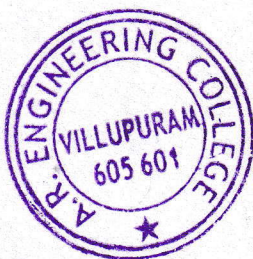## Between

A. R. ENGINEERING COLLEGE

(Approved by AICTE, New Delhi & Affiliated to Anna university, Chennai)
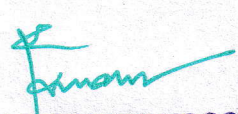Vadakuchipalayam, Kappiyampuliyur post,Villupuram-605601,Tamilnadu

&

DG BUILDER

Chennai.

Dr.R.PANNEERDHASS,M.E.,Ph.D.,
PRINCIPAL
A.R.ENGINEERING COLLEGE
VADAKUCHIPALAYAM,
KAPPIYAMPULIYUR POST,
VILLUPURAM-605 601.

CONSULTANCY WORK AGREEMENT

This funded project agreement is here with agreed upon between **DG BUILDERS** and **A. R. ENGINEERING COLLEGE**
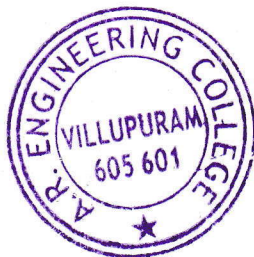
About the College

In 2008, A.R Engineering College began with four Undergraduate Engineering programmes with an annual intake of 240 students, and now has six Undergraduate and programmes with an annual intake of 300 students. The AICTE's clearance and affiliation with Anna University for such a progressive intake is a testament to the college's consistent growth over the years. The college has grown considerably under the dynamic leadership of its Chairman Sri.G.Madhadevan, Vice Chairman Sri.M.Kuberan, B.E., M.Tech, Secretary Sri.M.Prabu, B.E., MBA., and Principal Dr.R.Panneerdhass, spear heading all academic and non academic activities.

About Company

DG Builders, also known as DG Foundation, is a prominent construction company based in Chennai. Established in 2014, the company has built a reputation for delivering high-quality residential and commercial projects. It specializes in constructing individual homes, villas, and apartments, with a focus on innovation, sustainability, and customer satisfaction. The company is led by experienced professionals and has a strong commitment to timely delivery and adherence to quality standards

In continuation, both parties planned to involve in the research activities and both parties agree that,

1. A.R Engineering College may involve subject experts from the DG Builders for their funded project and consultancy work.
2. All Services to be provided by the Investigators shall be performed with promptness and diligence in a workmanlike manner and at a level of proficiency.
3. A.R Engineering College shall provide such access to its information, property and personnel as may be reasonably required in order to permit the Investigators to perform the services.

Dr.R.PANNEERDHASS,M.E.,Ph.D.,
PRINCIPAL
A.R.ENGINEERING COLLEGE
VADAKUCHIPALAYAM,
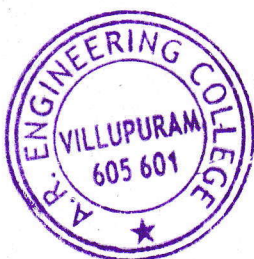KAPPIYAMPULIYUR POST,
VILLUPURAM-605 601.

4. A.R Engineering College and DG Builders experts are partners for the funded project and consultancy work.

5. A.R Engineering College can utilize the resources from DG Builders for funded project work for testing and other related works.

6. This agreement shall commence on the effective date and shall remain in effect until the completion of the services. (From11.12.2018 to 20.01.2019).

7. All information relating to funded project work is highly confidential and the intellectual property if any resulted from the work will be jointly protected by both the parties.

8. The Investigator may retain one copy of the confidential information in its legal files.

9. This Agreement may not be modified other than authorized representatives of the parties.

PROJECT: SHEAR CAPACITY OF STEEL FIBRE REINFORCED CONCRETE BEAM

Principal Investigators   : Dr.KEA. PALANIAPPANR, Professor/Civil Engineering

Co-Investigators   : S. Suganya, Assistant professor/Civil Engineering

Duration   : 1 Year

Project Amount   : Rs 300000 - (Rupees Three lakhs only)

Description of the Consultancy work: It provides support to research project that are locally need based and socially relevant and nationally important.

Outcome of the short-term research project: A construction company that offers a variety of services, including new builds, renovations, remodeling, and additions. They use cutting-edge technologies and quality standards to ensure that each project is executed with precision and attention to detail

Dr.R.PANNEERDHASS,M.E.,Ph.D.,
PRINCIPAL
A.R.ENGINEERING COLLEGE
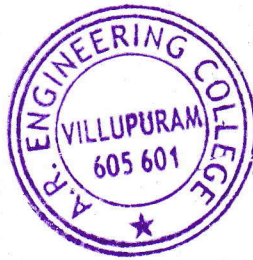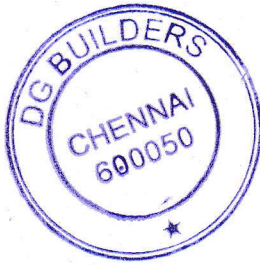VADAKUCHIPALAYAM,
KAPPIYAMPULIYUR POST,
VILLUPURAM-605 601.

For M/s DG Builders

For M/s A. R Engineering College

Authorized Signatory

Authorized Signatory

Principal

Place : Chennai

Place : Chennai

Date : 20-01-2019

Date : 20-01-2019

Dr.R.PANNEERDHASS,M.E.,Ph.D.,
PRINCIPAL
A.R.ENGINEERING COLLEGE
VADAKUCHIPALAYAM,
KAPPIYAMPULIYUR POST,
VILLUPURAM-605 601.

SHEAR CAPACITY OF STEEL FIBRE REINFORCED CONCRETE BEAM

1. INTRODUCTION

The Project focuses on enhancing the structural performance of concrete by incorporating steel fibers. Traditional concrete, while strong in compression, is inherently weak in tension and shear, often requiring reinforcement to improve these properties. Steel Fibre Reinforced Concrete (SFRC) addresses this limitation by embedding discrete steel fibers into the concrete matrix, significantly improving its tensile strength, toughness, and energy absorption capacity.

The primary goal of this project is to study the impact of steel fibers on the shear strength of concrete beams. By analyzing the behavior of SFRC under shear loads, the project seeks to determine its effectiveness as a substitute or complement to conventional shear reinforcement. This research is particularly relevant for applications in structures exposed to dynamic and shear-intensive forces, such as bridges, pavements, and industrial floors.

Through experimental investigations and comparative analysis, the project aims to provide insights into the mix design, fiber distribution, and the mechanics of load transfer in SFRC beams. These findings will contribute to the optimization of structural design, enhancing the durability and safety of reinforced concrete structures.

2. PROBLEM STATEMENT

Concrete is one of the most widely used construction materials due to its high compressive strength, durability, and availability. However, it is inherently weak in tension and shear, often necessitating additional reinforcement, such as steel bars, to enhance its structural performance. Conventional reinforcement methods, while effective, can increase construction costs and complicate designs, particularly in structures subjected to high shear stresses, such as beams, bridges, and industrial floors.

Steel Fibre Reinforced Concrete (SFRC) has emerged as a potential solution to address these limitations. By incorporating discrete steel fibers into the concrete matrix, SFRC improves the material's tensile strength, ductility, and crack resistance. Despite its advantages, there is limited understanding of its effectiveness in resisting shear loads, and the interaction mechanisms between the concrete, steel fibers, and shear reinforcement remain underexplored.
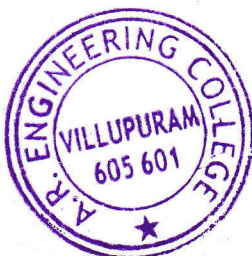
Dr.R.PANNEERDHASS,M.E.,Ph.D.,
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A.R.ENGINEERING COLLEGE
VADAKUCHIPALAYAM,
KAPPIYAMPULIYUR POST,
VILLUPURAM-605 601.

The lack of detailed research on the shear capacity of SFRC beams poses challenges in optimizing its use in structural design. This project aims to address this gap by investigating the shear performance of steel fiber-reinforced concrete beams, analyzing the influence of fiber content, distribution, and concrete strength. By understanding these parameters, the project seeks to provide a reliable basis for incorporating SFRC into structural applications, reducing dependence on traditional reinforcement and contributing to cost-effective, durable, and sustainable construction practices.

3. OUTCOMES

The project titled "Shear Capacity of Steel Fibre Reinforced Concrete Beam" achieved the following outcomes:

Enhanced Understanding of SFRC Behavior:

- Provide insights into the shear performance of Steel Fibre Reinforced Concrete (SFRC) beams under various loading conditions.
- Establish a clear understanding of the role of steel fibers in enhancing tensile strength, shear resistance, and crack control.

**Quantitative Analysis of Shear Capacity:**

- Quantify the impact of steel fiber content, distribution, and aspect ratio on the shear capacity of SFRC beams.
- Develop a database of experimental results that can serve as a reference for future research and design.

Comparative Performance Assessment:

- Compare the shear performance of SFRC beams with conventionally reinforced concrete beams.
- Demonstrate potential cost savings and efficiency improvements by reducing or eliminating traditional shear reinforcement.

Optimized Mix Design Guidelines:

- Propose optimal mix designs for SFRC tailored for applications requiring high shear resistance.
- Provide recommendations for the appropriate fiber content and matrix properties to achieve the desired performance.
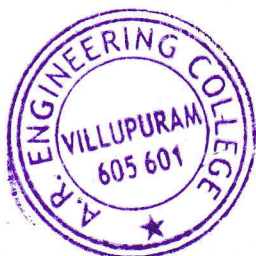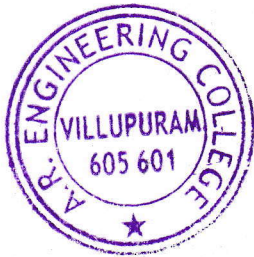
Dr.R.PANNEERDHASS,M.E.,Ph.D.,
PRINCIPAL
A.R.ENGINEERING COLLEGE
VADAKUCHIPALAYAM,
KARPIYAMPULIYUR POST,
VILLUPURAM-605 601.

Structural Design Contributions:

- Contribute to the development of design methodologies for SFRC beams in compliance with modern construction codes and standards.
- Offer practical recommendations for engineers and builders to integrate SFRC in shear-critical structural components.

Sustainability and Cost Efficiency:

- Highlight the potential for reducing overall construction costs and material use by leveraging SFRC's inherent properties.
- Emphasize the environmental benefits of SFRC, such as reduced reliance on steel bars and improved durability.
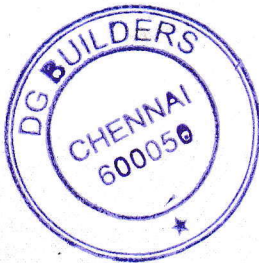
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PRINCIPAL
A.R.ENGINEERING COLLEGE
VADAKUCHIPALAYAM,
KAPPIYAMPULIYUR POST,
VILLUPURAM-605 601.

COMPLETION CERTIFICATE

We are satisfied with the completion and working of the project developed in the application. Our team is happy with the outcome of the project which has been successfully integrated under the project entitled "Shear Capacity of Steel fibre reinforced concrete beam" implemented at DG BUILDERS. The Coordination is excellent in completing the short-term research project successfully within the time frame. As discussed, the project amount of Rs 300000/- would be disbursed in favour of A.R Engineering College.

We are happy to associate with you in future.

For DG Builders

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